A Spatial Econometric Model of the Korean Economy

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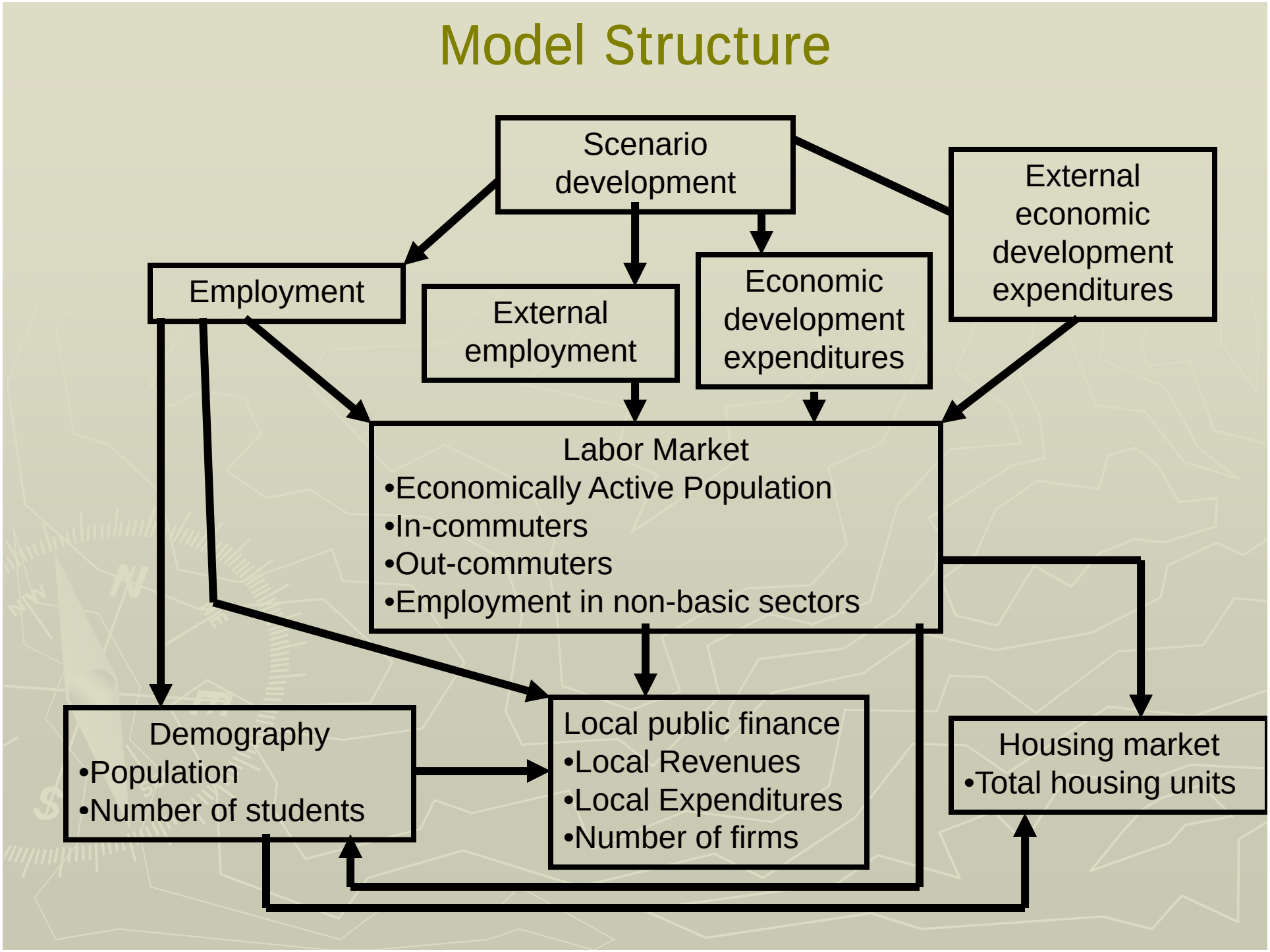
Motivation

- Application of community policy analysis framework in Korean regions
- Collaborative effort of CPAC with Korea Rural Economic Institute
- Impact of economic development expenditures and employment
- Forecasting of dependent variable based on projected exogenous variables

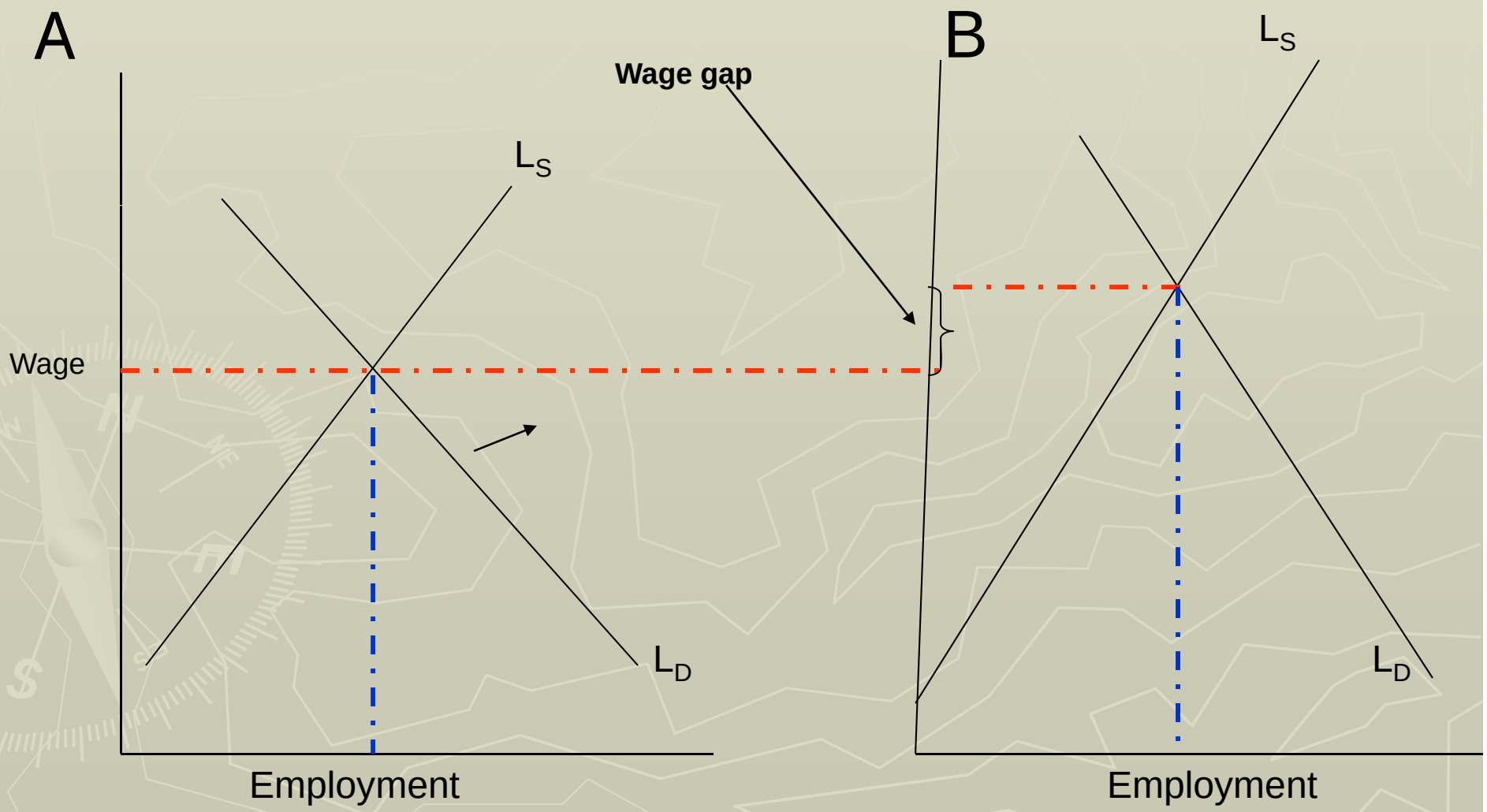
Community Policy Analysis System Framework

- Use of impact model for analysis of rural issues
- Flexible enough to address specific places and a variety of diverse needs (e.g., housing market impacts and demographic changes)
- Employment change is the main driver of the model

Model Structure



Spatial Equilibrium of Labor Market



Basic model

$$Y_n = Y_n \mathrm{B} + X_n A + E_n \qquad (1)$$

$$Y_n = Y_n B + X_n C + \bar{Y}_n A + U_n \qquad (2)$$

Kelejean and Prucha (2004) estimation procedure (instrument selection)

Spatial linkages

- Weight/distance

$$W_{G1} = [w_{ij}] = \frac{X_j / D_{ij}}{\sum_{J=1}^{N} X_J / D_{iJ}}$$

- Weight/distance squared

$$W_{G2} = [w_{ij}] = \frac{X_j / D_{ij}^2}{\sum_{J=1}^{N} X_J / D_{iJ}^2}$$

- Uniform

$$W_U = [w_{ij}] = 1 / N_i$$

Reduced form solution

$$Y_n = Y_n B + X_n C + \bar{Y}_n A + U_n$$

$$y_n = \left\{(I_m \otimes I_n) - [(B' \otimes I_n) + (A' \otimes W_n)]\right\}^{-1} (C' \otimes I_n) x_n$$

$$B'_{(m\times m)} = \begin{bmatrix} 0 & \beta_{12} & \cdots\cdots & \beta_{1m} \\ \beta_{21} & 0 & & \vdots \\ \vdots & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ \beta_{m1} & \cdots & \beta_{m,m-1} & 0 \end{bmatrix}$$

$$A'_{m\times m} = \begin{bmatrix} \lambda_1 & 0 & \cdots & 0 \\ 0 & \lambda_2 & & 0 \\ \vdots & & \ddots & \vdots \\ 0 & \cdots & \cdots & 0 & \lambda_m \end{bmatrix}$$

Model's Equations

1. Population=f(lag, economically active population) labor force-NA
2. Economically active population=f(lag, population, EMP_NBAS)
3. Number of students=f(lag, population)

Model continued..

4. Out-commuting=f(lag, economically active population, EMP, area, area*EMP, CEMP, economic development expenditures)
5. In-commuting=f(lag, economically active population, EMP, external EMP, area, area*EMP)
6. Non-basic employment=f(lag, EMP, area, area*EMP, economic dev. expenditures, area* economic dev. expenditures)

Model continued

7. Local public revenues=f(lag, population, non-basic EMP, in-commuting) income-NA
8. Local public expenditures=f(lag, population, in-commuting, non-basic EMP) income-NA
9. Housing units=f(lag, population, in-commuting) house price-NA.
10. Firm_tot=f(lag, population, in-commuting, economic development expenditures, area, area*emp)

Data and Data Sources

- Korean regions
  - 7 metropolitan cities
  - 77 cities
  - 88 counties
- Data sources
  - Local revenue and expenditures – Korean Local Financial Year Book 2005
  - Employment, population, housing, business – Korea's Si or Gun's Statistical Year Book 2005

GS3SLS Results Using Different Weight Matrices

Model	Variables	Uniform	Weight and distance	Weight and distance squared
		Sign	Sign	Sign
Local Revenue	Intercept	+	+	+
	W_REV_LOC	+	+	+
	POP_TOT	+	+	+
	EMP_NBAS	+	+	+
	COM_IN	-	-	-
Local Expenditure	Intercept	+	+	+
	W_EXP_LOC[a]	-	-	-
	POP_TOT	+	+	+
	COM_IN	-	-	-
	EMP_NBAS	+	+	+
Total Housing Units	Intercept	+	+	+
	W_HOUS_TOT[a]	+	+	+
	POP_TOT	+	+	+
	COM_IN	-	-	-
Population	Intercept	+	+	+
	W_POP_TOT	+	+	+
	POP_EAP	+	+	+
Economically Active Population	Intercept	-	-	-
	W_POP_EAP[a]	-	-	-
	POP_TOT	+	+	+
	EMP_NBAS	+	+	+
Students Total	Intercept	+	+	+
	W_STDT_TOT	+	+	+
	POP_TOT	+	+	+

1% 5% 10% NS

Model	Variables	Uniform	Weight and distance	Weight and distance squared
		Sign	estimates	estimates
Out-commuters	Intercept	-	+	+
	W_COM_OUT	+	+	+
	POP_EAP	+	+	+
	EMP_TOT	-	-	-
	AREA	+	+	+
	A_EMP	-	-	-
	C_EMP	+	+	+
	EXP_ED	-	-	-
In-commuters	Intercept	-	-	-
	W_COM_IN	+	+	+
	POP_EAP	-	-	-
	EMP_TOT	+	+	+
	C_EMP	+	+	+
	AREA	+	+	+
	A_EMP	-	-	-
Firms Total	Intercept	+	+	+
	W_FIRM_TOT	-	-	-
	POP_TOT	+	+	+
	AREA	+	+	+
	A_EMP	+	+	+
Employment in non-basic sectors	Intercept	-	-	-
	W_EMP_NBAS[a]	-	-	-
	EMP_TOT	+	+	+
	AREA	+	+	+
	EXP_ED	+	+	+
	A_EXPED	-	-	-

1% 5% 10% NS

Economic Impact Estimated From Spatial Lag Model[a].

Province	Gun or Si	REV_LOC	EXP_LOC	HOUS_TOT	POP_TOT	POP_EAP	STDT_TOT	COM_OUT	COM_IN	FIRM_TOT	EMP_NBAS
Pusan	Gijang-Gun	3602.8	3202.5	481.87	2206.21	1660.13	356.00	266.77	319.16	191.57	813.28
Yulsan	Yulju-Gun	-7	-8.14	-1.52	-0.14	-0.09	-0.037	2.268	3.584	0.006	0.016
Gyung-Buk	Pohang-Si	-0.01	-0.01	-0.002	0	0	0	0.004	0.004	0	0
Gyung-Buk	Gyungju-Si	0.18	0.17	0.044	0.01	0	0.002	-0.07	-0.096	0.001	0
Gyung-Nam	Changwon-Si	0	0	-0.001	0	0	0	0	0.001	0	0
Gyung-Nam	Gimhae-Si	0.23	0.23	0.057	0.03	0.02	0.01	-0.008	-0.105	0.004	0.001
Gyung-Nam	Milyang-Si	0	0	-0.001	0	0	0	0	0.001	0	0
Gyung-Nam	Yangsan-Si	-6.98	-7.85	-1.57	-0.35	-0.24	-0.093	2.175	3.539	0.017	0.043
Pusan	Pusan	-6.69	-5	-2.096	-2.83	-1.93	-0.762	0.189	2.878	0.088	0.306
Yulsan	Yulsan	-6.95	-7.59	-1.623	-0.62	-0.42	-0.168	1.879	3.454	0.02	0.067
Gyung-Nam	Jinhae-Si	0	0	0	0	0	0	0	0.001	0	0
Total Impact		3575.58	3174.31	475.156	2202.31	1657.47	354.951	273.206	332.42	191.706	813.709

[a]Effects of 1,000 new jobs created in Gijang County of Punsan Province, Korea

Intra-County Economic Impact Comparison of a Spatial and Non-Spatial Model

Variable	Impact from spatial model	Impact from non-spatial model	Percentage difference
Local revenue (million won)	3603	3144	-13%
Local expenditures (million won)	3203	2587	-19%
Housing units	482	466	-3%
Population	2206	2253	2%
Economically active population	1660	1695	2%
Number of students	356	364	2%
Out-commuters	267	331	24%
In-commuters	319	381	19%
Number of firms	192	172	-10%
Employment in non-basic sector	813	830	2%

Effects of 1,000 new jobs created in Gijang County of Punsan Province, Korea

Types of Spatial Simultaneous Equation Models Considered Here

$$Y_n = Y_n B + X_n A + E_n \quad (1)$$

$$Y_n = Y_n B + X_n C + \bar{Y}_n A + U_n \quad (2)$$

$$Y_n = Y_n B + X_n C + E_n \quad (3)$$

$$E_n = \bar{E}_n \mathrm{P} + U_n$$

$$Y_n = Y_n B + X_n C + \bar{Y}_n A + E_n \quad (4)$$

$$E_n = \bar{E}_n \mathrm{P} + U_n$$

Mean Absolute Percentage Error as a Measure of Forecasting Accuracy in Different Models

Equations	Spatial lag and spatial error model	Spatial error model	Spatial lag model	Non-spatial model
Local revenues	21.8	22.5	21.9	25.1
Local expenditures	15.0	15.6	15.2	19.1
Total housing units	13.0	13.7	12.7	13.6
Population	11.0	11.9	11.1	11.9
Economically active population	10.2	9.1	9.1	9.7
Number of students	48.4	53.0	45.5	53.3
Out-commuters	423.0	544.7	470.2	730.4
In-commuters	173.0	167.4	177.6	183.5
Number of firms	21.3	22.4	23.4	22.6
Employment in non-basic sectors	72.2	86.0	85.8	87.1
Average	81.0	94.7	87.3	115.8
Coefficient of variation	4.0	4.6	4.2	5.1

Conclusions

- Provided a comprehensive modeling framework for local economies in Korea and made a unique application of spatial econometric analysis
- Solved for the spatial reduced form solution and performed simulation analysis
  - Both the spatial interaction and cross equation interactions are significant
  - However, the equation parameter estimates are sensitive to the structure of the spatial linkages used (i.e., weight matrix). This appears to be due to the heterogeneity of sizes of spatial units in Korea (metro vs rural counties)

Conclusions continued..

- Other key findings
  - Adding spatial components increases the model's explanatory power
  - More importantly, the spatial components appears to improve the accuracy of the intra-county impacts
  - Any type of spatial model considered here was better than the non-spatial alternative model

Recommendations

- Better data
- Consider simultaneous spatial models that have different spatial structures (spatial error, spatial lag, both and non-spatial)
- Consider other spatial structures
  - Institutional networks
  - Functional connections (highways)
  - Central place notions

Thank you