

ECO 82900

Spatial Econometrics

City University of New York – Graduate Center
Fall 2019, R 9:30-11:30, 365 5th Ave, Room 5383

Instructor Contact Information

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Office hours: T 2:30-4:00, and by appointment

Course Pre-requisites, Co-requisites, and/or Other Restrictions

There are no formal prerequisites for this class, apart from enrollment in CUNY Graduate School. However, students are expected to have completed graduate courses in econometrics.

Course Description

This course provides an introduction to spatial econometrics. Spatial econometrics is concerned with the spatial aspects present in cross-sectional and space-time observations. Space is interpreted not merely in a geographic sense but also in an economic or sociological sense.

Learning Objectives

At the end of the course, students are expected to be able to:

1. Quantify spatial dependence in empirical variables
2. Appreciate and interpret spatial aspects of economic relationships from geographic and non-geographic perspectives
3. Understand spatial econometric estimation methods
4. Explain the conditions for identification of spatial models
5. Use statistical/econometrics software to estimate models with spatial elements
6. Test and interpret estimated relationships that contain spatial elements

Assessment: Grading Policy, Assignments, and Exam Dates

Assessment is based on two exams, several homework assignments, and a project proposal. The weights of these components are:

Midterm exam (24 October).....	35 %
Final exam (19 December).....	35 %
Homework assignments.....	15 %
Project proposal (due on 12 December).....	15 %

The midterm exam covers the more introductory material of the course and thus relates to learning objectives (1), (2) and (3).

The final exam is not cumulative but rather covers material discussed in the second half of the semester. Thus, it covers the more advanced topics of the course and relates to learning objectives (2), (3), (4), and (6).

The homework assignments focus on the practical process of estimation. We will discuss packages available in R that allow spatial analysis of various kinds: graphics, analysis, estimation. Homework assignments may be answered with other software, but there is no guarantee that a particular assignment can be worked out with the software of your choice if it is not R. Homework assignments are related to learning objectives (1), (5) and (6).

The aim of the project proposal is to draft the outlines of a research project that utilizes spatial econometrics techniques. A successful paper outlines the research question, the relevant background in economic theory, the reason for spatial econometrics or socioeconomic interactions, the nature of the data that are needed for this project (whether in existence or not), and the type of spatial econometric model that can address the research question. This assignment relates to learning objectives (2), (3), (4), and (6).

Important Dates

- 5 September: No class (on this Thursday, GC follows a Monday schedule)
- 16 September: Last day for filing Add/Drop changes without getting a W grade
- 24 October: Midterm exam
- 5 November: Last day to file for an unevaluated withdrawal (W) from the course
- 28 November: No class (Thanksgiving Day)
- 12 December: Due date for project proposal
- 19 December: Final exam

Reading Assignments

The following reading assignments are still tentative. Readings with an asterisk are expected to be the primary focus.

General sources

- L. Anselin (1988). *Spatial Econometrics: Methods and Models*. Dordrecht: Kluwer.
- L. Anselin (2001). "Spatial econometrics." In B. Baltagi, ed., *A Companion to Theoretical Econometrics*. Wiley, Ch.14.
- L. Anselin (2006). "Spatial econometrics." In T.C. Mills and K. Patterson, eds., *Palgrave Handbook of Econometrics. Vol. 1 Econometric Theory*. New York: Palgrave MacMillan, Ch.26.
- J. LeSage and R.K. Pace (2009). *Introduction to Spatial Econometrics*. Boca Raton, FL: CRC Press.
- J.P. Elhorst (2014). *Spatial Econometrics: From Cross-Sectional Data to Spatial Panels*. Heidelberg: Springer.
- H. Kelejian and G. Piras (2017). *Spatial Econometrics*. Cambridge, MA: Academic Press
- M.D. Ward and K.S. Gleditsch (2018). *Spatial Regression Models*. 2nd ed. Thousand Oaks: Sage Publications
- Bivand, Roger S., Pebesma, Edzer J., Gómez-Rubio, Virgilio (2008), *Applied Spatial Data Analysis with R*, Springer.
- N. Cressie (1993), *Statistics for Spatial Data*, Wiley.

Tentative Outline (subject to change)

1. Introduction

Various examples from the literature

- M. Bailey, R. Cao, T. Kuchler, J. Stroebel, and A. Wong (2018). "Social Connectedness: measurement, determinants, and effects." *Journal of Economic Perspectives*, 32:3, 259-280. See also an earlier version (2017): "Measuring social connectedness." NBER Working Paper 23608. Cambridge MA: NBER.

An introduction to R

2. Spatial Statistics:

- a. Examining data for spatial continuity

- *N. Cressie (1993), *Statistics for Spatial Data*, Wiley, chapters 2-3.
- *Bivand, Roger S., Pebesma, Edzer J., Gómez-Rubio, Virgilio (2008), *Applied Spatial Data Analysis with R*, Springer, chapters 8-9.
- H. Kelejian and I.R. Prucha (2001). "On the asymptotic distribution of the Moran I test statistic with applications." *Journal of Econometrics*, 104, 219–257.
- K.P. Lin, Z. Long, and B. Ou (2011). "The size and power of bootstrap tests for spatial dependence in a linear regression model." *Computational Economics*, 38:2, 153-171.
- F. Jin and L.F. Lee (2015). "On the bootstrap for Moran's I test for spatial dependence." *Journal of Econometrics*, 184, 295-314.
- *C. Ertur and W. Koch (2006). "Regional disparities in the European Union and the enlargement process: an exploratory spatial data analysis, 1995-2000." *Annals of Regional Science*, 40, 723-765.
- b. In Search of W
- *A. Getis and J. Aldstadt (2004). "Constructing the spatial weights matrix using a local statistic." *Geographical Analysis*, May, 36:2, 90-104.
- *J. Aldstadt and A. Getis (2006). "Using AMOEBA to create a spatial weights matrix and identify spatial clusters." *Geographical Analysis*, October, 38, 327-343.
- E. Fernández-Vázquez, M. Mayor-Fernández, and J. Rodríguez-Vález (2009). "Estimating spatial autoregressive models by GME-GCE techniques." *International Regional Science Review*, April, 32:2, 148-172.
- *R. Harris, J. Moffat, and V. Kravtsova (2011). "In search of 'W'." *Spatial Economic Analysis*, September, 6:3, 249-270.
- J. Mur and J.H.P. Paelinck (2011). "Deriving the W -matrix via p-median complete correlation analysis of residuals." *Annals of Regional Science*, October, 47, 253-267.
- M. Beenstock and D. Felsenstein (2012). "Nonparametric estimation of the spatial connectivity matrix using spatial panel data." *Geographical Analysis*, July, 44, 389-397.
- H. Seya, Y. Yamagata, and M. Tsutsumi (2013). "Automatic selection of a spatial weight matrix in spatial econometrics: Application to a spatial hedonic approach." *Regional Science and Urban Economics*, May, 43, 429-444.
- A. Ermagun and D. Levinson (2018). "An introduction to the network weight matrix." *Geographical Analysis*, 50, 76-96.
3. Software for spatial statistics and spatial econometrics
- *Bivand, Roger S., Pebesma, Edzer J., Gómez-Rubio, Virgilio (2013), *Applied Spatial Data Analysis with R*, 2nd ed., Springer, chapters 2, 8, and 9 (and 3 and 4).
4. Estimation of spatial-econometric regression models
- a. Basic models and Interpretation of estimates
- *L. Anselin (2006)
- *J. LeSage and R.K. Pace (2009), chapters 1-2
- J. Elhorst (2014), Section 2.7
- b. OLS estimation with HAC standard errors
- *H.H. Kelejian and I.R. Prucha (2007). "HAC estimation in a spatial framework." *Journal of Econometrics*, Sept, 140:1, 131-154.
- c. Maximum likelihood estimation
- *L. Anselin (2006), Section 5.2.

L.F. Lee (2004). "Asymptotic distributions of quasi-maximum likelihood estimators for spatial autoregressive models." *Econometrica*, Nov 2004, 72:6, 1899-1925.

d. GMM estimation

*L. Anselin (2006), Section 5.3.

*H.H. Kelejian and I.R. Prucha (1998). "A generalized spatial two stage least squares procedure for estimating a spatial autoregressive model with autoregressive disturbances." *Journal of Real Estate Finance and Economics*, 17, 99-121.

*H.H. Kelejian and I.R. Prucha (1999). "A generalized moments estimator for the autoregressive parameter in a spatial model." *International Economic Review*, 40:2, 509-533.

*L.-F. Lee (2003). "Best spatial two-stage least squares estimators for a spatial autoregressive model with autoregressive disturbances." *Econometric Reviews*, 22:4, 307-335.

*H.H. Kelejian, I.R. Prucha, and Y.Yuzefovich (2004). "Instrumental variable estimation of a spatial autoregressive model with autoregressive disturbances." In J.P. LeSage and R.K. Pace, eds., *Advances in Econometrics: Spatial and Spatiotemporal Econometrics*, Oxford: Elsevier, pp. 163-198.

*B. Fingleton (2008). "A generalized method of moments estimator for a spatial model with moving average errors, with application to real estate prices." *Empirical Economics*, 34:1, 35-57.

*O. Doğan and S. Taşpınar (2013). "GMM estimation of spatial autoregressive models with moving average disturbances." *Regional Science and Urban Economics*, 43:6, 603-926.

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*X. Lin and L.-F. Lee (2010). "GMM estimation of spatial autoregressive models with unknown heteroskedasticity." *Journal of Econometrics*, 157, 35-52.

*H.H. Kelejian and I.R. Prucha (2010). "Specification and estimation of spatial autoregressive models with autoregressive and heteroskedastic disturbances." *Journal of Econometrics*, 157:53-67.

*S. Taşpınar, O. Doğan, and A.K. Bera (2019). "Heteroskedasticity-consistent covariance matrix estimators for GMME of spatial autoregressive models." *Spatial Economic Analysis*, 14:2, 241-268. doi:10.1080/17421772.2019.1549366 (Also, SSRN paper ID 3074765)

X. Liu, L.-F. Lee, and C.R. Bollinger (2010). "An efficient GMM estimator of spatial autoregressive models." *Journal of Econometrics*, 159, 303-319.

D.M. Drukker, P. Egger, and I.R. Prucha (2013). "On two-step estimation of a spatial autoregressive model with autoregressive disturbances and endogenous regressors." *Econometric Reviews*, 32:5-6, 686-733.

D. Das, H.H. Kelejian, and I. Prucha (2003). "Small sample properties of estimators of spatial autoregressive models with autoregressive disturbances." *Papers in Regional Science*, 82:1, 1-26.

*O. Dogan, S. Taspınar, and W. Vijverberg (2018). "GMM Inference in spatial autoregressive models." *Econometric Reviews*, 37:8, 931-954, DOI: 10.1080/00927872.2016.1178885.

Breitung, J., & Wigger, C. (2018). "Alternative GMM estimators for spatial regression models." *Spatial Economic Analysis*, 13(2), 148–170. (Also: U of Cologne, WP 0089, 2017)

e. Computational concerns

J. LeSage and R.K. Pace (2009), chapter 4

*G. Arbia, C. Ghiringhelli, and A. Mira (2019). "Estimation of spatial econometric linear models with large datasets: How big can spatial Big Data be?" *Regional Science and Urban Economics*, 76, 67-73.

- *T. Smith (2009). "Estimation bias in spatial models with strongly connected weight matrices." *Geographical Analysis*, 41:3, 307-332.
- f. Higher order spatial autoregressive models
 L.F. Lee and X. Liu (2010). "Efficient GMM estimation of high order spatial autoregressive models with autoregressive disturbances." *Econometric Theory*, 26 (1), 187–230.
 H.H. Kwok (2019). "Identification and estimation of linear social interaction Models." *Journal of Econometrics*, 210, 434-458.
5. Endogenous explanatory variables
 *B. Fingleton and J. Le Gallo (2007). "Finite sample properties of estimators of spatial models with autoregressive or moving average disturbances and system feedback." *Annales d'Economie and de Statistique*, 87/88, 39-62.
 *B. Fingleton and J. Le Gallo (2008). "Estimating spatial models with endogenous variables, a spatial lag, and spatially dependent disturbances: finite sample properties." *Papers in Regional Science*, 87, 319-339.
 *H.H. Kelejian and I. Prucha (2004). "Estimation of simultaneous systems of spatially interrelated cross sectional equations." *Journal of Econometrics*, 118:1, 27-50.
 D.M. Drukker, P. Egger, and I.R. Prucha (2013). "On two-step estimation of a spatial autoregressive model with autoregressive disturbances and endogenous regressors." *Econometric Reviews*, 32:5-6, 686-733.
6. Testing for spatial interactions in a spatial econometric model
 *L. Anselin, A.K. Bera, R. Florax, M.J. Yoon (1996). "Simple diagnostic tests for spatial dependence." *Regional Science and Urban Economics*, 26:1 (January), 77-104.
 *L. Anselin (2006), Section 6.
 F. Windmeijer (2005). "A finite sample correction for the variance of linear efficient two-step GMM estimators." *Journal of Econometrics*, 126:1, 25-51.
 *O. Dogan, S. Taspınar, and W. Vijverberg (2016). "GMM Inference in Spatial Autoregressive Models." *Econometrics Reviews*, 2018, 37:8, 931-954. (DOI: 10.1080/00927872.2016.1178885).
 *O. Doğan, S. Taşpınar, and A.K. Bera (2019). "Simple tests for social interaction models with network structures." *Spatial Economic Analysis*, 13:2, 212-246. <https://doi.org/10.1080/17421772.2017.1374550> (Also, MPRA Munich Personal RePeC Archive Paper 82828, 2017)
7. Specifying and identifying spatial relationships
 a. *Various applications*
 *B. Sacerdote (2001). "Peer effects with random assignment: results for Dartmouth roommates." *Quarterly Journal of Economics*, 116:2, 681-702.
 *M. Bertrand, E.F.P. Luttmer and S. Mullainathan (2000). "Network effects and welfare cultures." *Quarterly Journal of Economics*, 115:3, 1019-1055.
 *A. Aizer and J. Currie (2004). "Networks or neighborhoods? Correlations in the use of publicly-funded maternity care in California." *Journal of Public Economics*, 83, 2573-2585.
 *E.A. Hanushek, J.F. Kain, J.M. Markman, and S.G. Rifkin (2003). "Does peer ability affect student achievement?" *Journal of Applied Econometrics*. 18:5, 527-544.
 J. Beugnot, B. Fortin, G. Lacroix and B.C. Villeval (2019). "Gender and peer effects on performance in social networks." *European Economic Review*, 113, 207-224.
 Y. Funashima and Y. Ohtsuka (2019). "Spatial crowding-out and crowding-in effects of government spending on the private sector in Japan." *Regional Science and Urban Economics*, 2019, 35-48.

- S.A. Borovkova and H.P. Lopuhaä (2012). "Spatial GARCH: a spatial approach to multivariate volatility modeling." SSRN paper 2176781.
- D. Scida (2016). "Structural VAR and financial networks: a minimum distance approach to spatial modeling." Federal Reserve Bank of Richmond. SSRN paper 2860866: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2860866 (last revision: 20 Sep 2017).
- b. *Motivating and analyzing spatial interactions: the issue of identification*
- *C.F. Manski (1993). "Identification of endogenous social effects: the reflection problem." *Review of Economic Studies*, 60:3, 531-542.
 - *C.F. Manski (2000). "Economic analysis of social interactions." *Journal of Economic Perspectives*, 14:1, 115-136.
 - *A.R. Soetevent (2006). "Empirics of the identification of social interactions: an evaluation of the approaches and their results." *Journal of Economic Surveys*, 20:2, 193-228.
 - *S.N. Durlauf and Y.M. Ioannides (2010). "Social interactions." *The Annual Review of Economics*, 2, 451-478
 - *Y. Bramoullé, H. Djebbari, and B. Fortin (2009). "Identification of peer effects through social networks." *Journal of Econometrics*, 150, 41-55.
- P. Goldsmith-Pinkham and G.W. Imbens (2013). "Social networks and the identification of peer effects." *Journal of Business & Economic Statistics*. 31:3, 253-264. (and comments provided in subsequent readings, pp.265-281)
- X. Liu, E. Patacchini, and Y. Zenou (2014). "Endogenous peer effects: local aggregate or local average?" *Journal of Economic Behavior and Organization*. 103, 39-59.
- *L.E. Blume, W.A. Brock, S.N. Durlauf, and R. Jayaraman (2015). "Social interaction models." *Journal of Political Economy*, 123:2, 444-496.
 - *A. Advani and B. Malde (2018). "Credibly identifying social effects: Accounting for network formation and measurement error." *Journal of Economic Surveys*, 32:4, 1016-1044.
- c. *Other thoughts on the validity of spatial econometric models*
- *L. Anselin (2010). "Thirty years of spatial econometrics." *Papers in Regional Science*, 89, 3-25.
 - *M.D. Partridge, M. Boarnet, S. Brakman, and G. Ottaviano (2012). "Introduction: whither spatial econometrics?" *Journal of Regional Science*, 52:2 (May), 167-171.
 - *J. Pinkse and M.E. Slade (2010). "The future of spatial econometrics." *Journal of Regional Science*, 50:1, 103-117.
 - *L. Corrado and B. Fingleton (2012). "Where is the economics in spatial econometrics?" *Journal of Regional Science*, 52:2 (May), 210-239.
 - *S. Gibbons and H.G. Overman (2012). "Mostly pointless spatial econometrics?" *Journal of Regional Science*, 52:2 (May), 172-191.
- d. *A different approach: Geographically Weighted Regression*
- *D.P. McMillen (2012). "Perspectives on spatial econometrics: linear smoothing with structured models." *Journal of Regional Science*, 52:2 (May), 192-209.
 - *C.L. Fang, H.M. Liu, G.D. Li, D.Q. Sun, and Z. Miao (2015). "Estimating the impact of urbanization on air quality in China using spatial regression models." *Sustainability*, 7, 15570-15592.
 - *G. Geniaux and D. Martinetti (2018). "A new method for dealing simultaneously with spatial autocorrelation and spatial heterogeneity in regression models." *Regional Science and Urban Economics*, 72, 74-85.
- A.S. Fotheringham, C. Brunson, and M. Charlton (2003). *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*. John Wiley & Sons: Hoboken, NJ, USA.

D.C. Wheeler (2010). "Visualizing and diagnosing coefficients from geographically weighted regression models." In *Geospatial Analysis and Modelling of Urban Structure and Dynamics*; Springer Netherland: Heidelberg, Germany, pp. 415–436.

e. *Miscellaneous other readings*

D. Knoke (2012). *Economic Networks*. Cambridge, UK: Polity Press. Ch.1-4.

S.N. Durlauf (2004). "Neighborhood effects." In J.V. Henderson and J.F. Thisse, eds., *Handbook of Regional and Urban Economics*, Vol. 4, Amsterdam: Elsevier B.V., 2174-2242.

M.O. Jackson and B.W. Rogers (2007). "Meetings strangers and friends of friends: how random are social networks." *American Economic Review*. 97:3, 890-915.

B.J. Asquith, J.K. Hellerstein, M.J. Kutzbach, and D. Neumark (2017). "Social capital and labor market networks." NBER Working Paper 23959, October.

R.H. Frank (1985). "The demand for unobservable and other nonpositional goods." *American Economic Review*, 75:1, 101-116.

R.H. Frank (1989). "Frames of reference and the quality of life." *American Economic Review*, 79:2, 80-85.

R.H. Frank (1997). "The frame of reference as a public good." *Economic Journal*, 107:445, 1832-1847.

R. Alessie and A. Kapteijn (1991). "Habit formation, interdependent preferences and demographic effects in the Almost Ideal Demand System." *Economic Journal*, 101:406, 404-419.

A. Kapteyn, S. van der Geer, H. van de Stadt, and T. Wansbeek (1997). "Interdependent preferences: an econometric analysis." *Journal of Applied Econometrics*, 12:6, 665-686.

T. Aronsson, S. Blomquist, and H. Sacklén (1999). "Identifying interdependent behavior in an empirical model of labour supply." *Journal of Applied Econometrics*, 14:6, 607-626.

D.I. Rees, J.S. Zax, and J. Herries (2003). "Interdependence in worker productivity." *Journal of Applied Econometrics*. 18:5, 585-604.

B. Cooper, C. Garcia-Penalosa, and P. Funk (2001). "Status effects and negative utility growth." *Economic Journal*, 111:473, 642-665.

M.S. Mizruchi (1996). "What do interlocks do? An analysis, critique, and assessment of research on interlocking directorates." *Annual Review of Sociology*, 20, 271-298.

G.F. Davis, M. Yoo, and W. Baker (2003). "The small world of the American corporate elite, 1982-2001." *Strategic Organization*, 1:3, 301-326.

C. Drago, F. Millo, R. Ricciutti, and P. Santella (2015). "Corporate governance reform, interlocking directorship, and company performance in Italy." *International Review of Law and Economics*, 41, 38-49.

8. Estimation of spatial econometric models with endogenous spatial weights matrices

*A. Advani and B. Malde (2018). "Credibly identifying social effects: Accounting for network formation and measurement error." *Journal of Economic Surveys*, 32:4, 1016-1044.

*C.-S. Hsieh and L.F. Lee (2016). "A social interactions model with endogenous friendship formation and selectivity." *Journal of Applied Econometrics*, 31, 301-319.

*X. Qu and L.F. Lee (2015). "Estimating a spatial autoregressive model with an endogenous spatial weights matrix." *Journal of Econometrics*. 184, 209-232.

*A. K. Bera, O. Dogan, and S. Taspinar (2018). "Simple Tests for Endogeneity of Spatial Weights Matrices." *Regional Science and Urban Economics*, (March), 69, 130-142.

I. Johnsson and H.R. Moon (2017). "Estimation of peer effects in endogenous social networks: control function approach." USC Dornsife Institute for New Economic Thinking, Working Paper No. 17-25, September.

- H. Kelejian and G. Piras (2014). "Estimation of spatial models with endogenous weighting matrices, and an application to a demand model for cigarettes." *Regional Science and Urban Economics*, 46, 140-149.
- X. Lu, E. Patacchini, and Y. Zenou (2014). "Endogenous peer effects: local aggregate or local average." *Journal of Economic Behavior & Organization*, 103, 39-59.
9. Discrete choice
- *K. Beron and W. Vijverberg (2004). "Probit in a Spatial Context: A Monte Carlo Analysis." In Luc Anselin, Raymond J.G.M. Florax, and Sergio J. Rey, eds., *Advances in Spatial Econometrics*, Ch.8, 169-195. Berlin: Springer Verlag.
- W. Vijverberg (1997). "Monte Carlo Evaluation of Multivariate Normal Probabilities," *Journal of Econometrics*, 76:1-2, 281-307.
- Pace, R.K., LeSage, J.P., 2016. Fast Simulated Maximum Likelihood Estimation of the Spatial Probit Model Capable of Handling Large Samples. In: Fomby, T.B., Hill, R.C., Jeliazkov, I., Escanciano, J.C., Hillebrand, E. (Eds.), *Spatial Econometrics: Qualitative and Limited Dependent Variables*, Emerald Publishing Ltd, pp. 3–34. <https://dx.doi.org/10.1108/S0731-905320160000037008>.
- *M. Fleming (2004). "Techniques for estimating spatially dependent discrete choice models." In Luc Anselin, Raymond J.G.M. Florax, and Sergio J. Rey, eds., *Advances in Spatial Econometrics*, Ch.7, 145-168. Berlin: Springer Verlag.
- *J. Pinkse and M.E. Slade (1998). "Contracting in space: an application of spatial statistics to discrete-choice models." *Journal of Econometrics*, 85, 125-154.
- O.A. Smirnov (2010). "Modeling spatial discrete choice." *Regional Science and Urban Economics*, 40, 292-298.
- L.S. Santos and I. Proença (2019). "The inversion of the spatial lag operator in binary choice models: Fast computation and a closed formula approximation." *Regional Science and Urban Economics*, 76, 74-102.
- K. Beron, J. Murdoch, and W. Vijverberg (2003). "Why Cooperate? Public Goods, Economic Power, and the Montreal Protocol." *Review of Economics and Statistics*, 85:2, 286-297.
- J. Murdoch, T. Sandler, and W. Vijverberg (2003). "The Participation Decision versus the Level of Participation in an Environmental Treaty: A Spatial Probit Analysis." *Journal of Public Economics*, 87:2, 337-362.
- *T. Klier and D.P. McMillen (2008). "Clustering of auto supplier plants in the United States." *Journal of Business and Economic Statistics*, 26:4, 460-471.
- J.-A. Guerra and M. Mohnen (2017). "Multinomial choice with social interactions: occupations in Victorian London." Universidad de los Andes, Serie Documentos Cede 2017-47, July.
- F. Alivon, and R. Guillain (2018). "Urban segregation and unemployment: A case study of the urban area of Marseille – Aix-en-Provence (France)." *Regional Science and Urban Economics*, 72, 143-155.
- B.H. Baltagi, P.H. Egger, and M. Kesina (2019). "Contagious exporting and foreign ownership: Evidence from firms in Shanghai using a Bayesian spatial bivariate probit model." *Regional Science and Urban Economics*, 76, 125-146.
9. Spatial panel econometrics
- L. Anselin (2006), Section 7
- *L. Anselin, J. Le Gallo, and H. Jayet (2008). "Spatial panel econometrics." In L. Matyas and P. Sevestre, eds., *The Econometrics of Panel Data*, Heidelberg: Springer-Verlag, Ch.19, 625-660.
- J.P. Elhorst (2014), Ch.3

- J.P. Elhorst (2003), "Specification and estimation of spatial panel data models." *International Regional Science Review*, July, 26, 244-268.
- J. LeSage and R.K. Pace (2009), Ch.7.
- *L.-F. Lee and J. Yu (2010). "Estimation of spatial autoregressive panel data models with fixed effects." *Journal of Econometrics*, 154, 165-185.
- *A.C. Case (1991). "Spatial patterns in household demand." *Econometrica*, 59:4, 953-965.
- *M. Kapoor, H.H. Kelejian, and I. Prucha (2007). "Panel Data Models with Spatially Correlated Error Components." *Journal of Econometrics*, 140, 97-130.
- B.H. Baltagi, P. Egger, and M. Pfaffermayr (2007). "Estimating models of complex FDI: are there third-country effects?" *Journal of Econometrics*, 140, 260-281.
- B.H. Baltagi, S.H. Song, B.C. Jung, and W. Koh (2007). "Testing for serial correlation, spatial autocorrelation and random effects using panel data." *Journal of Econometrics*, 140, 5-51.
- H.H. Kelejian, P. Murrell, and O. Shepotylo (2013). "Spatial spillovers in the development of institutions." *Journal of Development Economics*, 101, 297-315.
- L.-F. Lee and J. Yu (2010). "Some recent developments in spatial panel data models." *Regional Science and Urban Economics*, 2010, 40, 255-271 (Sections 2 and 4.1.1)
- *L.F. Lee and J. Yu (2012). "Spatial panels: random components versus fixed effects." *International Economic Review*, 53:4, 1369-1412.
- C. Ciccarelli and J.P. Elhorst (2018). "A dynamic spatial econometric diffusion model with common factors: The rise and spread of cigarette consumption in Italy." *Regional Science and Urban Economics*, 72, 131-142.
- W. Shi and L.F. Lee (2018). "A spatial panel data model with time varying endogenous weights matrices and common factors." *Regional Science and Urban Economics*, 72, 6-34.

10. Dynamic spatial panel econometrics

- *L. Anselin, J. Le Gallo, and H. Jayet (2008). "Spatial panel econometrics." In L. Matyas and P. Sevestre, eds., *The Econometrics of Panel Data*, Heidelberg: Springer-Verlag, Ch.19, 625-660.
- J.P. Elhorst (2014), Ch.4
- J.P. Elhorst (2012). "Dynamic spatial panels: models, methods, and inferences." *Journal of Geographic Systems*, January, 14, 5-28.
- J.P. Elhorst, E. Zandberg, and J. de Haan (2013). "The impact of interaction effects among neighbouring countries on financial liberalization and reform: a dynamic spatial panel data approach." *Spatial Economic Review*, 8:3, 293-313.
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