Spatial Productivity Analysis of Road Transportation Infrastructure

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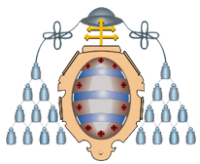
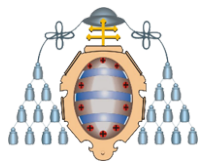
Seminario Santander



Índice

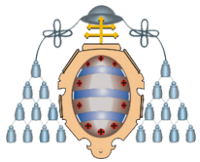


Motivación

Objectivo

Medir el impacto económico de las infraestructuras de transporte en la productividad regional.

- ¿El lento crecimiento de la productividad es causado por una provisión insuficiente de capital público?
- ¿Mejores infraestructuras aumentan la capacidad productiva de las empresas?

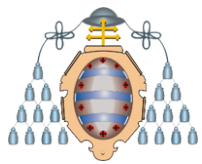


Resumen literatura

Principales resultados

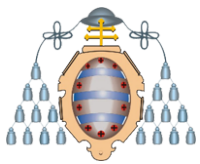
Literatura continúa INCONCLUSA!!!!!!

- Diferentes alternativas metodológicas
- Diferentes países bajo estudio
- Efectos spillover y niveles de agregación de los datos
- Problemas causados por el uso de variables stock



Fundamentos

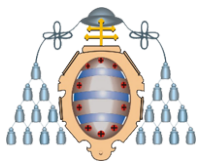
Woolridge (2002): “A situation that does requires special consideration occurs when cross section observations are not independent of one another. An example is spatial correlation models. This situation arises when dealing with large geographical units that cannot be assumed to be independent draws from a large population, such as the 50 states in the United States.”



Econometría Espacial

Problemas generados por datos referidos a áreas geográficas [Anselin, 1988]

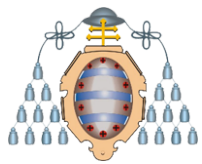
- Dependencia Espacial. Causas
  - Error de medición
  - El componente espacial es importante en la modelización (Externalidades espaciales y efectos spillover)
- Heterogeneidad espacial



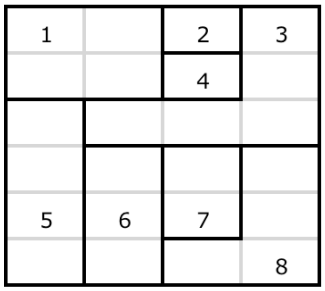
Econometría Espacial

Primera ley de la geografía de Tobler (1979) “Todo está relacionado con todo, pero las cosas cercanas, están más relacionadas que las lejanas. ”
Instrumentos

- Matrices de pesos espaciales (W)
- Rezagos espaciales (Spatial Lags)



Matrices de pesos espaciales (Ejemplo)



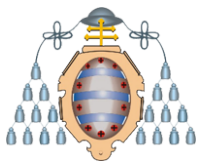
	1	2	3	4	5	6	7	8
1	0	1	0	1	1	0	0	0
2	1	0	1	1	0	0	0	0
3	0	1	0	1	1	1	1	1
4	1	1	1	0	0	0	0	0
5	1	0	1	0	0	1	0	0
6	0	0	1	0	1	0	1	1
7	0	0	1	0	0	1	0	1
8	0	0	1	0	0	1	1	0

	1	2	3	4	5	6	7	8
1	0	1	0	0	0	0	0	0
2	0	0	0	1	0	0	0	0
3	0	1	0	0	0	0	0	0
4	0	1	0	0	0	0	0	0
5	0	0	0	0	0	1	0	0
6	0	0	0	0	1	0	1	0
7	0	0	0	0	0	1	0	0
8	0	0	0	0	0	0	1	0

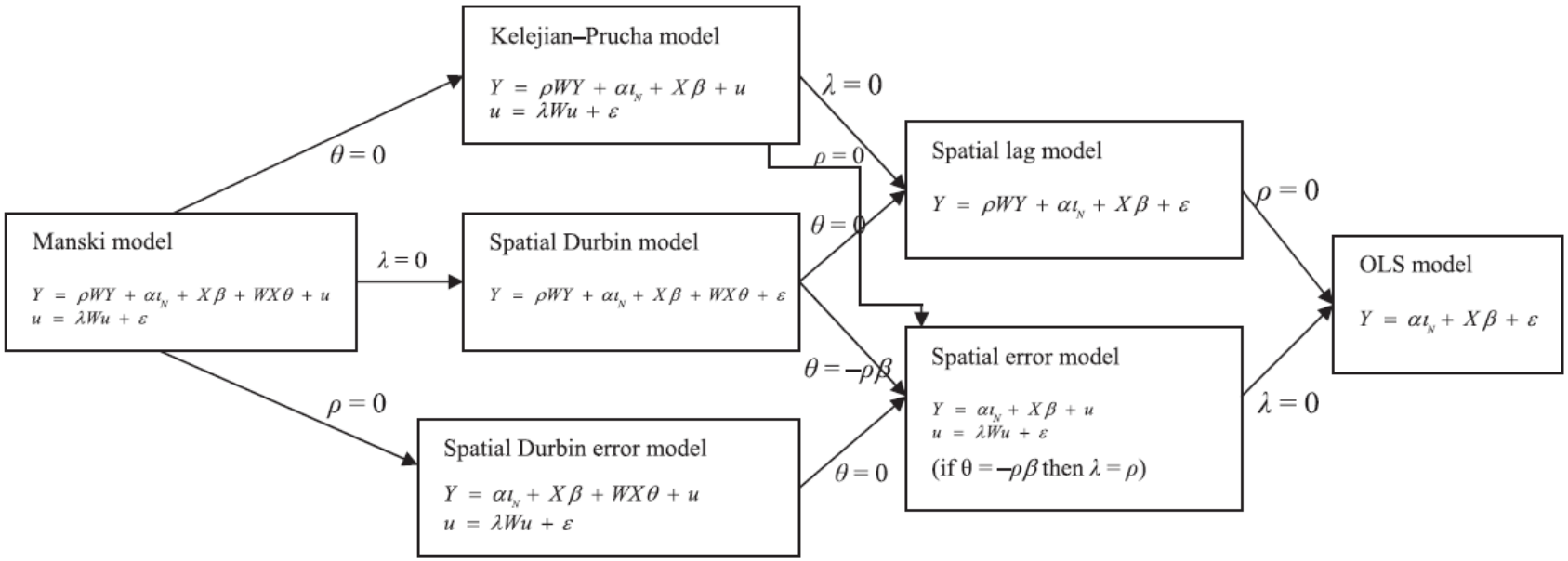
	1	2	3	4	5	6	7	8
1	0	1	0	1	0	0	0	0
2	1	0	1	1	0	0	0	0
3	0	1	0	1	0	0	1	0
4	1	1	1	0	0	0	0	0
5	0	0	0	0	0	1	1	0
6	0	0	0	0	1	0	1	0
7	0	0	1	0	1	1	0	1
8	0	0	0	0	0	0	1	0

Criterios:

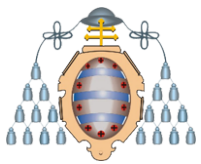
- Contigüidad.
- Vecinos más cercanos.
- Distancia < 2



Modelos

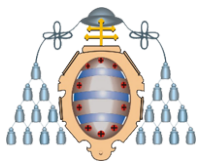


Elhorst [2010]



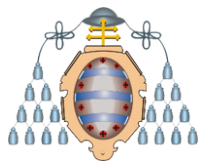
Interpretación

$$\left[\frac{\partial Y}{\partial x_{1k}} \quad . \quad \frac{\partial Y}{\partial x_{Nk}}\right]_t = \begin{bmatrix} \frac{\partial y_1}{\partial x_{1k}} & . & \frac{\partial y_1}{\partial x_{Nk}} \\ . & . & . \\ \frac{\partial y_N}{\partial x_{1k}} & . & \frac{\partial y_N}{\partial x_{Nk}} \end{bmatrix}_t = (I - \lambda W)^{-1} \begin{bmatrix} \beta_k & w_{12}\theta_k & . & w_{1N}\theta_k \\ w_{21}\theta_k & \beta_k & . & w_{2N}\theta_k \\ . & . & . & . \\ w_{N1}\theta_k & w_{N2}\theta_k & . & \beta_k \end{bmatrix}$$



Nuestra propuesta

- Correcta modelización de los efectos spillover (Modelo de econometria espacial)
- Variables para la utilización de los servicios de capital (Sustitutos de medidas stock)



Modelo

$$\ln Y = \alpha_0 + \alpha_1 \ln X + \alpha_2 \ln K + \alpha_3 \ln G + \upsilon \quad (1)$$

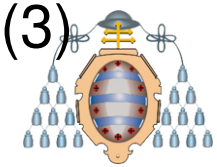
where $\upsilon \sim \mathcal{N}(0, \sigma_\upsilon^2 I_n)$.

$$CU = \frac{K^*}{K} \quad (2)$$

Grado de utilizacióón del k privado (Cu) depende de la coyuntura económica

$$CU = \lambda + \phi WY + \nu \quad (3)$$

donde λ es una constante ν se distribuye como $\mathcal{N}(0, \sigma_\nu^2 I_n)$



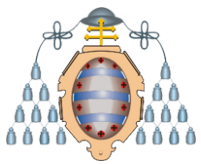
Modelo

$$\begin{aligned} \ln Y &= \alpha_0 + \alpha_1 \ln X + \alpha_2(\ln CU + \ln K) + \alpha_3 \ln G + \upsilon \\ &= \alpha_0 + \alpha_2\lambda + \alpha_1 \ln X + \alpha_2\phi W \ln Y + \alpha_2 \ln K + \alpha_3 \ln G + \upsilon + \alpha_2\nu \\ &= \mu + \alpha_1 \ln X + \beta W \ln Y + \alpha_2 \ln K + \alpha_3 \ln G + \epsilon \end{aligned} \quad (4)$$

donde $\mu = \alpha_0 + \alpha_2\lambda$ y $\upsilon + \alpha_2\nu = \epsilon \sim \mathcal{N}(0, \sigma_\nu^2 I_n)$

Incluyendo spatial lags para incluir efectos spillover:

$$\ln Y = \mu + \alpha_1 \ln X + \beta W \ln Y + \alpha_2 \ln K + \alpha_3 \ln G + \theta W \ln G + \epsilon \quad (5)$$

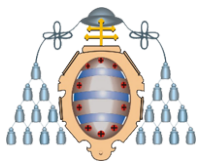


Modelo

Críticas a la utilización de variables stock de infraestructuras de transporte [Oosterhaven, 2003]

Servicios de carretera [Fernald, 1999]

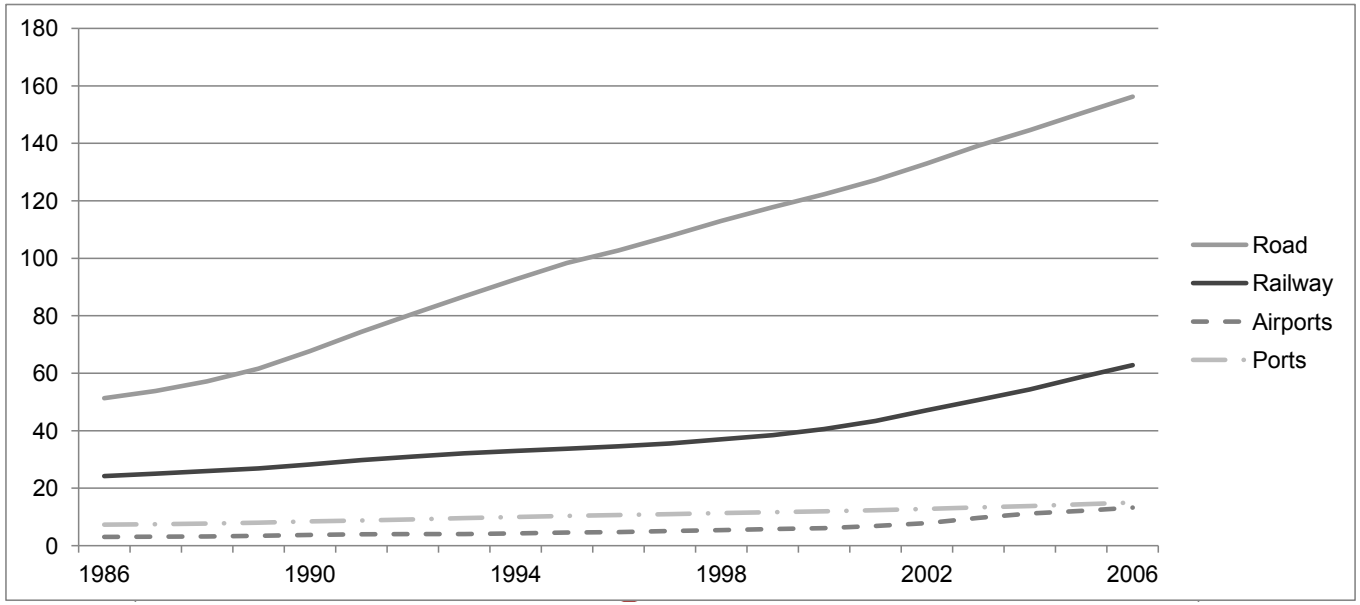
$$RS_{it} = f(ROAD_{it} * VEH_{it}) \quad (6)$$



Datos

- Base de datos de panel. 47 provincias peninsulares (NUTS-III)
- Periodo: 1986-2006
- Principales fuentes: INE y Fundación BBVA IVIE

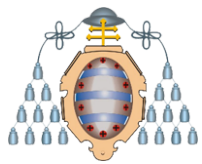
Figure : Stock de infraestructuras carretera



Especificación Econométrica

$$\begin{aligned} y_{it} &= \mu_i + \beta Wy_{it} + \alpha_1 l_{it} + \alpha_2 hk_{it} + \alpha_3 k_{it} \\ &+ \alpha_4 rs_{it} + \alpha_5 trans_{it} + \theta_1 Wl_{it} + \theta_2 Wkh_{it} \\ &+ \theta_3 Wk_{it} + \theta_4 Wrs_{it} + \theta_5 Wtrans_{it} + \epsilon \end{aligned} \tag{7}$$

Matrices de pesos espaciales (Wn y $Wd150$) normalizadas por filas.

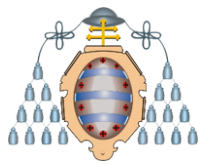


Interpretación de Modelo Durbin Espacial

Matriz de derivadas parciales:

$$\frac{\delta y_t}{\delta rs_t} = (I_N - \beta W)^{-1}(\alpha_4 I_N + \theta_4 W) \tag{8}$$

Scalar summaries: Efectos directos, indirectos y totales [Lesage and Pace, 2009]

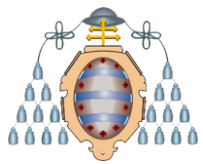


Resultados

Table : Modelo Durbin Espacial con efectos fijos

	Wn		Wd150	
Variable	**Coef.**	**t-stat**	**Coef.**	**t-stat**
K	0.157***	7.98	0.178***	8.98
L	0.272***	15.19	0.268***	14.99
HK	0.016	1.63	0.020*	1.84
RS	0.060***	7.26	0.061***	7.38
Trans	-0.002	-0.47	-0.001	-0.13
W*K	0.039	1.12	-0.001	-0.04
W*L	-0.080***	-2.97	-0.058***	-2.24
W*HK	0.001	0.08	0.005	0.29
W*RS	0.001	0.06	0.011	0.87
W*Trans	-0.018**	-2.00	-0.017*	-1.96
W*Y	0.297***	7.34	0.251***	6.18
Corrected R^2	0.967		0.966	
Log-likelihood	2010.00		1995.10	
Wald Test Spatial Lag	20.117	p = 0.001	15.25	p =0.009
LR Spatial Lag	20.586	p = 0.000	15.276	p = 0.009
Wald Test Spatial Error	45.135	p = 0.000	32.63	p =0.000
LR Spatial Error	50.256	p =0.000	35.307	p =0.000

Significance code: *p<.1, **p<.05, ***p<.01

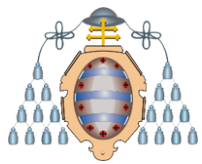


Resultados

Table : Direct, Indirect and Total Effects

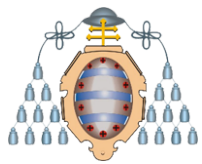
		Wn		Wd150	
	Variables	**Coeff.**	**t-stat**	**Coeff.**	**t-stat**
Direct Effects					
	K	0.162***	8.47	0.180***	9.43
	L	0.272***	15.33	0.270***	16.01
	KH	0.016*	1.66	0.0191*	1.92
	RS	0.061***	7.76	0.062***	7.60
	Trans	-0.003	-0.69	-0.002	-0.42
Indirect Effects					
	K	0.114***	2.79	0.057	1.35
	L	0.002	0.05	0.011	0.41
	KH	0.009	0.38	0.013	0.59
	RS	0.025*	1.73	0.034**	2.28
	Trans	-0.025**	-2.09	-0.022**	-2.10
Total Effects					
	K	0.276***	6.67	0.234***	5.59
	L	0.274***	10.13	0.281***	11.77
	KH	0.025	0.95	0.032	1.35
	RS	0.086***	6.44	0.096***	6.78
	Trans	-0.028**	-2.19	-0.024**	-2.14

Significance code: *p<.1, **p<.05, ***p<.01



Conclusiones

- Efectos positivos de proyectos de infraestructura de carretera en la economía de una provincia
- Efectos spillover positivos (Aprox. mitad de efectos directos)



Lecturas recomendadas

[Fernald, 1999] Fernald,J. (1999) Roads to Prosperity? Assessing the Link between Public Capital and Productivity. *American Economic Review* 89(3): 619-638

[Lesage and Pace, 2009] LeSage, J. and Pace, K. (2009) Introduction to Spatial Econometrics. *CRC Press*

[Oosterhaven, 2003] Oosterhaven, J. and Knaap, T. (2003) Spatial economic impacts of transport infrastructure investments. *Transport Projects, Programmes and Policies: Evaluation Needs and Capabilities*. A. Pearman (ed.)