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EDITORIAL

Spatial perspectives on urban systems: developments and directions

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1 Introduction

Urban systems have long excited the geographical imagination. Starting with early work in theoretical and quantitative empirical geography [including such seminal work as Christaller's central place theory, Berry's research on systems of cities (Berry 1958), and Getis' investigations of land uses (Getis 1964)], cities have been a constant and reliable source of motivation for adopting, adapting, and developing new ways to think about, describe, and try to explain the richness observed in complex human systems. As recent reviews indicate, the geographical interest in urban systems remains as vibrant as ever, with extensive use of GIS for urban research (Du 2001), an increased role of spatial analytical tools as a way to improve modeling practice (Miller 1999), and a literal explosion of applications of both GIS and spatial analysis to the study of urban systems (Páez and Scott 2004). The influence of geography has since extended to a variety of fields with intersecting interests, including regional systems (e.g., Páez and Suzuki 2001), planning (e.g., Hess and Almeida 2007) and civil engineering (e.g., Kim and Niemeier 2001), adding to the richness of a field that continues to thrive-as the present special issue of the *Journal of Geographical Systems* hopes to confirm.

The collection of papers brought together for this issue is a selection of research presented at the North American Meetings of the Regional Science Association International, held in Las Vegas, Nevada, in November 2005. The contributions were submitted in response to a call for papers intended to highlight the use of Geographic Information Systems, spatial analysis, and spatial statistics, to the study of urban systems, in particular land use and

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transportation. The special issue represents a continuation of the trends identified by Miller (1999) and Páez and Scott (2004). Each of the papers presented is an example of current research that offers a spatial perspective on a particular aspect of urban systems. Technically, the papers cover an impressive range of methodological areas (e.g., global and local statistics, exploratory and explanatory data analysis, linear regression and discrete choice models). Thematically it is interesting to note that (quite coincidentally I should note!) all four papers seem to gravitate towards a common idea. With papers on urban polycentricity, residential spatial price determination, firm clustering, and residential location decisions, urban form emerges as a unifying theme that underlies the issue. Overall the papers give a sense of both maturity and new directions for the field of spatial analysis of urban systems.

2 The papers: urban spatial processes, urban spatial behavior

Housing price determination is the focus of the paper by Bitter and Mulligan. Applying two spatial regression models [Casetti's expansion method (Casetti 1972) and geographically weighted regression (Brunsdon et al. 1996)], their research follows on the steps of earlier work on spatial hedonics, including Can (1992), and complements more recent work by Kestens et al. (2006) and Farber and Yeates (2006), who applied local forms of spatial analysis to this problem. There are two potential advantages to the use of locally adaptive models in the context of hedonic price analysis. First, location becomes an explicit and important part of the specification of a model, moving beyond simple measures of urban form such as distance to the CBD. Local models, unlike conventional and even most spatial methods, raise the possibility of exploring variations in spatial relationships (Fotheringham et al. 2002), and thus allow the researcher to investigate heterogeneities in spatial processes and behavior. And secondly, they can be used to improve the ''fit of a curve'' (Loader 1999), thus leading to higher quality predictions for assessment purposes (q.v. Long et al. 2006). While the question of whether these two objectives are mutually compatible or not remains open, the paper by Bitter and Mulligan furnishes evidence of spatial patterning in terms of the marginal prices of different attributes, and supports the idea that local models, in particular the use of geographically weighted moving windows, leads to improved statistical fit ('explanatory power'), as well as more accurate predictions. The expansion method, on the other hand, is found to be more suitable for hypothesis testing, and for the incorporation of large covariate sets, an important point in many practical applications.

The paper by Maoh and Kanaroglou presents an analysis of intra-metropolitan firm clustering, and explores the relationships of clustering processes to urban form. The paper makes effective use of exploratory (K-function and kernel estimation) and explanatory (spatial autoregressive models) statistical tools, as well as input–output tables, to study the issue of location and co-location of firms in Hamilton, Canada. A remarkable aspect of this paper is

the use of micro-data from the Canadian Business Register, which comprises the population of firms in the city of Hamilton for the years under study. While micro-data has been used in research before (e.g., Bartelsman et al. 2005), this is possibly the first study to do so from a spatial analytical perspective. The usual concerns regarding data completeness when applying exploratory tools, such as K-functions and kernel estimation, are obviated here thanks to the complete enumeration provided by the business register. However, while the use of a complete enumeration bodes well for the spatial analysis of firm location and co-location, the limited number of cross sections available for this research makes it difficult to understand the potentially very complex dynamics of clustering in a space-time setting. One outstanding research challenge will then be trying to answer the question of whether firm location shapes urban form, whether urban form facilitates firm location, or more likely, whether a process resulting from a combination of these two notions is in operation. Meanwhile, this paper offers a valuable spatial perspective that will help to complement firm demographics research in other disciplines, such as planning and industrial studies (Moeckel 2005; Bartelsman et al. 2005).

The focus of the paper by Griffith and Wong is on urban population density (an important element of urban form) and the estimation of density functions by means of statistical models. This paper contributes to a venerable stream of research in geographical analysis, dating back to Clark's paper on population density profiles (Clark 1951) through more recent work such as the switching regressions of Alperovich and Deutsch (2002). While the theory underlying this type of analysis-the monocentric city-has remained relatively unchanged (but not unchallenged; see Hoch and Waddell 1993), over time the reality of many modern cities, in particular in North America, has become such that the polycentric urban form is now the norm rather than the exception (see McMillen 2001). As in the case of house price determination, it could be argued that population density functions serve two purposes: they can help us to understand the processes that give rise to polycentric cities—an objective that needs a complement of stronger socio-economic theory than currently available—or they can be used to improve, through technical innovation, our descriptions of the spatial structure of cities. Wong and Griffith bring a technical approach to bear on this problem. Making use of spatially autoregressive models, Minkowskian distance metrics, and local statistics of spatial association for sub-center identification, they propose a polycentric spatial regression approach for the estimation of population density functions. Application of their approach to data obtained for 19 major US cities and San Juan de Puerto Rico, provides evidence of the existence of multiple centers in many of these cities, explores the notion of elasticity of urban spaces, and highlights the importance of taking into consideration autocorrelation concerns in model specification.

The final paper in this group, by Walker and Li, concerns the topic of household location decisions, and the vexing problem of self-selection identified in the travel behavior literature (e.g., Schwanen and Mokhtarian 2005;

Cao et al. 2006; Handy et al. 2006). In a nutshell, self-selection can be described as the question of whether people prefer to walk (or drive, etc.) mainly because their neighborhood (i.e., built and natural environment, social conditions, etc.) is conducive to these activities, or whether people with a strong initial preference for walking (or driving, etc.) prefer to live in neighborhoods that can accommodate these activities. If the latter, a systematical sorting over space of people with similar preferences would result, which could have important implications for our understanding of urban form and function, including impacts on the travel behavior and location decisions of the public, and on public health through the connection with physical activities such as walking. At a different level, the self-selection problem is very similar to the question of the interactions between urban form and the spatial clustering of firms. Walker and Li's approach in their paper involves the adoption of latent class choice models, which allows them to define household ''lifestyles'' as the latent classes, with household membership to a class estimated jointly with its location decision. Their case study, using data from Portland, Oregon, suggests the existence of three lifestyle groups: suburban dwellers, urban dwellers, and transit-riders. The models offer a rich behavioral picture of the location decision, and help point at some potentially powerful ways to help people maintain their lifestyles in a more environmentally positive way. While the models used in this paper lack the spatial modeling component of the other contributions, it is worthwhile to note that the explicit incorporation of spatial effects in discrete choice models is still in its infancy (Páez and Suzuki 2001; Bhat and Guo 2004; Miyamoto et al. 2004; Guo and Bhat 2007). A fruitful area of research will be to enhance Walker and Li's behavioral models in order to assess the relevance of spatial effects (i.e., the analog of detecting spatial autocorrelation), and if required, to provide adequate treatment of these effects in the analysis (i.e., modeling spatial autocorrelation).

3 What lies ahead?

As the papers in this special issue demonstrate, there are exciting research opportunities and challenges in the study of urban systems from a spatial perspective. Existing techniques can be further refined to improve our descriptions of urban systems. At the same time, while there have been calls to improve the behavioral content of our models (Kanaroglou and Scott 2003), the way space is introduced in behaviorally rich approaches is still limited and remains an open research area in need of attention. And finally the models will become more persuasive in the measure that the substantive theories underlying some critical urban issues catch up with the empirical evidence provided by ever more power and flexible techniques. Concepts deriving from the New Economic Geography (Fujita et al. 1999), the economic theory of externalities (Cornes and Sandler 1996), and the sociological concept of social networks (Wasserman et al. 1994), emerge as a promising way to further improve our ability to understand modern urban systems.

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