Spatial Externalities*

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Spatial externalities are a central element in the conceptual framework underlying the new economic geography (Fujita et al., 1999). In contrast to regional science, where it has long been accepted, an interest in economic spillover effects in other spaces has only recently become more common in "mainstream" economics. In part, this has followed from a theoretical paradigm shift where attention has moved to the interaction of agents rather than their behavior in isolation. This social interaction (Akerlof, 1997) also has a spatial imprint which must be modeled explicitly. Hence, concepts such as location, spatial interaction and spatial externalities are increasingly common in theoretical formulations in a growing number of sub-fields in economics, such as public, urban and real estate economics, environmental and natural resource economics. More importantly, they are increasingly expressed in a more realistic fashion, rather than in the context of points on an isotropic plain. In addition, complementing this theoretical attention, the explosion in the availability of geo-coded economic information collected at a range of spatial scales has strengthened the need to explicitly take into account spatial effects in econometric methodology, as exemplified in the growing application of spatial econometrics (Anselin, 2001).

In other social sciences besides economics, the relevance of an explicit spatial perspective is recognized as well, and maybe even more so than in economics. For example, this is illustrated by the use of spatial models of neighborhood effects in demography and criminology, as well as other formal treatments of context in sociology (Abbott, 1997; Sampson et al., 2002; Messner and Anselin, 2003). Arguably, this was a motivating factor behind the establishment of the NSF-funded Center for Spatially Integrated Social Science (CSISS) in 1999. C S I S S seeks to provide a research infrastructure to enhance and advance a spatial analytic perspective in social sciences, by disseminating information on techniques, software and state of the art applications, among other activities (Goodchild et al., 2000). In addition, C S I S S also convenes specialist meetings, small workshops where a selected group of participants address a focused research question.

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The papers contained in this special issue of the International Regional Science Review are the outgrowth of such a specialist meeting, devoted to spatial externalities, and held in Santa Barbara, CA, January 11-13, 2001. The meeting brought together about twenty leading scholars from a range of subfields in economics. The main objective was to assess the status and future of spatial thinking in economics in general, and in the context of the study of spatial externalities in particular. Specifically, participants were asked to address what is the perceived added value of spatial models and spatial methods, to identify critical impediments and to suggest the most promising research directions where a spatial perspective can provide added value to the solution of economic questions.

In order to better situate the six papers contained in this special issue, it may be worthwhile to briefly present an overview of the general discussion at the meeting, which was organized around four major themes: the role of space as an integrating factor in social research, theoretical perspectives on spatial externalities, methodological perspectives on spatial externalities, and the role for spatial analysis in economic research in general.

The discussion of the first theme raised several issues pertaining to the added value of a spatial perspective and the potential for a spatial perspective to form an integrating force across different theoretical frameworks. The latter was not necessarily viewed without disagreement, and the role of other integrating factors that are a-spatial, such as insights derived from cognitive science, was suggested as an alternative. Not unexpectedly, given the central attention to the time dimension in the economic discipline, the integration of time and space was seen as crucial. Similarly moving beyond the traditional spatial realm was the recognition of the importance of spaces other than “geographic,” such as social space (social capital) and the use of distance metrics other than the typical Euclidean (social distance, economic distance). A recognition of the qualitative aspects of spatial information was suggested as a promising direction, bringing to the fore the lack of precision (fuzzy analysis), predominance of spatial dependence, and the confounding aspects of scale and level of aggregation. In contrast to many physical sciences, where scale is treated at the process level, it was felt that in economic analysis, the choice of the proper unit of analysis is often ambiguous. In this context, it was deemed important to move beyond the limitations of current GIS technology to assess the value of spatial information. Powerful behavioral models are needed to drive the spatial analysis. Along the same lines, the importance of more robust models, heavily inspired by advances in observational tools was suggested as an alternative to the current dichotomy between data-driven analysis (exploratory) and the use of stylized models.

The interest in issues of scale, aggregation, specification and space-time dynamics expressed in the discussion of the first theme would also characterize the next three themes. From a theoretical perspective, the role of dynamics and associated consequences for equilibrium solutions were heavily stressed. The link between a spatial dynamic reality and the consideration of cross-sectional models must be further ex-

1The meeting was organized by a Steering Committee, chaired by Luc Anselin (University of Illinois, Urbana-Champaign) and including Jon Braecker (University of Illinois, Urbana-Champaign) and Robert Deacon (University of California, Santa Barbara). A complete list of participants and the position papers prepared to support the meeting can be found at http://www.ciss.org/meetings/externalities.htm.
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explored: what are the proper behavioral units, how do space and boundary matters, is space discrete or continuous, and how can the endogeneity of space be accounted for? These questions suggested a need to search for a general theory or overarching explanatory models, possibly along the lines of Alonso’s general theory of movement, or the Haag-Weidlich space-time mean value equation models familiar in regional science.

The discussion of methodological issues centered on model specification and identification, as well as the consideration of alternative approaches, mostly in the context of models for land use and urban housing markets. There were three important considerations. In terms of specific techniques for the analysis of spatial data, there was an interest in further exploring the potential of alternatives to a traditional econometric approach, such as geostatistical techniques and Bayesian network analysis, especially when it comes to handling highly irregular spatial units. Similarly, the familiar issue of the specification of the spatial weights matrix was raised and the further study of alternatives was suggested, such as parameterization and local estimation techniques. A second dimension of the discussion pertained to the specific market mechanisms underlying spatial markets, such as the joint or conditional determination of asset prices, the need to incorporate concepts from the efficient market literature, and the modeling of bubbles. Finally, there was a concern with the potential use of commercially available geo-coded data and their relevance for empirical research. Specifically, there was a suggestion of the necessity to more precisely link such data to the actual information acts of economic agents.

The final theme dealt with the incorporation of spatial analysis in current economic research. Attention centered primarily around conceptual and methodological aspects of the use of hedonic models. In addition, the difficulty of incorporating space in integrated modeling frameworks was considered and associated implications for spatial analysis evaluated. Common concerns pertained to the importance of equilibrium conditions and their sensitivity to the conceptualization of space. In this respect, the use of multiple markets to aid in the identification of spatial models was suggested. Also, the difficulty in the choice between models for discrete spatial objects or continuous surfaces was raised, and the related need to select appropriate distance metrics and spatial scale.

There were several consistent cross-cutting themes that emerged from the discussion in the two day workshop. The importance of scale (level of spatial aggregation) and range (extent of spatial interaction) in the measurement of economic phenomena was identified. In this context, the importance of spatial analysis tools (and GIS) was recognized. However, it was also suggested that further work is needed to deal with the difficulties associated with an explicit spatial perspective in model specification, identification and closure (equilibrium conditions). Both spatial and time dynamics must be combined in order to construct realistic models of dynamic phenomena. Space is seen as crucial in the conceptualization of interaction and externalities, but the way in which space is modeled requires further consideration, especially the tradeoffs involved in the choice between discrete objects and continuous surfaces. In closing, it was felt that much remains to be done to demonstrate the precise extent to which space matters and how it affects substantive findings in a significant manner.

The six papers selected for this special issue only reflect a subset of these overarching themes. In Spatial Externalities, Spatial Multipliers and Spatial Econometrics,
Luc Anselin outlines a taxonomy of spatial econometric model specifications that incorporate spatial externalities in various ways. The point of departure is a reduced form expression for the spatial relations in which local or global spillovers are incorporated as spatial multipliers. From this, a structural form is derived that demonstrates how various perspectives on spatial externalities are translated into specific spatial econometric models. Several unfamiliar specifications result from this exercise, many characterized by a spatial moving average structure. In addition, the limitation of some more familiar models (such as models that incorporate spatial autoregressive structures) in terms of their interpretation as models for spatial externalities are made apparent. The empirical relevance of the range of specifications outlined in this paper remains to be investigated.

In *Innovation and Spatial Externalities*, David Audretsch focuses on knowledge externalities and the spatial extent of knowledge spillovers. While central to the economic theory of endogenous growth, knowledge as a factor of production is still not well understood. Audretsch refers to the vast empirical evidence on the spatial limits to spillovers. This contrasts with the existence of little theoretical basis to explain the localization, or why the spillovers stop where they do. Furthermore, there is a lack of insight into the micro foundations for urban and regional growth. It is argued that in order to understand the mechanisms that generate spatial spillovers, new measurement is needed to track the movement of knowledge workers and the origination of new firms. This will require different data sets from the ones commonly used now, as well as different methodologies to analyze these data.

Jan Brueckner focuses on applications of spatial econometric models in the empirical literature in *Strategic Interaction Among Governments, An Overview of Empirical Studies*. He starts by outlining a formal argument to distinguish between a spillover model (where an agent or jurisdiction is directly affected by the decision variables chosen elsewhere) and a resource flow model (where the availability of a resource at a location is affected by the decision variables at all other locations). Both models yield an identical reaction function that needs to be estimated. This function results in a spatial econometric specification that incorporates spatial dependence in the form of a spatially lagged dependent variable and/or a spatially correlated error term. The magnitude, significance and sign of the coefficient of the spatially lagged dependent variable indicate the type of strategic interaction. Brueckner reviews a number of empirical studies of spatial externalities, where the specification of the spatial regression equation is rather ad hoc, and not necessarily grounded in a formal model of the strategic interaction process. He stresses the importance of a sound theoretical basis for the application of spatial econometric models in empirical practice.

In *Modelling Population Stratification Across Locations, An Overview*, Dennis Eppe focuses on the market implications of spatial externalities. He argues for a joint testing of spatial externalities and their market implications, which allows for the identification of the spatial externalities. Eppe illustrates this point with three examples where the link between the externalities and the market implications creates a spatial stratification of the market outcomes: neighborhood schools (peer effects and endogenous sorting); social capital and endogenous neighborhoods (sorting of households along neighborhood characteristics); and peer effects in higher education (stratification of college quality). He suggests that these sorting models provide a general framework to handle a large array of spatial problems in economics.
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Bernard Fingleton considers spatial models of productivity trends in 200 European regions in Externalities, Economic Geography and Spatial Econometrics: Conceptual and Modeling Developments. By combining a spatial econometric (spatial lag) specification and a simulation, he is able to create maps reflecting the spatial distribution of equilibrium manufacturing productivity under different scenarios. The essence of this approach consists of augmenting the results of the estimation of a spatial econometric model with a simulation exercise. Fingleton outlines several important methodological issues that merit further attention. The choice of the spatial weights used in the model conditions all results. This embodies the way in which spatial (distance) decay should be treated. While this is currently specified exogenously (on the basis of geographic location), some promising alternatives include the use of flow information (information on contacts between firms, worker migration) and the incorporation of ideas from spatial interaction modeling. Additional technical issues discussed pertain to the use of maximum likelihood vs. instrumental variables estimators to yield the parameters for the simulations.

In Spatial Autocorrelation or Model Misspecification, Daniel McMillen similarly stresses the importance of specification issues in spatial econometric models, in the particular context of models used in urban economics. McMillen cautions that the high degree of parameterization of spatial lag and spatial error models may easily induce an incorrect structure for the covariance. He focuses in particular on the choice of the weights matrix and the resulting specification of distance decay. He advocates the use of local estimation techniques such as kernel estimation to extract the spatial structure. He also illustrates the usefulness of diagnostic checking by means of an analysis of spatial patterns in residuals and squared residuals. He stresses the choice of the appropriate functional form and the associated fundamental identification problem in cross-sectional data as an important and often overlooked question.

While an incomplete reflection of the full range of issues related to spatial externalities, the papers included in this issue raise several important concerns. They form a useful point of departure for future work on model formulation, estimation and interpretation.

References


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