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# The Rural Role in National Value Chains

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# The Rural Role in National Value Chains

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FESER E. and ISSERMAN A. The rural role in national value chains, *Regional Studies*. Industry clustering is a useful concept for understanding the interdependence among industries and its implications for regional economic development and growth. The paper claims that the fullest understanding of the implications of industrial interdependence for rural economies requires viewing linked industries – or value chains – on a spatial continuum, from those that are national in geographic scope to those that are highly localized in specific places as regional clusters. From that perspective, rural economies may depend on – as well as contribute to – the competitive success of value chains anchored elsewhere. The perspective is operationalized using a new classification of 45 US industry value chains together with a new rural–urban county typology. The results demonstrate that rural America plays an integral part in a great variety of US value chains. Federal, state, or local development agencies must be careful not to view rural cluster strategy strictly as the development of groups of linked and related industries concentrated in specific rural places, as there are real opportunities to identify and leverage the advantages of rural locations for businesses and industries in globally competitive and geographically extensive value chains.

Value chains  Industry clusters  Rural development policy

FESER E. and ISSERMAN A. 农村在国家价值链中所扮演的角色，区域研究。本文认为，全面理解产业间相互依赖对于农村经济的作用需要考察在空间连续统上相互关联的产业或者价值链，即从国家的尺度到高度定位的具体区域集群。从上述视角出发，农村经济则有可能依赖且有助于其他地方价值链获得竞争性成功。利用45条美国产业价值链的最新分类与新型城乡类型学，我们将上述视角可操作化。结果表明，美国农村是美国价值链中不可分割的部分。联邦、国家或者地方发展机构不应当仅仅把农村集群策略视为关联产业在某一具体农村地域内的聚集发展，因为对于那些参与全球竞争以及空间拓展的价值连的商业与产业而言，在农村择址存在着真正识别与调节相关优势的种种机遇。

价值链  产业集群  农村发展  政策

FESER E. et ISSERMAN A. Le rôle du développement rural dans les chaînes de valeur nationales, *Regional Studies*. La notion de regroupement industriel sert à expliquer l'interdépendance des industries et ses retombées pour le développement économique régional et la croissance. On affirme que la compréhension la plus complète des retombées de l'interdépendance industrielle pour les économies rurales nécessite que l'on considère les industries regroupées – ou bien les chaînes de valeur – comme un continuum espace, à partir de celles dont la portée géographique s'avère nationale, jusqu'à celles qui sont très localisées en grappes régionales quant à leur emplacement. De ce point de vue, il se peut que les économies régionales dépendent de – ainsi que contribuent à – la réussite compétitive des chaînes de valeur ancrées ailleurs. A partir d'un nouveau classement de 45 chaînes de valeur industrielles aux E-U, conjointement avec une nouvelle typologie ruralo-urbaine des comtés, on met en vigueur ce point de vue. Les résultats laissent voir que l'Amérique rurale joue un rôle intégrant dans diverses chaînes de valeur aux E-U. Les agences de développement fédérales, étatiques ou locales, doivent faire en sorte qu'elles ne considèrent la stratégie en faveur des regroupements ruraux qu'en termes du développement de grappes d'industries reliées et connexes qui se concentrent dans des emplacements ruraux spécifiques, parce qu'il y a de belles occasions d'identifier et d'exercer une influence sur les atouts des emplacements ruraux pour les commerces et les industries situés dans des chaînes de valeur à la fois compétitives sur le plan global et de grande envergure géographiquement.

Chaînes de valeur  Regroupements industriels  Politique d'aménagement rural

FESER E. und ISSERMAN A. Die Rolle ländlicher Gebiete für nationale Wertschöpfungsketten, *Regional Studies*. Branchencluster sind ein nützliches Konzept zum Verständnis der Wechselwirkungen zwischen Branchen und ihrer Auswirkungen auf die wirtschaftliche Entwicklung und das Wirtschaftswachstum einer Region. Wir behaupten, dass für ein umfassendes Verständnis der Auswirkungen von Wechselwirkungen zwischen Branchen in ländlichen Ökonomien eine Betrachtung von miteinander verknüpften Branchen – bzw. Wertschöpfungsketten – in einem räumlichen Kontinuum erforderlich ist: von den Branchen, die von ihrem geografischen Umfang her national ausfallen, bis hin zu den Branchen, die an bestimmten Orten als regionale Cluster

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hochgradig lokalisiert sind. Ausgehend von dieser Perspektive können ländliche Wirtschaften vom Wettbewerbserfolg anderswo angesiedelter Wertschöpfungsketten abhängen und auch zu diesem Erfolg beitragen. Wir übertragen diese Perspektive auf die betriebliche Praxis, wofür wir eine neue Klassifizierung von 45 Branchenwertschöpfungsketten in den USA sowie eine neue ländlich-urbane Bezirkstypologie zur Anwendung bringen. Unsere Ergebnisse beweisen, dass ländliche Gebiete in den USA eine zentrale Rolle für ein breites Spektrum von Wertschöpfungsketten spielen. Die Behörden auf Bundes-, Landes- oder Gemeindeebene sollten es vermeiden, ländliche Cluster-Strategien ausschließlich als die Entwicklung von an bestimmten ländlichen Orten konzentrierten Gruppen miteinander verknüpfter und zusammenhängender Branchen aufzufassen, da sich eine echte Chance zur Identifizierung und Nutzung der Vorteile von ländlichen Standorten für Betriebe und Branchen in global wettbewerbsfähigen und geografisch umfangreichen Wertschöpfungsketten bietet.

Wertschöpfungsketten Branchencluster Ländliche Entwicklungspolitik

FESER E. y ISSERMAN A. El papel rural en las cadenas de valores nacionales, *Regional Studies*. La aglomeración industrial es un concepto útil para entender la interdependencia entre las industrias y sus implicaciones para el desarrollo y el crecimiento económico regional. Aducimos que para poder entender totalmente las implicaciones de la interdependencia industrial para las economías rurales es necesario ver las industrias vinculadas – o cadenas de valores – en una secuencia espacial, de aquellas que son nacionales en un alcance geográfico a las que son altamente localizadas en lugares concretos como aglomeraciones regionales. Desde esta perspectiva, las economías rurales podrían depender del – y también contribuir al – éxito competitivo de las cadenas de valores ancladas en otra parte. Tenemos en cuenta esta perspectiva usando una nueva clasificación para 45 cadenas de valores de la industria estadounidense junto con una nueva tipología rural–urbana de condados. Nuestros resultados demuestran que las zonas rurales de Estados Unidos desempeñan una parte integral en toda una serie de cadenas de valores en el país. Las agencias de desarrollo federales, estatales o locales deben tener cuidado de no considerar la estrategia de aglomeración rural estrictamente como el desarrollo de grupos de industrias vinculadas y relacionadas que se concentran en lugares rurales específicos porque existen oportunidades reales de identificar y aprovechar las ventajas de zonas rurales para negocios e industrias en cadenas de valores globalmente competitivas y geográficamente amplias.

Cadenas de valores Agrupaciones de la industria Política de desarrollo rural

JEL classifications: R12, R58

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## INTRODUCTION

The role of industry clusters in rural economies received renewed attention with the February 2004 release of a US Economic Development Administration (EDA)-funded study by Harvard Business School's Institute for Strategy and Competitiveness (PORTER *et al.*, 2004). The report, entitled *Competitiveness in Rural U.S. Regions: Learning and Research Agenda*, examines the rural incidence of groups of local, natural resource-dependent, and traded industries defined by Michael Porter's cluster mapping project (PORTER, 2003). The study emphasizes traded sector competitiveness as the central issue facing rural economies and finds evidence of industry clusters in rural areas, particularly in those adjacent to metropolitan counties. Based on those results, the authors call for additional research on the determinants of rural economic performance – especially the relationship between rural-metropolitan linkages and rural economic growth – as well as a national debate on federal policy toward rural economic development. As befits its title, the Harvard report's primary actionable policy recommendation is a series of conferences that would revisit federal rural policy and stimulate new research and initiatives (PORTER *et al.*, 2004, p. 4). The Economic Development Administration's recent interest in rural clusters is further reflected in its commissioning of research at the University of Minnesota on rural-based knowledge clusters (MUNNICH *et al.*, 2002).

The literature on industry clusters and rural economies is growing steadily, especially if consulting studies and planning documents are included (BARKLEY and HENRY, 1997; GIBBS and BERNAT, 1997; HENRY *et al.*, 1997; BERNAT, 1999; KIM *et al.*, 2000; ROSENFELD *et al.*, 2000; ROSENFELD, 2001, 2002; REGIONAL TECHNOLOGY STRATEGIES (RTS), 2003). Researchers have struggled with the seeming paradox that the cluster concept presents for rural development. If industry clusters are 'geographic concentrations of interconnected companies and institutions in a particular field' (PORTER, 1998, p. 78), with 'concentration' implying elements of both scale and critical mass, one is hard pressed to find many examples in rural areas. After all, 'rural' is sparsely populated by definition and therefore likely to lack either scale or critical mass in most every industry aside from those that are heavily agricultural or natural resource-based. Rosenfeld argues that cluster researchers overemphasize scale and that the usual secondary data sources, too limited by problematic Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) schemes and coarse geographic detail, often fail to capture small and unique rural specializations that operate very much like larger, conventionally understood clusters (ROSENFELD, 2001; RTS, 2003). Rosenfeld encourages greater use of primary data-collection methods for research and planning related to clusters in rural communities. Yet, the 2004 Harvard Business

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School study *did* detect clusters in rural areas using secondary data, as did broadly similar efforts by GIBBS and BERNAT (1997) and FESER *et al.* (2005). What is clear from those relatively comprehensive empirical applications is that the definition of the central concepts of *clusters* and *rural*, as well as the specific data sources used to operationalize those definitions, very much drive the results.

The cluster concept has two key dimensions: the *economic* dimension refers to interrelationships between businesses regardless of location; and the *geographic* dimension refers to the spatial juxtaposition or concentration of linked and related businesses (FESER and SWEENEY, 2000; FESER *et al.*, 2005). The conventional view combines the two dimensions by explicitly defining industry clusters narrowly as groups of interdependent industries and related supporting institutions co-located in identifiable regions, consistent with Porter's definition of regional clusters cited above. Such a circumscribed perspective has tangible utility in certain applications.

There is also considerable practical value to separating the two dimensions, both conceptually and analytically, especially for the purposes of rural economic development planning and policy-making. Even if several dozen rural-based regional clusters in a given country can be found, as the Harvard study demonstrated for the USA, the vast majority of rural places are not likely to be part of those clusters. Therefore, many of the compelling insights derived from applications of the industry cluster concept, particularly regarding the role of industrial interdependence as a key driver of business competitiveness, might be thought to have no relevance for most rural places. It is argued here that finding a few instances of clusters anchored in rural places, however, does not exhaust the potential of industry cluster analysis to inform local and regional development strategy design and implementation.

The fullest understanding of the implications of business clustering for rural economies requires distinguishing between the economic and geographic dimensions of the concept by viewing clusters on a spatial continuum, from those that are national in geographic scope to those that are highly localized in specific places. This paper operationalizes the first dimension of this perspective for the US economy. Specifically, it investigates the role rural economies play in integrated national systems of production by exploring the overall rural–urban distribution of US industry value chains and their functional economic characteristics in rural versus urban areas. A national industry value chain *i*, among a set of value chains *i* to *j*, is comprised of industries that are closely linked through their exchange of commodities and services. They are defined for the national economy as a whole and therefore are purposely aspatial. The approach enables identification of the rural role in every value chain in the US economy. In related work the second perspective is operationalized by asking which rural areas are part of *regional* industry clusters. This is done by using a local indicator of spatial association (LISA) to search for geographically distinct multi-county regions of high employment in a particular value chains.

The analysis is especially distinctive in two respects. First, a newly developed set of 45 national industry value chains is used as the basic industrial units of analysis. Second, a new urban–rural county typology is used that distinguishes counties by classifying them according to their internal urban–rural composition as well as their functional integration (or non-integration) with urban population centres. Under the typology, counties defined as *urban* have very little rural population (only up to 10%), while *rural* counties have very little urban population (ISSERMAN, 2005). Two intermediate categories of counties – mixed rural and mixed urban – acknowledge the large number of US counties that are to a considerable degree both urban and rural. Of especial interest are the 1486 counties that are strictly rural and non-metropolitan under the present typology. Strictly rural counties have at least 90% of their populations in rural areas and/or no urban area of 10 000 or more, and they are not linked substantially to a larger urban centre through commutation. Thus, they provide the purest statistical representation of a rural economy and present some of the most challenging cases for rural economic development.

The next section discusses the general concept of economic interdependence and the specifics of the derivation of 45 national value chains. An explanation then follows of the urban–rural county classification. The urban–rural distribution of employment in the 45 value chains, focusing on whether rural areas tend to specialize in selected segments of the value chains, such as lower wage industries, is then reported. It is shown that the approach helps to reveal rural economies' functional role in national systems of production.

## CAPTURING ECONOMIC INTERDEPENDENCE: NATIONAL VALUE CHAINS

There are two basic perspectives from which the role of industry clusters in rural economies might be viewed. The first, and perhaps most conventional, view is that linked industries and related institutions co-located in a rural region are the most important potential sources of income and productivity growth for that region. Though the direction of causality between clustering and economic performance has yet to be definitively established, some studies have found that clusters are characterized by higher rates of productivity, innovation, and wage growth (GIBBS and BERNAT, 1997; PORTER, 2003; PORTER *et al.*, 2004). Those findings have naturally encouraged searches for spatial clusters that are wholly contained, or at least primarily anchored, in rural places. For example, PORTER *et al.*

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(2004) find 25 examples of traded clusters centred in non-metropolitan counties in the USA, while RTS (2003) describes 22 domestic and five international cases of rural clusters, from aquaculture in coastal Maine to wireless communications in North Jutland, Denmark. The implication for rural development policy-makers is that they should provide the business framework conditions, and perhaps selected investments and incentives, to support the growth of locally anchored rural clusters.

A second perspective views industry clusters on a spatial continuum, from those that are national in scope to those that are highly localized, and views functional or economic interdependence as an important force underlying business and industrial competitiveness (Feser and Bergman, 2000). Economic interdependence might or might not be associated with a pattern of geographic concentration. Indeed, as Porter (1990) originally emphasized in *The Competitive Advantage of Nations*, while internationally competitive clusters may have a tendency to co-locate, co-location is not a rule. From that perspective, rural economies may depend on – as well as contribute to – the competitive success of clusters anchored elsewhere. Put differently, the most important 'cluster' for a given rural community's economic future might be based in the rural locality itself, in a nearby urban area, or 1000 miles away. A search for strictly locally based clusters, or even those nearby that spill into rural communities, may generate a misleading picture of the underlying economic base and prospective economic potential of a given place.

The characteristics of rural economies can be explored from both perspectives if a conceptual and operational distinction is maintained between economic interdependence and geographic clustering (Feser and Sweeney, 2000). This is done by first defining a set of national industry value chains, or groups of industries related through the mutual exchange of commodities and services, and examining the unique geography of the chains in a second step. Distinct spatial concentrations of the chains are called *geographic* or *regional clusters*. Note that regional scientists in the 1960s and 1970s referred to groups of linked industries as *clusters* and geographic concentrations of such clusters as *complexes* (Roepke *et al.*, 1974; Czamanski, 1976, 1977; Latham, 1976, 1977; Czamanski and Ablas, 1979; Ó hUallacháin, 1984; Howe, 1991). Although there was clarity in that early literature that still eludes much of the modern work on industry clusters, it was elected to drop the now infrequently used term *complex* but maintain the useful distinction between the economic and spatial dimensions of interdependence. The following describes the derivation of the national value chains. The methodology is similar in spirit to the approach given by Feser and Bergman (2000), but the algorithm and application to NAICS-based benchmark input–output data are entirely new.

A given industry *i*'s value chain might be thought of as industry *i* itself together with its supplier (upstream) and customer (downstream) industries. In principle there is a distinct value chain for each industry. In practice, however, one is often interested in identifying a reduced number of value chains that represent groups of industries with highly similar, and therefore linked, chains. Then, any given group would be comprised of industries whose linkages with one another are stronger than their linkages with industries outside the group. In any analysis of industrial linkages, there is a necessary trade-off between admitting detail in the specification of the linkages between industries and the practical need to narrow the focus to the strongest linkages in order to keep the scope of the application manageable.

Intuitively, what this paper would like to do is to compare the linkage patterns of each pair of industries in order to assess their degree of overlap. Depending on how the parameters of that comparison are specified, different types of value chains can be derived. For example, one could form, from an input–output transactions matrix $\mathbf{A}$, two matrices $\mathbf{X}$ and $\mathbf{Y}$ with elements:

$$x_{ij} = \frac{a_{ij}}{a_{+j}}, \; y_{ij} = \frac{a_{ij}}{a_{i+}} \tag{1}$$

where $a_{ij}$ is the dollar value of goods and services sold by industry $i$ in some period to industry $j$; and $a_{+j}$ and $a_{i+}$ are total intermediate good purchases and sales, respectively, of industries $i$ and $j$. The columns in $\mathbf{X}$ characterize the intermediate input purchasing pattern of each industry, and the rows of $\mathbf{Y}$ characterize the sales pattern of each industry. Then, linkage patterns along four dimensions – the similarity of the suppliers to industries $i$ and $j$, the similarity of the buyers from industries $i$ and $j$, the similarity in industry $i$'s suppliers to industry $j$'s buyers, and the similarity of industry $i$'s buyers to industry $j$'s suppliers – could be compared by calculating four pairwise correlations on the industry purchasing and sales vectors in $\mathbf{X}$ and $\mathbf{Y}$: $r(\mathbf{x}_i \cdot \mathbf{x}_j)$ would measure the similarity in input purchasing patterns of industries $i$ and $j$; $r(\mathbf{y}_i \cdot \mathbf{y}_j)$ would measure the degree to which $i$ and $j$ sell goods to a similar mix of intermediate input buyers; $r(\mathbf{x}_i \cdot \mathbf{y}_j)$ would measure whether $i$'s supplier mix is similar to $j$'s buyer mix; and $r(\mathbf{y}_i \cdot \mathbf{x}_j)$ would measure whether $i$'s buyer mix is similar to $j$'s supplier mix.

The basic logic of the approach is summarized in the top panel of Fig. 1. The correlations can be used singly or in combination to form similarity matrices for analysis with conventional data-reduction techniques such as factor analysis or statistical cluster analysis. Indeed, this approach was laid out by Czamanski (1974) and adopted more recently by Feser and Bergman (2000) to develop a set of national

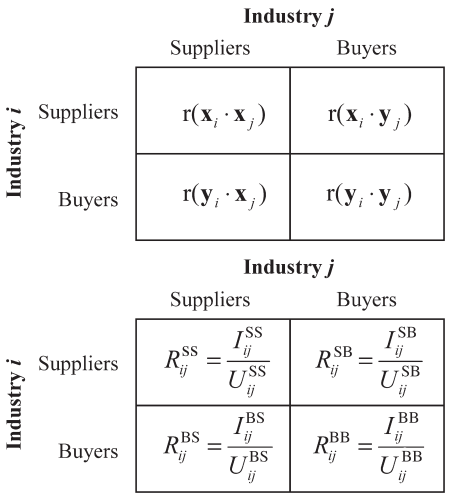


*Fig.* 1. *Measuring similarities in value chains*

manufacturing value chains using US 1987 input–output data.

A problem with using correlations calculated directly from purchases and sales figures is that they can be skewed by very large flows between comparatively few industries. The volume of purchases of industry $i$ from industry $j$ is sometimes, but not always, the best indicator of the importance of industry $j$ to $i$, for example. Because $i$ and $j$ both make relatively large purchases from the same comparatively small set of producer services industries, as most industries do, does not mean $i$ and $j$ are necessarily closely linked. Yet a correlation between the two industries' supply vectors would be very high. In general, the correlation approach has difficulty identifying distinct value chains, a problem that led FESER and BERGMAN (2000) to restrict their analysis to the manufacturing industry, thereby eliminating the tendency of purchases from general purpose producer services industries to 'pull' otherwise unrelated industries into large, nebulous value chains.

A solution to the problem is to begin by defining sets, $S_i$ and $B_i$, where $S_i$ is the set of supplier industries to industry $i$ and $B_i$ is the set of purchasing industries (buyers) from industry $i$.[1] At the extreme, $S$ and $B$ would contain, for industry $i$, all industries $j$ for which $x_{ij}$ and $y_{ij}$ are, respectively, greater than zero. In practice, one may set a threshold, $\alpha$, that $x_{ij}$ and $y_{ij}$ must exceed in order for industry $j$ ($i$) to be included in industry $i$'s ($j$'s) set of key suppliers (or buyers). Given $S$ and $B$, one can define:

$$\begin{aligned} I_{ij}^{SS} &= S_i \cap S_j, \quad U_{ij}^{SS} = S_i \cup S_j \\ I_{ij}^{BB} &= B_i \cap B_j, \quad U_{ij}^{BB} = B_i \cup B_j \\ I_{ij}^{SB} &= S_i \cap B_j, \quad U_{ij}^{SB} = S_i \cup B_j \\ I_{ij}^{BS} &= B_i \cap S_j, \quad U_{ij}^{BS} = B_i \cup S_j \end{aligned} \tag{2}$$

From (2) the following four measures can be constructed:

$$R_{ij}^{SS} = \frac{I_{ij}^{SS}}{U_{ij}^{SS}}, \; R_{ij}^{BB} = \frac{I_{ij}^{BB}}{U_{ij}^{BB}}, \; R_{ij}^{SB} = \frac{I_{ij}^{SB}}{U_{ij}^{SB}}, \; R_{ij}^{BS} = \frac{I_{ij}^{BS}}{U_{ij}^{BS}} \tag{3}$$

The ratios in (3) measure the proportion of shared linkages between industries $i$ and $j$ along four dimensions (see the bottom panel of Fig. 1). For example, $R^{SS}$ is the number of supplier industries that industries $i$ and $j$ have in common over the total number (or universe) of supplier industries to $i$ and $j$. The higher is $R^{SS}$, the stronger is the value chain linkage between $i$ and $j$ as indicated by joint sourcing from the same suppliers. Similarly, $R^{BB}$ is the share of common buyer industries. $R^{SB}$ and $R^{BS}$ are measures of second-tier relationships between each pair of industries; they increase as one industry's suppliers are another's buyers. The shares in (2) eliminate the volume of US dollar flows as an indicator of the importance of a given pairwise linkage. Each linkage as represented by the simple presence of a purchasing or sales flow is treated equally.[2]

More importantly, one can weight certain pairwise linkages more than others. Acknowledging the problem with producer services noted above when deriving the value chains, industries were designated such as wholesale trade, information, legal services, advertising, finance, and insurance as *enabling* industries and assigned a weight ($<1.0$) that reduced their influence in the calculation of the $R$ measures. Thus, distinct or unique linkages between industries were weighted more than the joint consumption of broadly similar mixes of producer services, without excluding linkages with producer services entirely as in FESER and BERGMAN (2000). Other weighting schemes could be used depending on the question at hand. For example, one might weight technology-intensive industries more than others as a means of emphasizing technology-based linkages. Note that each indicator in (2) may be interpreted as a simple share of common linkages and is therefore a simple and intuitive measure of the strength of the tie between any two industries.

Fig. 2 summarizes steps in the development of the chains with 1997 benchmark US input–output data.[3] The process begins by eliminating 26 primarily local serving and government enterprise industries, reducing the 489-sector inter-industry transactions matrix to a 463-dimension matrix. A weight of one-third, or 0.33, was then applied to each of 55 general enabling producer services industries before the calculation of the $R$ measures. While the weight is admittedly arbitrary, groupings generated by statistical cluster analysis with weights of 0.75, 0.50, 0.33 and 0.25 were compared to determine the thresholds at

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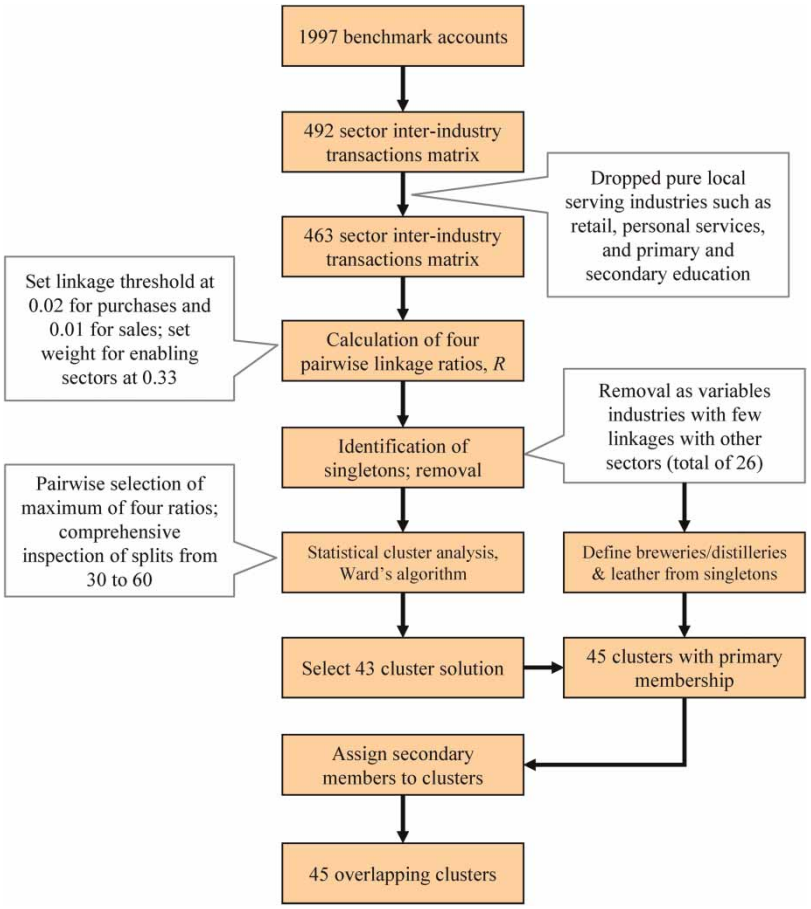


*Fig. 2. Benchmark cluster methodology*

which enabling linkages began to dominate adversely the identification of the value chains. The notion was to select the maximum weight that still yielded distinct and interpretable chains. The level 0.33 met that criterion.[4]

The next step is to check the number of total linkages per sector. The great majority of industries post at least 20 linkages with other industries. However, 32 of 463 industries post very few or no inter-industry linkages. Those 32 industries' predominant intermediate transactions are either with themselves or with the 26 local serving industries eliminated from the reduced transactions matrix in an earlier step. Such 'singleton' industries (or 'isolates' in a network analysis context) were dropped temporarily at this stage, reducing the linkage matrix to 431 industries. The singletons were reintroduced into the analysis in subsequent steps, as described below. Selecting the maximum of the four $R$ measures produced a 431-dimension linkage matrix ($\mathbf{R}^{MAX}$) that was then analysed using Ward's hierarchical clustering algorithm.

Initial inspection of Ward's clustering results indicated a solution of between 40 and 50 distinct value chains. To add an additional measure of sensitivity testing, all chain splits for solutions between 30 and 60 clusters were examined to identify the solution that met both statistical and interpretability criteria. That solution proved to be 43 distinct clusters or value chains.[5] At this stage, five of the singleton industries were reintroduced into the analysis. An inspection of purchase and sales flows for each singleton industry made clear that input–output sectors 312120 (breweries) and 312140 (distilleries) form the core of a small breweries and distilleries chain, while input–output sectors 316100 (leather and hide tanning and finishing), 316200 (footwear manufacturing), and 316900 (other leather product manufacturing) form a leather products chain. The breweries and leather products chains were therefore added to the set of 43 derived from statistical cluster analysis to produce a total of 45 value chains.

Industry membership in the 45 chains is exclusive at this stage; industries are members of only a single chain. The final step is to acknowledge the inherent 'fuzziness' among inter-industry linkages, namely that every industry is linked at some level to every other industry, with the strength of that linkage ranging from zero (no joint buyers or suppliers) to 1 (identical buyer and supplier linkages). Taken together, the industries that make up any one of the initial, mutually exclusive 45 clusters are simply more strongly related to each other than to any other identified

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groups. Any particular industry may also have reasonably tight linkages with other value chains. That fact is acknowledged by viewing the results of Ward's cluster analysis as defining a set of *core* value chains, each made up of *primary* sectors. A non-primary industry, *s*, is defined as a *secondary* industry to a given value chain if its average linkage with primary industries of that chain exceeds some threshold, $\delta$. Progressively lower levels of $\delta$ increases the 'fuzziness' among value chains. Setting $\delta = 0$ effectively includes all industries in all value chains (maximum fuzziness).

Selecting the appropriate level of $\delta$ was resolved by inspecting the distribution of average linkages with the use of *z* scores. An average linkage for each industry *i* across *n* primary industries *j* in cluster *k* was calculated as:

$$\bar{r}_{ik} = \frac{\sum_{j=1}^{n} r_{ijk}^{\mathrm{MAX}}}{n} \tag{4}$$

where the measure $\bar{r}_{ik}$ is the arithmetic mean of the maximum linkages between industry *i* and the primary industries in core cluster *k*. Including all singleton industries, the values $\bar{r}_{ik}$ can be arrayed in a 463 row by 45 column matrix and converted to *z* scores in the usual fashion:

$$z_{ik} = \frac{\bar{r}_{ik} - \mathrm{mean}(\bar{r}_{ik})}{\mathrm{SD}(\bar{r}_{ik})} \tag{5}$$

Each industry *i* was then defined as a secondary industry in cluster *k*, where $z_{ik} > 2.25$. Note that singleton industries, along with other industries, are assigned as secondary industries to the core chains for which they post the strongest average linkage. Thus, some singleton industries are not primary industries in any of the 45 value chains.

Table 1 provides an example of the value chain analysis results.[6] It reports the detailed sectoral makeup of the national motor vehicles value chain cluster, including each member industry's average linkage indicator and *z* score. The higher the linkage factor for industry *i*, the more closely *i* is tied to the overall chain (i.e., the more closely *i*'s own unique value chain aligns with the value chains of other cluster members). While primary industries are those that are most closely linked within the chain, they are not necessarily end market industries. Note that the motor vehicles value chain is comprised mostly of industries in NAICS 336, transportation equipment manufacturing. However, it also includes one industry from NAICS 334, computer and electronic product manufacturing, and 335, electrical equipment, appliance and component manufacturing. Six members are primary and six are secondary. Three of the industries in the chain – all other transportation equipment manufacturing, boat building, and electric lamp bulb and part manufacturing – are singleton industries that have comparatively few inter-industry linkages overall (indicated by a zero in the 'Primary ID' column); based on the limited linkages they do have, they are most closely related to motor vehicles. The primary members of the motor vehicles chain are mostly end market industries (trucks, cars, mobile homes, and campers).

The full list of 45 value chain clusters is provided in Table 2. The descriptor for each cluster represents the predominant economic activity among the group of industries, particularly those that are most tightly linked within the cluster. The descriptors should be interpreted carefully and not too literally. No descriptor can adequately capture all of the relationships among industries in each value chain. Together, the industries included in the value chains constitute a significant

*Table* 1. *US motor vehicles value chain*

| ID code | IO code | IO label | 2002 NAICS | Primary ID | Type | Linkage | *Z*-score |
|---|---|---|---|---|---|---|---|
| 23 | 336120 | Heavy duty truck manufacturing | 336120 | 23 | Primary | 0.51318 | 6.65 |
| 23 | 336211 | Motor vehicle body manufacturing | 336211 | 23 | Primary | 0.51100 | 6.62 |
| 23 | 336212 | Truck trailer manufacturing | 336212 | 23 | Primary | 0.50285 | 6.48 |
| 23 | 336110 | Automobile and light truck manufacturing | 336110 | 23 | Primary | 0.49863 | 6.41 |
| 23 | 336213 | Motor home manufacturing | 336213 | 23 | Primary | 0.46566 | 5.86 |
| 23 | 336214 | Travel trailer and camper manufacturing | 336214 | 23 | Primary | 0.44360 | 5.50 |
| 23 | 336300 | Motor vehicle parts manufacturing | 336300 | 16 | Secondary | 0.40194 | 4.81 |
| 23 | 336991 | Motorcycle, bicycle, and parts manufacturing | 336991 | 19 | Secondary | 0.34128 | 3.80 |
| 23 | 336999 | All other transportation equipment manufacturing | 336999 | 0 | Secondary | 0.29329 | 3.00 |
| 23 | 336612 | Boat building | 336612 | 0 | Secondary | 0.27436 | 2.69 |
| 23 | 334300 | Audio and video equipment manufacturing | 334300 | 12 | Secondary | 0.25887 | 2.43 |
| 23 | 335110 | Electric lamp bulb and part manufacturing | 335110 | 0 | Secondary | 0.17931 | 1.11 |

*Notes:* 'ID code' is a unique identification (ID) assigned to each (1, . . . , 45) identified value chain cluster.
'IO code and label' is the input–output classification code. *Source:* BUREAU OF ECONOMIC ANALYSIS (2002).
'2002 NAICS' is the 2002 North American Industry Classification System (NAICS) code (does not always concord directly to the IO code).
'Primary ID' indicates the value chain cluster in which row sector is a *primary* member.
'Type' indicates whether industry is *primary* or *secondary* to the value chain.
'Linkage and *Z*-score' measures of strength of the sector's linkage to overall chain (higher value = stronger linkage).

*Table 2. Forty-five US value chains: number of 2002 North American Industry Classification System (NAICS) industries represented wholly or partially in each chain*

| ID | Value chain | Two digit | Three digit | Four digit | Five digit | Six digit |
|---|---|---|---|---|---|---|
| 1 | Textiles and apparel | 3 | 6 | 12 | 22 | 49 |
| 2 | Packaged food products | 1 | 2 | 8 | 18 | 33 |
| 3 | Plastics and rubber manufacturing | 1 | 4 | 9 | 15 | 25 |
| 4 | Aluminium and aluminium products | 1 | 4 | 9 | 12 | 24 |
| 5 | Basic health services | 6 | 9 | 38 | 119 | 142 |
| 6 | Mining | 2 | 3 | 5 | 10 | 28 |
| 7 | Farming | 2 | 4 | 8 | 23 | 38 |
| 8 | Construction | 2 | 2 | 4 | 14 | 15 |
| 9 | Financial services and insurance | 5 | 10 | 22 | 68 | 91 |
| 10 | Chemical-based products | 3 | 7 | 11 | 18 | 31 |
| 11 | Machine tools | 1 | 4 | 12 | 14 | 34 |
| 12 | Precision instruments | 1 | 4 | 6 | 7 | 16 |
| 13 | Printing and publishing | 4 | 6 | 7 | 19 | 31 |
| 14 | Metalworking and fabricated metal goods | 1 | 3 | 6 | 9 | 18 |
| 15 | Dairy products | 2 | 2 | 5 | 9 | 14 |
| 16 | Non-durable industry machinery | 2 | 4 | 10 | 21 | 43 |
| 17 | Computer and electronic equipment | 2 | 4 | 8 | 10 | 31 |
| 18 | Wood products and furniture | 2 | 3 | 4 | 6 | 14 |
| 19 | Construction machinery and distribution equipment | 1 | 3 | 8 | 13 | 29 |
| 20 | Wood processing | 4 | 4 | 7 | 10 | 20 |
| 21 | Paper | 1 | 4 | 4 | 9 | 24 |
| 22 | Concrete, brick building products | 2 | 8 | 16 | 22 | 26 |
| 23 | Motor vehicles | 1 | 3 | 7 | 15 | 23 |
| 24 | Wood building products | 2 | 8 | 15 | 19 | 27 |
| 25 | Plastics products | 1 | 2 | 3 | 10 | 18 |
| 26 | Feed products | 4 | 8 | 21 | 40 | 55 |
| 27 | Arts and media | 8 | 17 | 47 | 137 | 153 |
| 28 | Management, higher education and hospitals | 13 | 20 | 69 | 178 | 213 |
| 29 | Information services | 5 | 11 | 38 | 104 | 121 |
| 30 | Petroleum and gas | 5 | 7 | 15 | 25 | 39 |
| 31 | Business services | 10 | 17 | 54 | 173 | 204 |
| 32 | Grain milling | 2 | 3 | 4 | 9 | 14 |
| 33 | Rubber products | 2 | 5 | 7 | 12 | 20 |
| 34 | Glass products | 2 | 2 | 5 | 6 | 18 |
| 35 | Pharmaceuticals | 2 | 3 | 8 | 9 | 14 |
| 36 | Steel milling | 1 | 2 | 4 | 5 | 7 |
| 37 | Non-residential building products | 3 | 10 | 17 | 28 | 39 |
| 38 | Tobacco products | 2 | 2 | 2 | 3 | 4 |
| 39 | Optical equipment and instruments | 2 | 6 | 7 | 10 | 18 |
| 40 | Appliances | 2 | 7 | 16 | 20 | 30 |
| 41 | Copper and copper products | 1 | 3 | 6 | 8 | 17 |
| 42 | Hotels | 10 | 15 | 41 | 75 | 110 |
| 43 | Aerospace | 1 | 2 | 2 | 2 | 7 |
| 44 | Breweries | 2 | 4 | 4 | 7 | 11 |
| 45 | Leather products | 2 | 6 | 8 | 8 | 19 |

*Note:* Value chains are not mutually exclusive.
ID, identification.

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fraction of US economic activity, roughly 65% of total US employment in 2004, and somewhat more if measured by payroll or output.[7] Industries not included in the clusters, as noted above, are retail trade, government (including the US Postal Service), primary and secondary schools, and consumer and personal services. Note that the value chains are not industries in the conventionally defined sense. For example, the 49 six-digit NAICS industries in the textiles and apparel value chain are drawn from three two-digit NAICS codes, six three-digit NAICS codes, twelve four-digit NAICS codes, and 22 five-digit NAICS codes.

## DEFINING RURAL AND RURAL ECONOMIC SPECIALIZATION

Given the chains, one can explore rural economies' role as production locations in these national systems of linked and related industries. However, investigating the spatial

characteristics of the 45 value chains, and particularly their rural–urban distribution, requires appropriate definitions of *rural* and *urban*. When researchers study the rural economy, they almost always use county data and treat non-metropolitan as synonymous with rural. In the USA, the federal government does it, the Federal Reserve Bank does it, and seasoned, excellent scholars do it, but it is wrong. As the OFFICE OF MANAGEMENT AND BUDGET (OMB) (2000) points out:

> The Metropolitan and Micropolitan Statistical Area Standards do not equate to an urban–rural classification; all counties included in Metropolitan and Micropolitan Statistical Areas and many other counties contain both urban and rural territory and populations.
>
> (p. 82228)

Indeed, the majority of rural people and more than 1 million farmers live in metropolitan counties.[8]

This section outlines a better approach for identifying urban and rural counties. It builds on the existing federal data system and categorizes counties by their urban–rural character. The key notion is that urban–rural *integration*, which the OMB seeks to capture in defining metropolitan and micropolitan core-based regions, differs from urban–rural *character*, which the US Census Bureau seeks to capture when it defines urban and rural areas. Both dimensions are important in understanding the rural role in national value chains.

### *The official definitions*

The Census Bureau system distinguishes between urban and rural, building up urban areas from census blocks, starting with cores that have 1000 or more people per square mile and adding surrounding blocks with 500 or more density and less densely settled territory that meets specified requirements, such as major airports. The algorithm, explained in various issues of the *Federal Register*, is distilled into ten steps by ISSERMAN (2005), who discusses in more detail the ideas presented in this section. Conceptually, the Census system identifies built up areas, thereby approximating the separation of the landscape into urban and rural, town and country, as one would see it if viewed from the air. If the population of the qualifying combination of block groups reaches 2500 it qualifies as an urban area.

In official Census terminology, urban areas with more than 50 000 people are called urbanized areas, and those with 2500–49 999 people are called urban clusters. Any space not assigned to urban areas is defined as rural. According to the 2000 Census, the nation's rural areas occupy 97.3% of the land and house 20% of the population, or 55 million people. In contrast, the 38 urbanized areas with 1 million or more people house 42% of the population on 1.0% of the land at a population density of 3400 people per square mile. In all, 70% of the nation's population lives in urbanized areas, and 11% in urban clusters.

Very little is known about the economies of urbanized areas or rural areas because there are no comprehensive economic data for them as are available for counties. The counties provide poor substitutes for urban and rural data, however, because only one in four counties is entirely rural or urban. There are 43 counties with no rural population, but only 7% of the urban population, 8% of the urbanized area population, and less than 6% of the nation lives in these purely urban counties. Likewise, there are 733 counties with no urban population, but only 10% of the rural population and 2% of the national population live in these purely rural counties. Most people live in counties that combine urban and rural areas: 90% of rural residents, 93% of urban residents, 92% of urbanized area residents, and 99.9% of urban cluster residents.

Well aware of the fact that most counties combine urban and rural areas, the OMB takes counties as building blocks and sorts them into core-based regions, including metropolitan statistical areas. The goal is to describe functionally integrated regions that have a densely settled urban nucleus. A Census urbanized area is the required nucleus for a metropolitan area, and its entire county or counties become the core of the metropolitan area. Adjacent counties, including purely rural ones, are added to the metropolitan area if 25% of their employed residents work in the core counties or, in rarer cases, if 25% of the core counties' employed residents work in the adjacent county. The same process defines micropolitan counties, but the required core is a Census urban cluster of 10 000 or more. Thus, an urban area of 50 000 or more seeds a metropolitan area, and a smaller one seeds a micropolitan area. All counties not in a metropolitan or micropolitan area are officially designated as 'Outside Core Based Statistical Regions'.

The federal government has defined metropolitan areas since 1950, always using the concept of integrated functional areas that combine urban and rural areas. Recognizing integrated regions centred on smaller urban areas is new, micropolitan areas having been designated for the first time in 2003. Also new is the reliance on commuting as the sole criterion for adding surrounding counties. Previously 'metropolitan character' also mattered, and it was defined in terms of density and urban population with various sliding scales and tradeoffs among the three measures. For example, if 50% of a county's employed residents commuted to the metropolitan area, the county was added if it had a population density of 25 people per square mile or 10% of its population lived in urban areas; if 25–40% commuted, the county could qualify by meeting two of three other criteria, such as a density of 35 people per square mile, 35% urban population, or 5000 people in an urban area. Removing all but the commuting requirement made more likely the inclusion of counties of rural character in metropolitan areas. In fact, there are 95 purely rural counties in metropolitan areas.

There was never any intent, explicit or implicit, to make metropolitan synonymous with urban and

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non-metropolitan synonymous with rural, but that is the widespread practice in academic and government research. The reason the practice should be abandoned is evident in Table 3, which shows counties organized by Beale codes, a popular taxonomy developed by the US Department of Agriculture and officially called the Rural–Urban Continuum Codes. The Beale code system's first three categories are counties in metropolitan areas. Those metropolitan counties together house 51.1% of the national rural population in 2000, hence the statement that the majority of rural people live in metropolitan areas. Likewise, over 40% of the farm population lives in metropolitan counties. Thus, continuing to treat non-metropolitan counties as proxies for rural America makes little sense.

Most categories of the Beale code have a mix of urban and rural residents. The rural proportion ranges from 7% to 30% of the populations of the three metropolitan categories and from 36% to 66% of the populations of the first four non-metropolitan categories. Thus, even the non-metropolitan counties are mixed and have substantial urban population shares. Only the last two categories of the Beale system come close to representing purely rural counties, but together they house only 9% of the rural population and 13% of the farm population.

### *A new approach*

The new categories used focus on the urban and rural character of counties as well as economic integration, the crux of the metropolitan and core-based system. The rationale is described more fully by ISSERMAN (2005). The four categories of urban–rural character and the criteria are as follows:

- Rural county: (1) the county's population density is less than 500 people per square mile, and (2) 90% of the county population is in rural areas and/or the county has no urban area with a population of 10 000 or more. The density requirement is the same used by the Census Bureau to distinguish urban and rural census blocks, and the urban area threshold follows the urban cluster requirement used by the OMB to define micropolitan core areas. The 90% requirement, which screens out low-density counties with substantial urban populations, has no official precedent or standing.
- Urban county: (1) the county's population density is at least 500 people per square mile, (2) 90% of the county population lives in urban areas, and (3) its population in urbanized areas is at least 50 000 or 90% of the county population. The density and the 90% requirement serve as above, and 50 000 is the OMB urbanized area threshold for the nucleus of a metropolitan county. The third criterion has two parts because of independent Virginia cities; treated as counties statistically by the Census Bureau, some have fewer than 50 000 residents but are entirely or almost entirely within larger urbanized areas that spill over their borders.
- Mixed rural county: (1) the county meets neither the urban nor the rural county criteria, and (2) its population density is less than 320 people per square mile. That density is 2 acres per person; it has no official standing but seems reasonable.
- Mixed urban county: (1) the county meets neither the urban nor the rural county criteria, and (2) its population density is at least 320 people per square mile. Thus, mixed urban counties are almost two-thirds of the way to the urban density threshold of 500 people per square mile.

Defined this way, rural and mixed rural counties house 85% of the rural population and 91% of the farm population (Table 4). Therefore, studying these two categories recognizes considerably more rural people than the non-metropolitan designation. Inclusion of the mixed urban counties accounts for 95% of the rural population. With each step from rural to urban, the rural population is a smaller proportion: 76% of rural counties, 33% of mixed rural, 15% of mixed urban, and 2% of urban. The four categories are a continuum, dubbed the rural–urban density code in ISSERMAN (2005). Fig. 3 maps the county types.

This system for identifying the urban–rural character of counties can be combined with any of the systems that identify integration and adjacency. Given the longstanding popularity of the metropolitan, non-metropolitan distinction, it is used herein not to distinguish urban from rural, but to identify counties that are integrated with urbanized areas, that is, with population centres of 50 000 or more residents. Rural metropolitan and rural non-metropolitan counties are two categories of such a combined system. Table 5 shows that 9% of the rural population is in rural metropolitan counties, 27% in mixed rural metro counties, 10% in mixed urban metro counties, and 5% in urban metro counties, thus accounting for the entire rural majority found in metropolitan areas. Besides being conceptually attractive in that rural economies linked to cities might be quite different than those without such linkages to urban services, markets, and jobs, the two-way classification reveals a distinction among mixed rural counties. Whereas the metropolitan ones are 27% rural, the non-metropolitan ones are 47% rural. Because the eleven mixed urban non-metropolitan counties, averaging 16 000 in population, are primarily small towns and result from peculiarities in the statistical system, the subsequent analyses will focus on the other six categories.

### *Differing economic specializations*

There are meaningful differences in the economies of rural, mixed rural, mixed urban, and urban counties. Table 6 reports the percentage of national employment in each two-digit NAICS industry in each of the six county types along with corresponding location quotients.[9] Rural counties – metro and non-metro

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*Table 3. Population and shares by Beale code, 2000*

| Code | Description | Total population | Per cent of total | Rural population | Per cent of rural | Farm population | Per cent of farm | *n* | Average population | Per cent rural population | Per cent farm population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Metropolitan* | | | | | | | | | | |
| 1 | County in a metropolitan area with 1 million population or more | 149 224 067 | 53.0 | 11 161 799 | 18.9 | 378 362 | 12.7 | 413 | 361 317 | 7.5 | 0.3 |
| 2 | County in a metropolitan area of 250 000 to 1 million population | 55 514 159 | 19.7 | 10 566 581 | 17.9 | 411 271 | 13.8 | 325 | 170 813 | 19.0 | 0.7 |
| 3 | County in a metropolitan area of fewer than 250 000 population | 27 841 714 | 9.9 | 8 448 344 | 14.3 | 409 412 | 13.7 | 351 | 79 321 | 30.3 | 1.5 |
| | *Non-metropolitan* | | | | | | | | | | |
| 4 | Non-metropolitan county with an urban population of 20 000 or more, adjacent to a metropolitan area | 14 442 161 | 5.1 | 6 676 168 | 11.3 | 281 556 | 9.4 | 218 | 66 248 | 46.2 | 1.9 |
| 5 | Non-metropolitan county with an urban population of 20 000 or more, not adjacent to a metropolitan area | 5 573 273 | 2.0 | 2 004 446 | 3.4 | 110 629 | 3.7 | 105 | 53 079 | 36.0 | 2.0 |
| 6 | Non-metropolitan county with an urban population of 2500–19 999, adjacent to a metropolitan area | 15 134 357 | 5.4 | 9 959 795 | 16.9 | 635 038 | 21.3 | 609 | 24 851 | 65.8 | 4.2 |
| 7 | Non-metropolitan county with an urban population of 2500–19 999, not adjacent to a metropolitan area | 8 463 700 | 3.0 | 5 054 629 | 8.6 | 361 278 | 12.1 | 450 | 18 808 | 59.7 | 4.3 |
| 8 | Non-metropolitan county completely rural or less than 2500 urban population, adjacent to a metropolitan area | 2 425 743 | 0.9 | 2 410 490 | 4.1 | 163 608 | 5.5 | 235 | 10 322 | 99.4 | 6.7 |
| 9 | Non-metropolitan county completely rural or less than 2500 urban population, not adjacent to a metropolitan area | 2 802 732 | 1.0 | 2 781 345 | 4.7 | 236 377 | 7.9 | 435 | 6443 | 99.2 | 8.4 |

*Source:* US Census and authors' calculations.

*Table* 4. *Population and shares by rural and urban density code*

| County type | Total | Per cent of total | Rural | Per cent of rural | Farm | Per cent of farm | *n* | Average population | Per cent rural | Per cent farm |
|---|---|---|---|---|---|---|---|---|---|---|
| Rural | 27 964 452 | 9.9 | 21 278 343 | 36.0 | 1 415 199 | 47.4 | 1790 | 15 623 | 76.1 | 5.1 |
| Mixed rural | 86 424 633 | 30.7 | 28 677 701 | 48.6 | 1 310 653 | 43.9 | 1022 | 84 564 | 33.2 | 1.5 |
| Mixed urban | 40 508 685 | 14.4 | 6 055 353 | 10.3 | 180 634 | 6.0 | 157 | 258 017 | 14.9 | 0.4 |
| Urban | 126 524 136 | 45.0 | 3 052 200 | 5.2 | 81 045 | 2.7 | 172 | 735 605 | 2.4 | 0.1 |
| Total | 281 421 906 | 100.0 | 59 063 597 | 100.0 | 2 987 531 | 100.0 | 3141 | 1 093 809 | 21.0 | 1.1 |

*Source:* US Census and authors' calculations.

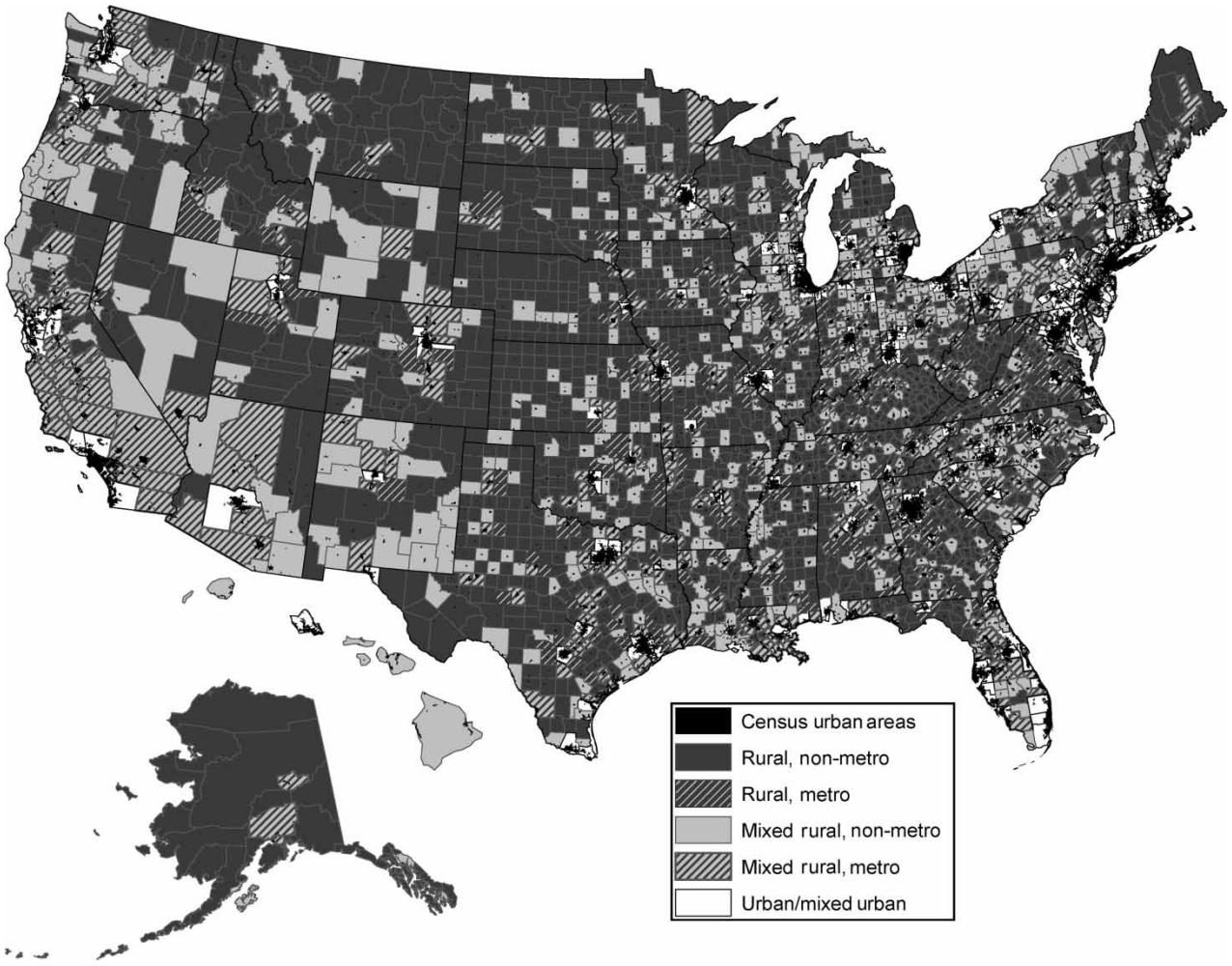


*Fig.* 3. *Urban areas and counties by urban–rural character and urban integration*

*Table* 5. *Rural population and shares by metropolitan designation, 2000*

| Type | Metro status | Total population | Per cent of total | Rural population | Per cent of rural | Farm population | Per cent of farm | *n* | Average population | Per cent Rural | Per cent farm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rural | Metro | 6 589 186 | 2.3 | 5 134 419 | 8.7 | 285 576 | 9.6 | 304 | 21 675 | 77.9 | 4.3 |
| Rural | Non-metro | 21 375 266 | 7.6 | 16 143 924 | 27.3 | 1 129 623 | 37.8 | 1486 | 14 384 | 75.5 | 5.3 |
| Mixed rural | Metro | 59 132 936 | 21.0 | 15 971 278 | 27.0 | 652 240 | 21.8 | 467 | 126 623 | 27.0 | 1.1 |
| Mixed rural | Non-metro | 27 291 697 | 9.7 | 12 706 423 | 21.5 | 658 413 | 22.0 | 555 | 49 174 | 46.6 | 2.4 |
| Mixed urban | Metro | 40 333 682 | 14.3 | 6 018 827 | 10.2 | 180 184 | 6.0 | 146 | 276 258 | 14.9 | 0.4 |
| Mixed urban | Non-metro | 175 003 | 0.1 | 36 526 | 0.1 | 450 | 0.0 | 11 | 15 909 | 20.9 | 0.3 |
| Urban | Metro | 126 524 136 | 45.0 | 3 052 200 | 5.2 | 81 045 | 2.7 | 172 | 735 605 | 2.4 | 0.1 |
| Total | | 281 421 906 | 100.0 | 59 063 597 | 100.0 | 2 987 531 | 100.0 | 3141 | 1 239 630 | 21.0 | 1.1 |

*Source:* US Census and authors' calculations.

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*Table 6. Rural–urban employment distribution of North American Industry Classification System (NAICS) two-digit sectors, 2002*

| | Rural | | | | Mixed rural | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-metro | | Metro | | Non-metro | | Metro | | Mixed urban | | Urban | |
| NAICS industry | Per cent employed | LQ | Per cent employed | LQ | Per cent employed | LQ | Per cent employed | LQ | Per cent employed | LQ | Per cent employed | LQ |
| 11 Forestry, fishing, hunting, and agriculture support | 27.0 | **5.8** | 5.3 | **4.5** | 19.8 | **2.5** | 28.2 | **1.6** | 7.2 | 0.5 | 12.4 | 0.2 |
| 21 Mining | 25.0 | **5.3** | 4.7 | **4.0** | 19.1 | **2.4** | 23.4 | **1.3** | 7.9 | 0.5 | 19.9 | 0.4 |
| 22 Utilities | 9.5 | **2.0** | 2.7 | **2.3** | 9.9 | **1.2** | 21.1 | **1.2** | 14.1 | 1.0 | 42.6 | 0.8 |
| 23 Construction | 4.5 | 1.0 | 1.5 | **1.3** | 7.1 | 0.9 | 22.3 | **1.2** | 16.3 | 1.1 | 48.3 | 0.9 |
| 31 Manufacturing | 8.2 | **1.7** | 2.0 | **1.7** | 13.1 | **1.6** | 20.6 | 1.1 | 15.8 | 1.1 | 40.2 | 0.8 |
| 42 Wholesale trade | 3.7 | 0.8 | 0.9 | 0.7 | 5.6 | 0.7 | 15.4 | 0.8 | 14.0 | 1.0 | 60.4 | 1.1 |
| 44 Retail trade | 5.7 | **1.2** | 1.5 | **1.3** | 9.8 | **1.2** | 21.2 | **1.2** | 15.9 | 1.1 | 45.9 | 0.9 |
| 48 Transportation and warehousing | 4.1 | 0.9 | 1.0 | 0.9 | 6.2 | 0.8 | 16.2 | 0.9 | 13.7 | 0.9 | 58.8 | 1.1 |
| 51 Information | 2.5 | 0.5 | 0.5 | 0.4 | 4.5 | 0.6 | 13.2 | 0.7 | 12.4 | 0.9 | 66.8 | **1.2** |
| 52 Finance and insurance | 2.9 | 0.6 | 0.7 | 0.6 | 4.5 | 0.6 | 13.6 | 0.7 | 12.7 | 0.9 | 65.6 | **1.2** |
| 53 Real estate and rental and leasing | 2.5 | 0.5 | 0.7 | 0.6 | 5.9 | 0.7 | 15.9 | 0.9 | 13.3 | 0.9 | 61.7 | **1.2** |
| 54 Professional, scientific and technical services | 1.8 | 0.4 | 0.5 | 0.4 | 3.7 | 0.5 | 12.2 | 0.7 | 12.5 | 0.9 | 69.2 | **1.3** |
| 55 Management of companies and enterprises | 1.2 | 0.3 | 0.3 | 0.3 | 3.3 | 0.4 | 11.0 | 0.6 | 13.3 | 0.9 | 70.8 | **1.3** |
| 56 Administration, support, waste management, remediation services | 1.9 | 0.4 | 0.4 | 0.4 | 4.4 | 0.6 | 15.5 | 0.9 | 14.4 | 1.0 | 63.3 | **1.2** |
| 61 Educational services | 3.1 | 0.7 | 0.7 | 0.6 | 6.4 | 0.8 | 13.7 | 0.8 | 12.0 | 0.8 | 64.0 | **1.2** |
| 62 Healthcare and social assistance | 5.4 | 1.1 | 1.2 | 1.0 | 9.2 | **1.2** | 19.3 | 1.1 | 14.4 | 1.0 | 50.5 | 0.9 |
| 71 Arts, entertainment and recreation | 4.2 | 0.9 | 1.4 | **1.2** | 7.4 | 0.9 | 19.1 | 1.0 | 14.6 | 1.0 | 53.3 | 1.0 |
| 72 Accommodation and food services | 5.0 | 1.1 | 1.3 | 1.1 | 9.3 | **1.2** | 22.2 | **1.2** | 15.1 | 1.0 | 47.0 | 0.9 |
| 81 Other services (except public administration) | 4.2 | 0.9 | 1.2 | 1.0 | 7.7 | 1.0 | 18.6 | 1.0 | 14.8 | 1.0 | 53.4 | 1.0 |
| 95 Auxiliaries (excluding corporate, subsidiary and regional management) | 2.4 | 0.5 | 0.6 | 0.6 | 7.3 | 0.9 | 14.4 | 0.8 | 14.0 | 1.0 | 61.1 | 1.1 |
| 99 Unclassified establishments | 7.7 | **1.6** | 2.1 | **1.8** | 9.7 | **1.2** | 18.3 | 1.0 | 16.2 | 1.1 | 46.0 | 0.9 |
| Total non-farm private employment | 4.7 | 1.0 | 1.2 | 1.0 | 7.9 | 1.0 | 18.2 | 1.0 | 14.5 | 1.0 | 53.5 | 1.0 |

*Source:* Enhanced 2002 *County Business Patterns* (ISSERMAN and WESTERVELT, 2006) and authors' calculations. Location quotients (LQ) $\geq 1.2$ are shown in bold.

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combined – have 6% of total private non-farm employment and 10% of manufacturing employment. All location quotients (LQs) greater than 1 indicate relative specialization; rural counties have almost twice the share of manufacturing employment (LQ = 1.7) as they do total non-farm private employment. Rural counties are relatively specialized in six two-digit industries: forestry, fishing, hunting, and agriculture support, mining, utilities, manufacturing, retail trade, and accommodation and food services. Mixed rural counties specialize in those industries as well. Metro status matters too. Rural and mixed rural *metropolitan* counties specialize in construction, while their *non-metropolitan* counterparts do not. Conversely, healthcare and social assistance is more strongly represented in the non-metropolitan counties.

Urban counties specialize in a very different set of industries, among them, information, finance and insurance, professional and scientific/technical services, management of companies and enterprises, real estate and rental and leasing, and educational services. Mixed urban counties show the least specialization, with no location quotient exceeding 1.1 or 10% above the national share. In several cases, such as mining, utilities, manufacturing, information, professional, scientific, and technical services, and management of companies and enterprises, specialization moves along a continuum from rural to mixed rural to mixed urban to urban or in the other direction, implying that the mixed counties are indeed a blend of urban and rural.

Another cut of these numbers is helpful in understanding the importance of each industry to rural economies. It demonstrates again that the new definitions of county types appear to be useful in identifying unique economic characteristics of rural places. Table 7 reports the per cent of all jobs each industry provides in each county type.

*Table 7. Employment in each county type, 2002*

| NAICS | industry | Per cent of country type employment | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Rural | | Mixed rural | | | | |
| | | Non-metro | Metro | Non-metro | Metro | Mixed urban | Urban | Difference of rural non-metro to urban |
| 11 | Forestry, fishing, hunting, and agriculture support | 0.9 | 0.7 | 0.4 | 0.3 | 0.1 | 0.0 | 0.9 |
| 21 | Mining | 1.8 | 1.4 | 0.8 | 0.4 | 0.2 | 0.1 | 1.7 |
| 22 | Utilities | 1.2 | 1.4 | 0.7 | 0.7 | 0.6 | 0.5 | 0.7 |
| 23 | Construction | 5.4 | 7.1 | 5.1 | 6.9 | 6.3 | 5.1 | 0.3 |
| 31 | Manufacturing | 22.6 | 21.9 | 21.2 | 14.7 | 14.0 | 9.7 | 12.9 |
| 42 | Wholesale trade | 4.1 | 3.9 | 3.7 | 4.4 | 5.1 | 5.9 | −1.8 |
| 44 | Retail trade | 16.1 | 16.6 | 16.4 | 15.5 | 14.6 | 11.4 | 4.7 |
| 48 | Transportation and warehousing | 2.8 | 2.7 | 2.5 | 2.9 | 3.0 | 3.5 | −0.7 |
| 51 | Information | 1.7 | 1.3 | 1.8 | 2.3 | 2.7 | 4.0 | −2.3 |
| 52 | Finance and insurance | 3.5 | 3.5 | 3.3 | 4.3 | 5.0 | 7.1 | −3.5 |
| 53 | Real estate and rental and leasing | 1.0 | 1.1 | 1.3 | 1.6 | 1.7 | 2.1 | −1.1 |
| 54 | Professional, scientific and technical services | 2.5 | 2.8 | 2.9 | 4.2 | 5.4 | 8.1 | −5.7 |
| 55 | Management of companies and enterprises | 0.7 | 0.7 | 1.1 | 1.6 | 2.4 | 3.5 | −2.8 |
| 56 | Administration, support, waste management, remediation services | 2.8 | 2.5 | 3.8 | 5.8 | 6.7 | 8.0 | −5.3 |
| 61 | Educational services | 1.6 | 1.5 | 1.9 | 1.8 | 2.0 | 2.9 | −1.3 |
| 62 | Healthcare and social assistance | 15.3 | 13.2 | 15.5 | 14.2 | 13.3 | 12.6 | 2.7 |
| 71 | Arts, entertainment and recreation | 1.4 | 1.9 | 1.5 | 1.7 | 1.6 | 1.6 | −0.2 |
| 72 | Accommodation and food services | 9.7 | 10.2 | 10.5 | 11.0 | 9.4 | 7.9 | 1.8 |
| 81 | Other services (except public administration) | 4.4 | 4.9 | 4.7 | 5.0 | 5.0 | 4.9 | −0.5 |
| 95 | Auxiliaries (excluding corporate, subsidiary and regional management) | 0.5 | 0.5 | 0.8 | 0.7 | 0.9 | 1.0 | −0.6 |
| 99 | Unclassified establishments | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |

*Source:* Enhanced 2002 *County Business Patterns* (Isserman and Westervelt, 2006) and authors' calculations.

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Manufacturing, retail trade, healthcare and social assistance, and accommodation and food services account for almost two-thirds of the private non-farm jobs in rural economies and in mixed rural non-metropolitan counties. The number falls monotonically thereafter, with those industries accounting for 64% of jobs in mixed rural non-metropolitan counties and 42% in urban counties. The biggest single difference is for manufacturing, which accounts for 23% in rural non-metropolitan counties and only 10% in urban counties.

## IDENTIFYING THE RURAL ROLE IN US VALUE CHAINS

The industrial and rural–urban classifications enable one to identify the distribution of the 45 US value chains among urban and rural areas of the country and, thereby, to demonstrate ways rural economies fit into the national system of production.[10] The investigation is focused on two questions: first, whether rural employment across national value chains is diverse – with appreciable activity in a broad range of chains, including manufacturing-, knowledge-, and service-based chains – or concentrated primarily in natural-resource based activities; and, second, whether rural areas specialize in selected segments of various value chains, either in industries less tightly linked within the chains or in lower wage industries within each chain. The first question investigates the geographic distribution of US economic activity and the integration of rural areas with the national economy, and the second asks whether the spatial pattern based on overall industry mix masks underlying differences in functional specializations among different kinds of places.

Therefore, what is the rural component of national value chain employment? Rural non-metro counties – which account for 4.7% of total US private non-farm employment – are a good beginning benchmark because they are both highly rural in terms of population and are not integrated with metro areas based on commuting flows. Table 8 shows that the top five chains with the strongest rural non-metro presence are

*Table 8. Rural–urban distribution of US value chains, 2002, sorted in descending order of rural non-metro percentage*

| ID | cluster | Employment (thousands) | Per cent of total US value chain employment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rural | | | Mixed rural | | | | |
| | | | Non-metro | Metro | Total | Non-metro | Metro | Total | Mixed urban | Urban |
| 6 | Mining | 274.6 | 29.8 | 5.7 | 35.5 | 20.7 | 23.7 | 44.4 | 8.6 | 11.5 |
| 20 | Wood processing | 1017.8 | 20.1 | 4.2 | 24.3 | 18.0 | 22.2 | 40.2 | 12.2 | 22.8 |
| 26 | Feed products | 301.1 | 18.9 | 4.0 | 23.0 | 21.0 | 26.2 | 47.2 | 10.3 | 19.5 |
| 7 | Farming | 12.8 | 16.4 | 1.2 | 17.6 | 16.3 | 24.6 | 40.8 | 6.6 | 35.0 |
| 18 | Wood products and furniture | 650.7 | 15.0 | 3.5 | 18.4 | 15.6 | 20.7 | 36.3 | 18.0 | 26.7 |
| 32 | Grain milling | 44.9 | 14.2 | 3.3 | 17.5 | 21.4 | 25.8 | 47.2 | 9.5 | 25.8 |
| 10 | Chemical-based products | 484.1 | 13.1 | 4.0 | 17.1 | 18.2 | 28.3 | 46.5 | 13.9 | 21.9 |
| 1 | Textiles and apparel | 953.9 | 13.0 | 2.9 | 15.8 | 16.0 | 19.4 | 35.4 | 13.2 | 35.1 |
| 24 | Wood building products | 858.1 | 12.6 | 2.8 | 15.5 | 15.8 | 24.1 | 39.9 | 15.4 | 29.1 |
| 45 | Leather products | 169.0 | 12.4 | 2.4 | 14.8 | 13.9 | 18.6 | 32.4 | 13.2 | 39.5 |
| 2 | Packaged food products | 1285.3 | 12.1 | 2.7 | 14.8 | 18.1 | 21.6 | 39.7 | 11.8 | 33.6 |
| 22 | Concrete, brick building products | 755.3 | 12.0 | 2.8 | 14.9 | 15.6 | 25.2 | 40.8 | 15.6 | 28.6 |
| 15 | Dairy products | 246.0 | 11.7 | 2.4 | 14.1 | 14.0 | 19.6 | 33.6 | 15.7 | 36.6 |
| 40 | Appliances | 995.2 | 10.9 | 2.2 | 13.1 | 16.3 | 23.2 | 39.5 | 15.4 | 31.9 |
| 19 | Construction machinery and distribution equipment | 594.5 | 9.2 | 1.9 | 11.1 | 17.1 | 20.5 | 37.6 | 16.0 | 35.3 |
| 3 | Plastics and rubber manufacturing | 632.7 | 9.1 | 3.3 | 12.4 | 13.6 | 27.2 | 40.8 | 15.1 | 31.3 |
| 23 | Motor vehicles | 1104.8 | 8.9 | 2.2 | 11.1 | 14.8 | 23.1 | 37.8 | 18.6 | 32.4 |
| 16 | Non-durable industry machinery | 1654.5 | 8.2 | 2.0 | 10.2 | 14.3 | 21.1 | 35.4 | 17.0 | 37.3 |
| 30 | Petroleum and gas | 1345.7 | 8.0 | 2.2 | 10.2 | 9.8 | 23.2 | 32.9 | 13.5 | 43.3 |
| 25 | Plastics products | 894.7 | 7.9 | 2.3 | 10.2 | 12.6 | 23.8 | 36.3 | 17.1 | 36.1 |
| 4 | Aluminium and aluminium products | 679.9 | 7.3 | 1.5 | 8.8 | 11.2 | 23.3 | 34.5 | 20.1 | 36.5 |
| 41 | Copper and copper products | 238.3 | 6.9 | 1.2 | 8.1 | 11.5 | 21.2 | 32.6 | 18.8 | 40.5 |
| 14 | Metalworking and fabricated metal goods | 702.6 | 6.8 | 2.4 | 9.2 | 12.5 | 22.2 | 34.7 | 15.9 | 40.1 |
| 11 | Machine tools | 1155.1 | 6.8 | 1.8 | 8.6 | 13.2 | 18.6 | 31.8 | 16.2 | 43.4 |
| 33 | Rubber products | 538.4 | 6.5 | 1.7 | 8.2 | 17.8 | 21.8 | 39.5 | 13.8 | 38.3 |
| 34 | Glass products | 354.0 | 6.5 | 1.7 | 8.1 | 15.0 | 23.7 | 38.7 | 15.7 | 37.4 |
| 36 | Steel milling | 220.3 | 5.9 | 1.6 | 7.5 | 11.6 | 23.0 | 34.6 | 25.5 | 32.4 |
| 44 | Breweries | 316.4 | 5.0 | 1.7 | 6.7 | 11.0 | 25.9 | 36.9 | 14.3 | 42.2 |
| 37 | Non-residential building products | 2222.0 | 4.9 | 1.4 | 6.3 | 8.0 | 18.7 | 26.6 | 15.7 | 51.3 |
| 21 | Paper | 538.1 | 4.8 | 1.2 | 6.0 | 10.9 | 21.0 | 31.9 | 16.1 | 45.9 |
| 12 | Precision instruments | 383.3 | 4.7 | 0.8 | 5.5 | 11.0 | 19.5 | 30.5 | 15.9 | 48.1 |
| 8 | Construction | 6373.3 | 4.7 | 1.5 | 6.2 | 7.3 | 22.3 | 29.6 | 16.3 | 47.8 |
| 28 | Management, higher education and hospitals | 30 884.9 | 3.8 | 0.9 | 4.7 | 6.5 | 16.1 | 22.6 | 13.3 | 59.5 |
| 39 | Optical equipment and instruments | 420.5 | 3.7 | 1.4 | 5.1 | 10.3 | 16.8 | 27.1 | 14.9 | 52.9 |
| 42 | Hotels | 19 964.8 | 3.1 | 0.8 | 3.9 | 5.4 | 15.7 | 21.1 | 13.2 | 61.7 |
| 35 | Pharmaceuticals | 462.9 | 3.0 | 1.1 | 4.1 | 5.7 | 14.5 | 20.2 | 13.8 | 61.7 |
| 27 | Arts and media | 14 752.6 | 3.0 | 0.7 | 3.7 | 5.3 | 14.4 | 19.8 | 13.2 | 63.2 |
| 5 | Basic health services | 21 599.6 | 2.9 | 0.7 | 3.6 | 5.6 | 15.8 | 21.3 | 14.1 | 61.0 |
| 31 | Business services | 27 645.9 | 2.7 | 0.7 | 3.4 | 4.9 | 14.5 | 19.4 | 13.1 | 64.0 |
| 29 | Information services | 13 410.1 | 2.6 | 0.6 | 3.2 | 4.4 | 13.2 | 17.5 | 13.0 | 66.2 |
| 13 | Printing and publishing | 2806.2 | 2.5 | 0.7 | 3.3 | 5.7 | 13.5 | 19.2 | 12.4 | 65.1 |
| 9 | Financial services and insurance | 15 702.6 | 2.2 | 0.5 | 2.8 | 4.2 | 13.6 | 17.8 | 13.1 | 66.3 |
| 17 | Computer and electronic equipment | 1451.3 | 2.0 | 0.5 | 2.4 | 4.0 | 15.4 | 19.4 | 17.2 | 60.7 |
| 43 | Aerospace | 554.7 | 1.3 | 0.4 | 1.7 | 2.9 | 14.8 | 17.7 | 18.6 | 61.9 |
| 38 | Tobacco products | 24.0 | 1.1 | 0.8 | 1.9 | 6.4 | 9.4 | 15.8 | 30.8 | 51.5 |

*Source:* Enhanced 2002 *County Business Patterns* (ISSERMAN and WESTERVELT, 2006) and authors' calculations. The table includes private, non-farm employment only (note that there is significant farm employment in the farming and feed products chains, and small amounts of farm employment in the dairy products, wood processing, grain milling, and tobacco products chains).

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indeed natural resource based: mining, wood processing, feed products, farming, and wood products and furniture. Yet a total of 28 of 45 value chains have 5.0% or more of their employment in rural non-metro counties, and among those 28 are several manufacturing chains, including chemical-based products, construction machinery and distribution equipment, motor vehicles, non-durable industry machinery, and machine tools. The patterns are similar if one considers rural metro and non-metro counties together, though two additional chains (construction and paper) – a total of 30 of 45 – are 'over-represented' in rural areas using as a benchmark the 5.9% rural metro plus rural non-metro share of private non-farm employment.

What is the rural role in some of the most knowledge-intensive chains? Many of the value chains, even those in traditional manufacturing and basic services, have knowledge-intensive components. However several, such as precision instruments, management/higher education/hospitals, and aerospace, have knowledge- or technology-based industries at their core. Table 8 shows that such industries are under-represented in rural non-metro counties, though they are not wholly absent. The knowledge-intensive chains with the strongest rural presence are precision instruments, management/higher education/hospitals, optical equipment and instruments, and pharmaceuticals. The value chains with the least rural presence are services-based, including financial services and insurance, information services, business services, basic health services, and arts and media. Indeed all services-based chains – those value chains with exportable services at their core – are under-represented in rural non-metro counties.

Turning to the second question, do rural areas specialize in selected segments of various value chains, namely industries with lower levels of interdependence within the chains or lower wage industries? These two issues are explored in turn. First, the paper checks the urban–rural distribution of value chain employment in the *primary* industries, defined as those most closely linked together within given value chains. In any value chain *i*, the degree of economic interdependence among primary industries is significantly greater than the interdependence among secondary industries or the degree of interdependence between primary and secondary industries. Recall from the value chain clustering methodology that *secondary* industries in value chain *i* are, by definition, more tightly linked to another value chain *j* (following terminology in Feser and Bergman, 2000). While secondary industries are not the core of a given chain, they are not necessarily lower productivity, lower value-added, lower wage, or intermediate market industries in comparison with primary industries.

On the one hand, industry cluster theories hypothesize that industries that are highly economically interdependent are more likely to co-locate to take advantage of spatial externalities. If only the secondary components of various chains are located in rural counties, the economic bases of rural areas may be less likely to benefit from competitiveness-enhancing spatial externalities. Theory suggests that a spatial cluster of primary industries is more likely to generate externalities than a cluster of secondary industries. On the other hand, since secondary industries are often members of multiple value chains, they both depend on a range of markets for growth as well as link different value chains together. In that sense, they often serve a kind of 'enabling' function within the broader US economic base. Secondary industries can be positive for rural areas by introducing a level of diversity via their ties to a variety of value chains and markets.

Rural counties have key roles at the defining core of some value chains and more generic roles in others. For example, rural non-metro counties capture 31.1% of US primary industry employment in the wood processing chain, compared with 20.1% of the chain's overall employment (Table 9). In contrast, rural non-metro counties are home to 8.9% of motor vehicles chain *overall* employment but only 6.7% of motor vehicles *primary* industry employment. In total, rural non-metro counties account for more than 4.7% of the US primary industry employment in 27 of the 44 chains for which primary and secondary industry activity can be distinguished reliably. Again, that is significant given that just 4.7% of private non-farm employment overall is found in rural non-metro counties in 2002. Several of those 27 chains are moderately to highly technology intensive, including construction machinery and distribution equipment manufacturing, non-durable industry machinery, appliances, motor vehicles, machine tools, and precision instruments, though most are tied to natural resources or agriculture, among them packaged food products, chemical-based products, wood building products, and rubber products.

Next the section examines the urban–rural distribution of higher wage employment in each chain, where 'higher' wage industries in US value chain *i* are defined as those at or above the median US wage for all industries in value chain *i*. Table 10 reports the share of each county type's value chain employment that is found in higher wage industries. Rural non-metro counties tend to specialize in the lower wage components of various value chains compared with more urban counties and/or counties in metro areas. The share of employment in high wage industries in urban counties exceeds the share in rural non-metro counties in 34 of the 42 chains for which high and low wage components could be distinguished. That compares with 32 chains for urban versus rural metro counties, 30 for urban versus mixed rural non-metro counties, 29 for urban versus mixed rural metro counties, and 28 for urban versus mixed urban counties.

At the same time the list of value chains for which the high wage share is 50% or higher in rural non-metro counties is fairly diverse. It includes financial services

*Table 9. Rural–urban distribution of US value chain primary industry employment, 2002, sorted in descending order of rural non-metro percentage*

| ID | cluster | Employment (thousands) | Per cent US value chain employment in primary industries | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rural | | | Mixed rural | | | | |
| | | | Non-metro | Metro | Total | Non-metro | Metro | Total | Mixed urban | Urban |
| 6 | Mining | 202.4 | 33.7 | 6.8 | 40.5 | 20.7 | 22.2 | 42.9 | 7.1 | 9.4 |
| 20 | Wood processing | 269.2 | 31.1 | 5.7 | 36.8 | 24.4 | 21.4 | 45.8 | 7.5 | 9.6 |
| 24 | Wood building products | 191.7 | 20.0 | 3.5 | 23.5 | 16.0 | 25.7 | 41.6 | 16.8 | 17.8 |
| 26 | Feed products | 156.1 | 17.6 | 4.6 | 22.2 | 19.9 | 31.3 | 51.2 | 10.2 | 16.4 |
| 10 | Chemical-based products | 336.5 | 15.4 | 4.5 | 20.0 | 20.0 | 27.6 | 47.6 | 12.3 | 19.5 |
| 32 | Grain milling | 40.8 | 14.6 | 3.3 | 17.9 | 20.7 | 25.1 | 45.8 | 9.9 | 26.4 |
| 45 | Leather products | 47.8 | 13.0 | 2.4 | 15.4 | 12.7 | 20.2 | 32.8 | 13.0 | 38.7 |
| 1 | Textiles and apparel | 842.6 | 11.9 | 2.7 | 14.5 | 15.8 | 19.0 | 34.8 | 12.1 | 38.2 |
| 2 | Packaged food products | 1246.7 | 11.8 | 2.7 | 14.4 | 18.2 | 21.9 | 40.0 | 11.9 | 33.7 |
| 18 | Wood products and furniture | 446.3 | 11.3 | 3.5 | 14.8 | 15.3 | 20.5 | 35.8 | 18.0 | 30.5 |
| 19 | Construction machinery and distribution equipment | 404.4 | 11.3 | 2.0 | 13.3 | 18.2 | 20.5 | 38.8 | 15.5 | 32.4 |
| 15 | Dairy products | 129.3 | 11.2 | 2.1 | 13.3 | 14.8 | 25.6 | 40.4 | 14.5 | 31.8 |
| 22 | Concrete, brick building products | 202.9 | 9.9 | 3.0 | 12.9 | 14.5 | 27.1 | 41.6 | 15.1 | 30.3 |
| 4 | Aluminium and aluminium products | 346.4 | 9.8 | 1.7 | 11.5 | 13.3 | 24.5 | 37.8 | 18.1 | 32.5 |
| 25 | Plastics products | 762.8 | 8.7 | 1.9 | 10.6 | 13.2 | 22.3 | 35.4 | 17.9 | 35.9 |
| 30 | Petroleum and gas | 1125.3 | 8.2 | 2.1 | 10.4 | 9.7 | 21.9 | 31.6 | 13.2 | 44.7 |
| 16 | Non-durable industry machinery | 1164.2 | 7.7 | 2.1 | 9.8 | 14.8 | 21.0 | 35.8 | 17.6 | 36.7 |
| 41 | Copper and copper products | 64.2 | 7.7 | 1.4 | 9.1 | 14.9 | 26.9 | 41.8 | 20.9 | 28.2 |
| 40 | Appliances | 412.3 | 7.6 | 1.6 | 9.3 | 15.7 | 21.0 | 36.6 | 15.6 | 38.5 |
| 33 | Rubber products | 449.5 | 7.2 | 1.7 | 8.9 | 18.6 | 22.7 | 41.3 | 13.8 | 35.8 |
| 14 | Metalworking and fabricated metal goods | 533.9 | 7.0 | 2.6 | 9.6 | 12.4 | 23.5 | 35.8 | 15.8 | 38.7 |
| 23 | Motor vehicles | 331.3 | 6.7 | 1.9 | 8.5 | 11.1 | 24.8 | 35.9 | 18.5 | 37.0 |
| 11 | Machine tools | 1068.0 | 6.6 | 1.7 | 8.3 | 13.1 | 18.5 | 31.6 | 16.3 | 43.7 |
| 3 | Plastics and rubber manufacturing | 266.8 | 5.8 | 2.9 | 8.8 | 10.4 | 30.0 | 40.4 | 15.2 | 35.2 |
| 12 | Precision instruments | 253.4 | 5.6 | 0.6 | 6.2 | 11.5 | 18.6 | 30.0 | 17.1 | 46.7 |
| 34 | Glass products | 305.1 | 5.6 | 1.2 | 6.8 | 14.4 | 22.8 | 37.1 | 16.0 | 39.8 |
| 37 | Non-residential building products | 222.3 | 5.2 | 1.7 | 6.9 | 9.3 | 22.0 | 31.2 | 18.5 | 43.3 |
| 21 | Paper | 394.5 | 4.4 | 1.2 | 5.6 | 10.7 | 20.1 | 30.8 | 17.0 | 46.5 |
| 28 | Management, higher education and hospitals | 16 854.4 | 4.2 | 1.0 | 5.2 | 7.4 | 16.4 | 23.8 | 13.3 | 57.6 |
| 44 | Breweries | 36.8 | 4.0 | 0.2 | 4.3 | 3.8 | 23.7 | 27.4 | 12.6 | 55.8 |
| 42 | Hotels | 7519.0 | 4.0 | 1.1 | 5.1 | 6.8 | 19.1 | 25.8 | 13.7 | 55.2 |
| 36 | Steel milling | 163.9 | 3.8 | 1.0 | 4.8 | 8.9 | 22.0 | 30.8 | 29.8 | 34.6 |
| 13 | Printing and publishing | 1337.7 | 3.6 | 0.9 | 4.5 | 8.1 | 16.0 | 24.1 | 13.7 | 57.7 |
| 39 | Optical equipment and instruments | 372.4 | 3.3 | 1.5 | 4.8 | 10.0 | 15.9 | 25.9 | 14.5 | 54.8 |
| 31 | Business services | 15 618.7 | 3.1 | 0.7 | 3.8 | 5.1 | 14.4 | 19.4 | 13.3 | 63.3 |
| 5 | Basic health services | 8693.3 | 3.0 | 0.6 | 3.6 | 6.4 | 17.3 | 23.7 | 15.0 | 57.7 |
| 35 | Pharmaceuticals | 341.3 | 2.8 | 1.0 | 3.8 | 5.0 | 11.9 | 17.0 | 13.6 | 65.5 |
| 27 | Arts and media | 1177.4 | 2.3 | 0.3 | 2.6 | 4.8 | 14.4 | 19.2 | 11.2 | 67.0 |
| 17 | Computer and electronic equipment | 1095.2 | 1.8 | 0.4 | 2.2 | 3.6 | 15.7 | 19.3 | 17.8 | 60.5 |
| 29 | Information services | 3011.1 | 1.5 | 0.3 | 1.8 | 2.7 | 10.7 | 13.4 | 13.1 | 71.5 |
| 9 | Financial services and insurance | 3384.2 | 1.4 | 0.4 | 1.8 | 3.0 | 12.2 | 15.2 | 12.0 | 70.9 |
| 38 | Tobacco products | 24.0 | 1.1 | 0.8 | 1.9 | 6.4 | 9.4 | 15.8 | 30.8 | 51.5 |
| 43 | Aerospace | 371.3 | 1.1 | 0.3 | 1.4 | 3.0 | 16.9 | 19.9 | 19.4 | 59.3 |
| 7 | Farming | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | Construction | – | – | – | | – | – | | – | – |

*Source:* Enhanced 2002 *County Business Patterns* (ISSERMAN and WESTERVELT, 2006) and authors' calculations. Value chains are not mutually exclusive. Includes private, non-farm employment only (note that there is significant farm employment in the farming and feed products chains, and small amounts of farm employment in the dairy products, wood processing, grain milling, and tobacco products chains). Primary versus total value chain employment cannot be distinguished for construction due to non-direct concordance between input–output and 1997 North American Industry Classification System (NAICS) classifications.

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*Table* 10. *Per cent county type's value chain employment in higher wage industries, 2002, sorted in descending order by rural non-metro percentage*

| ID | cluster | Rural | | Mixed rural | | | |
|---|---|---|---|---|---|---|---|
| | | Non-metro | Metro | Non-metro | Metro | Mixed urban | Urban |
| 30 | Petroleum and gas | 76.2 | 80.2 | 70.8 | 71.0 | 67.3 | 69.0 |
| 6 | Mining | 75.2 | 60.6 | 72.2 | 63.8 | 48.9 | 48.0 |
| 3 | Plastics and rubber manufacturing | 74.9 | 75.1 | 63.9 | 70.3 | 56.9 | 56.6 |
| 10 | Chemical-based products | 70.5 | 66.4 | 66.2 | 76.5 | 71.2 | 78.7 |
| 38 | Tobacco products | 70.2 | 66.3 | 48.2 | 67.9 | 98.5 | 96.1 |
| 39 | Optical equipment and instruments | 62.5 | 71.3 | 71.2 | 75.5 | 68.9 | 72.7 |
| 4 | Aluminium and aluminium products | 58.3 | 38.4 | 52.2 | 57.1 | 59.7 | 50.3 |
| 44 | Breweries | 57.2 | 65.6 | 42.5 | 54.7 | 58.1 | 60.6 |
| 43 | Aerospace | 57.1 | 51.0 | 36.5 | 74.3 | 65.7 | 67.3 |
| 21 | Paper | 54.9 | 60.7 | 66.0 | 64.7 | 68.2 | 64.6 |
| 45 | Leather products | 52.0 | 58.0 | 59.6 | 55.6 | 48.2 | 42.8 |
| 9 | Financial services and insurance | 50.5 | 57.1 | 43.2 | 43.9 | 45.2 | 51.4 |
| 36 | Steel milling | 48.0 | 16.2 | 50.4 | 62.7 | 82.6 | 72.1 |
| 1 | Textiles and apparel | 48.0 | 56.6 | 58.5 | 65.3 | 60.3 | 43.1 |
| 20 | Wood processing | 47.7 | 47.0 | 48.0 | 50.7 | 52.1 | 58.3 |
| 41 | Copper and copper products | 46.9 | 49.9 | 55.1 | 48.6 | 36.7 | 20.6 |
| 34 | Glass products | 46.1 | 31.1 | 38.5 | 45.0 | 29.9 | 26.3 |
| 29 | Information services | 45.6 | 46.5 | 51.4 | 56.8 | 63.3 | 65.6 |
| 31 | Business services | 45.2 | 47.6 | 45.9 | 47.7 | 54.4 | 59.4 |
| 28 | Management, higher education and hospitals | 44.2 | 38.1 | 49.4 | 53.9 | 59.6 | 63.9 |
| 35 | Pharmaceuticals | 44.1 | 58.9 | 54.2 | 53.8 | 53.5 | 59.8 |
| 42 | Hotels | 43.0 | 43.4 | 39.5 | 37.5 | 40.6 | 46.4 |
| 17 | Computer and electronic equipment | 42.9 | 44.8 | 40.8 | 70.8 | 62.4 | 71.1 |
| 27 | Arts and media | 41.7 | 38.6 | 45.4 | 53.2 | 60.6 | 65.4 |
| 5 | Basic health services | 40.9 | 44.4 | 45.5 | 47.2 | 49.5 | 51.8 |
| 32 | Grain milling | 39.5 | 44.7 | 67.9 | 55.6 | 91.4 | 90.3 |
| 14 | Metalworking and fabricated metal goods | 38.0 | 33.9 | 42.2 | 41.3 | 46.1 | 39.4 |
| 19 | Construction machinery and distribution equipment | 38.0 | 40.7 | 46.7 | 58.9 | 65.2 | 64.3 |
| 37 | Non-residential building products | 35.3 | 44.0 | 52.7 | 62.3 | 70.0 | 80.3 |
| 16 | Non-durable industry machinery | 35.2 | 42.2 | 46.2 | 45.6 | 49.4 | 52.3 |
| 11 | Machine tools | 33.3 | 32.2 | 42.1 | 33.6 | 35.2 | 36.4 |
| 18 | Wood products and furniture | 30.9 | 29.2 | 36.2 | 36.0 | 49.7 | 49.0 |
| 23 | Motor vehicles | 29.4 | 45.9 | 49.2 | 48.9 | 53.8 | 68.7 |
| 12 | Precision instruments | 28.4 | 38.6 | 39.2 | 60.9 | 67.2 | 83.1 |
| 33 | Rubber products | 27.3 | 31.7 | 47.9 | 45.3 | 46.6 | 54.1 |
| 40 | Appliances | 25.8 | 27.5 | 41.8 | 30.1 | 37.3 | 38.8 |
| 15 | Dairy products | 25.5 | 41.1 | 36.7 | 46.5 | 54.0 | 57.4 |
| 13 | Printing and publishing | 24.8 | 34.2 | 22.1 | 34.1 | 38.7 | 55.0 |
| 22 | Concrete, brick building products | 24.0 | 34.4 | 32.3 | 36.2 | 34.7 | 40.1 |
| 24 | Wood building products | 21.0 | 37.8 | 35.6 | 38.2 | 42.1 | 49.7 |
| 25 | Plastics products | 14.1 | 36.0 | 22.5 | 29.6 | 19.7 | 24.8 |
| 2 | Packaged food products | 13.7 | 21.4 | 21.9 | 33.6 | 44.4 | 55.2 |
| 7 | Farming | – | – | – | – | – | – |
| 8 | Construction | – | – | – | – | – | – |
| 26 | Feed products | – | – | – | – | – | – |

*Source:* Enhanced 2002 *County Business Patterns* (ISSERMAN and WESTERVELT, 2006) and authors' calculations. Value chains are not mutually exclusive. Includes private, non-farm employment only (note that there is significant farm employment in the farming and feed products chains, and small amounts of farm employment in the dairy products, wood processing, grain milling, and tobacco products chains). Higher wage value chain employment cannot be distinguished for construction, farming and feed products (construction due to non-direct concordance between input–output and 1997 North American Industry Classification System (NAICS) classifications, and farming and feed products because (non-farm) *County Business Patterns* data exclude the majority of component industries.

and insurance, optical equipment and instruments, aerospace, chemicals-based products, and petroleum and gas. Several of the chains for which the high wage share is very low are natural resources based, including packaged food products, wood building products, concrete and brick building products, and dairy products. In the case of those chains, rural areas are probably functioning as raw materials suppliers, with value-added processing often occurring elsewhere, perhaps closer to population centres. Indeed, the high wage shares for those four

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chains increase generally monotonically moving up the urban/metro scale. In the case of other chains, such as financial services, aerospace, and chemicals, rural areas may be playing the role of low cost location for footloose but higher wage value chain components.

Overall, rural counties play a significant role in numerous, diverse value chains. This statement holds true whether one focuses on the primary, distinguishing core industries of a value chain or its higher wage industries. It also holds true for rural counties whether they are within metropolitan areas or outside such integrated regional economies. Rural counties do not always play a secondary role in key US value chains, nor are they always the location of lower wage segments in key chains. Thus, understanding and supporting the competitiveness of US industry entails recognizing and supporting its rural-based component.

## SUMMARY AND CONCLUSION

The paper began by claiming that maintaining a conceptual and operational distinction between the economic and geographic dimensions of the industry cluster concept is a useful way to explore the role of industry clusters in rural economies. The economic space of a cluster refers to the functional interdependence among businesses and industries that make up the cluster, regardless of the locations of those businesses and industries (Feser and Bergman, 2000). The economic cluster defined by functional interdependence is the national value chain. The geographic space of a cluster refers to the spatial configuration of interdependent businesses and industries. Most existing research combines the two dimensions into a single definition of regional clusters, implying that industry cluster analysis as applied to rural economies constitutes a search for industrial specializations anchored in rural places.

Although useful in some instances, the conventional approach is overly narrow for understanding rural development and formulating rural development strategies. It ignores significant interregional growth dynamics – particularly the potential for urban to rural spillovers, and vice versa – as well as other external linkages that exert a substantial influence on the prosperity of rural places. The economic fortunes of communities, whether urban or rural, are often driven by industries based elsewhere. The most important economic clusters for any given rural place can be local, regional, national or international in geographic scope.

This paper has analysed the rural characteristics of national value chains by breaking out their rural, mixed rural, mixed urban, and urban components, as well as distinguishing between metro and non-metro categories. Some expected things as well as some surprises were found. Based on 2002 employment data, rural non-metro counties capture 4.7% of overall US private non-farm employment but 5.0% or more of US employment in 28 of 45 national value chains. As expected, many of those 28 chains are agriculture or otherwise natural resource based. It was found that rural counties do not always specialize in secondary industries of given value chains, though the chains for which they have relatively more primary industry employment are often natural resource based or closely linked to agriculture. The latter makes sense because natural resource-based value chains are the most likely to produce spatial clusters in rural places. It was also found that while rural non-metro counties are specialized in lower wage segments of value chains more frequently than other county types, there are many chains for which employment in rural counties is at least evenly distributed between lower and higher wage industries, including chains with knowledge-intensive industries at their core like aerospace, financial services and insurance, and optical equipment and instruments.

Overall, the results paint a rich picture of rural places, one that highlights the diversity of rural economies as well as their integration with national systems of production. The stereotypical image of the rural economy as consisting of farms, ranches, mines, forests, and the occasional manufacturing branch plant does not accurately characterize the degree of geographical and functional integration in the US economy. Rural America is closely tied to a wide range of national industries. National policies designed to help keep the country competitive must not overlook the rural contribution to the country's economic base, while US policies focused on rural industry competitiveness cannot focus exclusively on conventionally perceived 'rural' industries such as farming, mining and timber.

The analysis also has important implications for local economic development officials in rural areas. First, the analytical perspective and typologies can be used to develop a richer understanding of a rural community's economy vis-à-vis the national economy, a useful supplement to conventional approaches to applied industry mix analysis. No claim is made here that regions can or should develop all segments of various national value chains. However, local developers should ask why their region is specialized in selected segments of a particular chain, as well as why it has little activity in other segments. The answers to those questions, which are usually a blend of national industry growth trends, prevailing location requirements of the particular industry (given the current level of technology, product cycle dynamics, workforce requirements, and other factors), and local conditions over which local economic developers have varying levels of influence, can be valuable inputs into sector-targeting efforts. Indeed, the answers can form the basis of the market analyses and forecasting that drive resource allocation decisions.

Second, the findings emphasize that rural development planners would do well to avoid equating 'cluster strategy' with focusing solely on building locally

anchored clusters. Leveraging external linkages – whether it is with an urban-based cluster nearby or a national value chain – is also a 'cluster' strategy. That leveraging could take the form of identifying and cultivating footloose segments of value chains with strong national growth prospects, seeking to develop collaborative regional strategies that would benefit neighbouring jurisdictions' growth and development if mutual gains from that growth are a realistic possibility, identifying secondary industries for development that would diversify the local economy through their linkages with multiple value chains, and forming buyer–supplier networks or industry associations that help to connect in a better way local businesses to external markets. For rural America, economic interdependence *does* matter, but it is rarely exclusively, or even predominantly, local.

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## NOTES

1. For additional details on the methodology, see Feser (2005).
2. In practice, the *R* measures are derived from 0/1 matrices where a positive dollar flow (or a flow exceeding a specified threshold) between sectors *i* and *j* is assigned a value of 1.
3. All data manipulation and clustering algorithms were implemented in SAS software, primarily the Interactive Matrix Language (IML) module.
4. An alternative to weighting the enabling sectors would be to drop them from the linkage matrix (i.e., set their weight to zero) and then to include them in a second-stage identification of secondary cluster industries. However, that would preclude such industries from forming the core of their own value chains, which is a serious disadvantage.
5. The distinctiveness of the clusters formed by the various splits in a clustering algorithm is an important criterion for selecting an appropriate solution. In the present analysis, the 43-cluster solution separated distinct subsets of aerospace and instruments industries into two groups. The 44-cluster solution, however, separated two groups of miscellaneous paper industries. Checking the underlying purchasing and sales patterns, while clear differences in input–output linkages among the aerospace and instruments industries separated in the 43-cluster solution could be detected, the same cannot be said for the two paper industry groups. Subsequent cluster solutions (45, 46, 47, etc.) similarly split sectors whose similarities in linkages appear stronger than their differences.
6. An Excel file containing the full set of value chain definitions is available for download at: http://www.urban.uiuc.edu/faculty/feser/publications.html/.
7. Based on data from the Covered Wages and Employment (ES-202) Series of the US Bureau of Labor Statistics, and thus excluding sole proprietorships and a small number of other sectors not covered under employment security law.
8. These definitional issues and the misperception they cause are discussed by Isserman (2001, 2005, 2007).
9. The employment data are from a 2002 *County Business Patterns* data set that has been corrected for data suppression using the methods described by Isserman and Westervelt (2006). *County Business Patterns* data exclude farm workers, as well as government employees and selected other institutional employment categories.
10. To do this the same *County Business Patterns* data are used as outlined in the previous section. Therefore, the trends described refer only to the private non-farm sector activity of various value chains. That excludes a significant amount of employment in the farming chain and relatively small amounts in the feed products, tobacco, grain milling, and dairy products chains.

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