



# The Future of Spatial Econometrics

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A large, light-colored stone sculpture of a lion, likely the Nittany Lion, is visible in the background. The lion is shown from the chest up, resting its head on its right paw. The image is semi-transparent, allowing the text to be overlaid.

## 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.
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  - 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

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## Much of Theory

$$\mathbf{y} = \psi_0 \mathbf{W} \mathbf{y} + \mathbf{X} \boldsymbol{\beta}_0 + \mathbf{u}$$

known

i.i.d. normal, independent of  $\mathbf{X}$

- We know (almost) everything.

## 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  $W$ 
  - 1 Why  $\psi_0 W$ ?
  - 2  $W \rightarrow W$ , i.e. endogenous.



## Theoretical Extensions

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- **So: theoretical innovations should be driven by applications**

## 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.**

# A Few Interesting Problems

(more in the paper)

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## A Somewhat More Reasonable Model

$$y_i = \sum_{j \neq i} g(\delta_{ij}) y_j + x_i' \beta_0 + u_i, \quad i = 1, \dots, n.$$

## Pinkse–Slade–Brett

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

## Binary Choice

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

$$y_i^* = \sum_{j \neq i} g(\delta_{ij}) y_j + x_i' \beta_0 + u_i, \quad i = 1, \dots, n.$$

## 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.

A large, light-colored stone sculpture of a lion, likely the Nittany Lion at Penn State, is the background of the slide. The lion is shown in profile, facing left, with its front paws resting on a ledge. The lighting is soft, highlighting the texture of the stone.

## Conclusions

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