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Spatial Externalities, Final Report

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FINAL REPORT

CSISS Specialist Meeting on Spatial Externalities
Upham Hotel
Santa Barbara, CA
January 11-13, 2001

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and
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May 1, 2001

Executive Summary

Following a recommendation by the CSISS Advisory Committee, a specialist meeting on "Spatial Externalities" was held at the Upham Hotel, Santa Barbara CA, January 11-13, 2001. The meeting participants consisted of a group of leading scholars from a range of fields in economics, including urban and regional economics/regional science, real estate economics, environmental economics and natural resource economics. The singular focus on economics as a discipline was motivated by the perceived lack of dissemination of a "spatial" perspective in economics relative to the progress made in other social sciences.

The objectives of the specialist meeting were two-fold:
- 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.
- To assess the infrastructure needs to enhance and facilitate spatial thinking in economics and other social sciences. Specifically, this included identifying critical needs for learning materials, topics suitable for the organization of workshops, priorities in software tool development and other materials for inclusion in the CSISS "virtual community" framework.

The meeting was organized around three main topics: theoretical perspectives on spatial externalities; methodological perspectives on spatial externalities; and spatial analysis in economic research. Each topic was introduced by a short overview presentation by the session moderator, followed by brief statements from a subset of the participants and then opened for general discussion. In addition, presentations were made on the overall goals of CSISS and the vision of "spatial analysis" as an integrating force, on the various CSISS programs dealing with learning materials, best practices and workshops and on the CSISS software tools program. Also, participants presented materials on promising data sources for use in the study of agglomeration economies and real estate analysis.

Some common themes that emerged from the wide ranging discussion were the importance of space and scale in the measurement of economic phenomena (particularly in the interaction between economics and natural phenomena), the role of space in the conceptualization of interaction, and the necessity of proper model specification, identification and closure (equilibrium conditions). Specific recommendations for future CSISS activities included holding specialist meetings on the role of space in real estate analysis and in environmental economics, and on the frontier of methods in spatial econometrics. Suggestions for workshops included a strong endorsement of existing workshops on spatial data analysis and a new workshop on locational equilibrium models (non-market valuation). In terms of software tools, the need was identified for a computational infrastructure, with an emphasis on modularity, and on a role for CSISS to serve as a clearing house for spatial analysis software (and data access). Interest was expressed to start a collection of best practices to promote spatial analysis in economics.

Introduction

The concept of "externalities" in general and "spatial externalities" in particular has gained considerable recent attention in economics. Both from a theoretical perspective as well as empirically, the explicit modeling of interacting agents (e.g., strategic interaction) rather than isolated agents has come to the fore in a range of sub-fields in economics (economic geography, labor economics, public, urban and real estate economics, environmental and natural resource economics, etc.). In addition, paradigms that emphasize increasing returns, path dependence and imperfect competition have led to a renewed interest in agglomeration economies and spatial externalities. Complementing this theoretical focus, 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 (spatial econometrics).

Following a recommendation of the CSISS Advisory Board, a specialist meeting was held to address the topic of "Spatial Externalities" at the Upham Hotel, Santa Barbara, CA, from January 11-13, 2001. The meeting brought together twenty leading scholars from different fields in economics. The singular focus on economics as a discipline was motivated in part by the perceived lack of dissemination of a "spatial" perspective in economics relative to the progress made in some of the other social sciences. A complete list of the participants is given as Appendix A. Further details on their background and affiliation, as well as the position papers that were prepared for the meeting, can be found at http://www.csiss.org/meetings/externalities/externalities.htm.

The meeting was organized by a Steering Committee chaired by Luc Anselin (University of Illinois, CSISS) and including Jan Brueckner (University of Illinois) and Robert Deacon (UCSB). The underlying overall motivation for the meeting was to identify the ways in which CSISS can support the development and dissemination of spatial theories and concepts, tools and techniques (such as geographic information systems), and formal analytic methods that will support research efforts.

Specific workshop objectives were two-fold:
- 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.
- To assess the infrastructure needs to enhance and facilitate spatial thinking in economics and other social sciences. Specifically, this included identifying critical needs for learning materials, topics suitable for the organization of workshops, priorities in software tool development and other materials for inclusion in the CSISS "virtual community" framework.

The two days of the meeting were organized along these main objectives. The first day was devoted to "Spatial Thinking: Theory, Concepts and Methods", the second to

"Spreading the Word: Spatial Tools, Dissemination, Training". Each day consisted of a set of presentations outlining ongoing CSISS activities as well as focused discussion around three specific themes. The themes consisted of: "Theoretical Perspectives on Spatial Externalities", "Methodological Perspectives on Spatial Externalities" and "Spatial Analysis in Economic Research". Each theme session was introduced by a moderator who presented a short overview of salient issues and concerns. This was followed by a series of brief presentations by a subset of the participants, after which the discussion was opened to all participants. A detailed list of speakers and session moderators is given in the Meeting Agenda, attached as Appendix B.

Presentations on CSISS activities started with an introduction and motivation of spatial analysis as an integrating factor in social research by Mike Goodchild (CSISS, UCSB). Other presentations included an overview of learning resources activities, workshops and the web programs organized under the CSISS umbrella by Don Janelle (CSISS. UCSB) and an outline of the activities in the software tools program by Luc Anselin (CSISS, University of Illinois). Each of these presentations was followed by an open discussion.

In addition, and in part in reaction to the overall discussion, Stuart Rosenthal (Syracuse) demonstrated the Imarket data base with geocoded information on individual firms and its potential use in the analysis of agglomeration economies and spatial dynamics of firm locations. Also, Susan Wachter (University of Pennsylvania) and Ayse Can Talen (Fannie Mae Foundation) outlined a series of publicly available databases and "research maps" (Rmaps) provided by the Department of Housing and Urban Development, which can form the basis for a wide range of spatial analysis of social questions.

In the remainder of this report, first a summary is provided of the discussion that followed the initial introduction of participants and Goodchild's presentation on space as an integrating force. Next, each of the three main theme sessions will be summarized and the main conclusions outlined. Finally, a summary is presented of the recommendations made for future CSISS activities and some suggestions for specific action items.

Space as an Integrating Force

Following the presentation by Goodchild on the overall objectives of the CSISS project, a vigorous discussion ensued regarding the importance of space, the potential for it to be an integrating force and some general aspects related to spatial information and GIS.

Major points raised were:
- The qualitative aspects of spatial information: lack of precision (fuzzy analysis), predominance of spatial dependence, questions of scale and level of aggregation.
- The importance of spaces other than "geographic", such as social space (social capital), and distance metrics other than Euclidean (social distance, economic distance)
- The importance of integrating space and time, adding the time dimension to spatial analysis.

- The importance to go beyond the limitations of current GIS technology, focus on the transfer and use of spatial information (even by non-technical users), assessing the value of spatial information and the need for powerful behavioral models to drive the spatial analysis.
- The consideration of alternative frameworks (rather than space) to obtain integration in social science, such as cognitive science.
- The question of the proper unit of analysis, contrasting to physical sciences where scale is treated at the process level.
- The seeming dichotomy between measurement and data-driven analysis (exploratory) and the use of stylized models that require empirical verification (hypothesis testing). The emergency of some intermediate ground with more robust models that are heavily inspired by advances in observational tools.

The overall emphasis on issues of scale, aggregation, specification and space-time dynamics would also characterize the discussion in the specific "theme" sessions.

Theoretical Perspectives on Spatial Externalities

This first theme session was moderated by Jan Brueckner, who introduced the topic with a review of issues related to spatial interaction and spatial econometrics. Other speakers were David Audretsch, Gardner Brown, Carol McAusland, Stuart Rosenthal, Kerry Smith and Jon Sonstelie.

Jan Brueckner outlined 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 indicates the type of strategic interaction. Brueckner raised an issue related to many empirical studies of spatial externalities, where the specification of the spatial regression equation is ad hoc, and not based on a formal specification of the strategic interaction process. He stressed the importance of a sound theoretical basis for the application of spatial econometric models in empirical practice.

David Audretsch focused his remarks 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. He referred to the vast empirical evidence on the spatial limits to spillovers, although there is little theoretical basis to explain the localization, why the spillovers stop where they do, or the micro foundations for urban and regional growth. 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. He pointed out that this will require

different data sets from the ones commonly used now, as well as different methodologies to analyze these data.

Gardner Brown dealt with the need to incorporate space explicitly into natural resource models in order to better understand human behavior and to address policy questions. In this context, he stressed the necessity to add the time dimension. Accounting for the precise configuration of space and location leads to measurement issues that greatly impact the outcomes (costs and benefits) of models. When spatial heterogeneity (spatially separated nodes) is introduced, models become intractable analytically and new solution methods are required. He illustrated his remarks with examples from the spotted owl preservation in old growth forests and barnacle harvesting in coastal areas.

Carol McAusland situated her comments in the context of the changing effect of transport costs on international trade. The overall lowering of transport costs has diminished cultural differences, created a global society and increased the chances of externalities such as the accidental introduction of species. Whereas traditionally trade occurred between complementary natural environments, increasingly this is between similar environments, which may add to the risk of harmful invasions. These complex interactions are still not well understood.

Stuart Rosenthal focused on the role of agglomeration economies and spatial variability in the concentration of activities (manufacturing). Different theoretical explanations have been suggested for this phenomenon (labor market pooling, input sharing, knowledge spillovers), but little is known about the precise spatial decay (attenuation) and the exact role of proximity. Rosenthal illustrated this point with some examples from his empirical work. This utilizes a detailed and geo-coded micro data base of establishments in combination with spatial analytical techniques to study the spatial patterns in localization coefficients for different distance rings. He emphasized the need for a refined view of geography and the use of technologies to incorporate space at a high resolution. He called for further development and understanding of measures of spatial concentration such as a spatial Gini coefficient and the Ellison-Glaeser index of concentration.

Kerry Smith discussed the importance of location and space in environmental economics. He outlined four areas where space is central: the modeling of transport systems (where transport coefficients indicate how an effect moves from its origin to a recipient); non-market valuation (where a "quality" needs to be attached to a location); locational equilibrium models (where the spatial unit is treated as a discrete commodity) and policy experiments (where spatial differences may be exploited to gain further information). Crucial in each of these topics is the definition of the spatial unit, the consideration of space (neighborhood) as endogenous or exogenous, and the additional complexity (both theoretical as well as numerical) introduced by the explicit consideration of space.

Jon Sonstelie illustrated with a simple spatial model of crime how spatial externalities in the form of increasing returns can induce multiple equilibria. This contrasts with a non-spatial model where a single equilibrium follows. He raised questions about the testability of the spatial models and issues pertaining to the definition of the spatial units

(neighborhoods). He stressed the methodological challenges that follow from the fact that space defines the market space for behavior but does not necessarily follow political boundaries.

The ensuing open discussion identified a number of common issues:

- The role of dynamics and the consequences for equilibrium solutions. What are the dynamic ramifications of considering cross-sectional models?
- What are the proper behavioral units? How do space and boundaries matter? Is space discrete or continuous? What are the ramifications for theory?
- How can the endogeneity of space be accounted for? Are events in space purely random or structured? Can theoretical constructs be properly identified in empirical work?
- What is the potential for overarching explanatory models, such as a general theory of movement (Alonso) or space-time mean value equation models from physics (Haag-Weidlich).
- Spatial sciences are complex and require an accounting for a spatial dynamic reality.

Methodological Perspectives on Spatial Externalities

The second theme session focused on methodological issues and was moderated by Luc Anselin. Anselin set the tone by reviewing a number of outstanding issues in spatial econometrics. His remarks were followed by short presentations by Antonio Bento, Nancy Bockstael, Ayse Can-Talen, Bernard Fingleton, Daniel McMillen and James Murdoch.

Luc Anselin motivated the need for a specialized methodology for spatial data analysis both because of the abundance of geo-coded data as well as on theoretical grounds, as the tool required to empirically verify models of interaction. Four major issues related to the specification of spatial models were mentioned: setting the proper range of interaction (geographic notions of space vs. general notions of space); the substantive interpretation of spatial effects (true contagion vs. apparent contagion, identification problems, ecological inference); the incorporation of space-time dynamics (panel data with spatial effects); and the handling of discrete outcomes in space (spatial latent variable models). He briefly reviewed existing estimation methods and outlined a number of promising frontier areas where much progress is being made: non-parametrics, local estimators, Bayesian hierarchical models and simulation estimators. A number of hanging issues pertain to the use and potential of simulating spatial processes, a need to further develop methods for space-time forecasting and a better understanding of the "alternative" models (that is, models that incorporate spatial dependence) that are most useful in the development of diagnostics for spatial effects.

Antonio Bento addressed data problems in his remarks, primarily in the context of transportation and urban modeling. He questioned whether the data produced by various agencies are adequate for spatial modeling needs. He illustrated this with the example of how to characterize the spatial characteristics of metro areas and cited problems

associated with distance/travel cost being endogenous. He emphasized the importance of the proper spatial resolution and the issue of confidentiality and privacy encountered in this regard. He suggested that CSISS might play a role in ensuring that Federal Agencies provide such information and pointed to the need to support wider data availability.

Nancy Bockstael outlined a number of methodological issues encountered in modeling fragmented land use patterns (specifically, land use conversion in the Chesapeake region). While this is a context with substantial data availability, as such this is insufficient to identify the behavioral processes that drive the land market. This involves aggregating up individual micro decisions to the level of a land market in order to extract price signals. Problems of identifiability and endogeneity abound. There is a need for models that include both temporal as well as spatial dynamics, such as hazard models with space-time dependence, endogenous interaction models, mean-value interaction models, or cellular automata models, but each of these has its limitations and most are difficult to implement for realistically sized problems. A major challenge remains how to effectively use the temporal dimension in conjunction with the spatial dimension.

Ayse Can-Talen commented on the importance of neighborhood effects and spatial externalities in the modeling of house prices and values. The use of spatial econometric hedonic models that incorporate a spatially lagged dependent variable or a spatial error structure yield better results, but several challenges remain. Specifically, the spatial scale of spillovers or externalities is difficult to ascertain, appropriate GIS-based methods may be needed to specify flexible spatial weights structures. In situations with very large data sets it becomes difficult to distinguish different types of spatial models, more research is needed on the properties of diagnostics in this context. Further work is needed on the joint modeling of space and time effects (for example, appreciation and depreciation trends), sophisticated methods are needed that allow for the incorporation of spatial effects in panel data models.

Bernard Fingleton couched his remarks in the context of spatial models of productivity trends in 200 European regions. 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. Several important methodological issues 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) 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 pertain to the use of maximum likelihood vs. instrumental variables estimators to yield the parameters for the simulations.

Daniel McMillen similarly stressed the importance of specification issues in spatial econometric models, in the context of models used in urban economics. He cautioned that the high degree of parameterization of spatial lag and spatial error models may easily

induce an incorrect structure for the covariance. He focused in particular on the choice of the weights matrix and the resulting specification of distance decay. He advocated the use of local estimation techniques such as kernel estimation to extract the spatial structure. He also illustrated the usefulness of diagnostic checking by means of an analysis of spatial patterns in residuals and squared residuals. An important and often overlooked question is the choice of the appropriate functional form and the associated fundamental identification problem in cross-sectional data.

James Murdoch focused on data integration problems encountered in environmental economics. He provided the example of assessing the impact of air quality on property values, where information from a number of air quality monitoring stations is used to estimate an air quality surface for an urban area (the LA basin). Several methods have been suggested to address this interpolation question, but they yield different results, and little is known about the effect of these methodological choices on the ultimate model. He also pointed out problems resulting from boundary issues and outlined a number of different approaches to deal with these methodological issues, such as hierarchical modeling (HLM) and geostatistical techniques. He suggested the consideration of advanced GIS techniques to extract a hierarchical structure.

The discussion that followed centered on issues of model specification, identification and the consideration of alternative approaches, mostly in the context of models for land use and urban housing markets. The following issues were raised:
- What is the potential of geostatistical techniques (kriging) or Bayesian network analysis in dealing with highly irregular spatial units in economics. Are there commonalities from time series analysis that could be exploited in spatial analysis?
- How can the issue of the specification of the spatial weights be addressed (parameterization, use of local estimation techniques).
- What is the market mechanism in spatial markets: are asset prices jointly or conditionally determined, how can ideas from the efficient market literature be exploited, how are bubbles modeled in spatial markets.
- How can better insight be gained from commercially available data (e.g., on comparable sales in real estate) that is based on standard industry software. How can these data sets be related to the actual information sets of the agents.

Spatial Analysis in Economic Research

The third thematic session was moderated by Robert Deacon, who started by outlining a classification of research ideas where spatial insights have been prominent. Short presentations were made by Dennis Epple, Charles Kolstad, Peter Nijkamp, Susan Wachter and James Wilen.

Robert Deacon stressed the need for economists to devote similar attention to the space domain as has traditionally been given to the time domain. He outlined four areas where space plays an important role. From a theoretical perspective, accounting for space creates problems such as non-convexities, increasing returns, multiple local equilibria,

and path dependence. In addition, since there is no natural way to draw economic boundaries, aggregation problems are pervasive. When dealing with spatial models, identification becomes problematic (e.g., lag vs. error models). He suggested that the study of land use (i.e., the spatial configuration of economic activity) is the area in economics where a spatial (and spatial econometric) approach can be most important, since the predominant perspective based on landscape ecology ignores price systems. Two other important fields in economics where spatial analysis shows great potential are natural resource economics and the study of spillovers and sorting. Renewable resources are distributed across space and behavioral models are needed to handle the interaction between economics and ecology. These must address realistic aspects of the data such as contiguity and fragmentation. Moreover, many natural resource policies have an explicit spatial component suggesting that greater attention needs to be paid to spatial modeling. The study of spillovers and different sorting mechanisms can similarly be enriched by a more explicit consideration of the spatial component.

Dennis Epple focused on the market implications of spatial externalities. He argued for a joint testing of spatial externalities and their market implications, which allows for the identification of the spatial externalities. He illustrated this point with three examples where the link between the externalities and the market implications create 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 suggested that these sorting models provide a general framework to handle a large array of spatial problems in economics.

Charles Kolstad focused on the challenges posed by spatial characteristics in four areas in resource and environmental economics. First, he considered the issue of constructing estimable models for situations where demand and supply are spatially dispersed and the complete transport cost structure may be poorly known (coal supply model, Hotelling beach problem). Similar problems with implementing realistic models are encountered in the study of demand for environmental goods. Most approaches (such as revealed preferences, hedonic models) rely on partial equilibrium conditions while full equilibrium models are difficult to implement. In natural resource damage assessment, there may be close spatial substitutes for the losses, but so far this aspect of the problem has not been dealt with in the literature. Finally, he pointed out the difficulty in handling spatial differences in regulatory design since most environmental problems are encountered in a context where the spatial aspects are significant.

Peter Nijkamp took primarily a meta analytic perspective in his discussion of spatial aspects associated with environmental externalities. He noted the importance of comparing methods and accepted insights across disciplines and illustrated this by contrasting environmental economics and ecological economics. Each stresses different central concepts, such as externalities and market mechanisms in environmental economics, and bio dynamics and diversity in ecological economics. He highlighted the role of scale, both in terms of the appropriate time horizon as well as in terms of spatial range and unit. A central concept in this respect is the notion of "ecological footprint" to

address the problem that environmental externalities are often not constrained to spatially demarcated boundaries. He outlined a framework to model the interactions among different domains. Nijkamp closed with some suggestions for a research agenda for spatial externalities: the importance for computable general equilibrium models (CGE) to include explicit resource and environmental components; an intensified effort at research synthesis; a synthesis of methodology and model design; and an increased comparisons of spatially segmented studies.

Susan Wachter started her remarks by raising the question that the importance of "spatial" externalities is by no means accepted in mainstream economics. A central question remains whether space matters and how it matters. In this context, there are important measurement issues, especially in a policy arena. She illustrated this point with two examples from large social experiments to study the importance of social capital. One set of studies of Chicago neighborhoods demonstrated the existence of spatial externalities at the neighborhood level, although the exact drivers of this phenomenon are still poorly understood. A second example dealt with the overall policy of neighborhood improvement, where a lack of appropriate neighborhood indicators is an impediment to better understanding.

James Wilen outlined a number of examples of models that integrated biology and economics, specifically in the context of the management of marine reserves. He outlined a range of models of "patchy biological systems" differentiated by the degree of integration between the biological and economic spheres and the extent to which space was explicitly accounted for (fully integrated models, closed models, spatially-linear models, and sink-source models). He illustrated in a number of simulation experiments how the equilibrium outcomes of the models, and their corresponding spatial imprint varied. He closed by stressing the importance of using realistic models to depict spatial flows.

The ensuing discussion was centered around conceptual and methodological aspects of the use of hedonic models and the implications for spatial analysis of "integrated" modeling frameoworks. Some recurring themes were:
- The importance of equilibrium conditions and their sensitivity to the conceptualization of space.
- The use of multiple markets to aid in identification of spatial models.
- The value of modeling discrete spatial objects vs. continuous surfaces
- The issue of scale (mesh size) and appropriate distance metrics.

Summary and Recommendations

The discussion during the two day workshop, while touching on a wide array of subjects, revealed a number consistent cross-cutting themes:
- The importance of scale (level of spatial aggregation) and range (extent of spatial interaction) in the *measurement* of economic phenomena and the importance of spatial analysis tools (and GIS) in this respect.

- The role of space in the conceptualization of interaction and externalities; the importance of the way in which space is modeled (discrete objects, continuous surface).
- The importance of combining both spatial and time dynamics.
- The difficulties that are introduced by an explicit spatial perspective in model specification, identification and closure (equilibrium conditions).
- The remaining question of how space matters and if it affects substantive findings in a significant manner.

While the emphasis in the discussion was primarily on modeling and conceptual issues, a number of suggestions were formulated for future CSISS infrastructure activities.

Workshops
- Importance of workshops for spatial data analysis, spatial econometrics of space-time (panel) data, spatial econometrics of discrete dependent variables
- Possible new workshops on locational equilibrium models (non-market valuation)
- Workshops/specialist meetings in fields in economics where the spatial perspective has already gained some acceptance. Examples suggested were real estate economics and environmental/natural resource economics.
- Workshop/specialist meetings on the state of the art in spatial econometrics/spatial statistics.

Tools
- Lower the extent of mismatch between the methods GIS provides and what economists need.
- Tools as a computational infrastructure, portable across models.
- Flexible structure for GIS systems, no preconditioned by specific problems.
- Advancing observational tools.
- Developing a clearing house of spatial data analysis software.

Resources
- Compilation of examples of "good" applications of spatial econometric analyses.
- Advance and facilitate data analysis and access to data sources.

In conclusion, it was felt that CSISS should continue to address the issue that economists are currently not sufficiently aware of the spatial perspective. Therefore, there was a general sense that the group could not (yet) effectively inform future development of spatial tools. It was also felt that continued efforts at overcoming disciplinary divides will be crucial in promoting a spatial perspective.

Postscript

A subset of participants agreed to submit a short paper expanding on their position statement and remarks at the meeting for publication consideration in a symposium issue of the *Papers in Regional Science*.

Appendix A. Meeting Participants

Steering Committee

Luc Anselin, Chair
    Dept. Agricultural and Consumer Economics
    University of Illinois, Urbana-Champaign

Jan K. Brueckner
    Dept. Economics
    University of Illinois, Urbana-Champaign

Robert Deacon
    Dept. Economics
    University of California, Santa Barbara

Invited Participants

David B. Audretsch
    Institute for Development Strategies
    Indiana University

Antonio Bento
    Donald Bren School of Environmental Science and Management
    University of California, Santa Barbara

Nancy E. Bockstael
    Dept. of Agricultural and Resource Economics
    University of Maryland

Gardner Brown
    Dept. of Economics
    University of Washington

Dennis N. Epple
    Graduate School of Industrial Administration
    Carnegie Mellon University

Bernard Fingleton
    Dept. of Land Economy
    University of Cambridge

Charles D. Kolstad
    Dept. of Economics
    University of California, Santa Barbara

Carol McAusland
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Ayse Can Talen
    Office of Policy Development and Research
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Susan M. Wachter
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James E. Wilen
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    University of California, Davis

CSISS Participants

Helen Couclelis
    Geography
    University of California, Santa Barbara

Michael Goodchild
	Geography
	University of California, Santa Barbara

Don Janelle
	CSISS Program Director
	University of California, Santa Barbara

Appendix B. Meeting Agenda

January 11-13, 2001
Upham Hotel, Santa Barbara, CA
Agenda

Thursday 1/11

5-7pm Informal wine and cheese, Upham Hotel
       Dinner on your own

Friday 1/12. ***Spatial Thinking: Theory, Concepts and Methods (Garden Room)***

8:30   *Welcome, Workshop Goals and Organization*
       Luc Anselin, UIUC/CSISS
8:45   *Participant Introduction*
       short introduction, affiliation, interests < 2min/person
9:30   *Motivation, Objectives and Organization of CSISS*
       Michael Goodchild, UCSB/CSISS

10:15 Coffee break

10:45 *Position Statements*
       Chair, Luc Anselin, UIUC/CSISS
       Round table with brief summary by each participant of their position statement
       regarding the value of spatial thinking, approaches towards modeling and
       understanding spatial externalities, spatial methodology
       Presentations followed by open discussion

12:30 Lunch in Upham garden

1:30   *Theoretical Perspectives on Spatial Externalities*
       Chair, Jan Brueckner, UIUC
       Short presentations by selected participants, followed by open discussion on the
       contribution of spatial thinking to economic theory, the role of space (and spatial
       analysis) as a means vs. end, critical impediments, future directions, etc.
       Lead-off speakers: Audretsch, Brown, McAusland, Rosenthal, Smith, Sonstelie
       Presentations followed by open discussion

3:00   Coffee break

3:30   *Methodological Perspectives on Spatial Externalities*
        Chair, Luc Anselin, UIUC/CSISS
        Short presentation by selected participants followed by open discussion of the
        contribution of spatial econometrics, alternative inferential paradigms, the limits
        to ecological inference, large data set issues, etc.
        Lead-off speakers: Bento, Bockstael, Can-Talen, Fingleton, McMillen, Murdoch
        Presentations followed by open discussion

5:00   Summary

6:30   Informal wine/chees, Upham Hotel lobby

7:00   Dinner at Baccio's, 905 State Street (within walking distance)

Saturday 1/13. **Spreading the Word: Spatial Tools, Dissemination, Training (Garden
        Room)**

8:30   *CSISS Learning Resources, Workshops and Web Programs*
        Don Janelle, UCSB/CSISS
9:15   Open discussion of priorities for learning resources, etc., as they pertain to the
        research agenda for spatial externalities

10:15 Coffee break

10:45 *CSISS Spatial Tools*
        Luc Anselin, UIUC/CSISS
11:30 Open discussion of priorities regarding software tools for spatial analysis

12:30 Lunch in the Upham garden

1:30   *Spatial Analysis in Economic Research*
        Chair, Bob Deacon, UCSB
        Short presentations by selected participants, followed by open discussion of the
        role and importance of specific spatial analytical frameworks/concepts/methods to
        research questions in economic fields
        Suggestions for future activities, action items to build an effective research
        infrastructure to promote the use of spatial analysis in economic research
        Lead-off Speakers: Epple, Glaeser, Kolstad, Nijkamp, Wachter, Wilen
        Presentations followed by open discussion

3:00   Coffee break

3:30   *Summary Comments*

4:00   Workshop Ends

Example Sources Using Spatial Econometric Methods in Empirical Work in Economics

Books

- Anselin, L. (1988). *Spatial econometrics, methods and models*. Boston: Kluwer.

Edited Volumes

- Anselin, L. and R. Florax (1995). *New directions in spatial econometrics*. Heidelberg: Springer-Verlag.

Special Journal Issues

Special issues devoted to spatial econometrics (mostly methodological papers, but several are empirical)

- *Journal of Real Estate Finance and Economics* 17, 1998. Special Issue on Spatial Statistics and Real Estate
- *International Regional Science Review* 20, 1997. Special Issue on Spatial Econometrics.
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