Mostly Pointless Spatial Econometrics

(Gibbons & Overman, 2012)

Spatial Economics Seminar Presentation

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April 19, 2024

Spatial Econometric Models And Their Issues

The Experimentalist Paradigm And Spatial Econometrics

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y_i &= \rho \boldsymbol{w}_i' \boldsymbol{y} + \boldsymbol{X}\beta + \boldsymbol{w}_i' \boldsymbol{X}\gamma + \boldsymbol{u}_i \gamma, \\
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$$\begin{aligned} y_i &= \rho \boldsymbol{w}_i' (\rho \boldsymbol{W}\boldsymbol{y} + \boldsymbol{X}\beta + \boldsymbol{W}\boldsymbol{X}\gamma + \boldsymbol{u}) + \boldsymbol{w}_i'\beta + \boldsymbol{w}_i'\boldsymbol{X}\gamma + u_i \\ &= \rho^2 \boldsymbol{w}_i' \boldsymbol{W}\boldsymbol{y} + \rho \boldsymbol{w}_i' \boldsymbol{X}\beta + \rho \boldsymbol{w}_i' \boldsymbol{X}\gamma + \rho \boldsymbol{w}_i' u + \boldsymbol{X}'\beta + \boldsymbol{w}_i' \boldsymbol{X}\gamma + u_i \\ &= \rho^2 \boldsymbol{w}_i' \boldsymbol{W}\boldsymbol{y} + \boldsymbol{X}'\beta + \rho \boldsymbol{w}_i' (\boldsymbol{X}\beta + \gamma) + \rho \boldsymbol{w}_i' \boldsymbol{W}\boldsymbol{X}\gamma + v_i \\ &= \ldots \\ &= \boxed{\rho^n (\boldsymbol{w})_i' \boldsymbol{W}^{n-1} y} + \boldsymbol{X}'\beta + \boldsymbol{w}_i' \boldsymbol{X}(\rho\beta + \gamma) \\ &\quad + \rho \boldsymbol{w}_i' \boldsymbol{W}\boldsymbol{X}(\rho\beta + \gamma) + \rho^2 \boldsymbol{w}_i' \boldsymbol{W}^2 \boldsymbol{X}(\rho\beta + \gamma) + \ldots + v_i, \end{aligned} \tag{2}$$

Under standard regularity conditions: $\lim_{n\to\infty} \boxed{\rho^n (\boldsymbol{W}')^{n-1} \boldsymbol{W}^{n-1}} = 0$

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However, all of these models have the same reduced form, namely:

$$y_i = \mathbf{x}_i'\beta + \boldsymbol{w}_i'\boldsymbol{X}\pi_1 + \boldsymbol{w}_i'\boldsymbol{W}\boldsymbol{X}\boldsymbol{\pi_2} + \boldsymbol{w}_i'\boldsymbol{W}^2\boldsymbol{X}\pi_2 + \ldots + v_i \tag{3}$$

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Spatial Economics uses neighbors characteristics ($\boldsymbol{w}_i'\boldsymbol{X}$, $\boldsymbol{w}_i'\boldsymbol{W}\boldsymbol{X}$, ...) under the assumption that these are exogenous to instrument for $\boldsymbol{w}_i'\boldsymbol{y}$

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$$y_i = \rho_1 \mathbf{E}[y_i|a] + \boldsymbol{x}_i'\beta + \mathbf{E}[\boldsymbol{x}_i'|a]\gamma + v_i, \tag{4}$$

Solving for the reduced form by taking the expectation of (4) and rearranging yields:

$$y_i = \boldsymbol{x_i'}\beta + \boldsymbol{E}[x_i'|a]\frac{(\boldsymbol{\beta\rho_1} + \gamma)}{(1 - \boldsymbol{\rho_1})} + \frac{\boldsymbol{\rho_1}}{1 - \boldsymbol{\rho_1}} E[v_i|a] + v_i \tag{5}$$

No chance that we can distinguish the endogenous (ρ_1) from the exogenous peer effects (γ)!

The Difference Between the Peer Effects Literature and Spatial Econometrics

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Spatial Durbin Model again:

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In spatial econometrics (6) is assumed to be the **true** data generating process.

Identification of parameters works because:

- The structure of the spatial weights matrix $\boldsymbol{W}$ is said to be known
- Exogeneity of $\boldsymbol{X}$ and $\boldsymbol{w}_i' \boldsymbol{W} \boldsymbol{X}$, ...

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$$y_i = \boldsymbol{x}_i' \beta + \boldsymbol{w}_i' \boldsymbol{X}(\beta\rho_1 + \gamma) + \rho_1 \boldsymbol{w}_i' \boldsymbol{W} \boldsymbol{X}(\beta\rho_1 + \gamma) + \rho_1^2 \boldsymbol{w}_i' \boldsymbol{W}^2 \boldsymbol{X}(\beta\rho_1 + \gamma) + \ldots + \varepsilon_i \tag{7}$$

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Identification breaks down in most spatial econometric models because:

- the exact structure of $\boldsymbol{W}$ is not known! (exclusion restriction is not fulfilled)
- Weak Instruments because of high correlation between spatial lags $\boldsymbol{w}_i'\boldsymbol{X}$, $\boldsymbol{w}_i'\boldsymbol{W}\boldsymbol{X}$, $\boldsymbol{w}_i'\boldsymbol{W}^2\boldsymbol{X}$, ...

The Experimentalist Paradigm And Spatial Econometrics

Standard Spatial Models Are Plagued! (By Identification Problems)

[1] Gibbons and Overman (2012, p. 181)

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- These **reflection issues** transfer to differenced specifications and are not solved by randomization[2]

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- **How to proceed?**

How to Proceed With the SLX Model—And What Problems Remain

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"[Any] empirical research that aims to find out if x causes y needs to find a source of exogenous variation in x!"[3]

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Thank you!

Appendix: Spatial Econometric Models

Starting point:

$$y_i = \mathbf{x}_i'\beta + u_i \tag{9}$$

To incorporate spatial dependence we know the

SAR model:

$$y_i = \rho \mathbf{w}_i'\mathbf{y} + \mathbf{x_i}\beta + \mathbf{u_i} \tag{10}$$

SLX model:

$$y_i = \mathbf{x}_i'\beta + \mathbf{w}_i'\mathbf{X}\gamma + u_i \tag{11}$$

SE model:

$$y_i = \mathbf{x}_i'\beta + u_i, \tag{12}$$

$$\text{where } u_i = \rho \mathbf{w}_i'\mathbf{u} + v_i \tag{13}$$

References I

Gibbons, S., & Overman, H. G. (2012). Mostly Pointless Spatial Econometrics? *Journal of Regional Science, 52*(2), 172–191. https://doi.org/10.1111/j.1467-9787.2012.00760.x

Manski, C. F. (1993). Identification of Endogenous Social Effects: The Reflection Problem. *The Review of Economic Studies, 60*(3), 531. https://doi.org/10.2307/2298123