# The Future of Spatial Econometrics

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### In the Paper

- Overview direction spatial econometrics literature
- Important unresolved problems
- Advocacy to inspire theory by applications



# Status Quo

- Beautiful applications in economics, e.g.
  - Price competition in geographic space
  - Demand for differentiated products in product-characteristic space
  - Spillovers between firms in product, technology, geographic space



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  - Spillovers between firms in product, technology, geographic space
- Interesting econometric theory.
- Often no match.



## Reality

 $m_n(A) = u$ i.i.d. unobservables

matrix of observables

• Everything is possible.



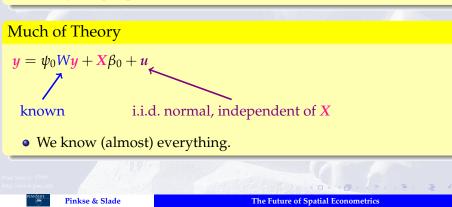
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## Spatial Autoregressive Model

- Normality unnecessary
- Relationship may not be linear
- Should include spatially lagged *x*'s
- *u* and *X* dependent (endogeneity and/or heterogeneity)
- We don't know W
  - Why  $\psi_0 W$ ? •  $W \rightarrow W$ , i.e. endogenous.

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### **Theoretical Extensions**

- smooth out some rough edges of simple models
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- So: theoretical innovations should be driven by applications





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## Problems with Spatial Data

- Endogeneity
  - Locations themselves endogenous
  - Missing data
  - Usual problems
- Locations and dependence relationships change with the sample size
- Dependence multidirectional
- No stationarity
- Identification problems
  - Reflection problem
  - Multidirectional dependence
  - Dependence strength
  - Multiple equilibria

# • So let's stop treating spatial data as a multidimensional time series.

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## A Few Interesting Problems

## (more in the paper)

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## A Few Interesting Problems

(more in the paper)

A Somewhat More Reasonable Model

$$\mathbf{y}_i = \sum_{j \neq i} g(\boldsymbol{\delta}_{ij}) \mathbf{y}_j + \mathbf{x}'_i \beta_0 + \mathbf{u}_i, \quad i = 1, \dots, n.$$

### Pinkse–Slade–Brett

- *g* unknown;  $\delta_{ij}$  distance.
- Spatial dependence all over the place, but *x<sub>i</sub>* exogenous.
- Still lots of questionable assumptions; objective is to illustrate.
- Endogeneity in  $\delta_{ij}$  difficult  $\rightarrow$  see PSB.
- Interpretation: Faced with rival actions y<sub>i</sub>, covariates x<sub>i</sub> and a variable u<sub>i</sub> observable to player i but not to us, player i would choose y<sub>i</sub>.



### **Binary Choice**

Payoff for player *i* to choose option 1 over option 0 is

$$\boldsymbol{y}_i^* = \sum_{j \neq i} g(\boldsymbol{\delta}_{ij}) \boldsymbol{y}_j + \boldsymbol{x}_i' \boldsymbol{\beta}_0 + \boldsymbol{u}_i, \quad i = 1, \dots, n.$$

### Problem

- Hard due to nonlinearity and nondifferentiability.
- Tricky even for fixed number of products and large number of markets; here large number of products in one market.
- What about dynamics?

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## No Work Either on

Partial identification.

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# Conclusions

- So many interesting well-defined empirically relevant problems.
- Let's work on those.





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