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Integrating Regional Economic Development Analysis and Land Use Economics

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by

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Abstract: Two largely separate literatures exist on regional economic development and land use economics. In this chapter, we argue that a full understanding of each of the two areas requires greater knowledge of their interrelationship. We review key studies of the two literatures, particularly those related to the close interconnectedness of regional economic development and land use. We contend that a critical shortcoming in the literatures is that key features that affect both land use and economic activity are typically not systematically considered. We then posit that the spatial equilibrium framework is especially suited for understanding the various feedback mechanisms that affect both. Also particularly promising are the increased availability of GIS and micro data, as well as recent methodological advances in empirical estimation and modeling.

1. Introduction

Academic economists historically separated issues related to land use from those related to regional economic development. One reason is that land use studies typically do not consider the connectedness of firm and household location decisions, while regional economic development studies rarely account for land (McDonald, 2001). Moreover, it appears that land use researchers think more at the micro-scale of neighborhoods (or intra-regional), while economic development researchers think more at the macro scale (or interregional).

The division between the two fields does not reflect how local economic development policy is undertaken. Economic development is inherently about land because it is about activity in a place or on a specific land area. Local governments compete with each other in trying to attract households and firms to their *place*.

Land use and economic development then are inherently linked through zoning, transportation, infrastructure, sprawl, and environmental attributes that jointly affect firm productivity and household utility. Because local policy is about place, land economics is linked to economic development policy through competition for new development. This raises further questions about governance and local government effectiveness in delivering public services that underlie development through Tiebout (1956) sorting and spatial equilibrium processes generally.

In this chapter, we attempt to tie together the two separate literatures. We stress the economic development literature in regional and urban economics that most closely relates to land economics. An implicit theme is that land economic studies should pay closer attention to joint firm/household location decisions, while the regional economic development literature should pay closer attention to land as it defines the place that the activity occurs. Likewise,

another theme is that research should focus more on the regional interaction of activity across space. Models and empirical approaches are needed that recognize regions as complex systems, fully understanding and modeling the interplay between land use and economic development, including the linkages between the intra-region distribution of economic activity and overall regional economic performance.

Figure 1 shows the interdependence of local and regional economic development (depicted as job creation and firm productivity) with several key factors including land use; amenities and quality of life; household migration; public services; and the urban system. In italics are some examples of these factors. The figure reflects the key role of land use in directly affecting economic development and in turn, being directly affected by economic development. Land use also indirectly influences economic development through its interactions with the other factors. These interactions also illustrate the difficulties of identification of causality in empirical analysis. The chapter will outline these direct and indirect effects that land use and economic development have with each other, illustrating the central connections between land economics and regional and urban economics.

Before describing the contents of the chapter, we note that some important topics are given brief treatment or omitted because of space limitations. Examples include public infrastructure, tax competition, urban amenities, and spatial econometrics. Some of these are covered in latter chapters in the handbook, while we view other topics as less central to our mission in this chapter. In what follows, Section 2 outlines the basic spatial equilibrium approach used in modern regional economic development studies and outlines ways to include land. Section 3 describes the natural link between land economics and economic development through proximity to urban centers. Economic activity across space is strongly affected by access to agglomeration economies that influences economic location both within and across regions, with

the latter being our focus. Section 4 describes how land use affects the provision of natural and urban amenities that influence whether households and businesses want to locate in a particular place. We focus on the common features in the two literatures in which the land use literature focuses on micro-scale amenities such as open space, while the economic development literature focuses more on amenities at the regional scale that affect regional economic growth.

Section 5 provides a brief introduction to government policy aimed to improve land use and increase economic activity. This literature is extensive and we can only provide a cursory treatment. Section 6 describes some of the empirical approaches used in the economic development literature, focusing on the quasi-experimental and structural approaches that currently predominate. We note that both have advantages for empirical assessment but they suffer from shortcomings. The unifying theme is that studies using either approach need to more rigorously assess the legitimacy of their identifying assumptions and check robustness. Section 7 briefly highlights areas ripe for future research while Section 8 presents our conclusions.

2. Land Use in Regional Economic Development Analysis

Despite its central role in firm and household location decisions and regional economic activity generally, land routinely is omitted in regional economic development analysis. In part, this results from the traditional tools used in economic development analysis, which often are chosen for convenience rather than demonstrated accuracy (Partridge and Rickman, 1998; 2010). In studies where land use is the focus, regional economic development considerations often are ignored or are of secondary importance. Nevertheless, there is growing recognition of the central role of land use in regional economic development.

Land is completely removed from consideration in economic impact analysis that involves application of an input-output model because of its implicit assumption of perfectly elastic supply. Factors of production implicitly are assumed in excess supply in short-run analysis or perfectly mobile in long-run analysis. As a fixed factor, often in limited supply, the

implicit omission of land from consideration questions the routine use of input-output models in regional economic development analysis. This omission likely leads to highly inaccurate impact assessments when land prices are highly responsive to economic development or where there is intra-regional heterogeneity in how land prices respond.

Computable general equilibrium (CGE) models incorporate factor supply constraints, making them more general than input-output models (Partridge and Rickman, 1998). Although CGE models potentially are more accurate in a wide range of applications, this depends critically on the formulation of the CGE models. For example, McGregor et al. (1996) formulate a CGE model with short-run labor supply and capital adjustment constraints. They relax the constraints in the long run in demonstrating how the CGE model then functions as an input-output model. Partridge and Rickman (2010) argue that the traditional method of formulating regional CGE models limits their applicability for regional economic development analysis; rather than patterning regional CGE models after their national counterparts, they should be based on spatial equilibrium theory, including explicitly incorporating land.

Rickman (1992) incorporates fixed land and imperfectly mobile capital and labor in a regional CGE model, demonstrating how this produces dramatically smaller economic multipliers than what is obtained by assuming factors of production are elastically supplied. Fixity of land drives up its price when exports increase, crowding out other production (the model did not separately consider residential land though). The CGE multiplier effects then greatly depend on the elasticity of substitution between land and the mobile factors.

Despite von Thünen's (1966) model of land use and the general importance of land in location theory, land has largely been ignored in the increasing returns literature (Combes et al., 2005). Helpman (1998) added a nontradeable housing sector to the New Economic Geography (NEG) model to introduce congestion costs, though land use is not explicitly modeled. Pflüger and Tabuchi (2010) incorporate land used in housing and in production by an increasing returns sector in a general equilibrium model, which produces a differing pattern of economic development than if land is only used in housing.

McDonald (2001) effectively argues for connecting regional economic development policies to both labor and land markets. Land markets not only affect predicted outcomes, but also may be a source of economic development gains. Consistent with Bartik (1991), benefits of regional economic development policies that allocate land to industrial uses include employment of previously unemployed or underemployed members of the labor force and higher land values. Welfare gains to original residents of the area from economic development are enhanced to the extent land is owned by residents (Morgan, Mutti and Rickman, 1996).

Burnett et al. (2007) incorporate land in a CGE model of Fort Collins, Colorado to examine potential crowding out effects on other industries from increased tourist activity and to assess whether tourism is an optimal land use. The supply of land is specified as price elastic for both commercial and residential uses. They found land used in tourism as having the largest per acre effect on gross city product and real household income. A notable feature of the model is the connection between sectoral land use, direct job creation, in-migration, and residential land use. Tourism reduced in-migration and hence less residential demand for land. Using the same framework, Culter and Davies (2007) report that sectors primarily employing low-skilled labor generally reduce in-migration and demand for residential land use compared to high-skilled sectors, producing a larger per acre contribution of gross product and income. Kim and Ju (2003) integrate an urban land supply module with a CGE model for Seoul in examining the impacts on gross regional product, welfare, and income distribution from converting industrial land and green space into residential use.

Another long-standing omission in the regional economic development literature is the positive role land plays as a natural amenity. Land used for public parks, or left as open space, for example, create recreational opportunities and provide attractive vistas, increasing the local quality of life. Higher quality of life increases retiree and labor force migration, stimulating regional growth.

Land's contribution to the local quality of life then provides another feedback loop in a regional economy. Changes in land use that enhance quality of life increase in-migration and

growth (Rickman and Rickman, 2011). Regional economic development analyses then must not only consider the relative direct benefits of alternative commercial or residential uses, they also should consider the effects on local quality of life.

Thus, we advocate that regional economic development analysis be conducted using a modeling framework broadly capable of capturing important feedback loops within a regional economy. One such framework is the widely used spatial equilibrium approach (Roback 1982; Beeson and Eberts, 1989). The spatial equilibrium approach is sufficiently flexible to reflect an array of quality of life and firm agglomeration considerations (Tabuchi and Thisse, 2006).

In the spatial equilibrium approach, households geographically locate so as to maximize utility, while firms maximize profits in their location. Central to both decisions are nominal wage rates and land costs, as well as perfect mobility. Higher wages, adjusted for land costs, attract households. Lower wage rates and land costs attract firms. In addition, the framework incorporates site specific characteristics, reflecting the quality of life and quality of the business environment. Quality of life includes benefits households derive from land use beyond those obtained from residential housing. In equilibrium, the values of site specific characteristics are capitalized into wages and land costs. The approach can be formulated in growth terms by assuming that economies transition across spatial equilibria as exogenous conditions change (Dumais et al., 2002). Besides predictive equations for wages and land costs, equations can be derived from a spatial equilibrium model for growth in employment, gross regional product, investment, and population (Brown et al., 2003; Partridge and Rickman, 2003; Brown and Taylor, 2006).

Both traded and non-traded goods can be included in the model, in which the traded good can be specified with varying elasticity of demand.[1] Alternative theories of agglomeration economies can be captured in the approach, ranging from NEG (Ottaviano and Pinelli, 2006) to

[1]The traditional approach assumes that firms producing a traded good are price takers. Alternatively, traded goods can be modeled using the Armington assumption, in which there is imperfect substitution between traded goods of differing origins (Partridge and Rickman, 2010). MacDonald (2001) examines the significance of alternative assumptions on the elasticity of demand for export goods in assessing regional economic development policies.

urbanization economies, and those related to Central Place Theory (Partridge et al., 2010). Quality of life includes exogenous attributes such as weather, proximity to oceans or freshwater, or mountains. Other natural amenity attributes may be endogenous, being affected by local economic activity, including, air and water quality, forests, open space, attractive vistas. Endogenous quality of life attributes also include man-made amenities such as public infrastructure.

In the traditional spatial equilibrium framework, regions are assumed to have uniform land use policies. However, within a growth context, Glaeser and Tobio (2008) extend the model to allow for the effects of differential changes in land use and housing policies. They find that in former Confederate states, policies favorable to housing development were more likely responsible for strong population growth near the end of the 20th century than favorable weather.

Along these lines, Rappaport (2009) numerically simulates a structural spatial equilibrium model to produce a series of equilibriums in examining U.S. metropolitan population growth. The model's sole congestion force is land, which is used to produce both a traded good and residential housing. Simulated feedback effects include population growth effects on area amenity attractiveness and the effects of increased population density on productivity.

3. Economic Development: Distance and Proximity

Land economics and economic development are linked through the location of households and firms. While urban economists often emphasize the location of households and businesses within a given urban or metropolitan area, regional economists tend to focus on the relative differences across space—i.e., comparing outcomes *across* economic regions that could be metropolitan, nonmetropolitan, or some combination. Because *intra*-metropolitan area location patterns are discussed elsewhere in this handbook, we only briefly highlight them, instead emphasizing broader regional patterns.

3.1 Distance and Regional Economic Development. Both land use and economic development are tied to a given place with its economic activity closely tied to proximity within the urban system. A first effort was Von Thünen's (1966) classic model of land use surrounding a single

urban center on a featureless plane (Hite, 1997). He shows that high value-added products with high transportation costs locate closest to the urban center. The missing feature is it does not reflect the interaction of cities and regions across an urban system.

Central Place Theory (CPT) represented the first formal effort to model the urban system (Christaller, 1933; Lösch, 1940). Under assumptions including a featureless plane, CPT shows how a multi-tiered urban system could develop in which the type of services determine the size and location of urban center—e.g., the top of the urban system has all higher-ordered services such as patent attorneys, while the very bottom has basic services such as convenience stores.[2] CPT is adept at predicting the location of cities within urban systems, particularly in areas such as the North American Great Plains with traditionally high farm intensities (Fox and Kamur, 1965; Wensley and Stabler, 1998; Olfert and Stabler, 1999). CPT is useful in predicting the location of actual business and consumer services and their population thresholds. A primary critique of CPT is its static nature. It is usually necessary to impose *ad hoc* assumptions regarding changes in technology and transport costs to describe an evolving urban system.

Nevertheless, CPT is still quite useful in understanding the organic process of how urban-centered regions have expanded since the 1950s (Irwin et al., 2010). This process is driven by many factors such as labor saving productivity gains in the primary sector that released labor for urban employment, further facilitated by the rising use of automobiles that aid long-distance rural-urban commuting. Increasing population thresholds for public and private services also led more services to be provided from a central location. The inherent spillovers as economies began to regionalize have long led to calls for government consolidation and regional collaboration around the functional economic regions delineated from CPT (Fox and Kumar, 1965; Tweeten and Brinkman, 1976). Increasing agglomeration economies imply that growth prospects are better in regions with critical mass (Portnov and Schwartz, 2009). Conversely, promoting growth in small communities in isolation would be ineffective because they lack the agglomeration

[2]See Mulligan (1984) for a review of the CPT literature.

economies necessary to generate endogenous growth (Fox and Kumar, 1965; Berry, 1970).

The question whether urban-centered growth helps the surrounding hinterlands spawned a regional version of the spread and backwash literature that originated in international development.[3] Namely, does prosperity in urban growth centers "spread" into the countryside and create economic opportunities, primarily through commuting, or does it create a "backwash" where urban growth pulls rural workers and capital into cities? U.S. results suggest urban growth spreads into the countryside (Hughes and Holland, 1994; Barkley et al., 1996; Henry et al., 1997), while spreading up to 200 kilometers in Canada (Partridge et al., 2007). Yet, urban spread is more likely when rural communities have sufficient quality of life and services to support a commuting residential population (Henry et al., 1997; Kahn et al., 2001; Partridge, Ali, and Olfert, 2010). Likewise, Ke and Feser (2010) found that spread effects predominate in China, though Chen and Partridge (2011) find that growth in the three Chinese mega cities (Beijing, Shanghai, Guangzhou) creates wide-scale backwash.

A key economic development question then is whether urban-led growth can reduce rural unemployment. There are reasons for pessimism. Renkow (2003) found that about 60% of the adjustment to local nonmetropolitan employment growth is accommodated through changes in commuting flows and another 30% is through changes in migration—i.e., employment growth is only partially met through increases in *local* labor-force participation.

While CPT inspired a large economic development literature, CPT theoretical research waned after the 1980s. One reason is that CPT was rather mature and enthusiasm shifted to NEG. Another is that Geographical Information System (GIS) technology was not sufficiently developed to produce reliable empirical measures. Not until Partridge et al. (2008a, 2008b) was there a full test of CPT across a broad landscape. They used U.S. county data to consider hundreds of metropolitan areas that are typically separated by rural space, forming a perfect setting for assessing the urban hierarchy's intervening effects on job and population growth. They employed detailed measures of access to the five nearest higher-ordered tiers in the urban

[3]See Myrdal (1957) for early applications and reviews by Richardson (1976) and Gaile (1980).

hierarchy. Their results show that urban proximity has strong intervening effects that act through access to all of the nearest higher-tiered urban areas.[4] Partridge et al. (2008b) also investigated the so-called "distance is dead" hypothesis that enhanced information technology and transportation had slayed the "tyranny of distance." They find that not only is distance not dead, but its effects are actually becoming stronger over time, most likely due to spatial transactions costs (e.g., face-to-face contact) in the expanding service sector. If distance is *more* problematic for rural areas and small cities, there are policy implications for the provision of broadband, transportation, business development, and regional governance.

Hedonic studies further support the notion that distance is a key factor behind spatial variation in wages and housing costs—which ultimately reflects how remoteness affects productivity and quality of life. Defining remoteness as being nonadjacent to a metropolitan area, Wu and Gopinath (2008) find that remoteness accounts for 76% of the expected differences in average wages between the highest and lowest U.S. county quintiles, exceeding the importance of other factors such as amenities and human capital. Partridge et al. (2009, 2010) further confirm that remoteness is a key factor behind wages and housing prices. Partridge et al. (2010) find that most of the distance effects relate to productivity disadvantages (not household effects) and that these disadvantages are rising over time even with new technologies.

NEG models generated significant enthusiasm after Krugman's (1991) seminal work. They capture agglomeration economies and product variety (both as inputs to firms and to consumers) that can lead to core-periphery patterns (Brakman et al., 2009a). Economists are attracted to NEG models because they have explicit micro-foundations, are analytically tractable, and they can explain uneven regional development (World Bank, 2009). For example, Fujita et al. (1999) show how a CPT urban hierarchy could initially form and Tabuchi and Thisse (2011)

[4]Partridge et al. (2008b) find that distance from the nearest metropolitan area of at least 50,000 population leads to an economic penalty. If the nearest metropolitan area is not at least 1.5 million people, there are added penalties for the distance to reach metropolitan areas of at least 250,000 people, to reach metropolitan areas of at least 500,000 people, and to reach metropolitan areas of at least 1.5 million. For a clever application of the attenuation of agglomeration economies *within metropolitan areas*, see Rosenthal and Strange (2008). For applications of how the CPT urban hierarchy affects locale industry composition, see Wensley and Stabler (1998) and Polèse and Shearmur (2004).

show how shocks affect the hierarchy. There are relative few empirical NEG applications, but examples include Brülhart and Koenig (2006) (transition economies), Volpe-Martincus (2010) (Brazil); Redding and Sturm (2008) (Post-War Germany); Brakman et al. (2009b) (European Union); and Hering and Poncet (2010) (China).

NEG has been used to inform regional development policy, often suggesting that traditional place-based policy to support lagging regions is misguided. The World Bank (2009) uses NEG to support its contention that regional policy should be spatially neutral because excessive support of peripheral regions shifts resources from central regions, leading to lower aggregate growth due to lost agglomeration economies. Likewise, providing infrastructure to peripheral regions could actually hurt them because it lowers transportation costs from central regions, allowing central firms to supply peripheral regions, further taking advantage of their agglomeration economies (Puga, 1999). NEG frameworks have also been used to argue that large cities can have higher tax rates, allowing them to capture some of the "agglomeration rents" they provide businesses (Baldwin and Krugman, 2004).

Despite their mathematical elegance, NEG models are criticized for lacking relevance for economic development policymaking. Several strict assumptions are typically employed to make these models solvable including a simplistic production function, iceberg transportation costs, little consideration of institutional factors, and household location preferences that are crude (Partridge, 2010). NEG models often produce knife-edge results in which small parameter changes generate unstable outcomes. Partridge (2010) argues that the patterns uncovered in NEG models have limited applicability in North America, especially when compared to factors such as amenities and human capital. Partridge et al. (2008b, 2009, 2010) find that standard CPT significantly outperforms NEG in explaining U.S. population movement, wages, and land costs. Krugman even notes that NEG models better described American development at the dawn of the 20th Century, not the dawn of the 21st Century, though he argues that contemporary China is a better setting.

3.2 Land Economics and intra-metropolitan area economic development. There are two

workhorse models that economists use to describe urban location theory. First is the Alonso, Mills, Muth Monocentric City Model (MCM) (Alonso, 1964; Mills, 1967; Muth, 1969). The MCM postulates an inverse relationship between land prices and distance to the central business district to compensate for longer commutes, though the rise of polycentric cities has reduced some of its applicability (McDonald and McMillan, 2000). Yet, in a MCM framework, lower transport costs and higher incomes imply an expanding city footprint—or sprawl (Glaeser and Kahn, 2004; Nechyba and Walsh, 2004; Wu, 2010). While sprawl has ambiguous impacts on social welfare (Glaeser and Kahn, 2004), Fallah et al. (2011) find that sprawl is associated with decreased firm productivity, presumably due to diminished agglomeration economies, suggesting businesses are less competitive in sprawling cities.

The Tiebout (1956) model is the second major model describing *intra*-urban location. People "vote with their feet" by sorting to places that offer higher utility on the basis of economic and noneconomic factors. Quality of life and environmental services could be one factor that induces self-sorting within metropolitan areas (Banzhaf and Walsh, 2008). Public finance applications stress intra-metropolitan differences in public services and their tax price.

Self-sorting in the Tiebout model gives communities incentives to use exclusionary zoning to attract the type of residents who will positively contribute toward public service provision. This could lead to equity and efficiency concerns if there is spatial mismatch between the location of workers and jobs (Kain, 1968; Ihlanfeldt and Sjoquist, 1998; Houston, 2005). Namely, zoning (and segregation) may limit affordable housing for lower skilled workers to the central cities, but firms that employ low-skilled workers relocate in the suburbs (Martin, 2004; Stoll, 2006). Blumenberg and Shiki (2004) argue that spatial mismatch may even be more severe in remote rural areas because thin labor markets and longer distances could further reduce employment access for specific skill groups.

Raphael and Stoll (2002) provide evidence that job accessibility for minority workers remains problematic, though it improved during the 1990s. Partridge and Rickman (2008) report indirect evidence that job accessibility is one reason for high poverty in central cities by showing

that job growth has a stronger inverse association with lower poverty in central counties. Conversely, sorting of residents with weak labor market attachment into central cities would have suggested a smaller job growth-poverty linkage. Providing low-skilled households better employment access through providing cars or public transit and finding ways to relocate households closer to employment seems to be sensible as this benefits the workers *and* the employers. Yet, the notion of Tiebout sorting and exclusionary practices by local governments may limit the effectiveness of such policies.

4. Land Use, Quality of Life, and Regional Economic Development

The quality of life afforded by natural amenities has long been recognized as a critical factor in regional growth. An area with high quality of life attracts both working-age adults and retirees (Vias, 1999; Deller et al., 2001; Gunderson et al., 2008; Whisler et al., 2008). In-migration of working-age adults shifts labor supply and the demand for land outwards, reducing the real wage rate through lower nominal wages and/or higher land prices. Firms also may consider the amenity attractiveness of an area in their location decision so as to attract skilled workers (Gottlieb, 1995), and because of preferences of managers or owners for amenity consumption. Retiree in-migration and new firms shift labor demand outward, particularly for workers employed in local service sectors, and increase land prices. Natural amenities especially may attract those with greater human capital, further boosting employment (Shapiro, 2006; McGranahan and Wojan, 2007), wages, and land prices. Whether nominal wages are lower in areas with a high quality of life depends on the balance of these forces in addition to a number of structural characteristics of the local economy (Rappaport, 2008).[5]

As a normal good, the demand for amenities in the United States increased in the 20th century with rising income (Costa and Kahn, 2003; Rappaport, 2007). In fact, argued to be fueled by rising income, increased wealth, and an aging population, Partridge (2010) reports natural amenities as dominating other theories, such as NEG, as the primary reason for U.S.

[5]Rappaport's (2008) model predicts that high quality of life is capitalized much more into land prices than wages. Empirically, Wu and Gopinath (2008) and Rickman and Rickman (2011) find that natural amenities are capitalized much more into housing prices than wages.

regional growth differentials in the latter half of the 20th century.[6] However, although increased demand for amenities increases household willingness to pay higher land prices, the extent it leads to in-migration depends on amenity consumption's elasticity of substitution with non-amenity goods and services; a lower elasticity leads to greater in-migration (Rappaport, 2009).

There are limits to the growth that can be attained in areas with high levels of natural amenities. For one, as amenities become capitalized into wages and land prices, household utility advantages in the region are reduced, causing growth to become more spatially equalized (Partridge et al., 2008a). Even with continued rising income, forward-looking households can lead to capitalization of amenities in the near term, shutting off growth.

Inelastic land supply is one reason for many cities having faster housing price growth and an increasingly right-skewed distribution of income (Gyourko et al., 2006). These cities often have limited land supply because of geographical barriers such as coastlines and mountains, and often enact policies that limit the development of new housing. Many also are places with perceived high levels of natural amenities (Rappaport, 2009).

Yet, if regional policies allow growth to diminish quality of life (Gabriel, Mattey, and Wascher, 2003), negative feedback effects on growth will occur (Chen et al. 2009). Rickman and Rickman (2011) find evidence of within-Census region deterioration of quality of life in nonmetropolitan areas possessing high levels of natural amenities during the 1990s. They conclude that localities should manage growth in ways to reduce negative amenity effects lest both the quality of life and growth be diminished.

Land use affects an area's quality of life through several channels, which is a consideration particularly critical for areas primarily dependent on quality of life for economic growth. Unmanaged growth in high-amenity areas can lead to sprawl, and the associated traffic congestion and pollution (Hansen et al., 2002). There also may be development-related losses in valued attributes such as open space (Vias and Carruthers, 2005; Cho et al. 2008), wildlife and

[6] See Partridge (2010) for discussion of amenity migration studies for other countries.

its diversity (Hansen et al., 2002), the quantity or quality of vegetation and forests (Cho et al., 2009), and scenic views (Benson et al., 1998).

Proximate public lands, land owned by nonprofit organizations, and restrictive zoning may contribute to an area's amenity attractiveness and its economy in some ways, but also may inhibit the economy in other ways (McGranahan, 2008). Henderson and McDaniel (2005) suggest that restrictive zoning in high-amenity areas may be one reason why they found manufacturing growth lagging that of other sectors. Yet, Rickman and Rickman (2011) did not find evidence of changes in land use regulations or reduced productivity affecting population growth in high amenity nonmetropolitan areas during the 1990s.

Lewis, Hunt and Plantinga (2002) find slightly higher net migration rates for counties with more conservation land in the U.S. Northern Forest region but no differences in employment growth. In an evaluation of the Northwest Forest Plan by the U.S. Forest Service, Eichman et al. (2010) find negative employment effects from reduced timber use that are only slightly offset by positive effects of increased in-migration, which contrasts with findings reported in other studies. They attribute the difference in findings in part to the productiveness of the timberland withdrawn from production in the northwest. Rosenberger et al. (2008) conclude that official Wilderness designation did not greatly affect the transition of Appalachian Region counties from being primarily dependent on natural-resource and manufacturing activity to primary dependence on non-labor sources of income and services. In a review of studies on Wilderness designation and local growth, Rosenberger and English (2005) conclude that the link depends on the structure of the local economy and its longer term trend.

Land use in cities also may adversely affect their environmental quality and feedback negatively on growth. City size can be associated with increases in various congestion forces such as crowded roads and increased pollution. Not only city size, but the degree of urban sprawl has often been identified as having a number of adverse environmental impacts (Johnson, 2001; Hasse and Lathrop, 2003; Nechyba and Walsh, 2004). Stone (2008) found sprawl to be associated with the number of times monitored ozone concentrations exceeded the National

Ambient Air Quality Standards across 45 U.S. cities. Other impacts include loss of open space, reduced diversity of wildlife species, increased water pollution, and emission of particulates, significant losses of native vegetation and forests, loss of natural wetlands, blocking of mountain views, and ecosystem fragmentation.

Some studies question the perceived negative relationship between sprawl and environmental quality. Despite growing numbers of higher income households living in suburbs and commuting to work, Kahn and Schwartz (2008) found reduced air pollution in California cities, which they attributed to technological improvements in auto emissions. Although Kahn (2001) found evidence of reduced quality of life in fast-growth California cities, he did not attribute this to air pollution because it had decreased, which suggested other causes such as increased traffic congestion. In surveying research on the dynamics of urban growth and ecological systems in the western world, Czamanski et al. (2008) conclude that "peri-urban" areas associated with sprawl provide ecosystem benefits because of their position between developed urban areas and agricultural lands. In an analysis of the impact on ecosystem services from urban sprawl in San Antonio Texas from 1976-1991, Kreuter et al. (2001) found that despite a dramatic increase in the area of urban land use and reduction in the size of rangelands, the shift of rangelands to woodlands greatly helped limit the loss of ecosystem services. Wu (2006) demonstrates how spatial variation in environmental amenities themselves can contribute to what is perceived as sprawl.

Therefore, an assessment of what constitutes sprawl and how it affects the quality of life is critical for sustainable regional economic development. More research is needed to assess the channels through which land use, growth, and environmental impacts interrelate. How these environmental changes affect perceived quality of life also require further investigation along the lines of hedonic studies of regional differences in quality of life.

5. Fiscal Federalism, Land Use, and Regional Economic Development

The spatial location of economic activity and land use also are affected by regional fiscal and land use policies. Both fiscal and land use policies can affect sprawl and regional economic

development. The complexity of regional economies also makes the policies interdependent, both within and across jurisdictions.

Within the spatial equilibrium framework, variation in state and local fiscal policies has been found to be as important as individual characteristics in explaining wage differentials across U.S. metropolitan areas and to matter as much for metropolitan quality of life as natural amenities (Gyourko and Tracy, 1989, 1991). They also have been found to be important in explaining U.S. nonmetropolitan county wage and land rent differentials, in which some policies primarily affect quality of life, while others affect the business climate (Yu and Rickman, 2011). State and local fiscal policies directly affect quality of life through the taxes that households pay and government services they receive. Likewise, firm profits are affected by taxes and government services. Indirectly, however, local fiscal policies may have spillover effects, affecting economic activity and land use in neighboring jurisdictions.

High taxes and inadequate services in central cities can push economic activity outwards into the suburbs and beyond, creating sprawl. Although there are potential social welfare gains from Tiebout-sorting of individuals according to their preferences for government services, the deconcentration of local government can affect the relative efficiency of the provision of government services, and hence the quality of life and productivity (Matoon, 1995; Innes and Booher, 1999). Public infrastructure exhibiting economies of scale or network effects (Dalenberg et al., 1998) may be underprovided in a deconcentrated environment.

In reviewing the literature, Matoon (1995) lists water and sewerage disposal as most efficiently provided by centralized metropolitan governments, while services such as education are reported as better provided with decentralized government. As discussed earlier in the chapter, increased sprawl can affect the amenity attractiveness in the broader metropolitan area such as through increased air and water pollution. Increased traffic congestion associated with sprawl can affect firm productivity. Therefore, the relative centralization and coordination of local fiscal policies can affect land use and economic development of the broader region.

Using state level data, Akai and Sakata (2002) find measures of local government

expenditures and revenue relative to those for the state to be positively related to growth. In an examination of all U.S. metropolitan areas, Stansel (2005) reports that decentralization increased growth (though state fixed effects are not accounted for and state laws and constitutions set the framework for local governments). In a related study, he found that the negative effect was weaker in the largest 100 metropolitan areas (Stansel, 2002). Hammond and Tosun (2011) examine all U.S. counties, finding that decentralization in metropolitan areas, as measured by increased fragmentation of single-purpose governments, increased employment growth, while reduced revenue centralization increased income growth. In contrast, they find that general purpose government fragmentation reduced population and employment growth in nonmetropolitan counties. They conclude that their varied results suggest that general claims cannot be made regarding fiscal deconcentration and regional growth.

Deconcentration also may occur in land use regulations. Jurisdictions in metropolitan areas with tighter controls push building activity into neighboring jurisdictions possessing fewer controls, which often are positioned at the periphery of the metropolitan area and beyond, creating sprawl (Carruthers, 2003). Mills (2006) argues that Tiebout competition increases jurisdictional competition and reduces inefficient low-density development, a point disputed by Vigdor (2006). Brueckner (2000) argues that urban expansion reflects consumer demands for larger houses and yards, as well as proximity to consumer amenities. If these suburban options are unavailable, this could reduce a metropolitan area's attractiveness to households. Lax land-use regulations and an absence of charging for social costs of development such as damage to ecosystem services also can lead to rural sprawl (Weiler, 2003), which may feedback negatively on growth.

So-called 'smart-growth' policies have been widely enacted to promote sustainable development (Wu, 2006; Braun and Scott, 2007) through increased efficiency of government services and added environmental protection. Yin and Sun (2007) report that metropolitan smart-growth policies increased the population share living in dense areas in the 1990s, while state-level smart-growth policies did not. Wu and Cho (2007) found that local and state land use

restrictions reduced land development in five western states. Boyle and Mohamed (2007) conclude that state, regional, and local attempts to limit urban sprawl in Michigan largely failed. Kline and Alig (1999) conclude that Oregon's land use planning program concentrated development within urban growth boundaries, but the effect on land use in forest and farm land use zones was uncertain. In comparing Portland, Oregon; Orange County, Florida; and Montgomery County, Maryland, Song (2005) reports a long-term increase in population density in residential neighborhoods, which is partly attributed to growth management policies. Yet, reduced external connectivity and a lack of mixed land use are bemoaned, including low access to mass transit.

Glaeser and Kahn (2010) consider the effect on national carbon emissions associated with transportation, home heating and cooling, and electricity use, from spatial variation in local land use restrictions. They suggest that strict land use restrictions in lower emissions areas might cause their economic activity to shift to areas with high emissions. A potential policy recommendation would be to impose federal fees on development in high emission areas.

Overall, a complex relationship exists between fiscal federalism, land use decisions, and economic development. Sustainable economic development at all levels of spatial aggregation requires conceptualizing local and regional economies as complex systems, including land use and economic development policy interactions (Innes and Booher, 1999). The extent of externalities across jurisdictions in a region, state, or nation suggests a need for some government coordination and more government involvement. Considerably more research on the complexity of interactions is needed to inform policymakers regarding government's proper role.

6. Empirically Assessing Economic Development

When assessing economic development, one needs to consider several issues such as (1) firm and household self-sorting; (2) the endogeneity of public policy (e.g., roads are built where policymakers expect future growth or maybe where they do not expect future growth); (3) unobservable factors that are correlated with both the dependent and independent variables that cause endogeneity and omitted variable bias; and (4) sample heterogeneity. The four main

approaches in assessing economic development are CGE models; simulations of theoretical models; instrumental variable (IV)/quasi-experimental approaches; and structural models.[7] CGE models have already been discussed. Brakman et al. (2009a) describe NEG simulations while other simulation approaches are covered elsewhere in this handbook. Thus, we outline the latter two econometric approaches.[8]

Ordinary least squares (OLS) consists of regressing the dependent variable *y* (e.g., population growth) on several explanatory variables **X** (e.g., job growth, taxes).

(1) $y = \boldsymbol{\beta}\mathbf{X} + e,$

in which e is the residual. A key assumption is Cov(e, **X**)= 0, or there is no endogeneity bias. Endogeneity bias can arise from direct reverse causality—e.g., regressing population growth on average wages—which is less of a problem in contemporary work because of improved research design. The more likely cause is omitted variables (unobservables) that are correlated with some of the **X**—e.g., persistent factors such as a good harbor that is correlated with job growth in the population model.

A Hausman test can be used to determine the existence of statistical endogeneity in Equation (1), which requires an instrument(s) *Z* that predicts the potentially endogenous explanatory variable(s) X_1, but *Z* cannot have a causal relationship with *y* (Cov(e, Z) = 0)–i.e., the exclusion restriction. That is, *Z* only influences *y indirectly* through how it affects X_1. It is essential that *Z* be "strong" (Stock and Watson, 2007), or does a good job of predicting X_1 in the first stage. Strong economic rationale and institutional features often are used to find *Z*. For example, a good instrument for interstate highway mileage is how many miles were in the original World War II era military plan for the interstate system (Duranton and Turner, 2011). In

[7]Holmes (2010) also labels reduced-form and descriptive exercises as another approach, noting its limitations for establishing causality. However, Angrist and Pischke (2009, p. 213) describe the inherent value of reduced-form models for careful empirical analysis. We do not separately consider descriptive approaches because the dividing line between IV and reduced-form approaches has greatly blurred.

[8]See Holmes (2010), Angrist and Pischke, (2009), and Stock and Watson (2007) for more econometric details. We do not describe spatial econometric methods because they are well known. In addition, their value has recently been questioned due to specification issues including a lack of theoretical motivation for their use and identification problems. See Overman and Gibbons (2010), McMillan (2010), and Pinske and Slade (2010) for recent critiques.

a population growth model, a good instrument for job growth is the predicted job growth if all of the local area's industries grew at the national rate—i.e., from shift-share analysis (Bartik, 1991). A related question is deciding which variables should be tested for endogeneity. Local economies are general equilibrium systems in which feedback loops are endemic. Good judgment needs to distinguish between statistical endogeneity that biases the coefficients in an economically meaningful way from trivial "endogeneity" that can arise from almost all any variable.

The primary solution for endogeneity is the IV approach (Stock and Watson, 2007). In a careful study of how roads influence driving, Duranton and Turner (2011) use the IV approach. Building a good economic case for their use, 'clever' instruments are developed for contemporary interstate highway mileage: military road plans, early explorer routes, and late 1890s' railroad mileage. Further, they test for the strength of these instruments and illustrate that an instrument can be conditionally valid after accounting for other control variables.[9] Alternative models such as limited information maximum likelihood estimators are used as robustness checks for weak instruments (see Angrist and Pischke, 2009 for related discussion).

Random experiments are the gold standard of empirical assessment, but rarely exist in economic development practice (Holmes, 2010). Quasi-experimental (QE) approaches are used to approximate this setting (Card, 1990). Holmes' (1998) study of business climate is one example. He examined the influence of state business climate on manufacturing employment growth in the border counties between U.S. states with and without right-to-work union laws. The key identifying assumption is that productivity would be the same at the border, in which state policy would be the main factor that causes employment growth to vary. Of course, there could be many other factors that could influence productivity such as historic location of cities. Holmes spent considerable effort in controlling for these persistent factors to strengthen identification.

[9]Duranton and Turner (2011) argue that 19th Century railroads were built for short-term profits and indirectly affect population today by affecting historic population. Thus, controlling for historic population from the early 20th century would remove any correlation of the instrument with the residual—i.e., $Cov(Z, \varepsilon \mid \mathbf{X}) = 0$.

Another QE approach is the difference-in-difference approach (DID) (Stock and Watson, 2007, Chapter 13). One example is Funderberg et al.'s (2010) examination of 1990s era highway expansions in California. They examined population and employment growth in the immediate surrounding census tracts around selected highway projects, comparing this to growth in nearby control tracts. Essentially, in the treatment tracts, they differenced growth in the years after the completion of the road from growth in the years immediately preceding completion. They did the same for the control tracts that did not receive a new project. If the treatment experienced significantly higher growth *after* the project, then the DID would be positive.[10] The identifying assumption is that the main factor affecting trend differences between the two groups is the road construction, a strong assumption. Funderberg et al. (2010) control for other factors that could account for different growth rates between the groups to strengthen their identification. A possible research design weakness is that the control tracts were very close to the treatment tracts. The new roads could shift growth from the treatment to the control tracts, positively biasing the impact of the road construction, which needs to be considered in research design.

Greenstone et al. (2010) (GHM) is an example of the advantages and potential pitfalls of QE design. They examine how large plant openings affect total factor productivity (TFP) of *other manufacturers* in the county with the opening. GHM argue that comparing winning county TFP to that in all other counties would produce biased results due to unobservables.[11] To develop a counterfactual, they compare "winner" county TFP to the runner up or "loser" county's TFP. Loser counties are identified in a monthly article in the trade publication *Site Selection Magazine,* which reported location announcements of large plants. The article lists the "loser" counties that GHM contend "narrowly" lost the competition. GHM's identifying assumption is that the loser county is like the winner county in every economically consequential way, forming

[10]Suppose that the DID window was five years before (period 0) and after (period 1) for employment growth. Then the difference across the two periods for the treated region: $\Delta T = EmpGrowth_1 - EmpGrowth_0$. The analogous can be written for the control region ΔC. The DID estimator is $\Delta T - \Delta C$.

[11]While GHM did not predict the sign of this bias, it seems reasonable that comparing the winning county's TFP to all counties would overstate the TFP effects of a large plant opening because the firm would likely locate in counties with underlying factors that would raise TFP for all firms.

a good counterfactual. GHM employ best-practice DID methodology augmented by time trends, industry dummies, and other plant specific inputs to account for other factors associated with that plant's TFP.

GHM finds that the winner's TFP growth averaged 5% to 12% more than in losing counties. Such strong agglomeration economies far exceed the typical estimates from the agglomeration literature (Rosenthal and Strange, 2004). GHM conclude that these spillovers justify the generous tax incentives offered by local governments to new firms. Yet, in an odd result, when they compared winner TFP to all U.S. counties, they found that all counties had TFP growth that was about 5% greater than the winners, suggesting that either their complete set of DID controls were ineffective (which seems unlikely) or their identifying assumption is suspect.

GHM's identifying assumption does not square with the institutional features of local governments bidding for firms. Profit maximizing firms would not engage in a publically announced bidding war to establish counterfactuals for researchers, but to strategically affect the bidding, possibly creating endogeneity. Take GHM's example of Greenville, SC beating Omaha, NE for a large Mercedes plant in the 1990s. Is Omaha a true counterfactual? It is located far from ports and far from markets and auto suppliers. Indeed, despite "narrowly" losing to Greensville for Mercedes, Omaha has never landed an auto assembly plant? Was Mercedes simply using Omaha to sweeten their deal from Greensville—i.e., "losers" may be more willing to offer large tax incentives to help their economy. Would not a better true counterfactual have been in the Southeast with similar market attributes and low union densities as Greensville? The point is QE studies should engage in robustness checks to assess their experiment. For GHM, a good robustness check would use matching or propensity score approaches.

Another econometric problem is unobservable variables. This is especially problematic when there are unobserved location-specific factors that are correlated with the **X** variables, producing omitted variable bias. If a researcher has pooled-time-series data, they can control for location fixed effects that account for persistent factors associated with the place. When including fixed effects, all cross-sectional differences are in the location fixed effects, meaning

that only within-location time-series variation in the variables is identifying the coefficients.

Including fixed effects, however, does not account for unobserved time-varying effects for the location. Also, if there is measurement error in the **X** variables, then the time-series variation will be increasingly dominated by noise, substantially biasing the coefficients towards zero. Finally, fixed effect models incorporate the very strong assumption that the $\mathbf{X_t}$ variables and the residuals are not only contemporaneously uncorrelated, but $\mathbf{X_t}$ has to be uncorrelated with the residuals across *all* time periods (Wooldridge, 2002). Conversely, first-difference models that net out location fixed effects do not need this strong assumption.

Heterogeneous responses can greatly alter the interpretation of the results. In such cases, locally weighted regression (LWR) approaches (or geographically weighted regression) can estimate different regression coefficients β_i that vary across locations.[12] LWR typically requires a separate regression for each observation on a sample of neighboring observations that is usually determined by proximity. LWRs have gained prominence and have been used to examine factors such as employment density (McMillen, 2004), housing prices (Redfearn, 2009; McMillan and Redfearn, 2010), population growth (Ali et al., 2007), and environmental hazards (Carruthers and Clark, 2010). Ali et al. (2007) and Carruthers and Clark (2010) show how to decompose the variance of the predicted effects into that due to variation in the **X** variables and that due to spatial variation in the regression coefficients.

Structural models use theory to derive identifying restrictions to help establish causality when there are heterogeneous agents (Keane, 2010). Yet, they have only been used at the edge of the economic development literature with most applications occurring in the fields of environmental economics or public finance (see Holmes, 2010; Kuminoff et al., 2010; Chapter xx in this handbook for reviews). If the correct theoretical model is employed, then structural models better inform policy because the underlying causal mechanisms are uncovered. Moreover, they are useful for evaluating non-marginal changes in policies or amenities.

[12]See McMillen (1996) and Fotheringham et al. (2002) for details.

The disadvantage of structural approaches is that the results can be sensitive to the underlying model or functional form of say the utility function (Kuminoff and Jarrah, 2010). Others criticize them for imposing too much structure and not "letting the data speak" (Angrist and Pischke, 2010), though structural proponents argue they are more upfront about explicitly stating the model's assumptions (Keane, 2010). Angrist and Pischke (2010) convincingly argue that another shortcoming is that authors do not subject structural models to sufficient robustness tests of their assumptions.

Structural models require further advances to capture the multiple dimensions of modeling economic development and land use. Modeling of forward-looking household behavior and place of work/place of residence behavior are in its infancy (Kuminoff et al., 2010) and both of these are key features of economic development and land use processes. Likewise, modeling firm behavior is still emerging; thus, the *joint* firm/household decision making that characterizes the special equilibrium approach is another area needing further research for developing structural models.

7. Conclusion and Future Research

The primary theme of this chapter is the need to fully integrate land use in economic development analysis. The complexity of regional economies combined with data and methodological limitations have too often led to piecemeal analysis of regional economic development and land use. Unfortunately, this has resulted in widely varying findings and an incomplete understanding of key issues. Too little is known about the interconnectedness of regional economic development and land use.

We outlined some areas for future research in the chapter but there are other possibilities that warrant mention. We have already noted that sprawl studies typically do not assess the interrelation between land use, regional economic growth, and environmental quality. Likewise, firm location and workplace decisions are understudied within this context. Modeling metropolitan areas or functional economic regions in isolation of the interaction of cities across the entire hierarchy may produce misleading findings as shown by Polèse and Shearmur (2004)

and Partridge et al. (2008a; 2008b; 2009). Likewise, we know little about how structural shocks such as energy shocks, housing bubbles/busts, and economic recessions such as the Great Recession alter the course of land use and local economic development trajectories. The CGE model is one tool that can be further utilized to structurally assess these complex interactions with studies by Burnett et al. (2007) and Cutler and Davies (2007) representing a good first step.

With income inequality reaching very high levels in the United States and elsewhere (Atkinson, et al, 2011), another topic warranting more attention is how land use and its interrelation with economic development affect poverty rates and income inequality. The spatial mismatch literature shows that housing availability and employment access can affect employment outcomes for low-income households. Likewise, land use decisions affect housing costs, which further affect income inequality.

Examining these issues requires better data. More work has been done with micro geo-coded housing data using GIS than with geo-coded firm-level data, though Greenstone et al. (2010) demonstrate the possibilities. Very little research brings both geo-coded firm and household data together, though the planning literature is one exception (e.g., Funderberg et al., 2010).

Combined with the increased availability of GIS and micro data, and improved methods of empirical estimation and modeling, the spatial equilibrium approach offers significant promise for increasing our understanding of the relationship between regional economic development and land use issues. Without a greater understanding of the connection between the two, regional economic development and land use policies may prove to be ineffective or harmful.

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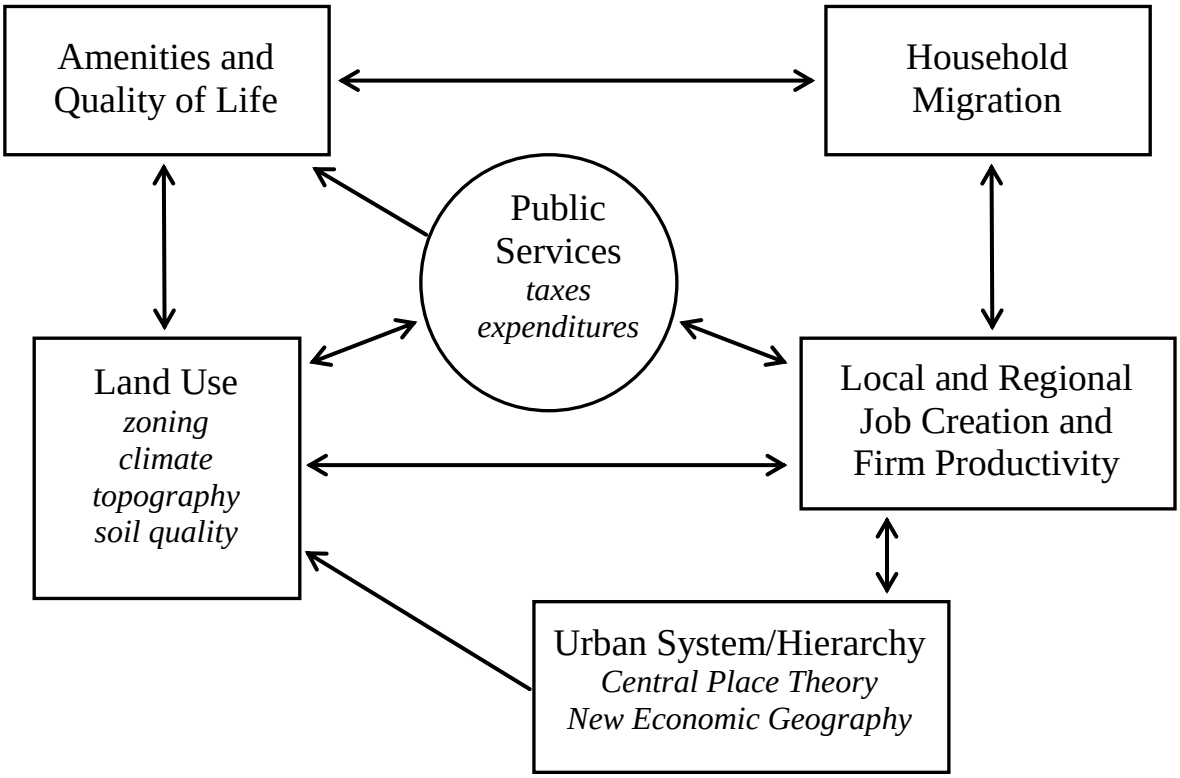
Figure 1: Model of Regional Economic Development with Land Use



Italics are examples