A CENTURY OF RESEARCH ON RURAL DEVELOPMENT AND REGIONAL ISSUES

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Rural North America has undergone a major economic transformation over the past century due to labor-saving technological progress, reductions in transport costs, and rising household incomes. The results are greater rural economic diversity, selected rural population decline, increased rural–urban interdependence, emergent exurban areas, and amenity-led rural growth. We summarize key research insights and provide a selected review of the economics literature over the past 100 years with a focus on this economic transformation of rural places, its implications for rural communities, and key modeling innovations and applications. The many important contributions by agricultural economists are highlighted.

Key words: rural economies, rural–urban interdependence, amenity-led growth, rural development policy, exurban, land use modeling, input-output models, computable general equilibrium.

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A discussion of rural and regional issues in economics requires a broadly cast net to capture the multiple areas of relevant inquiry: regional economics for its fundamental focus on subnational economic units; spatial economics for an understanding of the role of distance; rural and urban economics for their respective foci; and land economics for its study of land use and values. Economic geography encompasses all these concerns and thus provides a useful prologue. Simply, economic geography is about what happens where: Why do firms and people tend to concentrate in a few locations rather than spread evenly across the countryside? What explains the variety of economic activities and land uses in a region? What are the economic diversification prospects for low-population rural places that are costly to get to and from?

As Samuelson (1983) noted in his article "Thünen at Two Hundred," economic geography is not new. From the production location theory of von Thünen (1826/1966) to its further development by Weber (1929), Christaller (1933), Lösch (1940), Hoover (1948), and Isard (1956), a fundamental view has emerged of the importance of trade-offs among scale, transport costs, and endowments in explaining the economics of establishment location. Writing at midcentury, Hoover summarized these key insights in terms of three "foundation stones":

> [A]n understanding of spatial and regional economic problems can be built on three facts of life: (1) natural-resource advantages, (2) economies of concentration, and (3) costs of transport and communication. In more technical language, these foundation stones can be identified as (1) imperfect factor mobility, (2) imperfect divisibility, and (3) imperfect mobility of goods and services. (Reprinted in Chapter 1 of Hoover and Giarratani 1984)

From the pioneering insights of Adam Smith on compensating wage differentials to the

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more recent work of Tiebout (1956), and the theory of spatial equilibrium that emerged from the work of von Thünen (1826/1966), Alonso (1964), and other regional and urban economists, the important role of local public goods and amenities is a further elaboration of these "foundation stones" in explaining household and establishment location choices.

The contributions of economists to research on rural and regional issues have been organized around the study of these basic spatial economic processes and the implications for the evolution of rural places and for policies that seek to promote the vitality of these places (Castle 1991). Agricultural economists in particular have made numerous contributions. In some cases, these contributions were foundational in terms of methods and empirical analyses. In other cases, the applied work of research and extension economists has resulted in pushing the boundaries of highly stylized conceptions of space and improving the usefulness of the models.

This article provides a broad review of the economics literature on rural and regional economic issues over the past 100 years and highlights the important contributions by agricultural economists. While the focus is on contributions to these topics within agricultural economics, the discussion is necessarily broader, as many of the important theories and research developments have come from other areas, most notably regional science and urban economics. Our general approach is to identify so-called lessons from discernible lines of scholarship that summarize key insights in the evolution of the theoretical and applied research. We provide support for these summary lessons by reviewing the intellectual heritage of each line of scholarship (which often takes us outside the boundaries of agricultural economics) and then tracing the contributions within the agricultural economics literature.

Obvious constraints imposed by a journal-length article necessitate an abbreviated discussion of topics relevant to rural and regional issues. There is important work, some by agricultural economists, that regrettably has not been given its proper due here. In particular we note the omission of explicit discussions of rural poverty, endogenous growth, and human capital research. Other topics, while not discussed in the research review, are lifted up as important topics in our concluding discussion of future research directions. Lastly, with few exceptions, our review is of research on U.S. rural regions.

Rural Economies

Rural people have made productive use of the vast natural resources as inputs for agriculture, forestry, mining, and other primary production. However, over the past century rural North American economies have undergone a major transformation fueled by labor-saving technological progress in agriculture and other natural resource industries (Simon 1947), reductions in transport costs, and rising incomes. The results include improved rural–urban income parity, farm population decline, and significant rural economic diversification.

A comparison of the share of farm employment in U.S. metropolitan and nonmetropolitan areas shows that in both cases, agriculture's share was over twofold greater in 1969 than in 2007 (figure 1). The data suggest that even after the initial mechanization of farming had run its course, productivity growth still yielded fewer and fewer farm workers who were increasingly productive. This dramatic decline has affected even the most agriculturally intense places. For example, in describing the transformation of the local economy in Saskatchewan, Canada, one of the most agriculturally intensive economies in North America, Stabler and Olfert (2009) report that the farm share of employment declined from 60% in 1931 to 8% in 2008.

Despite far fewer farmers, the nonfarm U.S. rural population has remained remarkably stable over the century (figure 2). At the turn of the twentieth century, the rural farm population share was 42%, the urban share was 35%, and the nonfarm rural share was 23%. One hundred years later, the rural nonfarm share remained nearly 20%, but the rural farm share had declined dramatically to about 1%
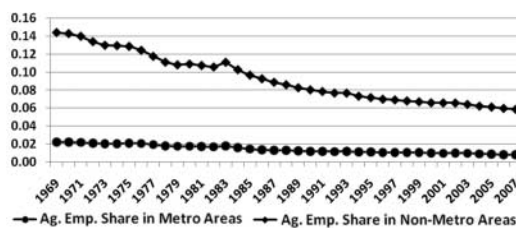

Figure 1. Agricultural employment shares in metropolitan and nonmetropolitan areas

Source: U.S. Bureau of Economic Analysis, Regional Economic Information System. Available at www.bea.gov, accessed October 15, 2009.
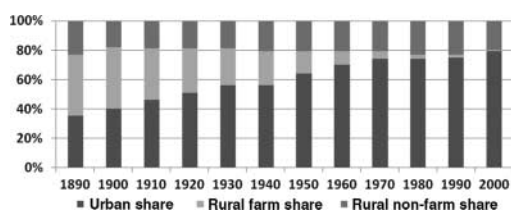
Figure 2. Percentage of U.S. urban, rural farm and rural nonfarm population, 1890–2000

Source: U.S. Census Bureau; Census 2000, Summary File 3: generated using American Fact Finder; <http://factfinder.census.gov>; U.S. Census Bureau, 1976; USDA-NASS, "Trends in U.S. Agriculture." [http://www.usda.gov/agency/nass/pubs/trends/farmpopulation.htm].

(Kilkenny and Johnson 2007). These dramatic shifts in farm employment and population have been accompanied by an increasing reliance of farm households on off-farm incomes. Recent data show that nearly 89% of farm households' income was from nonfarm sources (USDA 2006), a shift that "has led many to observe that agriculture is far more dependent on the rural economy than the rural economy is on agriculture" (USDA 2006).[1]

The shifts in rural employment and population reflect larger shifts in the national economy, including the expansion of employment in services and a decline in the relative size of the manufacturing sector. In fact, many rural areas benefited particularly during the 1970s and 1980s due to technological change and the relocation of manufacturing into rural areas. Other rural areas have benefited from the reductions in transportation and communication costs that have increased the accessibility of rural places with high-valued natural

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[1] Rural definitions differ depending on the data source and research question at hand. For example, using data from the U.S. Census Bureau, as in Figure 2, *urban* is defined as consisting of built-up areas with more than 2,500 people, and *rural* as everything else. Alternatively, the Office of Management category of *non-core* identifies counties without any urban areas of 10,000 people or more and with limited or no commuting to such towns or larger cities elsewhere. *Micropolitan* identifies counties with urban areas of 10,000 to 49,999 and surrounding counties linked to them through strong commuting flows, leaving as *metropolitan* counties with urban areas of 50,000 or more and their surrounding areas linked through commuting. Therefore, *nonmetropolitan*, which combines micropolitan and non-core counties as in Figure 1, includes a variety of landscapes ranging from small cities and their commuting sheds to some 1,084 counties that have no built-up areas of even 2,500 people. In 2000 the nonmetropolitan counties had 20 million residents living in urban areas and 29 million living in settlements with fewer than 2,500 people or in the country. See Isserman (2005) for a detailed discussion of these definitions, the constraints on research choices, and their implications.

amenities and made them desirable residential destinations for retirees, tourism-related businesses, and service sector firms. Rural areas are also home to those who are attracted by a rural lifestyle and lower land and housing prices and are willing to commute to cities for employment.

Today, rural areas are exceedingly diverse in terms of economic activity and employment. Farming (6%), mining, forestry, and fishing (<2%), and manufacturing (11%) provide about one-fifth of nonmetropolitan jobs. Two-fifths are typical town functions: retail trade (12%), health care and social services, (9%), accommodation and food services (7%), professional and technical services (3%), finance and insurance (3%), real estate and rental/leasing (3%), and wholesale trade (3%). Local government (10%) and state and federal government (6%) add another sixth. The balance comprises construction (7%), transportation and warehousing (3%), and miscellaneous services (15%). A USDA (2005) typology of nonmetropolitan counties based on industry thresholds underscores how diverse rural economies really are: 585 are manufacturing dependent, 403 are farming dependent, 222 are government dependent, 114 are services dependent, 113 are mining dependent, and 615 are nonspecialized nonmetropolitan counties.

These initial observations of some of the fundamental economic forces that have shaped rural economies over the past century lead us to our first lesson concerning the contributions of agricultural economists to research on rural economies.

Lesson #1: The rural economy is no longer a farm economy.

The idea that "rural" is no longer just "farm" would have sounded alien to most agricultural economists in 1950. Farming engaged the majority of rural people until the 1940s (figure 2). It was thus understandable that export base theory, which contends that a region's growth is led and determined by export demand in the context of perfectly elastic factor supplies, was the widely accepted view of rural growth (North 1955, 1956, 1959). Traditional economic base models would have predicted a complete collapse of the nonfarm rural economy as a result of the sustained decline of the agriculture export base employment since midcentury, but that collapse did not happen (Kilkenny and Partridge 2009). Instead, the share of nonfarm rural population

remained remarkably constant (figure 2) due to manufacturing and service sector employment growth. This is *prima facie* evidence that the farm sector is not the sole determinant of the rural economy.

While few mid–twentieth century economists disputed the notion that agriculture and natural resource industries were dominant, many were not inclined to assert that it would be the engine of future growth. Hoover (1948), for example, referred to areas that depended on agriculture, hunting, fishing, and other natural resource–based activities as "primitive." He pointed out that because food's share of the budget declines with rising incomes (Engel's law), industrialized areas would grow faster as incomes rise, while agriculture-dependent areas would grow slower.

The emergence of auto transport by the mid–twentieth century meant that commuting to urban employment was becoming a major mode by which rural people and communities engaged with nonfarm urban economies. Schultz (1950, 1953) argued that urban agglomeration effects extended far into the countryside. Rather than land quality, accessibility to urban markets was the key factor in the prosperity of rural regions. Ruttan (1955) found that the median income of farm families was related to the level of urban-industrial development in the area and that increased availability of off-farm jobs to farm family members was more important than increased labor productivity in agriculture in raising farm family incomes. Fox and Kumar (1965) described how urban commuting created functional economic areas that extended 50 miles out from cities of 25,000 or more people in Iowa. As they stated, "[We] are dealing with *people*-oriented rather than *resource*-oriented regions" (p. 62) [emphasis added]. They pointed out that even the rural peripheries of functional economic areas were increasingly dependent on anchor urban areas.

Due to their historical focus on the farm sector, Fox (1962) noted that "[a] few years ago only a handful of agricultural economists had much proficiency in interpreting interactions between agriculture and the non-farm economy" (p. 3). Noting "our tendency to equate farms with farmers and farmers with rural communities," Bishop (1967) asked in an address as president of the American Farm Economic Association (AFEA): "Surely, the problems involved are as important to rural people as changes in the structure of farming. Why have agricultural economists not devoted more resources to the study of structural changes in rural communities and to public policies relating to the location of economic activities and of population?" Years later, Pulver and Rogers (1986) studied nonfarm income in farm-dependent counties and recommended that rural development policy focus both on farm incomes, prices, and production and on vitality of the nonfarm rural economy: "The survival of rural American farms and rural communities depends equally on the expansion of nonfarm income and employment opportunities in rural areas" (pp. 1186–7).

By the 1970s, the notion that *rural* was not *agricultural* alone had become the dominant view among agricultural economists. As Edwards (1981) explained:

> Most of the rural economy in the United States is a nonfarm economy. Rural growth is not the equivalent to agricultural growth. In fact, technical progress in agriculture can release redundant agriculture labor into the nearby nonfarm rural economy and have a depressing rather than a stimulating effect. A growing commercial agriculture may have closer economic ties with the highly developed urban economy, where it sells products and purchases inputs, than with the spatial contiguous rural nonfarm economy. (pp. 223–224)

Today, agricultural and regional economists emphasize the economic diversity of rural places and do not associate long-term place prosperity with static notions of sector prosperity (Barkley 1993; Isserman 2001; Johnson 1997, 2007). This conclusion is supported by a variety of empirical evidence of the wide and varied economic contributions of rural areas. Smith (1984) and Porterfield and Pulver (1991) used surveys of businesses to demonstrate that services and other nonmanufacturing businesses export from rural areas. Therefore, in Smith's words, "They can reasonably be included with manufacturing in employment generation and economic development programs" (p. 153).

Similarly arguing that the narrow focus on goods-producing industries needs to be reexamined, Stabler and Howe (1988) found that "there can be no doubt that exports of services made a substantial contribution to the growth

of the four western Canadian provinces during the 1970s" (p. 312). Feser and Isserman (2009) provide the latest evidence of rural economic diversity by focusing on national value chains. They identify 45 national value chains, and using a two-way county taxonomy that considers population distribution and density (urban, mixed urban, mixed rural, and rural) as well as metropolitan–nonmetropolitan status (Isserman 2005), they find that rural nonmetropolitan counties specialize in 28 of these 45 chains. While many of those value chains are agriculture- or primary sector–based, such as feed products, wood processing, and mining, rural specialties also include appliances, construction machinery, motor vehicles, and machine tools. These shifts have affected even the most agriculturally intensive rural places. Stabler and Olfert (2009) report that modern rural Saskatchewan can be described as follows:

> Inputs used in agriculture are now purchased from all over the world rather than in the nearest town. But even as the industrial linkages between the agricultural industry and the rest of the rural economy have eroded, a mutual dependence between rural and urban Saskatchewan has developed. The two have become integrated as never before through rural dwellers commuting to a few large communities for employment, to shop and to access public services. It is as if all of rural Saskatchewan has become a *geographically removed neighbourhood of an urban center*. (emphasis added)

These trends of increased accessibility, spatial contiguity with expanding urban areas, rising incomes, preferences for amenities, and diversification of rural economies leads to our next lesson on rural economies.

Lesson #2: "Rural" vs. "urban" is more than a simple dichotomy. There is a strong interdependence that produces a continuum from dense urban places to remote rural places.

Distinctions between rural and urban aptly characterized the economic landscape for most of civilization. Before the Industrial Revolution, high transport costs and the relatively low productivity of farmers limited population densities and the extent of urbanization.

Less than 10% of a region's population could be sustained in cities, and even the largest cities (outside of Asia's more dense rice-based civilizations) were concentrations of no more than 150,000 people (Bairoch 1988; McEvedy 1992). Beginning in the nineteenth century, the Industrial Revolution produced a number of technological innovations in production and transportation that shifted production from the homes to large factories. Labor-saving technologies in agriculture and scale economies in manufacturing fueled large-scale rural-to-urban migration and the emergence of many large and medium-sized industrial cities. Innovations in transit, including electric trolleys in the 1890s and automobiles in the 1910s, decreased the cost of intra-city transportion and led to city expansion into the countryside. The extent of the city was nonetheless discrete, with the open countryside typically beginning right where the city ended.

These clear distinctions between rural and urban began to blur during the twentieth century with the continued rise in agricultural productivity, the greatly reduced costs of transporting farm products that put the whole United States within any one farm's market area, and the reduced costs of communication and commuting. After World War II the pattern changed dramatically: Urbanization slowed, extensive road networks made many once-remote places accessible, and population and production decentralized, leading to urban "sprawl" and exurban development. Most counties since the 1980s have contained both rural and urban areas and are home to many of the economic functions that previously had occurred only in cities.

Formal modeling of the numbers and spatial extents of the smallest to largest cities in the urban hierarchy was advanced by Christaller (1933) and Lösch (1940). Their Central Place Theory (CPT) explains the sizes, distances between, and sectoral compositions of cities, including towns in agricultural areas such as the Great Plains (Olfert and Stabler 2002). A major advantage of CPT is its realism in measuring actual business and consumer services and their population thresholds (i.e., the population that is needed to support given services such as a grocery store). The primary criticism of CPT is that it is static, requiring ad hoc assumptions regarding changes in technology and transportation costs to make it dynamic.

CPT generated great interest among agricultural economists of rural development

beginning in the 1950s. The declines in communication and transportation costs led to rising population thresholds, which in turn led to the consolidation of some private service industries in larger urban centers (Stabler and Olfert 2002). This provided increased pressure to consolidate government jurisdictions, which previously reflected the needs of a nineteenth-century agrarian economy (Allen 1931; Fox and Kumar 1965).

CPT also motivated regionwide economic development policies for functional economic areas surrounding larger urban centers of 25,000 people or more. Myrdal (1957) introduced the concepts of "spread" effects, in which growth diffuses to rural hinterlands through demand for agricultural products and raw materials, leading (if successful) to "new centers of self-sustained economic expansion" (p. 31). But interdependence with the core could also be destructive. Myrdal called "backwash" effects those in which urban growth attracts people and capital away from the hinterlands. For further discussion of the positive and negative dependence of rural areas on their urban centers, see the reviews by Gaile (1980) and Parr (1999a, 1999b) and the critical prescriptions for regional prosperity by Jacobs (1984).

The conceptual strength of the growth-center model led to support for urban growth-center policy, as well as a debate about rural participation in urban-led growth processes (Day 1968). Growth prospects being better for towns of sufficient size justifies targeting investment of scarce resources to towns with critical mass. Efficient government funding should target places promising higher returns. Proponents of strategic investment in growth centers argued that a "worst first" policy of providing funds to the smallest and poorest communities would be ineffective because they lacked the scale economies needed to sustain growth (Berry 1970; Hansen 1970). They supported targeting intermediate-sized cities ranging from 50,000 to 250,000 (Berry) or even 1 million in population (Hansen). On the other hand, agricultural economists argued that rural regions should have greater participation in the regional and national growth process and that targeted growth centers could be much smaller. Tweeten and Brinkman (1976) suggested that a city size of 10,000 people was large enough. The Appalachian Regional Commission designated even market towns and service centers of 5,000 to 7,000 as centers, pointing out they serve rural areas of 250,000 or more (Isserman and Rephann 1995).

Despite the initial enthusiasm for regional approaches, research in CPT, regionalization, and growth centers waned in the 1970s for many reasons. First, in the absence of modern geographic information systems (GIS) that have greatly facilitated large data sets and detailed spatial analysis, descriptive empirical analyses were limited, which prevented researchers' ability to empirically test CPT hypotheses. Second, migration into rural areas led to the so-called rural renaissance or "population turnaround," in which non-metropolitan growth outpaced metropolitan growth for the first time in the 1970s, especially to high-amenity rural areas (Bishop 1967; Beale 1975, 1977). With rural America's prospects improved, the major institutional change needed to coordinate a growth-center policy that engaged rural communities was less urgent. Third, though rural towns lacked capacity to unilaterally plan and conduct economic development programs, a regionwide scope was opposed by rural interests that feared the loss of political self-determination (Whisnant 1994). Fourth, as the Appalachian Regional Commission found, formidable pressure against growth poles comes from officials whose areas are not designated and, thus, are ineligible for funds (Isserman and Rephann 1995).

A final reason for the waning interest in CPT was a frustration arising from the lack of economic progress in rural areas near growth centers (Whisnant 1994). It appeared that the rural population decline was mainly the consequence of urban growth's counterproductive "backwash" effects. Proponents of growth-center policy responded that it takes more than a few years of modest investments to rejuvenate entire regions (Richardson 1976). Urban growth was also blamed for the "rural brain-drain," in which the highest-skilled were especially likely to leave. Schultz (1950, 1953), Sjaastad (1962), Huffman (1977, 1980), Tweeten and Brinkman (1976), Topel (1986), Barkley (1990), and many others have documented the "pull" effect of the relatively higher urban returns to human capital. Others argued that infrastructure policy that supported rural commuting to growth centers simply encouraged more out-migration by increasing rural residents' familiarity with urban locations (Jansma et al. 1981).

Following a relative dearth of research on rural–urban linkages for a couple of decades, the topic received renewed attention in the 1990s as exurban sprawl increasingly fueled

adjacent rural growth. Tolley (1981) argued that a "significant part of the increase in rural population is undoubtedly explained by people living in a rural area and commuting to a job in an urban area, a situation explained by the seeking of residential amenities" (p. 254). Regionwide development approaches were needed to deal with the environmental problems associated with sprawl and the increasing costs of infrastructure and public service provision (Barkley, Henry, and Bao 1996; Drabenstott, Novack, and Weiler 2004). Demand for regionwide approaches arose once again in remote rural regions that lacked natural amenities, since improved links to urban economies represented one of their few avenues for growth (Stabler and Olfert 2002). Complementing the policy demands were innovations in GIS that helped researchers provide empirical measures and spatial econometrics.

Spread and backwash represented one theme in the revived assessment of rural–urban interdependencies and the effects of urban growth centers (Hughes and Holland 1994; Rephann and Isserman 1994; Barkley, Henry, and Bao 1996; Henry, Barkley, and Bao 1997). The study by Henry, Barkley, and Bao (1997) was particularly innovative in its use of GIS data and spatial econometrics. Kahn, Orazem, and Otto (2001) investigated whether job growth in one county produces a "competition" with neighboring counties by attracting new migrants from these nearby counties. Like spread effects, they find that job growth is more "complementary" because it also leads to population growth in neighboring counties through increased commuting. These studies concluded that rural areas offering higher quality of life enjoyed urban spread effects such as in-migration and higher rural-to-urban commuting. Rural areas offering low amenities experienced urban growth backwash effects and out-migration. However, they also indirectly found that the backwash effects were weakening—in concert with the declining rate of rural farmer out-migration.

Partridge et al. (2008b) considered hundreds of metropolitan areas separated by rural space to investigate population growth in non-metropolitan and small metropolitan areas. They created detailed measures of access to the five nearest higher-ordered tiers in the urban hierarchy because urban proximity effects are multitiered. They also investigated the "distance is dead" or "world is flat" hypotheses,

in which information technology and low transportation costs (Glaeser and Kohlhase 2004) are claimed to have eliminated the "tyranny of distance." They concluded, however, that not only is distance *not* dead, but its effects are becoming stronger, most likely due to the expanding share of the service sector, a shopping-goods industry, given that human transport remains costly.

Other studies have focused on how commuting from nonmetropolitan to metropolitan regions affects nonmetropolitan local economies. Renkow (2003) found that about 60% of the adjustment to local nonmetropolitan job growth was accommodated through changes in commuting flows and another 30% was through migration. A key implication is that job growth is not fully accommodated through increases in *local* labor force participation. In weighing costs and benefits of development policy, local officials need to recognize that the economic benefits may not go to underemployed locals.

Hedonic studies have examined how rural wages and housing costs reflect remoteness. Wu and Gopinath (2008) found that remoteness, defined as nonadjacency to a metropolitan area, is the primary factor in the spatial variation in wages, accounting for 76% of the expected differences in average wages between the top and bottom 20% of counties. They found that it was much more important than other key factors, including amenities and human capital. Partridge et al. (2009) used finer delineations of urban tiers to measure the spatial decay in both wages and housing costs across U.S. counties. Relative to a metropolitan area with at least 1.5 million population, they found that remote rural wages were up to 43% lower and housing values 58% lower, all else constant.

Coupled with these empirically motivated studies of rural–urban interdependence, theoretical innovations associated with the New Economic Geography (NEG) beginning with Krugman (1991) generated great enthusiasm for regional and urban economics. These models formalized the trade-offs between enjoying internal and agglomeration economies of scale and avoiding transportation costs with respect to spatially immobile resources. Product variety, either among intermediate inputs for firms or among final goods to consumers, allows for monopolistic competition, average-cost pricing, and higher profits where there are more firms, which in turn explains the

spatial concentration of production and urban centers.

The analytical tractability of the canonical NEG model and its ability to mimic urbanization reinvigorated broader interest among economists in spatial and regional economics. But canonical NEG models cannot explain the simultaneous existence of small and large population centers. Agricultural economists interested in rural development made significant improvements in order to explain it. Kilkenny (1998) presented the first NEG model to rationalize the simultaneous existence of small and large concentrations of population and diverse economic activity in one competitive spatial economy. She did so by formalizing features ignored by the canonical model but critical for understanding rural economies, such as the decision to invest in a locality as determined by latent or potential demand for the locality's product and the non-inframarginal effect of the entrance of that new business on local wages and local market prices. In addition, Kilkenny (1998) introduced Kuhn–Tucker equations into general equilibrium to formalize the discrete choice of where to live and work to maximize real (as opposed to nominal) income. Her model rationalizes key features of urban–rural interdependence, including the spatial decay in urban–rural wages and effects of transportation costs on the geographic concentration or dispersion of economic activity and population. It also suggests the importance of geo-labeled rural products, rural place specificity, and rural quality of life for modern rural growth.

Agricultural economists have played an important role in testing the implications of declining transport costs and lack of agglomeration economies in rural areas. Their findings demonstrate the competitive disadvantages faced by rural areas—for example, the importance of positive feedback arising from establishment co-location (Shonkwiler and Harris 1996; Barkley and Henry 1998). Other work examines the importance of other externalities that generate regional growth, e.g., that arise from labor pooling, learning by doing, knowledge spillovers, and innovation (Barkley, Henry, and Kim 1999).

A primary reason that few agricultural economists interested in rural development have adapted NEG models is that the canonical NEG model lacks predictive capacity for North American settlement patterns. A standard NEG model would also have failed to explain the persistence of the nonfarm rural population (figure 2) even though the farm workforce has dramatically declined. Likewise, given the economy of the 1950s and the ongoing declines in transportation costs, an economist using a standard NEG model would have predicted greater concentration in the Northeast and Great Lakes manufacturing belts. Instead, there was massive migration to the "hinterlands" and other "remote" regions of the 1950s, including the Sunbelt, the Pacific Northwest, and the Rocky Mountains. Most NEG models lack predictive capacity because they could only simplistically account for institutional and amenity effects that had first-order influences on firm and household location. Such shortcomings led North American regional economists to prefer a Tiebout sorting or a Roback (1982) spatial equilibrium approach, which better account for joint firm and household behavior (Deller et al. 2001; Glaeser 2007). This leads to the next lesson.

Lesson #3: Since World War II, migration flows have been explained increasingly by amenities and quality-of-life differences across regions. Consumption of natural amenities has become one of the primary determinants of rural growth.

The attraction of natural amenities and their influence on the economic development of rural areas is a long-standing trend in the United States, one that dates back to the 1920s and that by the 1950s had begun to transform the spatial pattern of economic development at local and regional scales. Two forces drove this emerging pattern. First, amenities are a normal or superior good. Hence, as households acquire sufficient incomes to sustain an "adequate" lifestyle, they increasingly demand a higher quality of life and move to locations with nice climates and natural amenities. The second force driving this migration was the advent of new technologies, most particularly advances in air conditioning, which made living in the Sunbelt more attractive.

While this transformative trend did not have widespread impacts on rural areas much before the 1970s, early land economists noted the incidence of amenity-led rural development as early as the 1930s. By this time, much of the "cutover lands," harvested for their hardwood timber in the nineteenth century, had reverted from private to public ownership and presented a major challenge for public lands management. Early research by land

economists explored the suitability of these lands for potential recreational development (Wehrwein and Spilman 1933) and demonstrated the economic benefits of established recreational lands in attracting tourists and supporting new employment that "filled the gap" in the tax base created by the declines in the forest industry (e.g., Wehrwein and Johnson 1943).

Ullman (1954) appears to be the first to describe amenity-led migration in the United States and provide a discussion of hypothesized factors, including an increasing number of footloose households and firms, improved roads, and universal car ownership. Clawson (1962), then at Resources for the Future, noted the combined influences of increasing incomes and leisure time and hypothesized that these would imply a greatly increased demand for recreation uses of rural land. By the 1970s, amenity migration was the key factor for reversing the decades-long rural-to-urban net migration (Beale 1975; Dillman 1979; Graves and Clawson 1981). Empirical investigation of population migration provided evidence of the important role of regional amenities, most notably climate, in regional migration (Cebula and Vedder 1973; Liu 1975; Graves 1976) and led to an important extension of the spatial equilibrium model of urban economics (Alonso 1964) to regional amenities and migration. Graves and coauthors reasoned that if amenities and rising incomes induced households to move to amenity-rich places, then market rents and wages would adjust until utility was constant over space, resulting in higher housing costs and lower wages in desirable places (Graves and Linneman 1979; Graves 1980). This theory was also articulated by Rosen (1979) and further developed by Haurin (1980) and Roback (1982), leading to what is now known as the spatial equilibrium Roback model. An impressive empirical literature followed that sought to value amenities by estimating compensating wage and housing price differentials across metropolitan regions, a literature to which agricultural and environmental economists notably contributed (Bloomquist, Berger, and Hoehn 1988).

The spatial equilibrium model provided an alternative hypothesis to observed wage differences that were hypothesized to be the result of disequilibrium employment differentials (Greenwood 1975) and new evidence in the "jobs versus people" debate that had emerged beginning in the 1960s (e.g., Borts and Stein 1964; Muth 1971). In his seminal article, Graves (1980) demonstrated that there is no "right" or "wrong" sign associated with income and unemployment variables in a model of population migration, since in a spatial equilibrium world they simply compensate for better or worse amenities. In addition, he showed that inclusion of climate in a model of gross migration of selected U.S. metropolitan areas adds substantial explanatory power to the model. It is difficult to overestimate the importance of his finding, which has provided the foundation for subsequent work on amenities and regional growth.

The compensating differentials research focused on interregional migration, and it was not until sometime later that work began on the relationship between natural amenities and rural population growth (Cromartie and Nord 1996; Beale and Johnson 1998; McGranahan 1999; Rudzitis 1999). Duffy-Deno (1998) appears to be the first to introduce amenities into the simultaneous population-employment regional adjustment model first proposed by Carlino and Mills (1987). A limitation, however, of the Carlino-Mills model is that it begins with a partial adjustment model for employment and population growth without any structural interpretation of labor demand and labor supply (Partridge and Rickman 2003). Thus, the resulting coefficients are difficult to interpret in any causal form in terms of, say, jobs versus people debates.

Deller et al. (2001) estimated that the simultaneous relationship among population, employment, and income changes as a function of a wide array of natural amenities and other control variables. Their paper, published in the *AJAE* and one of the most cited papers on amenities and rural growth, demonstrates the positive impact on rural county growth of a wide range of natural amenities, many of them local and malleable and therefore potential targets for rural development policy. This and other work (e.g., Carruthers and Vias 2005; McGranahan and Wojan 2007; McGranahan 2008) provides empirical evidence of the attraction effects of natural amenities and potential benefits to rural areas, suggesting that environmental policy and preservation of natural areas may have important rural development implications (McGranahan 2008; Wu and Gopinath 2008). Additional work underscores the differential effects of amenities on different population cohorts (Ferguson et al. 2007; McGranahan and Gibbs 2005) and the importance of retirees in

spurring amenity-led growth (Jensen and Deller 2007).

Recent work has taken into account the explicitly spatial nature of amenities and rural growth. For example, Partridge et al. (2008b) use geographically weighted regression (GWR), an empirical method that accounts for local spatial heterogeneity, to examine differences in the association between amenities and growth. They find substantial differences across U.S. counties, e.g., mountains are more favorably related to population growth in the western United States, and lakes have a higher positive association with growth in the arid southern Great Plains. Other work has accounted for other aspects of space, including spatial spillovers (Ferguson et al. 2007), distance effects (Schmidt and Courant 2006), and spatial error dependence (Rupasingha and Goetz 2004; Kim, Marcouiller, Deller 2005; Ferguson et al. 2007). In general, these and other studies have found amenities to be strong and statistically significant contributors to rural economic growth, although this effect may be specific to U.S. regional development (Ferguson et al. 2007).

Like most economic processes, amenity-led economic development creates trade-offs and may not translate into other measures of rural well-being (e.g., Isserman, Feser, and Warren 2009). Amenity-led growth is associated with faster population and job growth. Yet, to maintain equal utility across locations in spatial equilibrium, greater site-specific amenities and "quality of life" imply offsetting lower real per capita income (and vice versa). In equilibrium with mobile populations, one does not observe both a high quality of life and a high real per capita income. This reality has set off a debate as to whether amenity-led growth worsens income inequality because it is associated with only, say, low-wage people cleaning hotel rooms (Marcoullier, Kim, and Deller 2004). Another complicating feature is that amenity-led growth is usually complemented by man-made facilities such as ski resorts, boat marinas, and other recreational facilities (Deller et al. 2001; Kim, Marcouiller, Deller 2005). Thus, in addition to a high-quality natural environment, private or public investments are usually necessary to spur this growth.

The discussion thus far has highlighted the contributions that agricultural economists have made to the research on rural economies, particularly in documenting and explaining the transformation of rural places from their historical role as natural resource reserves to the diverse economic places they are today. Economists have also played an important role in understanding the implications of these changes and, in particular, the implications for rural policies. Next we highlight the contributions of agricultural economists to the rural development policy needs that have emerged with this rural transformation.

Lesson #4: Sector-based policies are neither efficient nor effective rural development policies.

Prior to World War II, most farm households were much poorer than urban nonfarm households. Schultz (1953, p. 286) reported that the typical industrial worker's real earnings were more than double the typical farmer's earnings in 1940. After World War II, rural poverty was identified as primarily a problem of low farm incomes (Bryant, Bawden, and Saupe 1981). When off-farm jobs in rural industries (those having a major advantage in locating near agricultural or forestry raw material or local agricultural markets) were proposed as a solution to the low-income problem in agriculture, Robock (1952) concluded that despite the emotional attachment of rural industry for people in agriculture, other fields of industrial, trade, and service employment made more sense. Low income was a main factor behind the large migration from farms to urban areas (Tweeten and Brinkman 1976). Recent evidence from the USDA (2007) shows how different these realities are today. As of 2004, median farm household incomes were 21% higher than their nonfarm-household counterpart, and 95% of farm households had greater assets than the median U.S. household.

Evidence that these remarkable gains in farm incomes have lifted the prosperity of counties most dependent on farm income is, at best, mixed. Data from the Economic Research Service (ERS) of the USDA and from the Bureau of Economic Analysis (BEA) show that between 1969 and 2007, farming-dependent[2] counties lost about 10% of their population, with about 6% lost over the shorter 1990–2007 period. This compares with 14%

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[2] The USDA Economic Research Service defines farm-dependent counties as having "either 15 percent or more of average annual labor and proprietors' earnings derived from farming during 1998–2000 or 15 percent or more of employed residents worked in farm occupations in 2000." See USDA (2005) for more details.

growth on average for all nonmetropolitan counties over the 1969–2007 period and a 7% gain over 1990–2007. When viewed through a Tiebout lens—that people vote with their feet in search of the highest levels of utility—these farm-dependent local economies have not fared well. However, when judged based on other measures of rural prosperity—namely, lower rates of poverty, unemployment, school dropout, and housing problems (Isserman, Feser, and Warren 2009)—the farm-dependent rural counties are doing well: 26% did better than the nation on all four measures in 2000, and 62% did better on at least three.

The traditional belief that the best way to support rural prosperity is to lift farm incomes explains why U.S. federal rural development policy falls under the purview of the USDA. Farm support policies have not typically sought to promote local job growth, however, and in fact may detract from rural growth given the need for productive farms to shed labor to remain competitive. On the other hand, there is no agreement on the effectiveness of alternative rural development policies or even the more basic welfare question of what the objective of rural development policy should be. Nonetheless, a consensus among rural development economists has emerged on policies *tailored* to place versus those based on sectors or on people (Fluharty 2002; RUPRI 2002).

Economists have long supported "people-based" policies of facilitating education, workforce training, and workforce supports such as childcare and transportation (when needed) and of providing relocation assistance from stagnant locations to more economically vibrant ones (e.g., Glaeser 1997; Tweeten and Brinkman 1976). Many economists have advocated an even stronger notion of spatially neutral people-based policies, as most famously stated by Harvard economist Edward Glaeser when he argued that it was better to provide each resident of the city of New Orleans $200,000 than to have federal funding to rebuild it after Hurricane Katrina (Pettus 2006). Fully spatially neutral people-based solutions are much less effective when constraints limit labor-force movements toward economically stronger locales and lead to a spatial mismatch between the available jobs and the people who need them. Partridge and Rickman (2008) provide evidence that mobility is limited in more remote rural areas, questioning the effectiveness of fully spatially neutral policies. Hurter and Martinich (1989) demonstrate why even a nationwide spatially

neutral tax or incentive policy can have spatially varying effects on economic activity and business location because of spatial heterogeneity in endowments, spatial heterogeneity in the types of industries locating across these heterogeneous places, and the multidimensional differences in distances to the various different input source locations and markets. Likewise, spatially neutral people-based policies can have spatially heterogeneous effects. People who have chosen to live in places with different endowments and employment opportunities are likely to have different preferences about market goods and policy alternatives. Thus, the same people-based policy can lead to many different outcomes in different places (Kilkenny and Huffman 2003; Blank 2005).

The implication of fixed costs that there is a minimum efficient scale (or critical mass/population size) below which per unit costs rise also suggests that there is no such thing as "one size fits all." Tweeten and Brinkman (1976), Shonkwiler and Harris (1996), and Wensley and Stabler (2002), for example, provided empirical evidence of the different market sizes or critical mass, in terms of both population and business interdependencies, below which different types of establishments are not sustainable. The implication is that attempting to provide every person everywhere with the same level of services may be prohibitively expensive in low-density rural places.

Policies *based* on place are those for which the location or spatial category of the beneficiary is a key criterion for eligibility. Many economists are skeptical of policies that are not spatially neutral, and instead argue that place-based policies should be incorporated as a last resort (see World Bank 2009). Kilkenny and Kraybill (2003) discuss six pitfalls and shortcomings of place-based policies: They may (1) generate nothing but rents for the (potentially absentee) owners of property in targeted places; (2) attract or retain (trap) poor people in poor areas; (3) distort business as well as human migration decisions; (4) enable the postponement of necessary adjustments; (5) create dependencies; and (6) be abused by place-based politicians.

Consider places with chronic unemployment problems. Research shows that in the United States, labor typically adjusts to local unemployment shocks through migration (Topel 1986; Bartik 1993). All else equal, people move from places with poor employment opportunities to places with better ones. The people who migrate become better off. If there were no

negative spatial externalities, this better outcome costs society nothing. However, policies that mobilize people out of low-income rural areas unintentionally add to the size disadvantage implied by scale economies by pushing rural communities further below their minimum efficient scale (Kilkenny and Johnson 2007).

Gabe and Kraybill (2002) provide evidence that a place-based rural development policy that waives taxes or provides subsidies to entice businesses to employ more people in rural towns may do nothing more than increase the net profits of absentee owners. There is no guarantee that the businesses will redirect the new revenues to hire more of the local unemployed. Indeed, place-based policies may simply introduce perverse incentives. If larger tax breaks or subsidies are targeted to places with higher unemployment, the less that businesses do to reduce local unemployment, the larger are their gains from policy transfers. Furthermore, businesses that do not depend on local purchasing power for their sales, the oft-chased export industries, have the weakest incentives to reduce local unemployment or to bid local wages up.

In contrast, Kilkenny and Johnson (2007) argue for policies that are tailored to fit local conditions, specifically "place-tailored" as opposed to "place-based." Place heterogeneity justifies place-tailored policies. For example, where the school-age population is less dispersed, less need be spent on either transport or infrastructure in order to provide all citizens with the same outcomes. Locally sensitive policies should also be more effective or better matched to local preferences than one-size-fits-all. However, as Kilkenny and Johnson noted, place-tailored policies are welfare improving only if the cost of local tailoring is not excessive.

Rural Development Modeling

Rural *development* is distinct from rural growth. Growth usually means "more of everything": more population, more resource employment, and more aggregate income without a significant change in industry mix, technology, productivity, or income per capita. One definition of development, on the other hand, "consists primarily in employing existing resources in a different way, in doing new things with them" (Schumpeter 1911/1961, p. 68). Therefore, "rural development" entails more

varied nonfarm rural industry and land uses, new rural occupations, and higher income per capita. The relevance of multiple sectors and multiple factors, the interplay of demand and supply, and the need to understand household and producer responses to market signals and policies are obvious in this setting, which leads us to the next lesson.

Lesson #5: Rural development is a general equilibrium problem that requires general equilibrium tools. These and other quantitative tools provide a necessary foundation for community economic analysis.

Input-output models Wassily Leontief won the 1973 Nobel Prize in Economics for developing the input-output method. Said the Royal Swedish Academy of Sciences, "This important innovation has given to economic sciences an empirically useful method to highlight the general interdependence in the production system of a society. In particular, the method provides tools for a systematic analysis of the complicated inter-industry transactions in an economy." Even by that time, few anticipated that the input-output method would become so widely used within agriculture economics.

The first appearance of an input-output model in the refereed economics literature appears to be Leontief's (1936) analysis of technical progress in the United States. Leontief documented the changes in the use of each industry's output as intermediate goods by other industries. Soon after this paper, the usefulness of input-output modeling as a general equilibrium planning tool was demonstrated. Knowledge of the country's input-output relationships enabled the federal government to coordinate production among all sectors to deliver the ordnance needed for the war effort in World War II simultaneously (Leontief 1951). Despite the obvious differences between planning a centrally administered, centrally financed, centrally coordinated expansion of production to meet new final demands for military goods and predicting the effects of decentralized changes in economic opportunities, Leontief subsequently touted input-output models as a forecasting tool: "The immediate purpose of interregional input-output analysis is the determination of the differential impact of any given change in the final bill of demand" (Leontief 1952, p. 9).

Agricultural economists have long made important contributions to input-output modeling. Following Leontief (1951) and Isard

(1951), Heady and Schnittker (1957) presented the simple arithmetic of the method, results for agriculture differentiated by region using 1949 data, and an assessment of the method's limitations. Ram (1958) created a five-sector system for eight North Carolina counties with labor and land equations to demonstrate how input-output could be used in "a small homogeneous agricultural area." Davis and Goldberg (1957) traced the forward and backward linkages of farming, food processing, and fiber processing and coined a novel word to describe the linked industries: agribusiness. USDA continues to use this basic approach when identifying, monitoring, and analyzing the food and fiber system (e.g., Henry and Schluter 1985; Schluter, Lee, and Edmonson 1986; Lee and Schluter 1993; Edmonson 2004, 2008).

Maki, Barnard, and Suttor (1964) were perhaps the first to embed an input-output model within an econometric model. Little and Doeksen (1968) devised a procedure to measure leakages from the local economy. Heady and Sonka (1974) used input-output and math programming to address implicitly the question "Is agricultural policy good rural development policy?" They developed an impressive eleven-region interregional math programming model to estimate the agricultural sectors' input demands, employment, and farm household income under four farm size scenarios in eleven regions. They then applied eleven tailor-made regional input-output models to simulate the local economy-wide effects of the differences in farm input demand and farm household demand for consumer goods and services that they estimated using the math programming models. They found that having smaller farms, rather than the larger farms that were encouraged by agricultural policies, would support greater income generation in rural communities. Apparently agricultural economists have not yet econometrically tested this intriguing simulation result.

Agricultural economists have also used input-output to predict the changes in supplies of various occupational types of labor needed to accommodate a new local enterprise (e.g., Doeksen 1972; Kraybill and Dorfmann 1992; Lego, Gebremedhin, and Cushing 2000) and, conversely, to predict which occupational types may become unemployed due to contractions (e.g., Waters, Holland, and Weber 1994) or alternative natural resource uses (e.g., Seung et al. 2000).

The possibility of extending the input-output method to allow economic-ecological

modeling attracted the giants of the field, Leontief (1970) and Isard (1969), but the innovative work of agricultural economists Hite and Laurent (1972; Laurent and Hite 1972) stands out because their approach was practical and operational. They added a matrix of resource use or emissions per dollar of gross industry output to the input-output model, thereby enabling calculations of changes in pollution as a result of changes in output, albeit with the typical input-output modeling assumption that pollution is proportional to output.

The initial period of modeling innovation was followed by much research focused on cost cutting. Building survey-based input-output accounts for an area can be very expensive, so researchers sought ways to adapt the national input-output accounts and create what became known as nonsurvey or partial survey methods (see Round 1983 for a critical review). The goal, one influential model builder explained, is "holistic" accuracy, getting the general picture right (Jensen 1980). Agricultural economists were particularly creative in building models for small areas. Robison and Miller (1991) used ideas from CPT in modeling a timber economy in Idaho with six communities and about 20,000 people. Robison (1997) divided two counties with fewer than 12,000 residents into seven community-centered regions.

By 1986 the technology for quick construction of an input-output model for any county or groups of counties had proceeded so far that Brucker, Hastings, and Latham (1990) were able to conduct an experiment. Five modelers agreed to run the same seven simulations using their systems and compare the results. Two participants were federal government agencies: the BEA, inventor of RIMS II (Regional Input-Output Modeling System), and the USDA Forest Service, inventor of IMPLAN (Impact Analysis for Planning).

Since that time, IMPLAN has swept the table. USDA officially adopted it to estimate the potential job creation effects of the American Recovery and Reinvestment Act of 2009 (Kort 2009). According to Scott and Johnson (1998, p. 51), IMPLAN became popular among applied economists at land grant universities after a small investment by the USDA Extension Service and the four USDA Regional Rural Development Centers led to training programs starting in 1986. IMPLAN county data are key components in Miller and Robison's subcounty community models, and IMPLAN modeling results are parts of recent

AJAE articles, from bioenergy (de la Torre Ugarte, English, and Jensen 2007) to tourism (Cline and Seidl 2009). Scott and Johnson (1998) claim, "The availability of IMPLAN has influenced decisions involving millions of dollars of private and public funds" (p. 51).

It all began when the National Forest Management Act of 1976 required the Forest Service to prepare five-year management plans based on analyses of alternative land management options and their predicted socioeconomic effects on local communities. The Forest Service made a major investment to develop the IMPLAN modeling software (USDA-NRCS 2009). In 1988 Minnesota's Department of Agricultural Economics started providing software and support to non–Forest Service users, and in 1993 these activities were spun off as a private company. The principals continue to innovate, recently releasing a multiregional system for analyzing effects of activities in one county on other counties (Lindall, Olson, and Alward 2006).

The use of the input-output method has now become routine, which is a danger (Henry and Johnson 1993). One can just push the buttons, but that usually is a mistake. The IMPLAN software allows users to override the default assumptions, which is important because agricultural economists often are interested in new industries that are not among the 509 sectors of the model, like dry-mill ethanol, and because technologies vary greatly across the country. Knowledge of the regional economy and local industry is very important to be able to adjust the IMPLAN model and specify the scenario reasonably well, as Lazarus et al. (2002) demonstrate when analyzing the Minnesota pork industry. Low and Isserman (2009) show the many complex decisions that must be made outside the model without the help of the model when estimating ethanol's local economic impacts.

Another temptation lurks. Leones, Schluter, and Goldman (1994, p. 1123) warn, "Politics often motivates undertaking studies on the size or importance of agriculture in a state or region. State and federal departments of agriculture and state-supported colleges of agriculture use this information to lobby either on budgetary or policy issues by touting the importance of agriculture to the economy.… Agricultural economists have a responsibility to make sure that such studies follow acceptable procedures in economic accounting." Hamilton et al. (1991) caution that value-added reflects an opportunity cost.

The value-added simulated using an input-output model measures a net benefit only to the extent that unemployed resources or labor are brought into production or are used more productively. Watson et al. (2007) caution against describing input-output results as economic benefits and call for a "consistent and explicit semantic," distinguishing among economic activity, economic contribution, and economic impact.

Community Economic Analysis

In 1966 AFEA had no specialization in rural development, but by 1982, 3.5% of the membership in the Agricultural and Applied Economics Association (AAEA), 112 individuals, claimed "community resource economics" as their specialization (Swanson 1984). The book *Micropolitan Development*, by Tweeten and Brinkman (1976), claimed apparently accurately to offer "a comprehensive look at rural development totally lacking in any previous publication" (p. vii). Its approach, grounded in theory and methods, is activist in intent: "Our overriding concern is to improve the well-being of micropolitan people, wherever they eventually reside" (p. 6). *Community Economics* by Shaffer (1989) discusses more quantitative methods, including the use of concepts from CPT-like demand thresholds and market areas, as well as input-output, but mastery of the methods is not an end in itself. The methods are to be used with people in a community, because community economic analysis "is a comprehensive effort to change the economic situation within the community" (p. 8).

A prominent step on this movement to bring input-output and related methods into the service of rural communities has been the Community Policy Analysis Network (see Scott and Johnson 1998). *Community Policy Analysis Modeling* (Johnson, Otto, and Deller 2006) is the product of a multistate effort to go beyond the capability of the input-output model to consider labor markets and fiscal impacts using cross-sectional and panel data econometric models. The fiscal impact modeling techniques developed by agricultural economists (e.g., Johnson and Keeling 1985; Halstead and Johnson 1986; Swallow and Johnson 1987; Johnson 1988) provide state and federal governments with estimates of the magnitudes and distributions of the benefits and costs, including the deadweight losses, of proposed changes in fiscal, trade, industrial recruitment, and other policies and programs (see also Midmore 1993;

Waters, Holland, and Weber 1997; Seung and Kraybill 2001). Input-output is also used to predict the employment and income payoffs of particular investments, projects, and development programs (e.g., Berck, Robinson, and Goldman 1990; Berck and Hoffmann 2002; Deller and Shields 1998).

Agricultural economists also developed a more realistic treatment of the rural labor force and how it changes, on the basis of their econometric analyses of rural labor markets (e.g., Renkow and Hoover 2000; Mills and Hazarika 2001; Khan, Orazem, and Otto 2001; Renkow 2003; Rupasingha and Goetz 2004; Barkley, Henry, and Li 2004). Recent econometric analysis of "exogenous" export sector employment, rural income, and population growth over time has provided a summary lesson: Rural labor supplies are not perfectly elastic (Kilkenny and Partridge, 2009). Rural labor supply appears to be inelastic with respect to *increases* in labor demand and elastic with respect to *decreases*.

Targeting regional economic development (Goetz, Deller, and Harris 2009), with 30 authors, mostly agricultural economists, is the most recent collaborative effort and was preceded by papers that developed the input-output–based methods to inform and evaluate local industrial targeting initiatives (e.g., Leatherman, Howard, and Kastens 2002; Deller and Shields 1998). Another Harvard research project, that of Porter (1998), had launched a wildly popular quest to foster regional competitiveness, including in rural regions (Porter et al. 2004). Vintage methods and concepts are in play, such as location quotients, shift-share analysis, input-output, import substitution, location analysis, industrial complexes, and others discussed authoritatively half a century ago in *Methods of Regional Analysis* (Isard et al. 1960). The key analytical step, identifying existing or potential spatial clusters of interrelated industries, commonly involves the location quotient, introduced in the United States by the National Resources Planning Board (1943) and debuting in the refereed literature in *Review of Economics and Statistics* by Hildebrand and Mace (1950). Although high-speed calculations with large databases and inter-industry linkages revealed by national input-output tables are involved, so is concern with the community process within which the analysis is used. "By combining the *process* of targeting analysis with the *contents* of the analysis," Goetz, Deller, and Harris (2009) argue, "powerful insights into the regional economy can be gained.... The

TRED exercise can be as much an educational tool as it is the foundation of a technical report" (p. 2).

Computable General Equilibrium Models

The abstraction of input-output models from price endogeneity and the inability to account for factor supply inelasticity are inherent limitations of the I-O method. For this reason, when the technology to compute general equilibrium was discovered in the early 1970s, agricultural economists pursued it. The development of computable general equilibrium (CGE) modeling techniques by agricultural economists has been a major contribution to the entire economics profession. Computable general equilibrium models are the only ones that endogenously determine primary factor supplies as well as all prices and incomes in an economy.

Many "founding fathers" of CGE were international development economists concerned about agriculture and development policy (Adelman and Robinson 1987; Dervis, de Melo, and Robinson 1982; de Janvry and Sadoulet 1987). Other key progenitors were economists interested in tax, trade, or industrial policy (Shoven and Whalley 1973; Hertel and Tsigas 1988; Mutti, Morgan, and Partridge 1989), many of whom are also agricultural economists. The study by Shoven and Whalley (1973), the first CGE article to appear in a refereed journal, was followed by an initial trickle. Models were laboriously written in FORTRAN code. The number of refereed CGE journal articles took off after Herb Scarf developed a practical algorithm for solving fixed-point problems (see Kehoe, Srinivasan, and Whalley 2005), the advent of microcomputers, and release of the General Algebraic Modeling System (GAMS) software by Brooke, Kendrick, and Meeraus (1988). In the decades since the early 1970s, almost one thousand articles using applied or CGE methods have been published in refereed social science journals.

CGE models are important for rural policy analysis, and rural development economists have made important contributions to CGE modeling of regional economic issues. In Adelman and Robinson's (1987) early model of Korea, for example, the "rural" economy consisted of the agricultural sector, and "rural households" were those employed in agriculture. The stylization of a rural economy as the agricultural sector abstracts from the role of distance in segmenting land, labor, and

other markets and the many other factors that account for why rural is more than just agriculture.

The first multisector two-region (rural and urban) Walrasian CGE model to explicitly model interdependent rural and urban economies and the associated market segmentation was published in *AJAE* by Kilkenny (1993). The model endogenizes commuter income, absentee landownership and transregional capital income flows, rural–urban goods trade, rural government and intergovernmental transfers, and the offsetting rural and urban current/capital account imbalances. With that model, Kilkenny showed that coupled farm subsidies were not as effective as decoupled (nonfarm) income transfers at promoting rural prosperity.

CGE methods have also been developed by agricultural economists to predict the effects of, for example, agricultural liberalization on intersectoral labor reallocations (Kilkenny and Robinson 1990), macroeconomic imbalances on a state economy (Kraybill, Orden, and John son 1992), cuts in defense spending on a state economy (Hoffmann, Robinson, and Subramanian 1996), and property tax limitations (Waters, Holland, and Weber 1997), as well as to describe the role of agriculture in the rural economy (Midmore et al. 1997), local economic trade-offs between recreational and agricultural water uses (Seung, Harris, and Englin 2000), and the local economies of small towns (Schwarm and Cutler 2003). Given their expertise with CGE, agricultural economists were also able to adapt, use, and properly evaluate the tools of NEG for modeling rural development (Hite 1997; Kilkenny 1998).

Rural Land Use Modeling

Land and its location are long-standing areas of inquiry within economics. Fundamental to land economics are the works by Ricardo (1817), whose concept of rent as equal to the differences in product caused by the difference in soil fertility was fundamental to the economic theory of value, and von Thünen (1826/1966), whose work on the role of transport costs in determining the value of location in space provided the foundation for location and land economics (Isard 1956). While traditionally the purview of resource economics, the economics of land use has emerged as an important rural and regional issue with the expansion of urban areas into once rural places and the emergence

of "exurbia" as a recognized category along the rural–urban continuum. Current land use economics research is found in both environmental and resource economics journals as well as regional and urban economics journals.

The beginning of land economics in the United States is marked by the establishment of the Division of Land Economics within the USDA in 1919, the founding of the Institute of Land and Public Utility Economics by Richard T. Ely at the University of Wisconsin, and the launch of the journal *Land Economics* (known then as the *Journal of Land and Public Utility Economics*) in 1925. The original scope of land economics was broad and included the economics and management of all natural resources under the general heading of land, as well as land policies and reforms, private and public land ownership, land values, taxation, and other institutional concerns. Land utilization was and continues to be an important topic as well. Indeed, Salter (1942) called "the study of problems associated with major changes in the pattern of economic use of land" a primary organizing topic in rural land use economics.

Much of the early work of economists on land utilization was descriptive, e.g., analyses of regional land use patterns that linked, for example, farm management considerations with land suitability and other regional factors that influenced farm-level decision making (Salter 1948, p. 27). Following World War II, agricultural economists modeling land as a factor of production transformed land economics research by applying the new method of linear programming (LP) to quantify optimal land use decisions. The focus was naturally on farmer decision making, and thus this work was concerned primarily with allocations of land to different agricultural commodities. At the forefront of this new research were two agricultural economists, Earl Heady and Glen Johnson. According to Castle et al. (1981), their work is one of the most significant developments in agricultural economics (p. 414). For example, Heady and Egbert (1964) created a land-constrained cost minimization programming model of agricultural commodity production to allocate farm land optimally in 122 producing regions of the United States. The regions were delineated by soil quality and other physical land features, and thus their approach defined the spatial distribution of heterogeneous landscape features of land suitable for agriculture. However, despite their microeconomic foundations, the

underlying normative assumptions and aggregation bias problems with the large regional and national LP models (Taylor and Howitt 1993) were problematic. From a rural land use planning perspective, these models ultimately failed to provide reasonable projections of future land use allocations, and thus policy-oriented researchers were forced to develop alternative econometric models of land use change (Alig, personal communication).

Following the marked increase in housing demand and population suburbanization after World War II, concern over "urban sprawl" and its impacts on both cities and rural regions began to attract the attention of an increasing number of researchers (Bishop 1967; Clawson 1962; Harvey and Clark 1965; Kaiser 1968). The planning needs for future predictions of rural land use transitions prompted new reduced-form approaches to the empirical modeling of land use and land use change. Agricultural and resource economists were key innovators. We summarize this contribution in the first of two lessons on rural land use modeling.

Lesson #6: Reduced-form empirical models of land use and land use change have proven useful in examining land use outcomes and in identifying the effects of policies on rural land conversion.

A large literature on econometric modeling of land use change has emerged since its beginnings in the early 1980s. In addition to the planning needs of federal agencies that sought large-scale regional projections of future land needs, these models were spurred by growing concerns over the urbanization of rural land and analyses by researchers at USDA of gross land use transitions that revealed much more dynamic rural land use processes than what was revealed by net statistics.

The key turning point came in the development of reduced-form econometric models that provided a full accounting of all land across alternative land use categories. Two agricultural and natural resource economists (Alig and White) working in tandem with an urban/environmental economist (Healy) were the first to develop land use and land use transition models that accounted for land across multiple land uses (e.g., cropland, pasture, forest, urban) using state-level data on land use and socioeconomic variables from the U.S. Census (White and Fleming 1980; Alig 1986; Alig and Healy 1987). From these

highly aggregated, sparse data beginnings, agricultural economists have forged the way in making continual improvements to econometric land use modeling through the use of better data, theory, and methods. Following on the innovations of the early and mid-1980s, agricultural economists continued to improve upon the basic land use share model, e.g., to account for heterogeneous land quality (Stavins and Jaffe 1990; Wu and Segerson 1995), uncertainty (Parks 1995; Schatzki 2003), forestry dynamics (Plantinga 1996) and land use transitions (Lubowski, Plantinga, and Stavins 2008). These models have been usefully applied to study the effects of a variety of federal policies on regional land use allocations, including federal flood control projects (Stavins and Jaffe 1990), wetlands restoration programs (Parks and Kramer 1995), climate change strategies (Lubowski, Plantinga, and Stavins 2006; Plantinga, Mauldin, and Miller 1999), federal farm policies (Lichtenberg 1989; Plantinga 1996) and deforestation in Brazil (Pfaff 1999).

The GIS data revolution of the 1990s spawned new sources of spatially disaggregated data and further transformed empirical land use modeling. It became possible to match the spatial scale of the data with the scale of the economic behavioral process. This integration of microspatial data (e.g., at the scale of land parcels or subdivisions) with discrete choice econometric models provided new opportunities for examining the associations of spatially heterogeneous features with fine-scale land use patterns and improved econometric parameter estimation. Chomitz and Gray (1996) and Nelson and Hellerstein (1997) were among the first to estimate spatially disaggregated land use models using remotely sensed data from Belize and Mexico respectively. In both cases, a theoretical model of deforestation was used to motivate a reduced-form empirical model in which access to roads is a key variable. A seminal contribution is found in Bockstael (1996), the text of her Waugh lecture at the American Agricultural Economics Association in 1995. This paper lays out a basic framework for a discrete choice model in which land is fully allocated to the use that maximizes its net present discounted value of returns. It then applies the model to urban land development in a central Maryland region.

The spatial disaggregation that is the keystone of these more recent models has substantially reduced problems of measurement error

and facilitated the use of newer methods that enable the empirical identification of policy effects. Endogeneity and selection bias problems frequently arise in the context of evaluating land use regulations. This is due to the endogenous nature of most local land use policies, e.g., growth controls are most often imposed in areas that already face rising demand for rural land development. Evaluations of the outcomes of such policies that fail to correct for the inherent selection problem will naturally be biased. Recognition and attempted treatment of these problems in this context represents a real stride forward beyond simple models that regress outcomes (e.g., land development) on some measure of policy stringency assumed to be exogenous. While some urban economists provided early analyses of land use regulations using aggregate data, e.g., at the community or metropolitan scale (see Irwin et al. 2009 for a review), disaggregated data have facilitated the use of quasi-experimental methods and are necessary if the policy in question is spatially differentiated at a local area scale. Recent examples from *AJAE* include Bento, Towe, and Geoghegan (2007) and Lynch and Liu (2007), both of whom used parcel-level data and propensity score matching methods to estimate the effects of specific growth control policies in targeted regions of Maryland. A recent *AJAE* paper by Towe, Nickerson, and Bockstael (2008) provides another example of the utility of parcel-level data in estimating the influence of agricultural preservation policies on the development timing of rural land parcels, in this case using a real-options framework.

Spatial disaggregation of the data and models has also shed new light on the importance of localized externalities and interactions. This leads us to our next lesson, and the second one on agricultural economists' contribution to land use models.

Lesson #7: Accounting for local spatial heterogeneity and interactions is critically important in understanding rural–urban land use transitions and patterns.

Agricultural economists have been at the forefront of developing theoretical and empirical land use models that have demonstrated the important role of spatial heterogeneity and spatial externalities, including the effects of open space, in land markets and on land use patterns. Theoretical models with multiple sources of spatial heterogeneity have provided more realism to the traditional urban economic model (Alonso 1964; Muth 1969; Mills 1967) that identified transportation costs to an urban center as the sole factor that differentiates one location from another. This model, commonly referred to as the monocentric model, describes concentric-ringed patterns of location and urban land use based on the microeconomic behavior of economic agents. Despite its elegance and initial usefulness in explaining aggregate urban land use patterns around an exogenously defined urban center, the monocentric model's ability to explain the much more complex land use patterns that have emerged as a result of the growing interdependence among rural and urban areas is limited at best. Earlier models of leapfrog development explained temporary fragmented patterns of land use as the result of intertemporally optimal land development (Ohls and Pines 1975; Mills 1981). However, these models could not explain the persistent patterns of scattered urban land use patterns that had become typical of many U.S. outer suburban and exurban regions by the 1990s.

Wu (2001) and Wu and Plantinga (2003) were the first to explore the implications of additional spatial heterogeneity within the framework of the basic monocentric model by extending the model to account for an additional rent gradient from exogenously placed open space. They identify the conditions under which the trade-off between transportation costs and open space spillovers will generate leapfrog development. Cavailhès et al. (2004) introduce rural amenities into a monocentric model with commuting households and farmers, both of whom compete in the land market. They analyze the effect of changing commuting costs on the predicted urban–rural pattern of land use and calibrate the model using French data. Tajibaeva, Haight, and Polasky (2008) model the optimal long-run local government's provision of open space amenities and the influence on residential location and land markets within a multicentric urban area. Recent development of agent-based simulation models of land markets (e.g., Filatova, van der Veen, and Parker 2009; Magliocca et al. 2009) and extensions of the monocentric model with local spatial effects to a dynamic setting (Caruso et al. 2007; Chen, Irwin, and Jayaprakash 2009) have provided dynamic frameworks for further examination of the evolution of these patterns over time.

Empirical evidence of the role of local spatial externalities in influencing exurban land use patterns was first presented by Irwin and Bockstael (2002). Their empirical findings confirm the negative effect of neighboring development, and spatial simulations demonstrate the important role of these negative spillover effects in explaining the observed scattered patterns of exurban development in their central Maryland study area. Other spatially disaggregated models have provided evidence of other spatially heterogeneous factors on rural land development and urbanization patterns, including the influence of preserved open space (Irwin and Bockstael 2004), the differential influence of public sewers and water on suburban versus exurban residential development (Newburn and Berck 2006), and the influence of subdivision regulations on resulting lot sizes and neighborhood density (Lichtenberg, Tra, and Hardie 2007; Lewis, Provencher, and Butsic 2009). Collectively, the theoretical and empirical work by agricultural economists has demonstrated the waning importance of transportation costs and the increasing importance of local spatial effects, both endogenous and exogenous, in explaining rural–urban patterns of exurbanization and sprawl. This has important implications for local policies that seek to manage this growth. For example, evidence of the attraction effects of local open space suggests that local policies that seek to preserve rural land may have the unintended effects of attracting new development and exacerbating sprawl.

Future Needs and Directions

As we turn from the impressive accomplishments of the past to contemplate the research needs and potential directions of the future, we acknowledge that just as our accounting of past contributions is necessarily selective, so too are our considerations of the future. These musings are shaped by our own interests and biases as researchers as well as our particular vantage point in time. Economists typically are loathe to predict too far into the future and with good reason: Who in 1850 would have predicted automobiles and their far-reaching impacts on the location of economic activity? Who in 1950 would have predicted the development of the Internet and how it would so radically transform regional and national economies? Here we avoid these certain pitfalls by sidestepping any attempt to provide

a conclusive or comprehensive statement of future research needs and directions. Instead, we conclude by offering summary discussions, presented in order of authorship, of research topics that collectively we view as important to advancing research on rural and regional issues.

Spatial Dynamics

Regional economists have separately modeled dynamic processes with general equilibrium feedbacks and spatial processes with spatially explicit interactions, but models of spatial dynamics derived from microeconomic foundations are in their infancy (see Desmet and Rossi-Hansberg 2010 for an example and Irwin 2010 for additional discussion). *Spatial dynamics* refers to a spatially dependent dynamic process in which a change over time at one location is dependent on the state or changes in the state at other locations. This type of endogenous spatial dependence may arise, for example, from local interactions among spatially distributed agents or cumulative spatial feedbacks generated by the decisions of many individual agents over time and space. Spatial dynamics are common in regional, urban, and rural processes but are challenging to account for because these models require (*a*) assumptions about expectations by households and firms of future market opportunities, (*b*) explicit expressions of the behavioral (or structural) equations that determine the dynamic equilibrium, and (*c*) the specification of interactions across time and space. The complexity of the system suggests that multiple equilibria may be possible, which greatly complicate policy analysis if alternative equilibria cannot be ruled out. Analytical tractability is limited, which necessitates a computational approach to simulate model outcomes and makes parameter specification a key task. Empirical identification of spatial structural parameters is hampered by endogeneity and selection biases and spurious spatial dependence. The latter is often due to the aggregate data limitations that introduce substantial measurement error. But even with spatially disaggregated data defined at the same scale as the behavioral process, standard spatial econometric models may often be insufficient for identifying structural parameters. Quasi-experimental approaches are useful in reducing spatial error dependence and can provide an alternative approach to identifying spatial interactions (Carrion-Flores and Irwin 2010). Current theoretical and econometric

models have only scratched the surface, however, and more work is needed in developing and empirically specifying economic models with spatial dynamics.

Diversity and Resilience

Two matters noted a century ago in *Principles of Rural Economics* (Carver 1911) still require attention, the rural legacy of slavery and the viability of rural farming communities. Whether measured by persistent poverty or broader indicators, rural areas with African American or American Indian populations do very poorly. Strong empirical findings for rural places with these populations are forceful reminders that the United States has not overcome the legacies of its original racial policies. The other variables in our models and the rural development theories they represent do not explain conditions in places with American Indian and African American populations. Hence, our results argue against "color-blind" rural development policy that ignores race; conditions are worse in those rural communities than other factors predict. Rural economists might prefer to leave this dually wicked problem (Batie 2008) to sociologists, but a recent survey in the *Journal of Economic Literature* (Alesina and La Ferrara 2005) demonstrates that diversity is a powerful economic variable. Farming communities face a twofold resilience challenge: how to prosper and how to remain rural. Powerful forces threaten their economic base of agriculture and manufacturing and their roles as regional trade centers. Remaining rural is difficult where metropolitan areas spread, small towns grow into urbanized areas, and urban folks buy farmland for bucolic life or cheaper housing from which to commute to city jobs. Yet, one in four farming dependent counties in the United States does better than the nation in terms of poverty, unemployment, housing problem, and high school dropout rates. Can we learn something from them that might help other places? Case studies have emphasized local actions and institutions; econometric studies consistently find important two factors local action can affect, i.e., jobs and education; and extension programming is based on the premise that local action matters (see Shaffer, Deller, and Marcouiller 2004). In the face of global markets, technological change, and geography, is local action a rural development solution or a chimera? More research is needed.

Policy Effects and Market Outcomes

Jim Hite (1993) wrote that "rural development often is the result of a struggle between rent defenders and rent seekers," and Kilkenny and Johnson (2007) are concerned that our current rural development policies *cause* negative pecuniary externalities in rural places. What are the distributions between wages to rural workers and rents to local or absentee monopsony or monopoly rural firm owners from our "sector-based" policies? Do our "people-based" education and safety-net policies support local growth, or do they just mobilize rural citizens, one by one, out of declining rural towns? Do our rural infrastructure policies reward own-effort or encourage dependency? How can we tell if a rural community needs to grow or if it is a sustainable size? The general equilibrium, economic impact simulation models, and reduced-form approaches we usually use often ignore that space is costly, track interregional current and capital account transactions with difficulty, ignore scale and critical mass issues, and ignore imperfect competition and the moral hazard and selection bias issues plaguing both access to funds for investment and local responses to rural development initiatives or policies. We need new theoretically sound hypotheses to better identify the effects of new rural opportunities or policies on rural market signals and to identify the effects of changes in signals on behavior. We should use the most scientifically sound methods to estimate structural parameters and apply them to simulate rural economies, and continue to develop innovative econometric techniques, such as experimentalist approaches, to avoid selection biases and to identify "treatment effects" (e.g., Isserman and Merrifield 1982; Artz et al. 2007). As Holmes (2010) argues, all three methods—structural, reduced form, and experimentalist—are needed to further our understanding of rural economic processes, policy effects, and outcomes.

Migration Patterns

Americans are remarkably footloose. Lessons 1–3 illustrate how this mobility shaped rural America over the last 100 years. On net there was dramatic migration from rural farms to urban areas followed by (*a*) significant geographical expansion of the influence of urban areas in terms of sources of employment for rural commuters and (*b*) the relocation of footloose urban households to high-amenity

rural areas. Yet, migration flows have greatly declined since the 1980s (U.S. Census Bureau 2009), suggesting that these broad trends are waning. Indeed, a spatial equilibrium approach suggests that the persistent effects of remoteness and amenities would (eventually) be fully capitalized into housing prices and wages. In fact, McGranahan (2008) suggests that higher housing prices now may be reducing amenity-led migration flows, and technological change has its effects as well. Such shifts would mark an entirely new environment and would require the development of novel paradigms that agricultural economists would need to develop to describe rural job and population growth. Moreover, policy recommendations that economists have developed in the last few decades would have to be altered. Thus, agricultural economists should research whether the long-standing patterns of the last 60 years are ending or just taking a pause. If they are ending, we need to assess how migration patterns (and associated factor prices) are adjusting and then develop new policy recommendations. Just as the subsequent transformation of rural America was unthinkable even in 1940, the twenty-first century will be very different as well.

Taken together, our diverse set of forward-looking research sketches provides a sense of where we stand today and of some of the promising directions we see for research. In summary, the questions faced by rural development and regional economists today are theoretically interesting, empirically testable, and extremely policy relevant. It will be exciting to see how new research techniques, data, and findings will inform these questions as our profession pursues research on rural and regional issues over the next 100 years.

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