REGIONAL SCIENCE AT SIXTY: TRADITIONAL TOPICS AND NEW DIRECTIONS

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ABSTRACT: This paper addresses international research in regional science—a multidisciplinary field that is now 60 years old. The mainstream research is discussed using six broad categories of analysis: demographic, environmental, location, regional, transportation, and urban. The paper then proposes 14 topics or themes for future research, chosen especially to encourage new or younger scholars to the field. In alphabetical order these are: behavior and heterogeneity, environmental issues, global urbanization, happiness, housing and land use, metropolitan sorting, neighborhood change, networks, nonmetropolitan living, post-event growth and development, regional creativity, regional decline, regional specialisation, and resource inequality. Useful insights to all of these topics likely can be made at different geographic and temporal scales and scholarship might involve a wide variety of research perspectives and methodologies. However, some approaches (e.g., hedonic pricing) and some topics (e.g., strategic government behavior, decline of metropolitan areas) are presently of greater interest to U.S. scholars and it remains unclear whether these will prove to be equally popular elsewhere. The paper also calls for more international research on issues related to spatial welfare and resource inequality.

KEY WORDS: Regional Science, Review, New Directions

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1. INTRODUCTORY REMARKS

The multidisciplinary field of regional science arose 60 years ago because of perceived shortcomings in the social sciences. Walter Isard (1956, p. vii), for one, was dissatisfied that time and especially space were not satisfactorily incorporated into "… a comprehensive theory of society or economy." The sentiment also existed that while economics largely ignored the consequences of space, geography and planning were not sufficiently rigorous in dealing with those matters. Evidently this cleavage still persists: economists favor abstraction, analysis, and generalization; geographers and planners favor description, synthesis, and specificity (Garretson and Martin, 2011).

In the very broadest sense regional science demonstrates how space and location matter in economic development. It is widely known that national development does not occur everywhere at the same time: in fact, it is uneven in space and unbalanced in time. While growth and change do drive a variety of processes like household migration and business expansion, these processes are always embedded—spatially and temporally—in complex webs of local and regional events. Healthy methodological debate has arisen as how best to address the geographic complexity of economic development (Martin and Sunley, 1996; Garretson and Martin, 2010).

As national (regional) development proceeds there are always regional (local) winners and regional (local) losers. These qualitative shifts invariably lead to social and regional tensions and national governments typically choose between competing policies in order to redistribute resources to people and places. State (provincial) and local governments are then strategic in forging their own redistributive policies at lower levels (Bartik, 1991; 2012; Isserman, 1993). With its multidisciplinary approach and its emphasis on both location and linkages, regional science is uniquely positioned to analyze the spatial aspects of economic development. Although there have been some studies of resource distribution advocating a spatial perspective, regional science has not really made the issue of spatial welfare a central concern—at least not in the way advocated by Smith (1977). So there are few studies that trace the likely spatial patterns of costs and benefits that will accompany alternative private or public investments. As for informing different levels of government about the likely spatial outcomes of their

redistributive policies, the voice of regional science has been especially weak.

Evidenced in a growing body of international research and the launching of several new journals, the research of regional science has substantially widened in both approach and scope during recent years. This has occurred, in part, because scholars are not so tied to the paradigms and methods that dominated the inquiry of earlier decades. At the same time the core research of the field has become increasingly focused on cities and complex urban issues; a notable example is Glaeser (2011). In light of recent global events—which have disrupted lives and created many uncertainties—now seems an especially opportune time to examine the main perspectives and topics of research in regional science. The first part of this paper gives a summary of the most enduring research traditions in the field. This serves as a foundation for the second half of the paper, which provides a selective list of some of the more promising directions for new inquiry in the field.

The mainstream research to date is seen to be spread across six overlapping areas of analysis: (i) demographic, (ii) environmental, (iii) location, (iv) regional, (v) transportation, and (vi) urban. Various methods and tools have been developed over the years to assist in or sharpen the inquiry of scholars (Isard, 1960; Nijkamp, 1979; Oppenheim, 1980; Isard *et al*., 1998; Tong and Murray, 2012). Wide-ranging conceptual and technical advances have also been made in spatial statistics and spatial econometrics, whose contributions are subsumed in this paper under the six topical areas identified above (Berry and Marble, 1968; Paelinck and Klaassen, 1979; Anselin, 1988; LeSage and Pace, 2009; Charlton and Fotheringham, 2009). Notable planning and policy studies, especially in development planning, have also contributed to the substance of these six broad areas of inquiry (Friedmann and Alonso, 1964; Dear and Scott, 1981; Nijkamp and Rietveld, 1984; Puga, 2002; Barca *et al*., 2012).

2. TRADITIONAL TOPICS

Demographic Analysis

Population studies, while commonplace in regional science, have perhaps been underappreciated. Some of the earliest work focused on formulating

simple population projections but this changed in the 1960s when regional accounting systems were adapted from mathematical demography and larger data sets became more accessible (Keyfitz and Caswell, 2005). In particular, the cohort survival approach was adopted so that matrix algebra could be used to forecast interregional population growth and distribution (Rogers, 1970). Advanced work led to speculation about the properties of stable solutions for the future populations of interconnected regions. Moreover, in those early years rather simple gravity models were designed to estimate migration flows between large geographic units like states or provinces (Isard, 1960). The Lowry (1966) model, which examined intercity migration flows, was an important exception that introduced wages and unemployment rates into the 'mass' variables of the usual model.

In later years demographic change was especially recognized to be important by practitioners forecasting the behaviors of regional labour markets, especially when those areas had been impacted by large private or public investments (Chalmers and Anderson, 1977). A demographic module typically generated labour supply, an economic base or input-output model generated labour demand, and future in- or out-migration was determined by the projected gap between supply and demand (Isserman, 1986). These sorts of models are still very applicable to frontier or boomtown development today. But the deeper appreciation of population change also clarified the need for more endogeneity to be brought into regional econometric models (West, 1986).

Without doubt, though, the study of intraregional mobility and interregional migration are the two demographic topics that really stand out in the regional science literature (Plane and Rogerson, 1994). The latter subject is especially notable for pitting disequilibrium and equilibrium approaches against one another. Disequilibrium models are based on the standard assumption that high-wage, low-unemployment regions normally attract migrants from low-wage, high-unemployment regions until the properties of the two labour markets converge. At the same time, migrants are expected to invest in their human capital and move to those regions providing the largest present value of net benefits over their lives (Sjaastad, 1962). Equilibrium models, on the other hand, are based on the idea of amenity compensation (see below) where migrants are indifferent between low wage, high-amenity locations and high-wage, low-amenity locations. Early work was done on disequilibrium models

by Greenwood (1969) and on equilibrium models by Graves (1980) and substantial reconciliation was eventually reached in Mueser and Graves (1995). Over a three decade study period, amenities were shown to have a fairly steady effect on moves between U.S. cities but changing regional fortunes induced periodic ebbs and flows in employment-related moves.

In recent times, two migration-related topics have become especially popular. First, there is now wide appreciation of the various impacts of international migration on both sender and receiver nations (Collier, 2013). Immigrants are known to affect total factor productivity in the major cities of receiving nations and they also bring great heterogeneity in their talents, including entrepreneurship (Ottaviano and Peri, 2013). Second, regional scientists have become increasingly interested in the role that human capital plays in affecting the economic fortunes of regions (Storper and Scott, 2009; Scott, 2010). In the U.S., Whisler *et al*. (2008) have identified cities that have been especially attractive to knowledge workers and, in doing so, have shown how preferences appear to change with the life cycle of households. Other work in the U.K. has tied this interregional movement of human capital to significant changes in the regional patterns of innovation (Faggian and McCann, 2006).

It is surprising, though, that regional science has been slow to comment on some of the most important demographic shifts of the day. First, national fertility rates have fallen in many areas but it remains unclear whether the space-time patterns of those declines are related more to the intergenerational erosion of traditional values or to neighborhood effects among the regions of those nations (Waldorf and Franklin, 2002). Second, all well-developed nations are facing the prospects of an ageing population but it remains unclear what the likely regional implications of this process will be. Or, to phrase the issue differently, it is uncertain if today's high levels of urbanisation will be nudged even higher given the strong big-city preferences shown by many retired households at the present moment (see below).

Environmental Analysis

Regional science arose at about the same time that people first became concerned about resource-based 'limits to growth' and began asking questions about the regenerative capacity of the natural environment. A sense

of the progressive environmental thought of the 1960s and early 1970s, especially as it concerns cities, can be found in Berry and Horton (1974). Here the editors mention that many resource issues could no longer be addressed by traditional economy theory because of pricing misallocations, spillovers, and conflicts over ownership. Sections of the book dealt with such emerging issues as urban heat islands, water runoff due to land use change, and the air quality of major U.S. cities. Regional scientists of the day also made important contributions to the study of exhaustible resources. Here Copes (1970) was notable for pointing out that the supply curve could be backward-bending for common-area resources like open access fisheries: a minor shift in demand could lead to a serious degree of overproduction, a result that eventually reduces sustained yield and increases price.

During this same time period other regional scientists—most notably Charles Leven and William Miernyk—commonly made use of Leontief's input-output model when analyzing the economic impacts of environmental change. First a study region like a river basin or a depressed area was identified, sub-regions were established by political or physiographic criteria, and region-wide impacts were estimated for proposed sub-regional changes in activities like energy production or recreation. Later in the 1970s, when Miernyk's interests had turned to studying rising energy costs, he identified those U.S. states that were likely to be winners and losers as the demand for coal substantially rose (Miernyk, 1976). At the same time Isard (1969), who had earlier experiences with atomic energy, began to recognize various 'ecological' factors in input-output analysis. Interprocess coefficients were calculated to complement the usual intersector coefficients of the regional accounts matrix, other coefficients were devised to link the ecology and economy, and then both 'goods' and 'bads' were considered in the analysis. At the same time Isard brought his abiding interest in conflict studies to shed light on resolving multi-level environmental management problems. Intraregional agencies might have internal conflicts between risky (or polluting) low-cost and non-risky (non-polluting) high-cost energy developments at a lower level but interregional agencies might have external conflicts arising from the spillovers of risky (polluting) behavior at a higher level (Isard *et al*., 1976). While this research indicated the regional and interregional impacts that would follow from substantial changes in the natural environment, it is disappointing that the methods were not widely

used to evaluate the welfare outcomes of different policy-related scenarios. Surely some sort of cost-benefit analysis could have been devised to rank the different spatial outcomes arising from injections of new economic activity.

The research of the middle decades refined many of these important ideas (Lakshmanan and Bolton, 1986). Borrowing ideas from public economics, energy markets were seen to affect people both as producers and as consumers so attempts were made to establish general equilibrium models. Here negative externalities, including unpriced withdrawals taken from the environment, were increasingly recognized to be important factors (Ayres and Kneese, 1969). But practical solutions only came later with the advent of computable general equilibrium models (Rose, 1995). In energy production some analysts especially focused on who earned rents from the various inputs involved in resource extraction and conversion. Put bluntly, were non-residents sometimes escaping taxes and thereby depriving residents of the localized benefits of public goods and services? There was also recognition that people working in occupations not closely related to local energy production might suffer because of rising local prices—especially for housing (Helliwell, 1981).

By the 1990s much interest had turned to how environmental quality is generally tied to regional or national economic development (Kahn, 2006). Here the Environmental Kuznets Curve has often been invoked by those claiming that development actually decreases pollution because, as their incomes rise, households shift their demands from lower-quality manufactured goods to higher-quality goods and services (Dasgupta *et al*., 2002). However, there are still many skeptics contending that growth in general degrades the natural environment.

Regional scientists have also shown an abiding interest in how environmental conditions affect other aspects of local and regional development. While much of this analysis has involved hedonic analysis (see below), there have been other important studies that are notable. Power (1996), for one, has argued that *place* itself often has significant value and has persuasively called for an environmental view of the local or regional export base. In post-industrial societies many households are both affluent and mobile, so they can bring significant non-earnings income into those places that have either pristine environments or historic relevance. The work of McGranahan (1999) is also notable because, in studying the factors that drive U.S. urban-to-rural migration, he computed county-level natural

amenity scores for most of the nation's counties. These standard scores, based on six separate sub-indices, have been used in many other studies that highlight the role of natural amenities in the behavior of economic agents.

Most regional scientists today seem to espouse some version of smart environmentalism (Glaeser, 2011). Here adopted policies, especially in highly urbanized societies, have included housing densification and carbon emission taxes. Since public choices always involve a mix of penalties and incentives, regional scientists are nicely positioned to clarify the spatial consequences of such new programs. So when densification policies are challenged residential development typically moves to the urban fringe, with the unintended consequence of creating even more sprawl and inducing even longer commuting times. At the same time, new emission taxes must be balanced by a public commitment to give back energy dividends that favor the poor more than the rich.

Location Analysis

Regional scientists use the central themes of location theory—location rent, cost minimization, spatial demand, and hierarchical organisation—to explain the ever-changing location patterns of economic activities. From the early days, people like Edgar Hoover (1948) were clearly aware that different industries had distinctive location patterns that were sometimes determined by a wide variety of factors. Moreover, there was realization that those patterns were ever-evolving and that public policy could either reinforce or disturb those industry patterns.

Theoretical research in those early days, led by Martin Beckmann, involved modernizing, extending, and testing the seminal ideas of the German School (Beckmann, 1968; Dean *et al*., 1970). Some important work was focused on establishing the equilibrium properties of spatial economic systems by using the techniques developed in operations research (Takayama and Judge, 1971). But after the summary of August Lösch's thinking that was provided by Valavanis (1955), most interest was focused on three interrelated topics: (internal) economies of scale, transportation costs, and agriculture's need for land. Comparative cost studies and variable cost analysis emerged as regional scientists grew to appreciate the complex and pervasive role that space plays in affecting the decisions of economic agents (Smith, 1971). A huge literature

has arisen since that time where most theoretical inquiry has assumed one of three emphases or perspectives: location heterogeneity, including uneven resources; externality models, with endogenous growth; and imperfect markets (Fujita and Thisse, 2002).

Some of the most interesting work of the middle years took advantage of the advances that were being made in the New Industrial Economics, where analytical interest focused on issues like barriers to entry, firm integration and disintegration, and network externalities (Shy, 1995). During this period the issue of spatial agglomeration arose to be the key focus of many studies. Borrowing ideas from both Alfred Weber (least cost theory) and Alfred Marshall (industrial districts), theoretical regional scientists made great efforts to explain why firms and households densely co-locate in space. As for firms, special attempts were made to sharpen the somewhat vague concepts like localization and urbanisation economies that were often used (Puga, 2010). In the end, analysts established that 'savings from proximity' arise especially from knowledge spillovers, cheaper and more available intermediate inputs, and better matching in labour markets (Rosenthal and Strange, 2001).

At about the same time cluster analysis, championed by Porter (1990; 1998), was widely adopted by practitioners to address the complex issues—product strategy, business rivalry, integration and value chains, and new technology—that firms deal with in highly competitive business environments. Much like the literature on growth poles in an earlier day, the idea of functional clusters soon led to the complementary notion of location clusters. While the success stories of the zaibatsu in Japan and the craft industries of the Third Italy were lauded in the earliest studies, a certain amount of selection bias was seen to be evident in many analyses. Nevertheless regional clusters continue to be the focus of many case studies, in metropolitan and non-metropolitan areas alike, and the cluster idea continues to inform policy-related research around the world.

Other subject areas stressing location decisions that arose to special prominence during this time period were spatial competition and public facility location. Spatial competition, which once informed the retailing literature, identifies market outcomes that arise when the price and location decisions of private agents are interdependent (Beckmann and Thisse, 1986; Norman, 1986). Conjectural variations, developed for oligopoly models, were first applied to pricing and (sometimes) location decisions but this

approach was eventually replaced by two-stage strategic games. But in recent times this literature has become very concerned with matters like asymmetric information and search costs (Biscaia and Mota, 2013). In fact, the contribution of spatial competition studies to regional science has diminished in recent decades, in large part because the analysis has become so focused on the behavior of a small number of firms in highly stylized settings. So, to this day, we have little understanding of how concentrations of retail firms set their prices and locations in complex, urban environments. This shortcoming is even more pronounced in multi-good markets, where evidence exists that firms cannot easily re-create their different-sized market areas whenever their initial spatial equilibrium is disturbed (Eaton and Lipsey, 1976).

Public facility location, in various guises, has remained a popular subject for numerous decades. Most of the early work identified the different location solutions that would arise when decision-makers optimized while using alternative criteria like efficiency or equity (Massam, 1975). Later work incorporated multiple criteria into that decision-making and even allowed the underlying motivations of agents to vary (Ghosh and Rushton, 1987; ReVelle, 1987). More recently still, research has used GIS technologies to identify the best solutions for servicing spatially continuous populations, such as work-related transit users, as opposed to servicing discrete population groups that are located on networks (Murray, 2010). However, this literature has moved ahead much farther in computation than in citizen participation: it seems only limited progress has been made in allowing potential users to 'share responsibility' in deciding the placing of new public facilities or the delivery of new public goods (Massam, 1993).

Regional Analysis

Other scholars in regional science have focused more on understanding regional economic growth, the spread or transmission of this growth over space, and the complexities of interregional relationships (Isard, 1960; McKee *et al*., 1970; Hewings, 1977; Nijkamp, 1986; Armstrong and Taylor, 1993; Capello and Nijkamp, 2009). Much of the early research involved use of either the economic (export) base or the input-output model (Tiebout, 1962; Polenske, 1981; Miller and Blair, 1985; Hewings and Jensen, 1986).

Significant improvements were made along both applied (e.g., survey techniques, shortcut methods) and theoretical lines (e.g., interregional feedbacks) and both approaches have remained very popular to the present time (Lahr and Dietzenbacher, 2001; Oosterhaven and Polenske, 2009; Kilkenny and Partridge, 2009). Other early research often made use of the product life cycle: a notion that helps explain the geographic diffusion of new ideas, products, and processes, especially in manufacturing where increasingly routine processes could seek out those areas having increasingly cheaper labour (Norton and Rees, 1979; Markusen, 1985). Later research often questioned the restrictive features of those models and a number of alternatives resulted, including multi-equation econometric models for forecasting the performances of regional labour markets and computable general equilibrium models for capturing scale economies in regional production (Bennett, 1979; Adams and Glickman, 1980; West and Fullerton, 1996).

However, by the 1980s there was a growing interest in the role of increasing returns in regional development (Arthur, 1994). Here the ideas of Krugman (1991) on the geographic concentration of production proved to be a game changer. Illustrating many of his ideas with only two interacting regions, he demonstrated that regions could enjoy long periods of economic stability but could then experience very sudden change. Once his argument was assimilated by other regional scientists a stream of research arose that led to both Geographical Economics and the New Economic Geography (Martin, 1999; Brakman *et al*., 2001). Soon these same ideas informed much new thought in urban analysis (see below).

But other influential approaches to studying regional change also arose. First, fresh perspectives were offered by people like Markusen (1996) who noted how the business patterns of post-industrialism were often qualitatively different from those of industrialism. Second, the autoregressive time-series approach was adopted to construct regional adjustment models, an approach that often exposes biases in simplistic cause-and-effect models addressing employment, population, or land use change (Carlino and Mills, 1987; Vias and Carruthers, 2005). Third, numerous studies after Barro (1991), especially in Europe, have examined the issue of regional convergence (Tondl, 2001; Beugelsdijk, 2003). Moreover, regional analysis in general has really benefitted from the advances made in spatial econometrics, as notable cross-regional features— like income gradients or population spillovers—can now

be accounted for in appropriate specifications (Rey and Montouri, 1999; Fingleton and López-Bazo, 2006).

Transportation Analysis

Transportation studies, addressing the movement of people, information, and goods both within and between regions, have also enjoyed a long history in regional science (Boyce *et al*., 1970; Batten and Boyce, 1986; Taaffe *et al*., 1996). During the 1950s and 1960s there was much optimism about public transportation and regional scientists assisted in formulating a variety of comprehensive, multi-modal transportation plans for metropolitan regions (Meyer *et al*., 1965). At the same time, other efforts were made to develop place-to-place interaction models, often making use of concepts taken directly from physics (Wilson 1970; Batty, 1976; Fotheringham, 1983; Sen and Smith, 1995). More complicated trip-generation and trip-assignment models were devised to forecast either commuter movements within the metropolitan region or household migration among metropolitan regions. But clearly the most powerful theoretical insights of those early days were provided by Beckmann again who helped lay the foundations both for network equilibrium models and continuous traffic flow models (Beckmann and Puu, 1990; Puu, 2003; Boyce, 2012).

Transportation is central to regional science because link- or modal-specific rate changes and system-wide modifications will always favour some areas or locations over others. In the short run, major transportation projects will induce a lot of local activity that in turn can stimulate other local economies through regional or interregional purchases (Rephann and Isserman, 1994). More important, though, in the long run some regions are conferred with new competitive advantages as they become more accessible either to international or national suppliers and markets. This is particularly true in the U.S. where non-metropolitan growth has been shown to be dependent upon distances to larger metropolitan centers (Partridge *et al*., 2009). Transportation improvements also have important implications for the intraurban movement of goods and people. In fact, Glaeser and Kolhase (2003) have even suggested that changing urban morphology has been largely determined by the ability to reduce transportation costs, especially for goods. System-wide transportation changes typically reconfigure

metropolitan traffic flows, thereby shifting land use changes across the city and in turn inducing new location-specific pressures on the upgraded infrastructure (Bollinger and Ihlanfeldt, 1997).

Regional scientists have made important contributions to other aspects of transportation studies. First, traffic congestion has long been recognized as a severe problem; in fact Vickrey (1963) proposed a half-century ago that pricing was more wasteful in urban transportation than in any other area of human activity. Arnott and Small (1994), adopting the Pigovian paradox where individual travelers are forced to bear the costs they impose on others, have shown that sound congestion solutions require that planners understand the full range of decisions being made by commuters. Second, regional scientists were among the first to adopt random utility or discrete choice models to address user choices when commuters are presented with modal alternatives (McFadden, 1977; Ben-Akiva and Lerman, 1985). These models have also proven very useful in such diverse areas as freight shipping, retailing, and household migration, all instances where users must make decisions in complex, information-rich environments (Timmermans and Golledge, 1990). And, third, geographers have been particularly active in adopting GIS and geocomputational techniques to address network-based traffic problems, particularly those where stakeholders must make decisions about the best articulation of possible land uses with infrastructure alternatives (Fischer and Leung, 2001; Miller and Shaw, 2001).

Urban Analysis

As the world has become progressively urbanized it is not surprising that regional scientists have devoted more and more attention to urban issues over the past 60 years. Early contributions to understanding the internal features of cities were made by a variety of social scientists (Leahy *et al*., 1970; Bourne, 1971; Edel and Rothenburg, 1972). Following the insights of William Alonso (1964), a powerful microeconomic theory was outlined that explained land use patterns and population densities within the monocentric city (Henderson, 1985; Mills, 1987; Anas *et al*., 1998; Cheshire and Mills, 1999). This literature spawned much work on housing markets and eventually brought ideas from real estate economics into mainstream regional science (DiPasquale and Wheaton, 1996). Another key early idea was sketched out

by Charles Tiebout who saw that differences in public goods provision had wide implications for understanding urban-suburban welfare gaps, urban mobility rates, municipal finance problems, and metropolitan fragmentation (Tiebout, 1956). He recognized that large cities were being continuously refashioned as better informed and richer households enjoyed options to move to those jurisdictions that would maximize their net benefits (see below). At the same time, the complex social organisation of the metropolis was being clarified by a variety of social area and factor-ecologic studies (Berry and Kasarda, 1977). A fundamental finding here was that urban neighborhoods exhibited significant variation in socioeconomic status, family status (life cycle), and ethnicity. As a result, the city was shown to be a lot more complicated—demographically, sociologically, and spatially—than what was being depicted and analyzed in microeconomic urban models.

As for city systems, regional scientists also shed early light on a number of issues (Bourne and Simmons, 1978). Geographers did a lot of work on economic (functional) specialisation but this research was poorly integrated with other ideas about growth possibilities or cyclical instability in urban economies. There was also much discussion, often by planners, about optimality in city size but this was muted after a paper by Mera (1973) suggesting that cities could never be too large. Moreover, there was wide study of central place systems, often focusing on consumer behavior and sometimes on hierarchies, and the results here clearly demonstrated the merit and wide applicability of the ideas developed by the German School (Berry and Parr, 1988).

Economists have recently come to dominate the urban research of regional science, especially with the emergence of the New Economic Geography. In large part this has occurred because of the overwhelming success of the Fujita-Krugman-Venables paradigm, which highlights increasing returns and endorses circular-and-cumulative growth (Fujita *et al*., 1999; Combes *et al*., 2008). Here even new cities can emerge and older cities can rapidly decline when conditions of extrinsic dynamics (slow-moving population growth) meet with conditions of intrinsic dynamics (fast-moving wage-driven migration) The theory also provides a formal explanation for why ports, transportation hubs, and other places having initial advantages turn into major cities.

But, as a series of edited and special volumes attest, many other urban topics either became or remained very popular in regional science (Capello and Nijkamp, 2004; Henderson and Thisse, 2004; Arnott and McMillen, 2006). This list includes, but certainly is not restricted to, the following: morphology (Gordon and Richardson, 1996); land-use regulation (Huang and Tang, 2012); finance and governance (Haughwout and Inman, 2002); spatial mismatches in labour markets (Ihlanfeldt, 2006); primacy (Moomaw and Shatter, 1996); and quality of life (Gyourko and Tracy, 1991). Several of these urban topics are addressed in the second part of the paper.

3. NEW DIRECTIONS

This longer second part of the paper identifies 14 areas of research that seem especially promising for especially young regional scientists to pursue at the present time. More mature scholars, for reasons related to temperament, training, or career path, might prefer to continue pursuing some of the traditional themes outlined above. Most of these new areas involve two or more of these traditional topics and, moreover, each area has been identified because it involves analytical, empirical, and policy dimensions.

Behavior and Heterogeneity

After Simon (1955) many social scientists became suspicious of the very strong Rational Man assumptions adopted in mainstream economics. Particular concerns were raised about every agent having the same information base and the same ability to use that information. Only limited efforts have been made to outline the consequences of non-optimizing behavior and to identify the implications of agent heterogeneity.

Regional science could identify satisfactory alternatives to the optimal solutions typically found in location and transportation models. In land-use studies, for example, programming models assign parcels of land to their highest and best uses and the assignments are usually compared to real-world patterns (Hanink and Cromley, 1998). But the constraints on these models could be relaxed to determine alternative land-use assignments that would be approximately optimal. Using this approach, along with numerous simulations, analysts could identify parcels that are fit for single uses and (competitive) parcels that are fit for multiple uses. Along similar lines, one or

more constraints of location-allocation models could be progressively changed in order to identify those sites that are approximately optimal for public facilities like fire stations, schools, and the like. Sites actually available for development could then be matched to sites repeatedly targeted as being quasi-optimal as the constraints were progressively relaxed, and a set of highly satisfactory sites could be identified. Likewise, in transportation studies, more attention could be given to identifying the 2nd, 3rd, and *n*th best shortest-path solutions when addressing the travel choices made by commuters or shoppers. In this way it should be possibly to identify, after aggregation across all users, those choke points that will most likely arise in transportation networks due to users practicing sub-optimal travel behavior. This approach might have especially useful implications for understanding the effects of diurnal congestion on travel behavior.

The heterogeneity existing among agents should also be recognized to a greater extent. In shopping studies, for example, households exhibit significant variation in such attributes as age, gender, size, and disposable income (Mulligan, 2012). Adopting a representative household certainly assists in generating optimal solutions to shopping problems but these solutions are of limited value when trying to make sense of choices made in dense, urban retail environments. At the very least, these models must recognize that separate markets can be comprised of households with very different attributes. So, when attributes like user age shift over time, the behaviors of retail firms will also shift in response. The same is true for locating multi-use public facilities where public needs shift over time as the demographic bases of the surrounding communities or neighborhoods evolve.

In fact, regional science could really benefit from new microeconomic models that recognize the implications of time in a much wider sense. Existing models emphasize time discounting of resource values but, unfortunately, say very little that is useful about how preferences change over the lifetime of the individual or household. Econometric models for housing and transportation work because they address a cross-section of different users but these models have little merit from the perspective of individual users changing their demand patterns over time. As a result, urban theory especially suffers because the microeconomics of ageing households has not been clarified. In past times the young household first lived near the city center, moved to the suburbs to raise its children, and then returned to the

city when ageing took place. Today, however, many individuals and couples simply bypass this stylized pattern that was once recognized as family status in a litany of factor ecologies (see below). So a new theory of urban choice is needed to account for the aggregate effects of the various time-specific decisions being made by both traditional and non-traditional households.

Finally, as is well known, there are other approaches to decision-making that regional scientists should consider. Many behavioral studies distinguish between decisions that involve retaining the status quo and those that involve accepting an alternative (Kahneman, 2011). Here Thaler (1980) clarified that an 'endowment effect' occurs whenever agents are considering parting with assets that they presently own. Consequently buying and selling prices, adjusted for transaction costs, do not always equate in markets. The ideas of Kahneman and Tversky (2000), especially in prospect theory, would seem to have many implications for spatial decision-making, especially those involving commuting, shopping, and migration. Moreover, loss aversion promotes individual and systemic behavioral stability, and clearly accounts for some of the mismatches that are constantly recognized in intra- and inter-regional labour markets.

Environmental Issues

Quality-of-life studies have enjoyed a substantial revival of popularity in recent years (Mulligan *et al*., 2004; Carruthers and Mundy, 2006; Marans and Stimson, 2012). In part, this has been due to the fact that regional scientists have increasingly noticed the effect of environmental quality on the spatial choices made by households and businesses. Here the hedonic approach has been adopted to estimate the marginal compensation given to households for the presence or absence of amenities in their living and working environments (Albouy, 2008). A first-generation model was used by Costa and Kahn (2003) to estimate how people in the U.S. valuate local public goods. This approach estimates wages (controlled for worker attributes) and house prices (controlled for housing characteristics) separately where both equations include a vector of public goods that has both natural and human-created amenities. Here climate represents all metropolitan area non-market goods and, in a series of four estimates taken between 1970 and 1999, households are shown to place a heavier and heavier emphasis on climate in their preferences. In terms of housing costs, Kahn (2006) claims that people

in 1970 would pay an extra $1300, whereas people in 1990 would pay an extra $7500 (in 1990 dollars), to purchase San Francisco's moderate climate instead of Chicago's more severe climate.

However, a second-generation hedonic model, one that uses the regression residuals from a single equation tying housing costs to household income and amenities, is a lot more flexible and somewhat easier to interpret (Glaeser *et al*., 2001; Carruthers and Mulligan, 2006). In a recent study of the contiguous U.S. counties, Carruthers and Mulligan (2012) showed, in the aggregate, that natural amenities were increasingly valuated while human-created amenities were decreasingly valuated between 1980 and 2000. But, during this time period, households were also clearly exerting more and more demand for certain areas with high levels of human-created human amenities, especially near the national capital.

While regional science has given a fair amount of thought to quality-of-life issues, it is clear that there is room for more international research on well-being that can use already existing methodologies (Maddison and Bigano, 2003). Moreover, as already mentioned, there is a need for more historical or longitudinal studies at a variety of geographic scales. Indicator-based studies suggest that there will be winners and losers over time among the individual observations but that discernible regional trends will emerge. How these regional winners and losers will change with increased climatic volatility is also uncertain at this time. Moreover, as Kahn (2006) argues, there is a clear need to introduce more demographic heterogeneity into the various hedonic estimates. Obviously different-sized families will be willing to pay different amounts for a given array of natural and human-created amenities (public goods): here the expenditure patterns for young singles will be very different from those for senior couples.

Much recent quality-of-life research has turned to the issue of location-specific environmental degradation. Particular interest has focused on the spatial hedonics of disamenities, a literature stream that began in the 1990s. Here Freeman (2003) has pointed out that because environmental quality is not traded in conventional markets, the willingness to pay for it can not be measured directly but must be estimated. A persisting problem deals with identifying appropriate demand equations where price and quantity are endogenously determined; Carruthers and Clark (2010) outline a detailed study of environmental hazards in greater Seattle, where the negative price

elasticity for these hazards depends upon the type of hazard and the distance form the hazard. The findings, which endorse those of Brasington and Hite (2005), indicate that households are very sensitive to hazards only at close distances. All types of hazards appear to be normal goods so richer people will distance themselves from all types, although each type of hazard can be ranked for its effects on price and income elasticities.

A very different approach to studying hazardous sites has been taken in the facility location literature since the 1970s. Here the noxious site problem falls under the more general topic of facility dispersion, which has its roots in central pace theory, and addresses the sites of a number of other activities like military bases and unpopular franchises in retailing. The early literature was consolidated in the analysis by Erkut and Neuman (1989) and the newer literature was re-examined in Curtin and Church (2006). Basically, a number of different technical rules have been established for locating new facilities—such as maximizing the minimum inter-facility distance—where each rule has certain advantages and disadvantages. The literature now parallels that for establishing spatial weights matrices in that the analyst always has tradeoffs to consider, including the number of neighbors and the nature of activities, when examining local or regional spatial structures (Lei and Church, 2013). More research could clearly be devoted to solving dispersion problems where new facilities enter, and old ones exit, in the face of current expectations about changing levels of environmental hazards.

A clearer analytical understanding of the geographic implications of climate change is also needed. Land use has been a concern to regional science since its inception but now, since the call for a land change science by Turner *et al*. (2007), more spillovers and interdependencies of a spatial nature must be recognized in the current transformation of the earth's surface. So the various costs and benefits discussed by Nordhaus (2013), and others, must be understood to be location-specific costs and benefits. Regional science has the unique ability to consider the actions of agents found at different locations and then, through various markets, demonstrate the expected aggregate spatial outcomes of their actions. One interesting approach, adopted by Walker (2014), makes use of the traditional Thünen location rent model in discussing two land change effects that have been recently witnessed in the Amazon Basin (Faminow, 1998). On the one hand, mechanized crops have displaced cattle which in turn have been moved to the forest frontier; on the other hand, there are a few instances where improved

technologies have enhanced crop production enough to allow agricultural land to be released back to native vegetation. Evidently indirect land use change (the first effect) has contributed a lot to the deforestation that has occurred in Amazonia where sugarcane and soybeans first encroached on "intensive" cattle, but then "extensive" cattle continued to flourish with the continuance of high international prices for beef. Given this substitution of fertile land for marginal land, Walker is not at all optimistic that market signals will change soon enough to allow sufficient land to be spared (the second effect) and returned to traditional forests. Clearly this line of analytical research could and should be extended in various ways. Useful insights could be gained from a two-party trade model where the land use decisions in a temperate nation and those in a tropical nation are connected. As per capita incomes, urban populations, and tastes were changed in both nations, but at different rates, future land use allocations could be simulated and policy alternatives—having both national and global implications—could be evaluated.

Global Urbanisation

There are numerous areas of research where regional science could improve our understanding of the widespread urbanisation now taking place around the world. As nicely explained in the Harris-Todaro model, most migrants move to the formal sector of cities to raise the level or certainty of their wages. In recent times this migration has become of great interest because, to many observers, urbanisation constitutes a critical component of national economic development (Ravallion, 2002; 2007). Smart urban policies, including land titling and better public infrastructure, should improve the lives of both urban and rural residents in the world's emerging economies.

While S-shaped urbanisation curves have been analyzed and much discussed, using either historical or contemporary data, surprisingly little attention has been given to the estimation of regional urbanisation curves (Mulligan, 2013). At the very least regional rates of urbanisation must be adjusted to account for spatial dependency, although (like other similar spatial processes) the underlying factors driving logistic change could be either simple propinquity or other location-specific attributes (cultural values,

etc.). In fact, with the world now 50% urbanized, more attention could be given to all parts of the urbanisation curve. In the poorer nations, like India, it is unclear how having limited urban options (including few intermediate-sized cities) affects changes in urbanisation rates along the lower tail; in the richer nations, like Japan, it is still somewhat unclear how the physical margins to *ecumene* affect changes in urbanisation rates along the upper tail. In any case, there will be somewhat different upper limits to urbanisation attained in different regions and nations, and the identification of these upper limits would be a worthwhile pursuit along both theoretical and applied lines. At the very least different regions and nations will belong to separate urbanisation clubs, which in turn should bear a generic resemblance to the Barro-type income convergence clubs that have been much discussed in economics. In fact it is likely that there are optimal (welfare-maximizing) levels of urbanisation that vary from one place to another.

In recent times, regional science has made considerable efforts to understand the evolution of national city-size distributions (Berry and Okulicz-Kozaryn, 2012; Kim and Law, 2012). Much of this research, in part influenced by the ideas of the New Economic Geography, has centered on identifying the statistical attributes of growing national systems (Gabaix, 1999; Gabaix and Ioannides, 2003). However, many models are deficient either because they fail to recognize the role of spatial dependency or they do not incorporate different growth rates that typically occur at the regional level. In fact, calls have been made to focus more on the economic or institutional reasons for urban growth and decline than on the stochastic properties of the entire size distribution; presumably, these alternative models will address how the opposing forces of agglomeration and congestion must adapt to different thresholds as cities grow in size (Duranton, 2006; 2007; Storper *et al.*, 2012).

In recent times the most interesting work on urban primacy has been carried out by Henderson (2002; 2003). Following up on earlier work done on the decentralization of manufacturing in South Korea, this research has been especially aimed at uncovering the causes and implications of excessive urban concentration in the developing economies. On a cross-country basis, primacy appears first to rise with increasing national output but then to decline after a certain income threshold as been exceeded. More important, primacy evidently increases when national governments centralize their bureaucracies or fail to provide adequate high-density infrastructure. In such

cases mega-cities with multiple problems often arise. Here the consequent losses in growth probably rival the losses attributable to deficient investment in either human or physical capital. Regional science could provide a great service by clarifying how different improvements in local and regional conditions—in such matters as fiscal autonomy, tertiary education, and all types of infrastructure—could enhance the prospects of sustained urban growth in the second- and third-tier cities of the emerging economies.

Happiness

In recent years wide interest in the social sciences has turned to the causes, correlates, and implications of human happiness (Kahneman *et al*., 1999; Easterlin, 2001; Frey, 2008; Stevenson and Wolfers, 2008; Ballas and Tranmer, 2012). Compared to narrower income-based quality-of-life studies, the new approach recognizes the key roles of personal and social factors in affecting subjective levels of satisfaction with life. Happiness is increasingly seen as being part of overall well-being and some analysts even include perceived life satisfaction as one of the foundations for achieving sustainable development. Humans are seen to derive happiness not only from the consumption of private and public goods but also from self-determination, relationships in social networks, and from ideas of fairness and justice (Smith, 1994; Lin, 2001; Sen, 2009). In fact, it has become clear that people not only value the alternative outcomes of their consumption decisions differently but they also value the alternative ways to achieve those outcomes differently.

The study of happiness is motivated by the widespread idea that personal satisfaction is only in part determined by income. Moreover it is widely known that individuals experience diminishing marginal utility of income: so, from the outset, non-income factors are likely to increasingly affect happiness levels as individuals become richer. There is now longitudinal evidence that as a society becomes increasingly wealthy, its richer individuals remain happier than its poorer individuals but, as a whole, the entire society does not seem to become any happier. Various explanations for this paradox exist but unchanging relative status is perhaps the most convincing.

Regional science should study happiness if only because levels of satisfaction are unequally distributed both within and across nations (or regions). In any case happiness is more equally distributed across nations (or regions) than is income: one recent study estimates that 42% of the worldwide variation in log of household income is between countries, a figure that is much higher than the estimate of 22% for life satisfaction (Helliwell *et al*., 2013). This is the case because the other components of satisfaction are more equally distributed than is income. Many of the very poorest countries also have lower trust and weaker social relations, both of which have strong links to happiness. However, within the U.S. there is evidence that a happiness gradient exists where rural areas and small cities have the highest scores and large cities have the lowest scores (Berry and Okulicz-Kozaryn, 2011). Regional science could help sharpen the estimates of life satisfaction by controlling for neighborhood effects, thereby shedding light on whether some of the more obvious regional or national groupings (e.g., all Scandinavian nations are very happy) are due more to geographic propinquity or to having a shared history or common institutions. Moreover, as appropriate data bases expand in size, regional science could help disentangle the geographic and longitudinal correlates of happiness.

Happiness appears to have implications for public policy as well. Public transfers among sub-national areas not only narrow the gap between the very rich and the very poor but also allow happiness-inducing programs to flourish in education and the arts. Happiness is closely tied to self-esteem which in turn is tied to employment status and the quality of one's work. So during the recent Great Recession unemployment spiked in the Sunbelt states of the U.S.—especially in those areas that were highly dependent on construction and retirement housing sales—and happiness levels doubtless fell across that broad region. Moreover, in societies like the U.S. with high degrees of spatial mobility, levels of happiness will significantly shift as migrants change their places of residence at different points in the life cycle. Ballas (2013), for one, has recently suggested that urban happiness policy should be directed more at social programs than at targeting individuals.

Housing and Land Use

Although regional science has certainly made important contributions to the housing literature, there are still various areas of inquiry deserving of

more attention (Gyourko *et al*., 1999). To begin with, hedonic models are largely restricted to the U.S. experience and cross-national comparisons are needed to see if widely accepted generalizations about the American housing market hold in other regions and nations. While there are recent exceptions, including price-index studies in Spain (Bover and Velilla, 2002) and Croatia (Kunovac *et al*., 2008), these focus on serial change and lack any element of regional variation. More clarification is needed, too, of how housing markets operate in regions having different attitudes about owning versus renting and different preferences about living in low- versus high-density environments. But even the analysis itself in the U.S suffers from several limitations. One lingering problem deals with incomplete geographic coverage (or biased sampling)—the widely-used Case-Shiller data only address changing real estate price conditions in the nation's very largest metropolitan areas (Davis and Palumbo, 2007). As a result, the effects of natural and human-made amenities or land-use regulation on house prices in the nation's smaller and mid-sized cities are not known with any certainty.

Land use is of continued interest in both the developing and developed worlds. For regional scientists, all land-use policies can be viewed as offering market constraints affecting either the supply or demand of space at different locations (Fischel, 1990). In the aggregate the supply of demand is highly elastic; however, the supply of location-specific land is highly inelastic. Moreover, land uses in cities are heterogeneous so it frequently happens that contiguous properties, for various reasons, actually adopt conflicting uses. Sheppard (2004) has provided a comprehensive summary of the various effects that land-use regulation can have on social welfare. So there is a clear sense that land use should be regulated in order to maintain or improve the public good.

The post-Tiebout discussion of municipal government behavior has been heavily informed by Fischel's homevoter hypothesis (see below). As the good and bad practices of local governments are eventually capitalized into residential property values, homeowners have a direct interest in ensuring that their services are provided efficiently and with high quality. Continuous accountability comes into play as people vote, often with their feet, for those public officials who can maintain the best interest of those homeowners. The ability of local governments to accomplish this task mostly involves their capability to regulate the type, amount, and pace of real estate development

occurring within their jurisdictions. In fact, local governments strategically interact (Brueckner, 2003). As this local fragmentation proceeds, communities move towards even greater homogeneity, thereby allowing the already smaller local governments to take on even narrower social and economic agendas. As a result, tightly regulated land markets secure enduring property values and dissuade future, especially high-density, population growth.

In recent times, better data have allowed regional scientists to test or refine more of their ideas about land-use regulation. For instance, in examining conditions in the pre-crash U.S. housing market, Glaeser and Gyourko (2003) found that house prices in many large cities were not significantly higher than the prevailing construction costs. However, in those cities exhibiting a significant gap between current price and the cost of building, either construction restrictions or land-use regulation were seen to be critical factors. So there were clear regional variations in how regulations affected urban housing prices. Other evidence indicates that wealthier places allocate more land to parks and protected areas and less land to commercial and industrial activities, thereby driving both property taxes and real estate prices higher than would be the usual case. But more empirical work is needed, especially outside of the U.S., to clarify just how these decisions affect local fiscal and real estate conditions.

Unfortunately, most studies focus on the implications for the representative household and do not pay much attention to important distributional issues. An exception is the interesting study by Cheshire and Sheppard (2002), which attempts to simulate the value of benefits and costs that are typically generated by a comprehensive municipal planning system. Evidence is provided that household resources (including income equivalents for planning amenities) are made even more unequal by policies like open-space preservation at the boundary of the city. While the wealthy typically pay for most of these land-use regulations, they also benefit disproportionately from their eventual adoption. Again, this welfare topic is one worthy of more attention by regional scientists.

Metropolitan Sorting

Recent reports based on America's 2010 Census and Canada's 2011 Census indicate the very largest metropolitan areas in those two countries are

growing in very different ways (Wilson *et al*., 2012; Cox, 2013). Evidently, for the first time in a century, urban growth is exceeding suburban growth in the US—the very opposite is true in Canada. In fact, across Canada's 33 largest metropolitan communities, only 12% of the population now live in central cities while 69% live in low-density auto suburbs, 11% live in high-density transit suburbs, and 8% live in dispersed exurbs. In addition ethnic groups have become majorities or near majorities in many suburban areas.

The main contention, following Tiebout (1956), is that municipalities compete with one another in the provision of public goods and taxed businesses and households locate where their net benefits are perceived to be highest (Fischel, 2001). Here Voith (1998) was among the first to connect the decline of central cities to the wider decline of entire metropolitan regions and some of his conjectures have been tested by Leichenko (2001) and Hollar (2011). But Brueckner (2000) adds much clarity in tying together metropolitan form and public policy: he argues that programs like subsidized road building and mortgage tax deductions only create cities that are too large to be socially optimal. Moreover, the full benefits of open land are rarely if ever properly reflected in rural land prices so the opportunity cost of developing land at the urban fringe is invariably too low. As a result, the costs of providing suburban public goods and services are also typically underpriced. In fact, this entire stream of thought suggests that fiscal redistribution policies could be designed so that both central city and suburban municipalities would be better off (Haughwout, 2010).

This conversation has been resumed by Bayoh *et al*. (2006) who compare two alternative approaches to studying suburbanisation: 'natural evolution' versus 'flight from blight.' Inner- versus outer-city differences in neighborhood attributes, especially in the quality of public schools, were seen as being very important in inducing the suburban growth that unfolded rapidly in Columbus, Ohio during the mid-1990s. More recently still, Irwin (2010) has called for the wider adoption of geocomputational models in studying metropolitan-wide land use changes, in part because those landscapes are so highly heterogeneous and, increasingly, distinctive ecological patches must be recognized if land development is to be informed by the available data on wildlife habitats and natural vegetation. More research should be so sensitive to the different land use requirements of city

centers and the various types of suburbs that comprise the modern metropolis.

Neighborhood Change

Big cities are constantly experiencing turnover in their neighborhoods and this is another topic worthy of more research in regional science. Neighborhoods, however defined, represent the geographic scale at which people experience many of the costs and benefits of urban life (Sampson, 2009). At one time geographers—with their abiding interests in residential choice and mobility—spearheaded such inquiry but their contributions have been modest in recent decades (Cadwallader, 1996). Perhaps the most compelling recent work is by Rosenthal (2006), who has outlined two competing housing-based theories regarding neighborhood change. One approach is based on the traditional filtering argument, where the housing stock ages and deteriorates until, eventually, that housing becomes of such poor quality that a cycle of neighborhood redevelopment is initiated. Often this redevelopment occurs only because of public intervention and here the politics of neighborhood choice can be very interesting. The second approach borrows from the tipping-point model and emphasizes the role of information networks and social externalities. Here small initial changes in race, age, lifestyle, or income might gain momentum due to the similar preferences of well-informed and mobile outsiders, and the features of a neighborhood might change quickly. What is novel here is that neighborhoods would not only be tipping from higher to lower status. Of course, changing neighborhoods also engender shifting spatial externalities and these spillover effects might be perceived to be either positive or negative by the residents of other contiguous or nearby neighborhoods. Anyways, as Ellen and 0'Reagan, (2010) stress, micro-level research is needed in different cities to test not only which of these two mechanisms now prevails but which mechanism is the most promising to adopt for public policy. These findings can only assist local governments as they strive to efficiently allocate their scarce monies to competing programs like housing renovation, school improvement, or the upgrading of parks or community centers.

Neighborhood effects are also recognized to be important in job searches and they influence, in both time and space, the incidence of both segregation

and urban poverty (Dawkins, 2004). (In fact, the persistence of poor outcomes in some communities has sometimes been called the endogenous neighborhood problem.) In the first case, there are beneficial search externalities embedded in well performing communities: employed neighbors provide more and better information about job openings than do unemployed neighbors. Moreover, it seems that these spillover effects are typically strongest in those neighborhoods having lower education levels and higher fractions of minorities; the more affluent unemployed rely instead on referrals and their more cosmopolitan contact fields (Topa, 2001). In the second case, there is extensive research outside of regional science on policy experiments that involve the spatial reassignment of either individuals or entire households. Here there is some evidence of success in both health and education outcomes, although the reasons for this success remain unclear in part because of the self-selection that often occurs in these experiments (Ioannides and Topa, 2010).

Demographers and facility location analysts could also prove to be very helpful in ameliorating some of the long-run public goods problems that are associated with cyclical neighborhood change. Local and regional governments invest heavily in the capital costs of new schools, specialised parks, and community centers and these considerable expenditures should only be forthcoming when the neighborhood demography indicates that aggregate demand or general usage will remain high into the foreseeable future. Of course, the population of some older neighborhoods can be nudged upwards by allowing more densification. At the same time, the efficiency or equity criteria used to site those public facilities should accommodate both the life span of the facility and the shifting usage rates (and living densities) of the neighborhood's residents. So, as present residents either age in place or exit and new residents enter, the provision of public goods and services can be optimally located for the full life of the facility and not for a much shorter time horizon. Obviously the use of geocomputational methods would be very useful here.

Networks

The study of networks in regional science dates back to the 1950s when work focused on understanding the structure and flows of various types of

transportation systems. In many cases the early ideas were borrowed from the military research on logistics that was undertaken during World War II and a good number of these early works are summarized in Haggett and Chorley (1969). These studies typically involved the use of concepts from graph theory including nodes (vertices), links (edges), and routes (paths); and often attention was specifically given to allocating flows of people or goods between origins and destinations. In the former case, William Garrison and others used various indices to measure accessibility and connectivity in highway, rail and air systems, while in the latter case Martin Beckmann and others addressed the problem of users choosing a minimum-cost route given the route choices of all other users (see above). The latter approach has even shown promise in understanding the problem of human migration (Nagurney *et al*., 1993). In present-day regional science there is much room for additional work on networks in at least four different areas.

One perspective involves differentiating simple neighborhood effects from more complex network effects in various lines of empirical research. Neighborhood effects, sometimes called spillovers, typically involve either the idea of geographic contiguity or that of geographic nearness. Contiguity among various regions is normally captured with a spatial weights matrix and this operator has become a mainstay of adjusting regression estimates upwards or downwards in spatial econometrics. However, most studies restrict the use of this spatial weights matrix to uncovering first-order relationships and do not bother with detecting higher-order relationships (Anselin, 2003). Likewise most studies only consider constant spatial weights and do not allow the weights to change over time. So in studies of workers (shoppers) travelling in metropolitan areas, movers might well be attracted to those employment (shopping) zones surrounded by other dense employment (shopping) zones but the positioning in turn of those other zones is rarely considered as a secondary effect (Fotheringham, 1983). As a result, first-order neighborhood effects have become almost the only relationship accounted for in many spatial econometric studies. While first-order neighborhood effects are expected to be the most important of all neighborhood effects, in an era of diminishing transportation and communications costs more research is clearly needed to uncover how higher-order effects might cascade through the network of all zones being included in a study of people or goods being moved.

A second area of interest focuses on the networks that exist both within and between cities (Castells, 1996; Derudder and Taylor, 2005). The former perspective often overlaps with the study of regional clusters (see above), but where emphasis is given to the cooperation that is created and maintained across the various firms in the cluster. Here there is recognition that reciprocal trust and shared norms are two important parts of social capital in the local *milieu* and that either can serve to reduce government regulation or lower the probability of either firm disputes or defectors (Camagni, 2004). The latter perspective often involves identifying the differential strength of linkages tying together hubs of activity found at different locations: a good example is the co-authorship network identified by Larsen (2008) that shows world leaders in the research of nano-structured solar cells. Intercity network studies sometimes stress that cities, like firms, can have very different behavioral intentions when they enter into networked relationships with other cities—successful cities are often more content with legitimation, other places are content with information-gathering, and even others are adopting strategic behavior to overcome socioeconomic adversity (Camagni and Capello, 2004). But more research is needed before it becomes clear how cities actually generate network surpluses from these sorts of relationships. Much data and many reports on world-city networks are available online at the Globalization and World Cities (GaWC) website maintained by Loughborough University and it is surprising that more regional scientists have not made good use of this resource.

For decades regional scientists have been aware of the presence of important interregional feedback effects when applying the input-output model to two or more regions. In fact, some input-output specialists have even suggested that single-region models should always be expanded to two regions, where the second region represents the rest of the world. In a 2-region model there are 4 sub-matrices to contend with in both the transactions matrix and the Leontief inverse matrix, where in an *n*-region model the number of sub-matrices expands geometrically. Ideally it would be nice to have data to cover the flow from sector *i* to sector *j* from region *r* to region *s* but these data are not commonly available. So researchers have tried to estimate this sector-to-sector flow by taking the total flow from sector *i* (between regions *r* and *s*) and allocating it to sector *j* by some sort of information- or entropy-based scheme, thus changing an interregional model

to a multi-regional one. Here perhaps the best known work has been done by Roy (2004). In recent times, however, the transshipment flows between multiple regions have become much greater and there is a real need to better understand the network of sending and receiving regions in studies of interregional or international trade. Roy and Hewings (2009) have even cited studies where changes in interregional flow patterns have a greater impact on levels of regional output than do changes in production technology. So as geographic trading relationships shift, perhaps in response to agreements made at the national level, the impacts on specific regional economies can be enormous. Regional science can shed much light on the entire matter and notify both regional and national governments about the most probable economic outcomes that will follow from proposed trade agreements.

However, the most promising current application of networks in regional science follows from the notion of social capital (Lin, 2001; Westlund, 2009). This perspective recognizes that the behavior of each individual is tied to the behavior of others, that this interdependency can change, and that market outcomes will depend in part on the nature of this interdependence (Manski, 1993; Brueckner, 2006). This joint dependence is especially complex in regional science because individuals are linked to other individuals through friendship or work-related links, and this means that relationships exist in both relative space (neighborhood effects) and in relational space (network effects). A key idea in this emerging literature is the notion of the social multiplier, which captures the endogenous or total social effect of some action (Glaeser *et al*., 2003). Here individual-level coefficients (reflecting specific attributes) are randomly estimated for some action (e.g., crime, marriage, employment). Aggregate-level coefficients are estimated next based on some sorting procedure, and then the difference between the actual aggregate outcomes and the predicted aggregate outcomes is used to estimate the social multiplier effect. These sorts of models have a lot in common with analysis-of-variance studies where the total variance is comprised of the within-group effect and the between-group effect—in this case researchers typically focus on the composition of the between-group effect, especially if that level is different from what would be expected due to group-level heterogeneity alone. In any case, regional science should pay more attention to this entire methodology if only because it has important implications for formulating socioeconomic policy across arrays of spatial groups (i.e., neighborhoods, counties, etc.).

Nonmetropolitan Living

In all urbanizing nations, but especially in the U.S., there continues to be considerable interest in the future of nonmetropolitan areas. These areas include rural areas as well as sub-metropolitan centers, where the latter are commonly called micropolitan in the U.S. if the core urban cluster ranges between 10 000 and 50 000 inhabitants. Rural areas everywhere are especially plagued by high unemployment, widespread poverty, and low job creation rates although there are some pleasant exceptions (Partridge and Rickman, 2007). One very surprising and underappreciated finding is that the economies of both types of sub-metropolitan areas are remarkably heterogeneous (Mulligan and Vias, 2006; U.S. Department of Agriculture, 2006).

Micropolitan areas have generally grown in size because they offer both labour and land costs that are lower than in metropolitan areas. Moreover, as long as these places are not too isolated from national infrastructure both of these savings can be a great incentive to business investment (Kilkenny, 1998). Micropolitan centers actually benefit from the migration streams moving upward from rural areas and downward from larger cities—both of these being streams that seem to behave in a cyclical fashion (Plane *et al*., 2005; Vias, 2012). Some rural areas and micropolitan places have also grown because of the sorts of amenity-related advantages that were noted above (Rickman and Rickman, 2011).

Much recent interest has turned to the growth prospects of sub-metropolitan areas, where Kilkenny and Partridge (2009) have been especially skeptical of the traditional export base model. Alternatively, as McGranahan *et al*. (2011) argue, recent growth in the rural U.S. appears to depend upon each county's mix of natural amenities, human capital, and business acumen. They claim that business establishment growth in the U.S. during the 1990s was driven by the interaction of entrepreneurs with the region's creative class, where the latter seem especially attracted to high natural-amenity locations. There is considerable optimism for rural development in some places, but clearly permanent barriers to rural development persist in other areas (Mulligan, 2013)

Regional science practitioners should be especially interested in the research being carried out by resource economists. Resembling some of the

work done on eco-demo models back in the 1970s, various new studies address such matters as industry clusters, firm and sector survivorship, and business targeting (Goetz *et al*., 2009). Some of this work borrows from input-output analysis in identifying candidates for industry targeting or recruiting by identifying input suppliers and product markets for existing industry clusters in the target region. In fact, this approach has a dynamic dimension in that new manufacturing technology typically diffuses through space according to interregional trading linkages. Adopting this logic, Feser *et al*. (2009) outline the use of interindustry benchmarks in clarifying the niche of a targeted regional economy within the more diversified national economy. There is also room for more research on nonmetropolitan innovation because inventive urbanites typically spend some of their productive lives in non-urban areas and because, as Michael Porter and others have noted, distinctive regional brands can often provide advantages in the development of new product lines.

Post-Event Growth and Development

In the past few decades a somewhat new literature has grown up around modeling regional growth or development following traumatic events. Short-term events include natural disasters like storms, floods, and earthquakes, as well as major human-created accidents involving industry or transportation. Long-term events are, for the most part, created by humans and these include conflicts, wars, and those accidents (e.g., nuclear) with prolonged recovery periods. Studies that address short-term events typically examine specific issues that are most pertinent to resuming growth while studies that address long-term events tend to be more speculative about the possibilities of impacted regions being able to resume their development trajectories. Both types of events are highly appropriate for study given the tendency for human populations to increasingly concentrate in space, especially along ocean and inland coastlines.

Although there is an earlier literature, including much work on environmental management and natural hazards (see above), the analysis of the effects of Hurricane Andrew on southern Florida by West and Lenze (1994) remains a landmark among the studies of real short-term events. These authors do a great service by highlighting the many conceptual and operational problems that are associated with estimating such events: the full

extent of the disaster is not quickly known; the destructive effects are not confined to one or a few sectors; both supply and demand linkages are typically affected; issues like wealth distribution and insurance coverage will influence the nature and timing of the recovery; and, finally, community or regional attitudes can skew decision-making about the recovery path. Severe damage to the housing sector alone presents a litany of short-run estimation problems: do people deplete savings to supplement insurance, do they double up with relatives or rent hotel space (if possible), or do they simply out-migrate to greener pastures? The authors also do an admirable job of showing how 'normal' regional models might undercount or double-count various items: for example, household durables and residences are usually treated separately but now they will be jointly purchased? In fact this is an area of research where regional scientists of very different skills and interest can make significant contributions. People interested in interregional purchasing can identify those other regions that are most likely to be impacted by a major event; people interested in housing can estimate if the nature and even location of the housing stock will change after the event; while people interested in social capital (see below) and even 'sense of place' can gauge how particular communities or regions will respond to such traumatic events (Bolton, 1992).

A number of similar studies, focusing on natural disasters and terrorist threats, have since been done by colleagues at the University of Southern California. One comprehensive study (Richardson *et al*., 2008) looks at the disruption of life in and around New Orleans following Hurricane Katrina. This event is now recognized to be a classic in mismanagement and the authors, drawn from diverse fields, review many of the decisions that created or exacerbated the disaster. In this and other work the authors stress that extensive floods and storms will have severe implications for the smooth operation of interdependent regional economies due to the disruptions in the supply chains that firms manage with globalized just-in-time inventory systems. In fact, a special literature has even evolved to address the issue of production rescheduling where attempts are made to measure the degree of resilience existing in regional economic systems (Park *et al*., 2011). In any case, most studies suggest that the overall costs of these interregional disruptions are apt to be less than those given by the media. Moreover, these events are of increasing concern to the insurance industry and various

recommendations have been made, across different nations, on how to provide more elastic capital to those property owners who have been severely affected by catastrophes (Quigley and Rosenthal, 2008).

The literature on long-term events is not so fully developed and much of the thinking appears to be confined to a few papers. Glaeser and Shapiro (2001) suggest that terrorist threats have both centripetal and centrifugal effects on human settlement patterns: on the one hand people are apt to disperse in order to avoid dense, urban targets but, on the other hand, people might well move into cities because intercity transportation systems will be perceived to be at risk. Davis and Weinstein (2002), who focused on the bombing of Japanese cities during World War II, argue that here the overall affect on population growth was only temporary and that Japanese cities resumed their growth trajectories soon after the cessation of hostilities. Their findings support the view that each city has its own 'natural' size given national demographic and technological circumstances, and that most cities will return to this size even after large and prolonged shocks. The alternative view is that city productivity depends upon city population size and spillover effects, and when both of these are severely shocked the city might never recover and simply assume a different growth pattern. Brakman *et al*. (2004) examined these competing hypotheses for German cities after World War II and found that most heavily damaged (especially in housing) West German cities exhibited rapid post-War growth but the heavily damaged East German cities did not. The reasons for this are somewhat complex but in part involve the very different policies of the two governments with regard to enhancing the supply of housing.

In light of recent events both the short-term and long-term perspectives clearly deserve more attention by regional scientists. More case studies would prove useful in testing some of the more tentative conclusions, especially for long-term events. In any case, this research could focus on a wide variety of factors ranging from social capital to regional economic diversity to transportation redundancy.

Regional Creativity

Regions, especially large urban regions, achieve economic growth only when their workers become sufficiently motivated and skilled to adopt new processes, technologies, and organisational forms. But, in addition to having

an environment that is conducive to sustained worker learning, regions must also be both creative and innovative in order to enjoy prolonged economic success (Stough, 1998). Most observers contend that creativity involves imagination and conceptualization while innovation involves the practical and commercial use of those ideas, although the lines between the two stages can be blurry.

Regional science has already given much attention to innovation. Papers and books abound on such topics as trust and social capital, knowledge diffusion and spillovers, the attributes and movement of human capital, entrepreneurial capitalism, ethnic dynamism, patents and patent citations, the role of research universities and science parks, and the policies of government (Karlsson *et al*., 2009). However, much less study in regional science has been devoted to the understanding of creativity where clearly the contributions of the Europeans have been the most notable.

Hall (1998) summarizes various attempts to define the common features of creative milieux through history. At the very least, fashioning new ideas means that people not only have ready access to (often stored) information but the ability and freedom to use that information. Other institutional factors, including a sound financial system and efficient public infrastructure, can also play an important role in aiding creativity in today's economies. Various people also observe, in the sense of Schumpeter, that a society must often be willing to overcome existing rules or restrictions before it can achieve some measure of sustained creativity. Not surprisingly, the analogy to Thomas Kuhn's paradigm shift is often cited. Certainly, too, demography must play a part in regional creativity although this factor seems to have been given only scant attention.

Andersson (2009), for one, has emphasized the role of the genius or star in bringing new ideas to the forefront. In the first case he has recognized the work of various psychologists in highlighting the attributes of the creative personality while in the second case he has emphasized the role of pecuniary rewards. He outlines a very plausible multi-stage theory of probabilistic success in the most reproductive art and entertainment industries, qualities that lead to high fixed costs and global concentrations in production. In these endeavors new artists are forced to compete against other living artists and their predecessors as well. Similar processes presumably occur in business,

government, and academia where skewed distributions of recognition also lead to skewed distributions of compensation.

A different approach to individual creativity, now popular in evolutionary economics, involves the notion of adaptive learning (Cantner *et al*., 2000). Such learning not only involves acquiring image representations but modifying them as well, where the modifications might either be goal-directed or stochastic. Genetic programming models typically use recombination functions to generate new sequences of rules that mimic human behavior; there is an obvious analogue to biological systems where mutations can lead to the appearance of entirely new species (Holland, 1998).

A central concern to regional science is the endogeneity problem, an issue that has restricted wider acceptance of Florida's (2002) creative class thesis. Put succinctly, do star individuals and firms create star cities or do star cities create star individuals and firms (Kourtit and Nijkamp, 2013)? Consideration should also be given to the seemingly relentless demand of humans for variety in goods and services, much as espoused in Dixit-Stiglitz imperfect competition models. The result is that today's old ideas will by their very nature feed on one another and generate tomorrow's new ideas, thus inducing a process very similar to that of Jacobs (1968) where old work always leads to new work. There is also something fundamental in the work on regional (usually urban) milieux where economic agents not only compete but cooperate through networks (Camagni, 1993). Here creative individuals should engage in cooperative action with other creative individuals as long as the benefits of such cooperation are perceived to exceed the risks of that cooperation. In fact, Fujita (2009) has outlined a micro-model of knowledge creation where heterogeneous people establish social groups in order to achieve cooperation in the production of new ideas.

In any case it is evident that regional science could do much more to clarify why new ideas first appear only at certain locations and not at others. These locations are usually large urban regions but there are some cases of non-metropolitan creativity as well (Shearmur, 2012). Perhaps the work of Andersson and Persson (1993) should be revisited where the authors outline an analytical model to show how the ease of human social interaction directly affects the rate of creative outcomes.

Regional Decline

The literature on regional specialisation (see below) informs some of the growing debate about the origin and nature of regional decline, where most media attention has focused either on faltering Rustbelt economies or the demise of once great cities (Business Insider, 2013; Ryan, 2012). The literature on income convergence, which recognizes the role of conditioning factors in economic growth, also sheds useful light on the issue of regional decline (Tondl, 2001). The inquiry, while not yet apocalyptic, certainly recognizes that many developed economies will be vulnerable to headwinds like demographic aging and the demise of public education (Gordon, 2013; Kim *et al*., 2011). Here the case of large regions tends to invite generalization whereas the case of small regions tends to invite case studies instead. Although the falling fortunes of important cities, like Manchester or Detroit, are rarely anticipated during the heady days of growth and accumulation, such cases do not qualify as Black Swan occurrences (Taleb, 2007). In fact, a whole series of events transpire in such large places, across both the private and public sectors, before businesses become distressed, unemployment and poverty become highly visible, and public bankruptcy emerges. The key factor precipitating significant urban decline is invariably the loss of competitive advantage, something that tends to unfold over years if not decades. This loss involves a steady erosion of the city's traditional economic base and, also, the city's inability to create (or finance) new industries and thereby acquire an alternative economic base.

For modern capitalist economies, Glaeser and Gyourko (2005) have been especially persuasive in arguing that the price of housing is a key factor in urban decline: when those prices fall below construction costs the city soon becomes a magnet for low skilled workers and the unemployable. Declining cities might experience variety in past negative shocks, including the loss of manufacturing, but the initial drop in demand for housing is critical for setting in motion the extended process of decline. The durability of housing ensures that this process of decline will likely extend across several generations. The other key factor appears to be the region's ability to attract and retain human capital (Storper and Scott, 2009). Workers in large cities not only accumulate a wage premium but they learn from other workers. Moreover, these educated workers are responsible for creating more urban

amenities which in turn attract other high-capital workers to the city (Duranton and Puga, 2013). It has even suggested that there is an entire ecosystem—with innovators, skilled workers, and capital providers—that has arisen in successful cities and that governments should consider moving the unemployed to these places (Moretti, 2012). It also seems certain that those cities fortunate enough to have large, research-driven universities will continue to enjoy brighter futures. However, the complicated endogeneity issue involving skills, urban learning, and city amenities requires a lot more conceptual and empirical work and some of this work will likely require following the life histories of workers as opposed to applying cross-sectional regressions.

However, another less tangible factor in regional decline is also worthy of consideration. In assessing how human psychology plays an important part in driving various markets, Akerlof and Shiller (2009) have introduced the notion of the confidence multiplier. Although there are questions of measurement, the idea is that a one-unit change in confidence by either businesses or households sets in motion the usual round-by-round changes in regional income that are characteristic of other induced processes. Here the authors differentiate animal spirits from simple expectations about future events and, moreover, they emphasize that the confidence multiplier is more important when the economy is heading into a downturn. This raises several issues of interest to regional scientists. First, steps should be taken to improve our understanding of the signals economic agents typically read when formulating their expectations: in other words, what are the best leading indicators for informing agents or analysts that regional confidence is shifting? And, second, how do these shifting expectations actually affect regional consumption and investment, especially in the private sector. It is widely known that regions are smaller and more volatile than nations so the effects of this confidence multiplier should be more important to those regions. Leading confidence indicators might be somewhat different for small versus large regions although global processes can now impact either type of economy.

Regional Specialisation

While geography has a long history of measuring regional (especially urban) specialisation, the implications of this specialisation were not widely

discussed in regional science until the 1970s. Specialisation in an industry usually means the absolute employment exceeds some critical threshold or the relative employment exhibits a high location quotient. Some economies have one dominant industrial specialisation while others exhibit two or three less dominant industrial specialisations: in either case the entire economy is usually said to be specialised. The absence of specialisation has usually denoted industrial diversity. Economists have long speculated how regional specialisation is tied to economic cycles while geographers have often traced out the locations of cities sharing the same industrial specialism (Thompson, 1965; Yeates and Garner, 1980).

A once-popular approach to assessing diversification arose from the portfolio model where industries were treated like financial assets. Conroy (1974) adopted the Markowitz model, with covariance matrices, to analyze fluctuations in regional growth. The main methodological problems centered on adjusting the national data for regional use and identifying the appropriate industries to include in the study. The paper by Brown and Pheasant (1985) was enlightening because it looked at the performances of two similar counties in the U.S. having very different levels of employment instability. Here the Sharpe portfolio method, having lower data requirements, pinpointed new industries that would likely offer regions a better combination of growth and stability than some current industries. However, these models were misspecified and failed to exclude systematic variation across all industries (Hunt and Sheesley, 1994). It now seems clear that any portfolio-based policy must be supplemented by other knowledge of the region's economy, and some knowledge of the region's relationships with other regions, as economic stability might not always follow from actions taken to diversify the economy (Trendle, 2011). This line of research on regional instability seems to have been replaced by more straightforward regression models that account for the effects of demographic, labour market, and industry-mix variables, with adjustments being made for spillover effects (Trendle, 2006).

However, some of the earlier ideas about specialisation have reemerged with the New Economic Geography. The seminal study was that of Glaeser *et al*. (1992) who established that specialisation hurts and diversity helps sustain long-run employment growth in large cities. Duranton and Puga (2000) then claimed it is appropriate that specialisation should refer to individual

industries (driven by localization economies) while diversification should refer to all industries (driven by urbanisation economies). More recently, Duranton and Puga (2005) have examined the ratio of jobs in management to jobs in production to measure functional (overall) specialisation. They establish a formal model for how the changing organisation needs of firms will lead to differences in those ratios. Business services are required by firms found across all sectors so headquarters will tend to cluster together in a few large cities; however, manufacturing does not have the same needs for external economies and will therefore search out locations in smaller cities having lower congestion costs. As a result, the urban hierarchy has a few large diverse economies but many small specialised economies.

As noted elsewhere humans appear to have an insatiable demand for variety in goods and services. So, as Quigley (1998) has stressed, cities will continue to become larger because such size ensures greater variety in both consumer services and producer inputs. But efficiency limits do seem to exist for most cities and regional science could shed more light on the forces that pose limitations on urban size. Debate might even resuscitate discussion of optimality in city size. In any case, present concerns seem to be very focused on micro issues (congestion, crime, etc.) when macro issues (size distribution, resource inequality) might also have a significant role to play in the matter.

Resource Inequality

There has been long-standing interest in how private and public resources are distributed, both among households and regions. John Galbraith, for one, claimed 50 years ago that the production problem of wealthy societies was largely solved so the distribution problem was of greatest concern (Dunn and Pressman, 2005). While discussions of resource inequality always evoke disagreement, most parties concur that the conditions of this inequality are self-perpetuating—both in time and in space. Here Tilly (1998) has uncovered the categorical and institutional mechanisms that lead to persistent resource inequality while Clark (2014) has demonstrated that social mobility—a major factor in reducing inequality—is probably overestimated in most regions and nations.

The debate about resource inequality has become more heated in recent times (Noah, 2012). There is now wide recognition that a host of health

issues and social problems are directly tied to resource inequality (Wilkinson and Pickett, 2009). The list includes but is not confined to obesity, mistrust, life expectancy, and violent crime. While economists have helped clarify how best to measure income inequality (Galbraith, 2012), social and health scientists have been more active in uncovering the causes and consequences of such inequality. Here the arguments of Sen (1992; 1999) are an important exception. But a more ominous reason for the spike of interest in resource inequality is the speculation that many nations are reaching a tipping point where social upheaval might erupt if existing welfare gaps become much worse.

Regional science could contribute to this dialogue in several ways. First, more efforts could be made to sharpen the income inequality hypothesis by applying better controls for the demographic and social conditions that vary substantially across states and provinces (Mellor and Milyo, 2002). Furthermore, there is no clear idea about the spatial history of inequality in most nations. In fact, when moving beyond common income measures, very little seems to be known about how the other patterns of spatial welfare—including infant mortality, education attainment, etc.—have changed over time. Also, given all the rhetoric, surprisingly little is known about the implications of spatial inequalities at either the local or metropolitan levels. Some national governments, like Canada's, regularly redistribute money out from revenue-generating regions in part to subsidize economic activity in less competitive regions. The Canadian approach not only dampens regional inequalities but leads to lower rates of regional poverty and reduces job-related interregional migration.

A related issue worthy of attention concerns the differences in the persistence of informal or shadow activities across nations. These activities are known to occur when residents grow to distrust the government, often because of burdensome taxes, and opt for reciprocity instead of redistribution (Schneider and Enste 2000). Using the MIMIC model one study estimates that, on average, the size of the shadow economy in Organisation for Economic Co-operation and Development (OECD) nations is now about 20% but over 40% in many transition economies; another study estimates that in the U.S. states this level now varies between about 9% and 11% (Wiseman 2013). At the international level research could uncover whether (shifting) national blocks exist for this phenomenon. Even among the richer OECD

nations international money laundering regulations are unevenly observed and this oversight could certainly affect the incidence of shadow activities in both sender and receiver nations. At the national level other research on informal activities could uncover whether or not geographic contiguity alone leads to the emergence of sub-national blocks; in the U.S. it should be possible to establish the existence of these shadow-economy regions by using a straightforward bottom-up clustering methodology.

4. CONCLUDING REMARKS

Research in the field of regional science, now 60 years old, has substantially widened and deepened during recent times. However, most of this inquiry can still be categorized into one of six broad research traditions. These traditions are briefly summarized in the first half of the paper. Then, in the second half, 14 promising directions for future research—some ongoing and some more novel—are identified and discussed. These future directions, which of course reflect the author's own biases and interests, all have analytical, empirical, and policy-related dimensions. This paper calls for more international research on topics like quality of life, strategic government behavior, and regional decline—all topics that have been largely pursued only in the U.S. Hopefully, better data sets and more sophisticated methodologies should improve the understanding of the complex endogeneity issues that characterize many of these topics. This paper also calls for appreciably more work on spatial welfare and distributional issues across the entire international regional science community.

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