

County Information Networks, Social Capital and Poverty Reduction



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Overview

- Examine role of spatial information or communications flows in reducing poverty
- Regression model examining changes in county-level poverty rate, 2001-2011
 - conventional explanatory variables
 - new network-based information measures
 - interaction w/ social capital → weak & strong ties
- Results and policy recommendations

Spatial information, networks

- Does information or knowledge exist in some communities that can be useful for others?
 - *Tacit* versus codified knowledge
- World Bank: migrants transmit more than just remittances
- Information flows across county borders: commuting (Goetz et al. 2010), migration
- Eagle et al. (2010): Effect of Communications Network in the UK

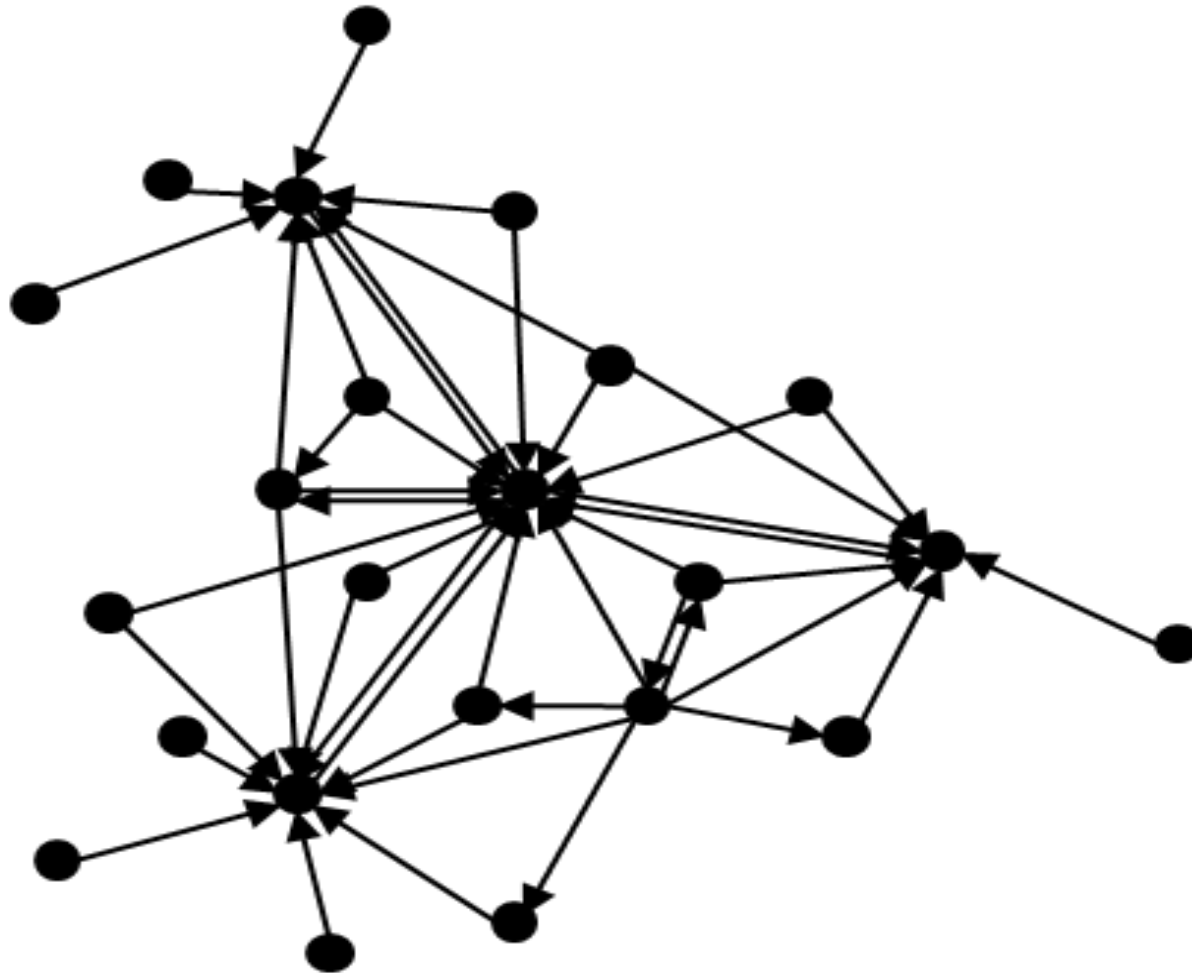


The diversity of individuals' (spatial and social) communications relationships is strongly correlated with the economic development of communities.

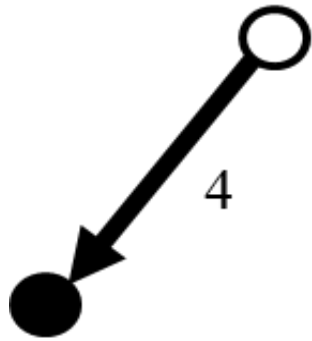


Eagle et al. (2010)
Network Diversity and
Economic Development,
Science 328: 2019-1031

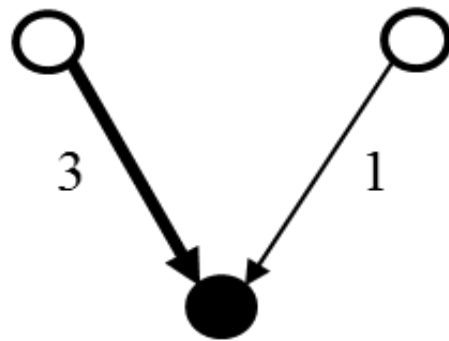
The concept of a polycentric spatial structure



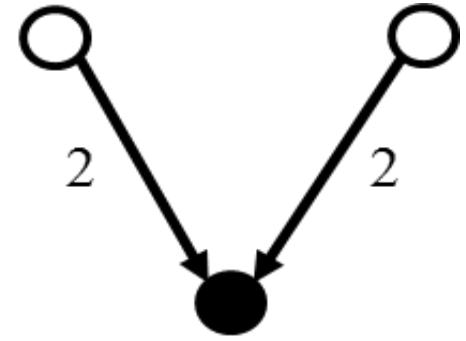
Information in-entropy values by type of connection



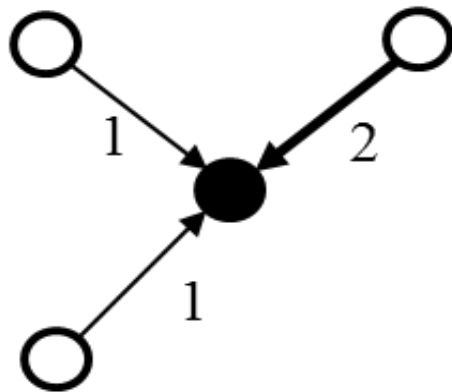
$$e_i^{in} = 0$$



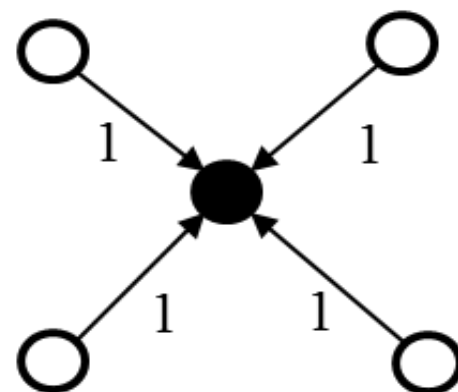
$$e_i^{in} = 0.81$$



$$e_i^{in} = 1$$



$$e_i^{in} = 1.5$$



$$e_i^{in} = 2$$

Equations

In-entropy

$$e_i^{in} = -\sum_j \left(\frac{m_{ji}}{\sum_k m_{ki}} \log_2 \left(\frac{m_{ji}}{\sum_k m_{ki}} \right) \right)$$

out-entropy

$$e_i^{out} = -\sum_j \left(\frac{m_{ij}}{\sum_k m_{ik}} \log_2 \left(\frac{m_{ij}}{\sum_k m_{ik}} \right) \right)$$

Where m_{ij} is movement from county i to j

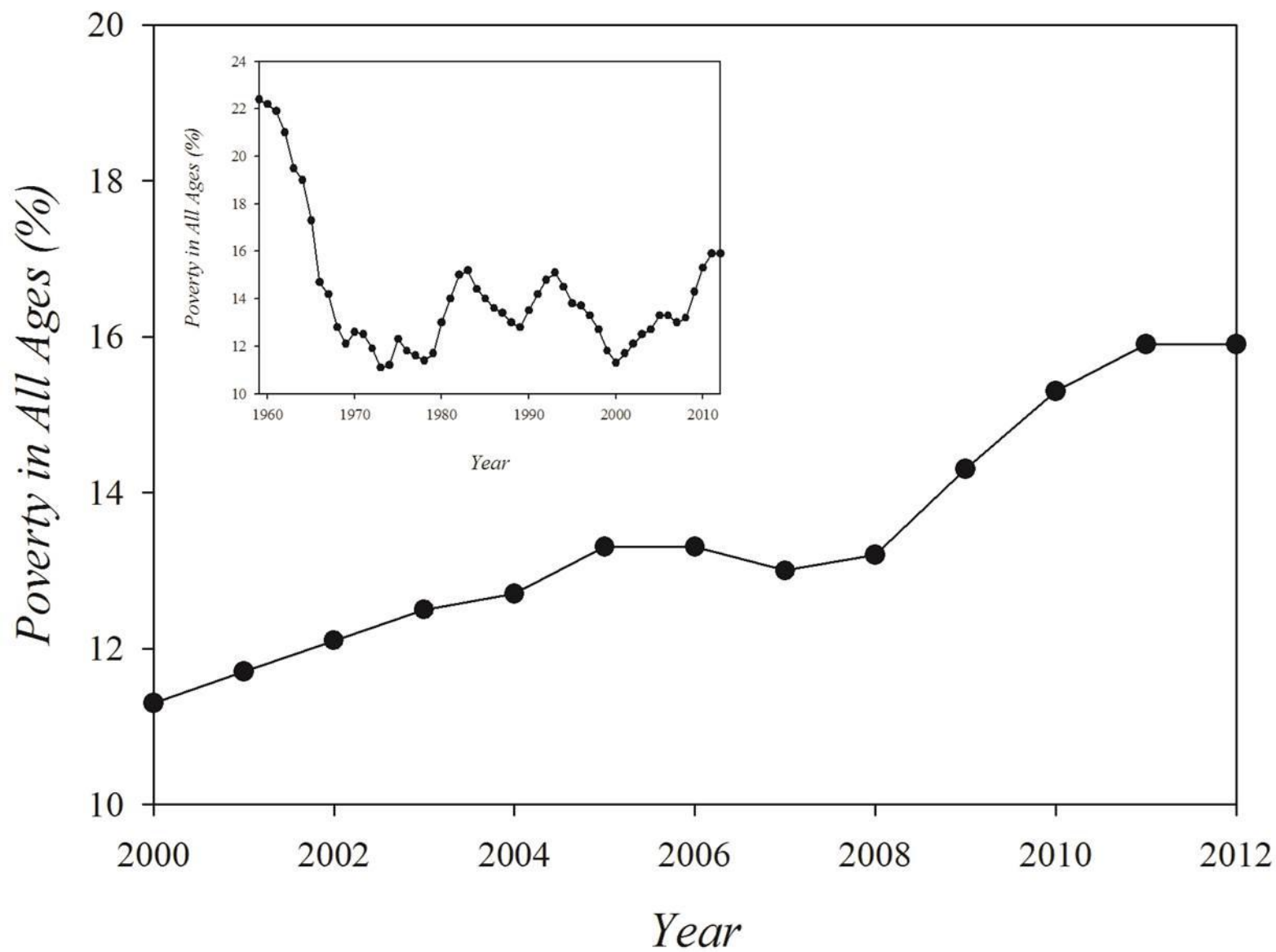
Empirical Model

$$\Delta pov = \alpha + \beta pov_t + \gamma \Omega_t + \lambda RFE_t + \zeta Mig_t + \theta Com_t + \varepsilon$$

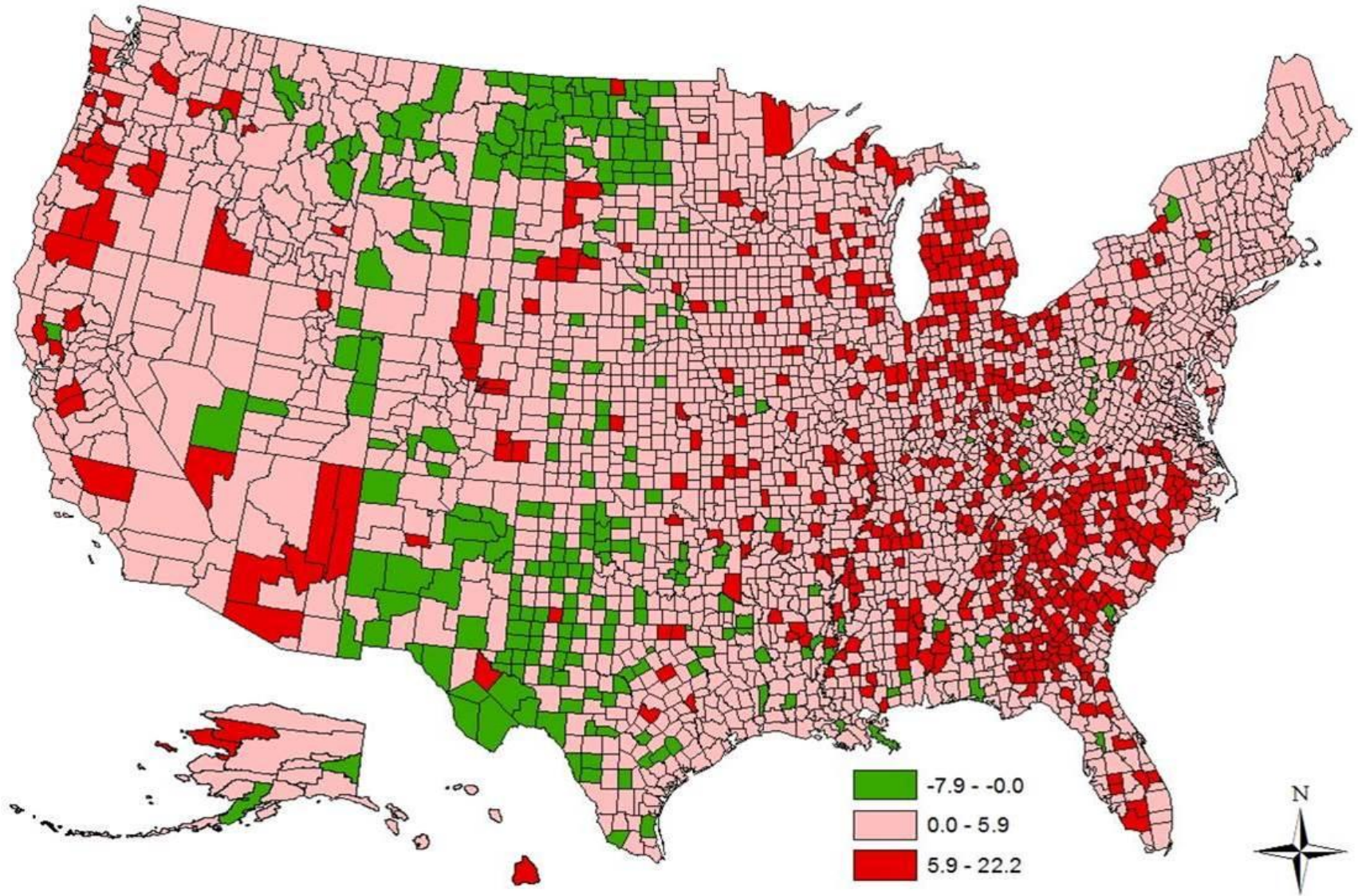
Social capital and entropy interaction

$$\frac{\partial \Delta pov}{\partial entropy} = \alpha + \beta SOC$$

Poverty rates for the United States, 1959-2012



Change in Poverty Rate, the United States, 2001-2011



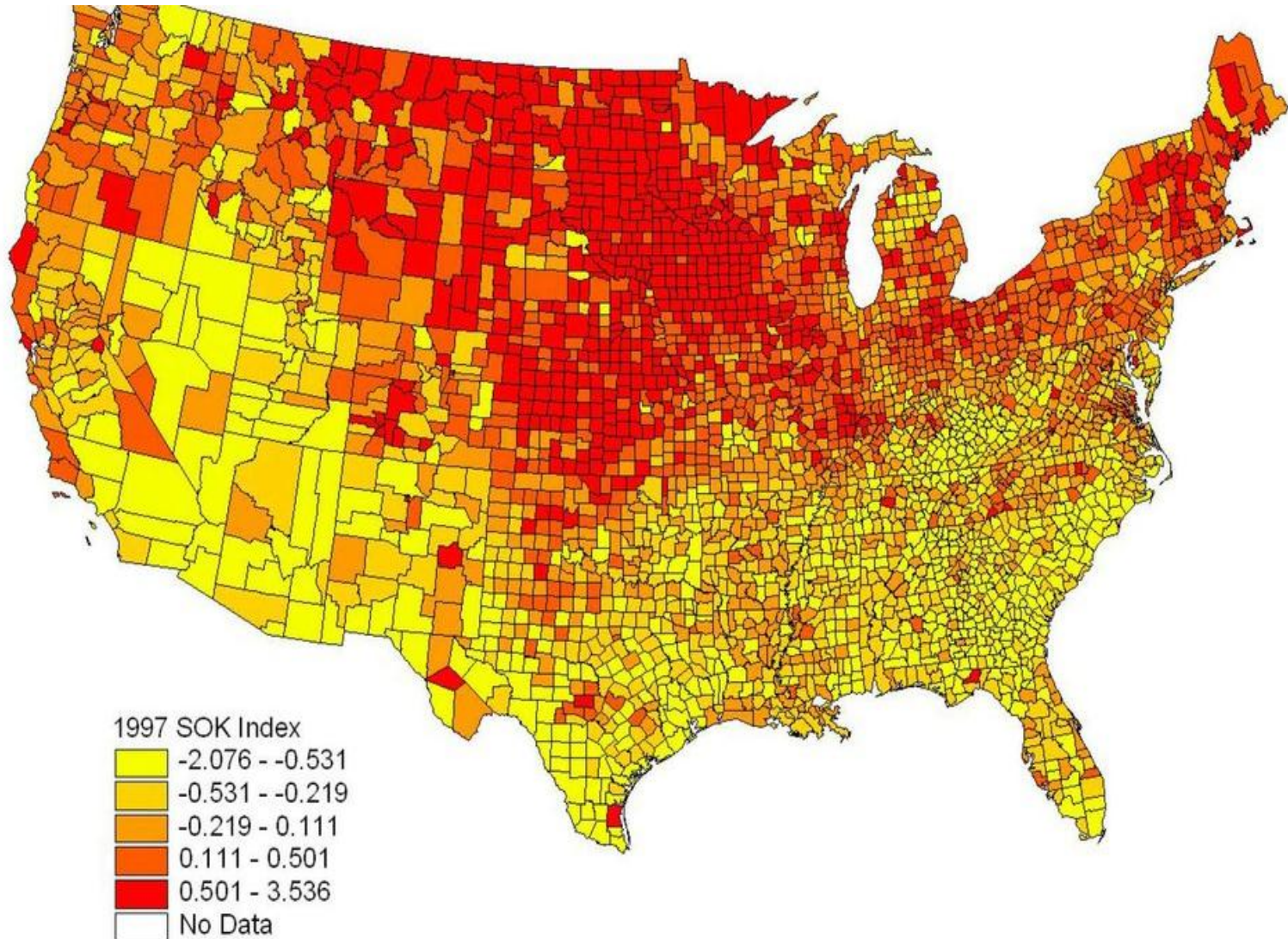
Explanatory Variables

initial pov.	Poverty percent all ages, 2001
population (x10 ³)	Resident total population, estimated, 2001
pop_density(x10 ³)	Resident population per square mile, 2001
%age_15-24	Resident population 15 to 24 years, percent, 2001
%age_65+	Resident population 65 years and over, percent, 2001
%edu_college+	Persons 25 years and over, percent college's degree or higher, 2000
%race_african	Resident population, Black alone, percent, 2001
%race_hispanic	Resident population, Hispanic or Latino Origin, percent, 2001
%female_householder	Female householder, no husband pres. w/ own children, 18 yrs, %, 2000
%emp_agri	Employment in farming, ag, forestry, fishing, and hunting, percent, 2001
%emp_manucon	Employment in manufacturing and construction, percent, 2001
%unemployment	Civilian labor force unemployment rate, 2001
in-migrants per pop	In-migrants per 100 resident population, 1996-2000
out-migrants per pop	Out-migrants per 100 resident population, 1996-2000
in-commuters per emp	In-commuters/100 employees who work in a given county, 1999
out-commuters per emp	Out-commuters /100 employees who reside in a given county, 1999
SOC	Social Capital 1997

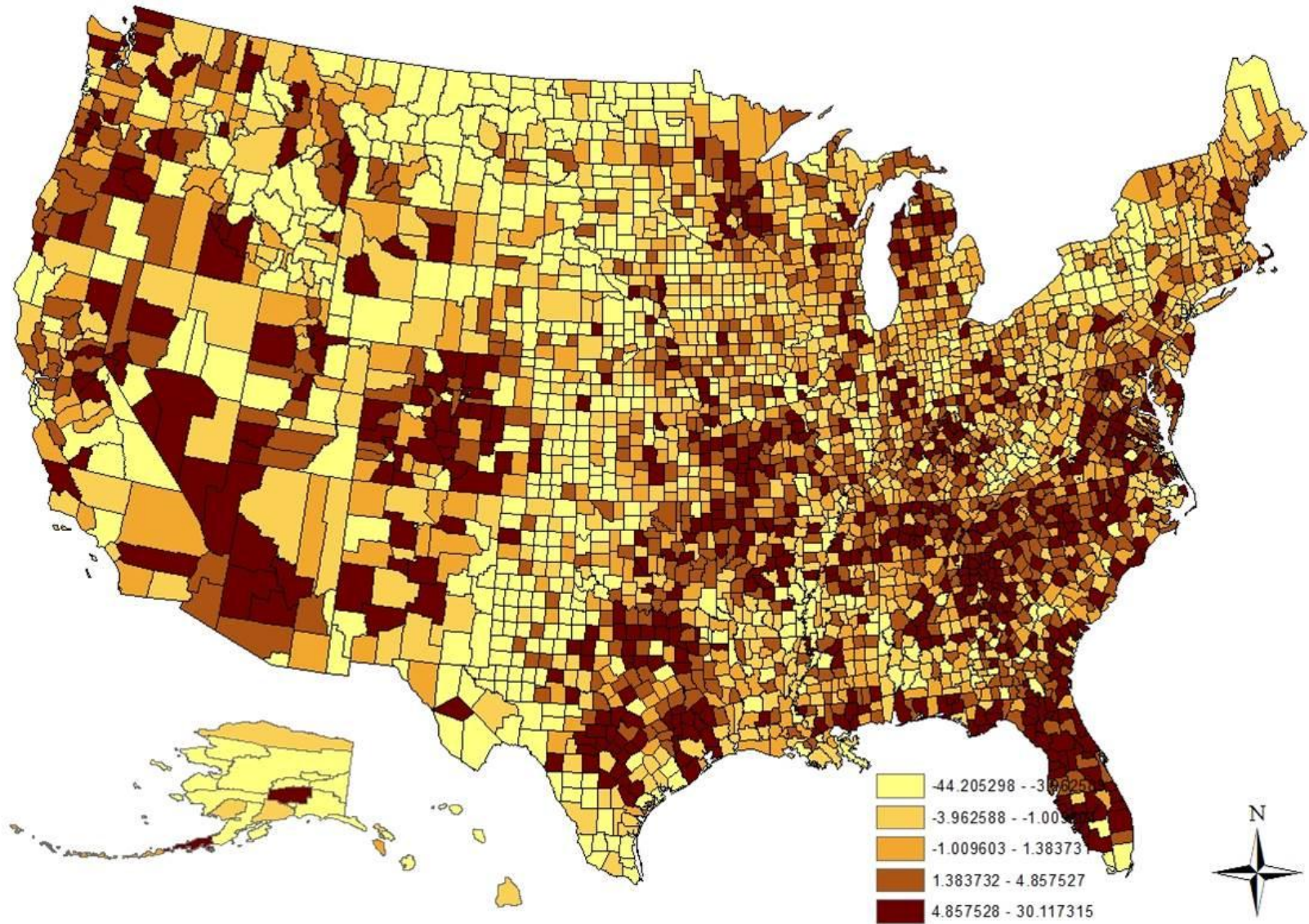
Strong vs. weak network ties

- Strong ties
 - Social capital stocks within communities
- Weak ties
 - Information received from (or sent to) more distant communities:
 - Migration entropy
 - Commuting entropy
- Consider *interactions*: do weak, strong ties reinforce or counteract one another?

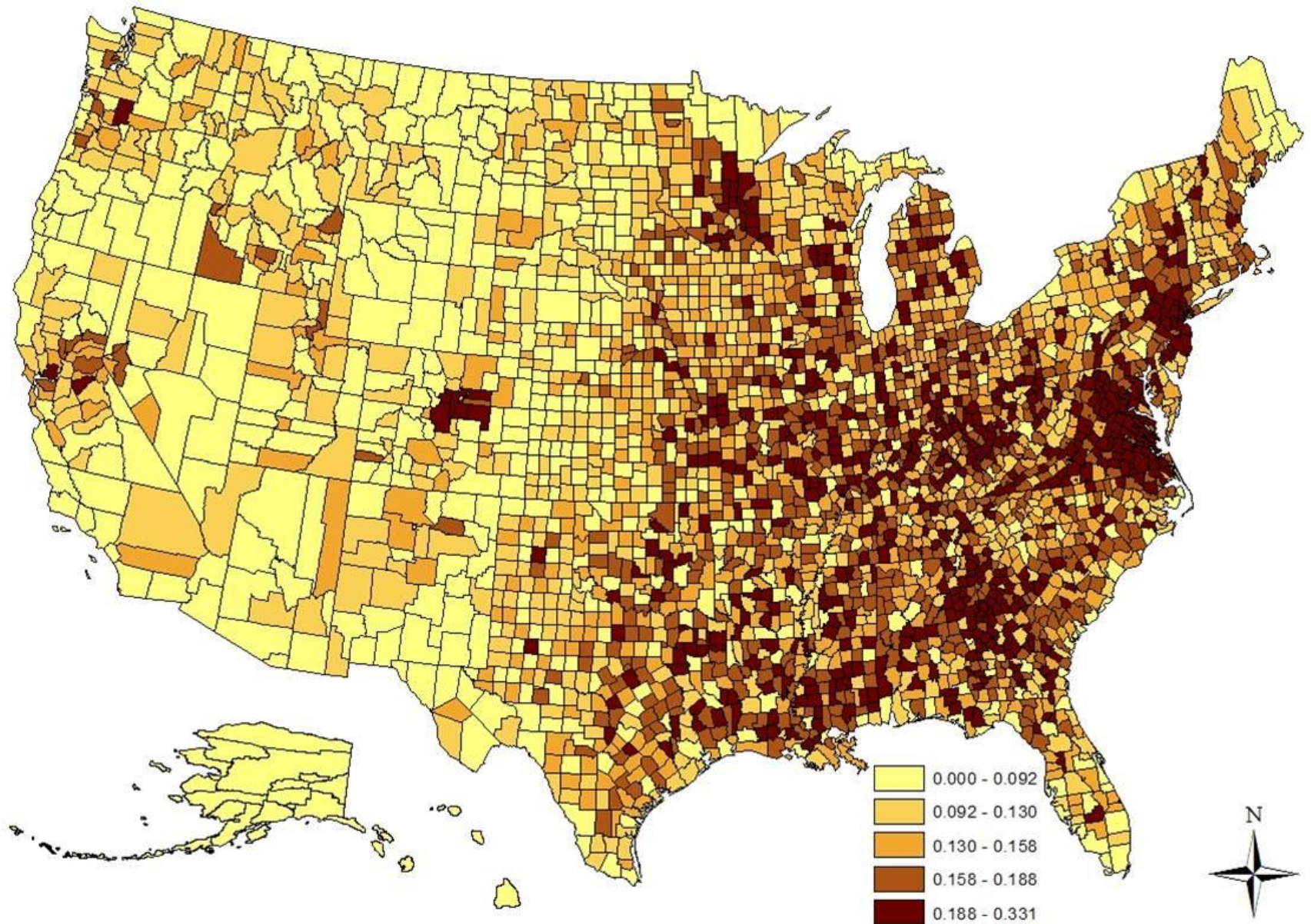
Social capital index

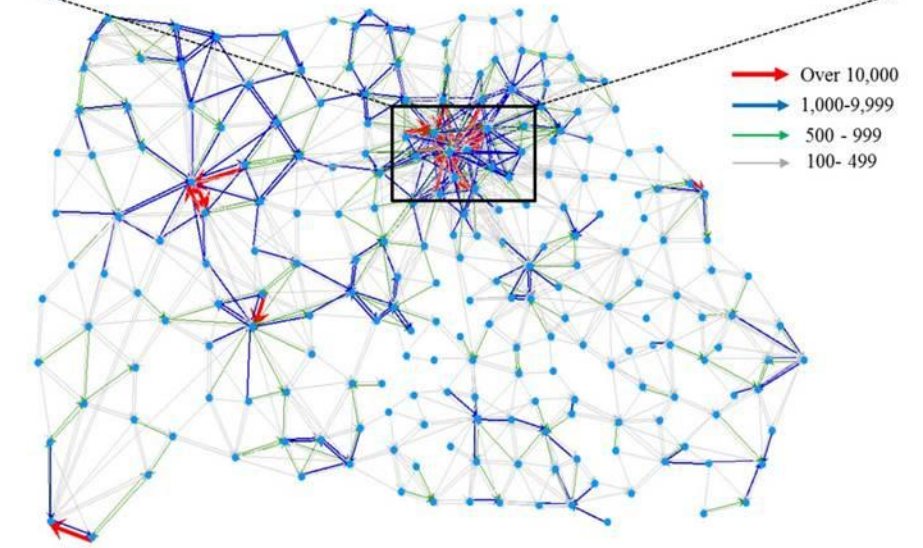
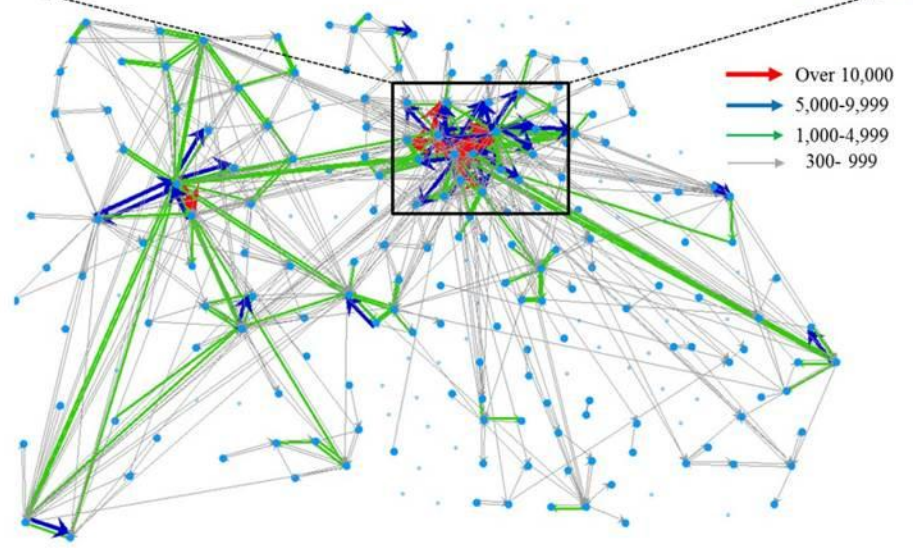
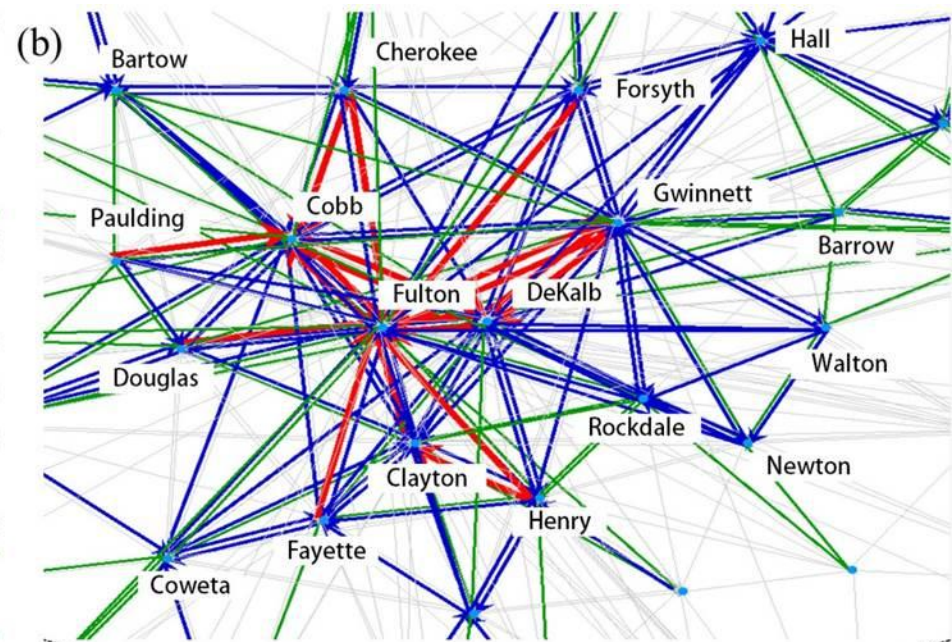
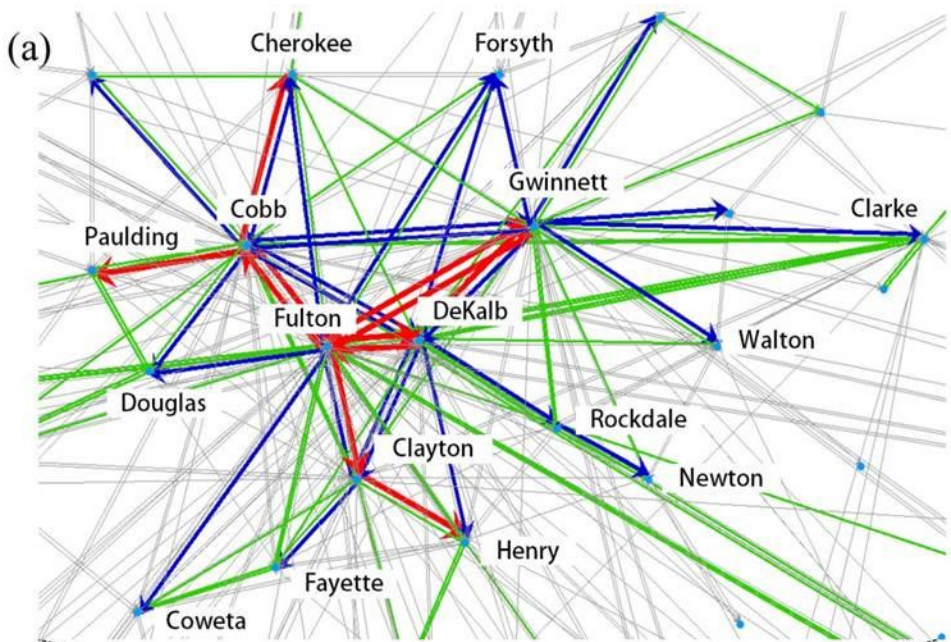


Per capita net-migrants (IN-OUT)

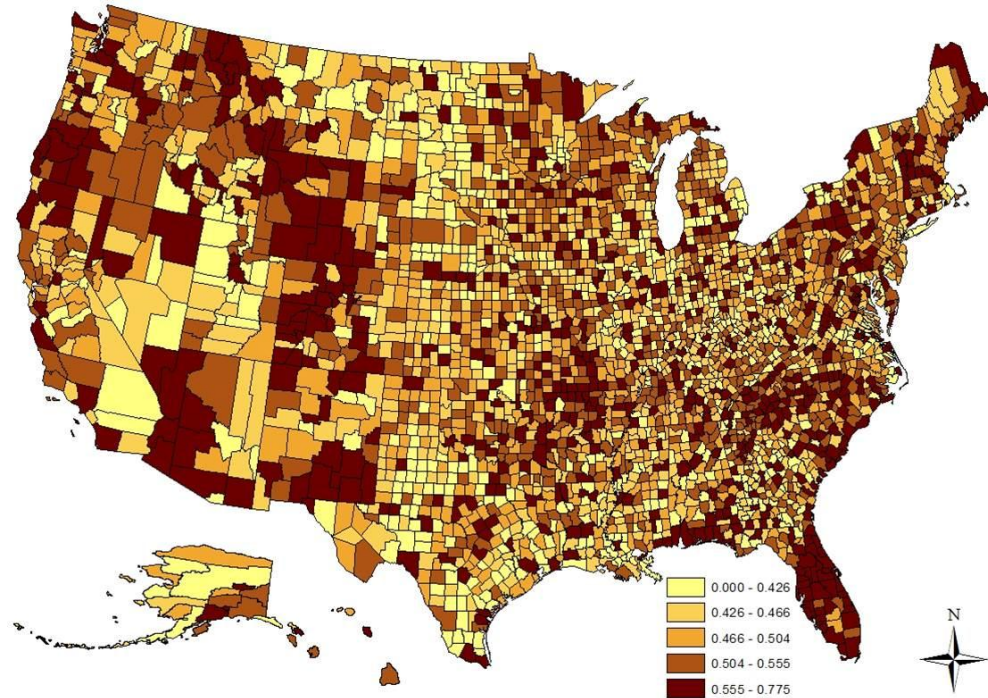


Map of percent out-commuters



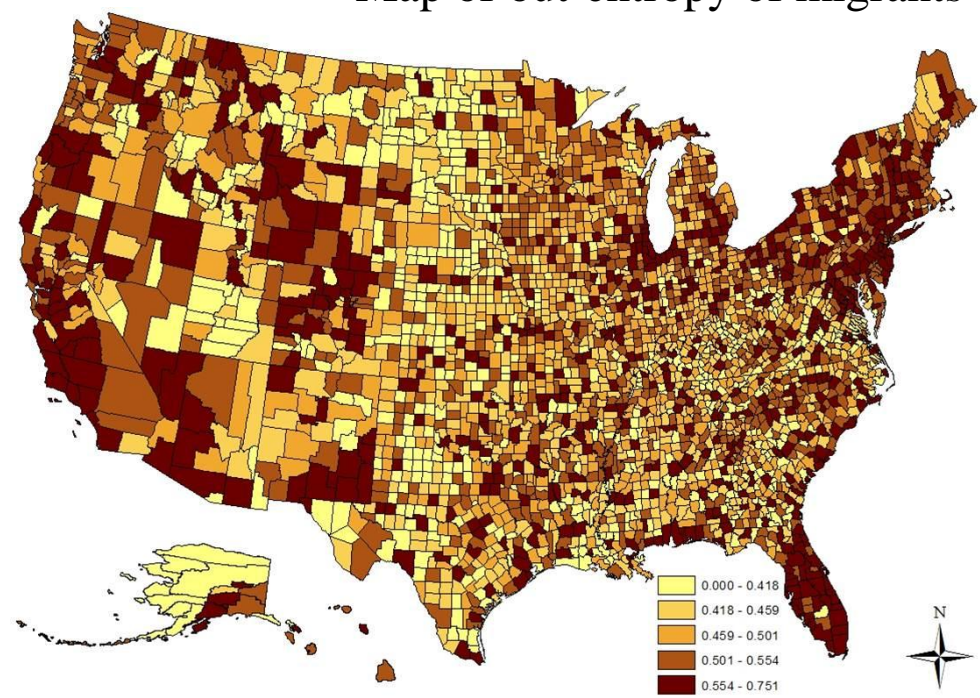


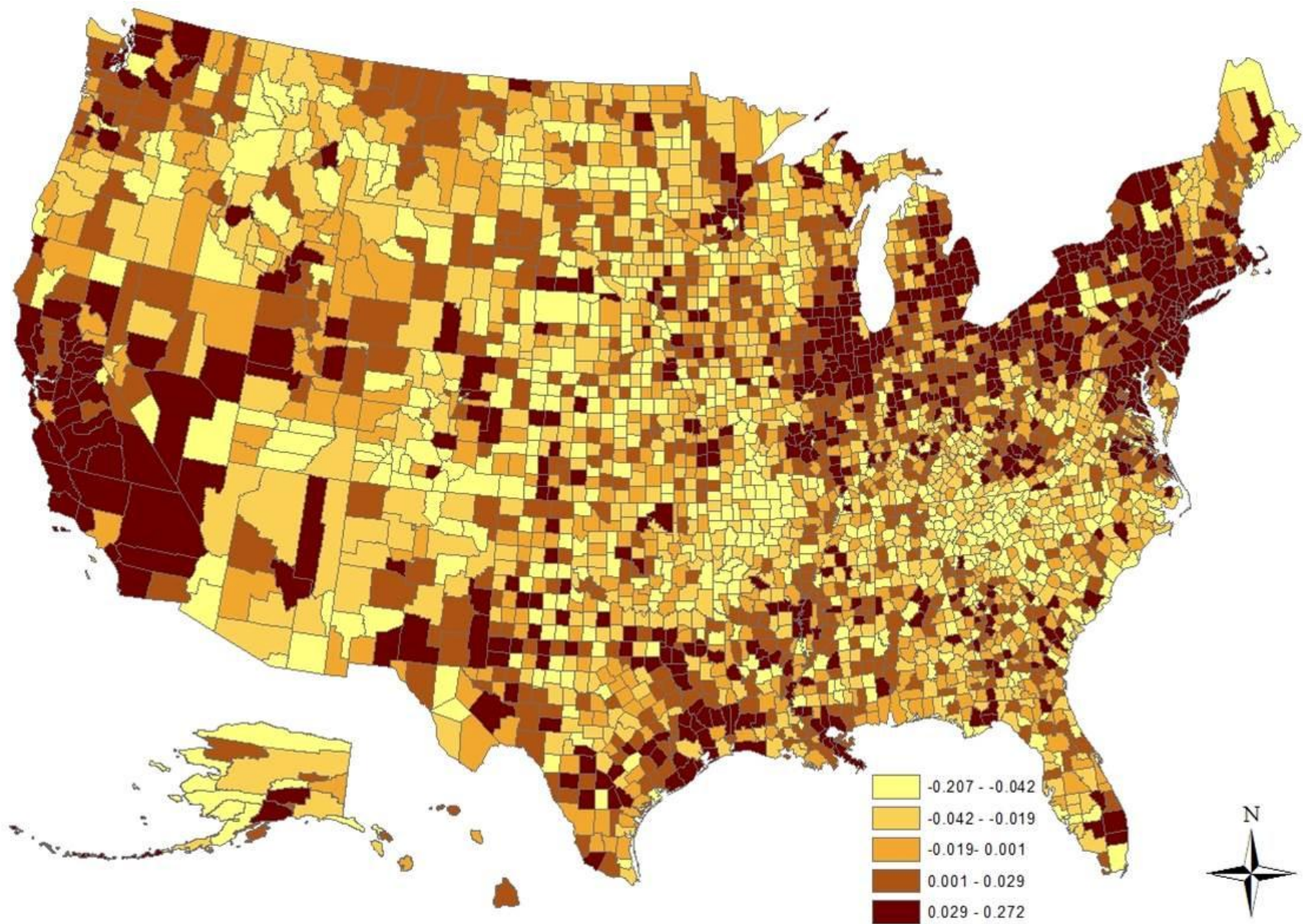
Movement of People in Alabama and Georgia; (a) migration and (b) commuting



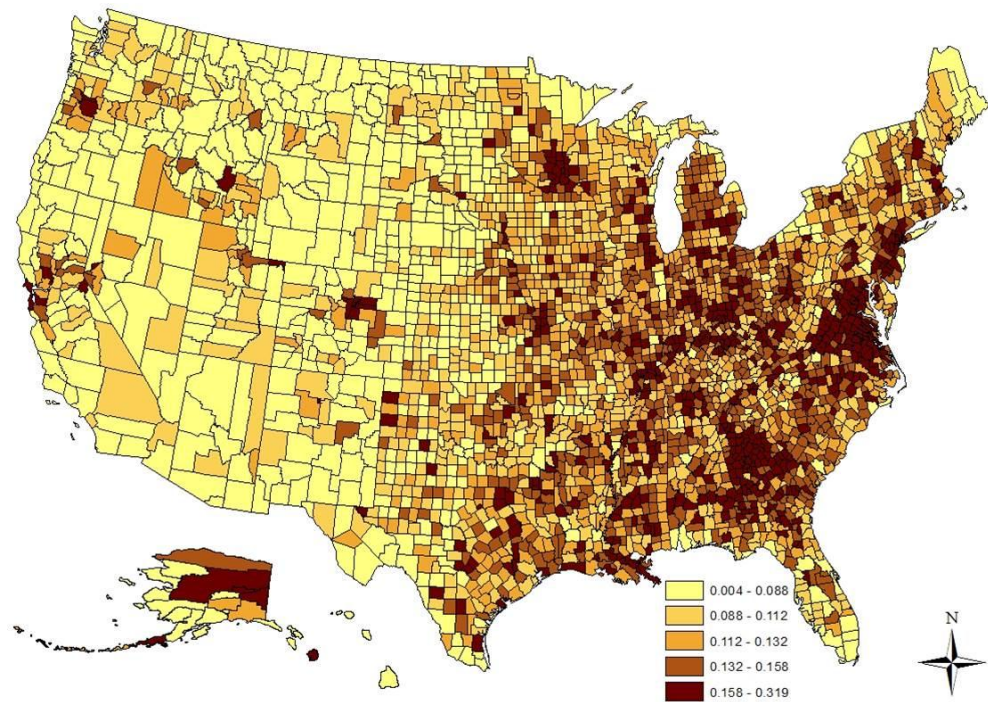
Map of in-entropy of migrants

Map of out-entropy of migrants

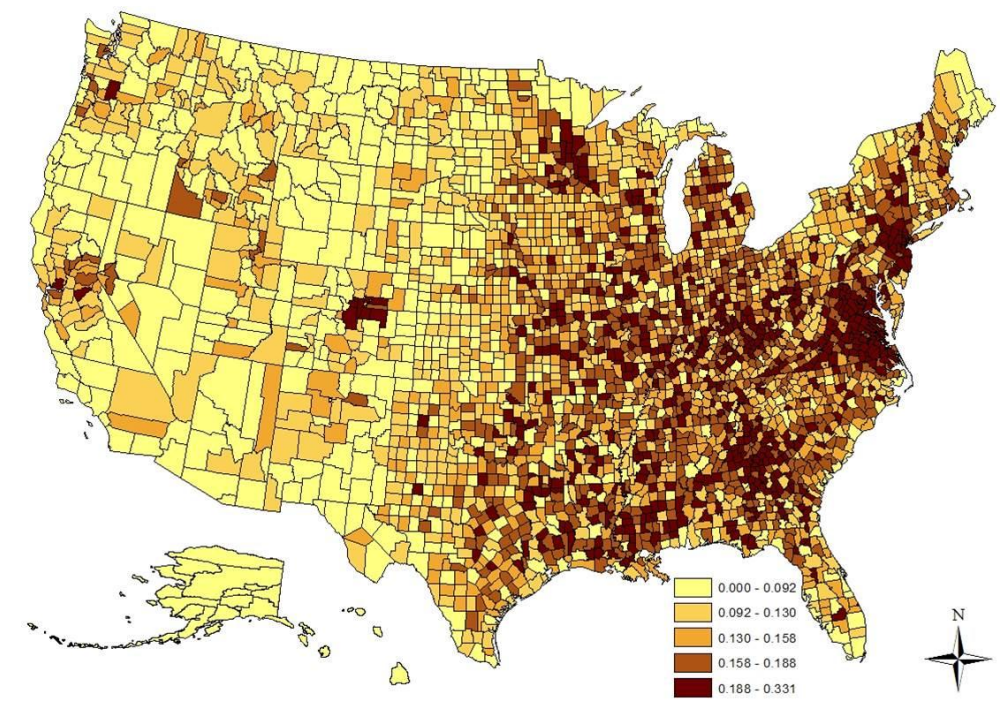




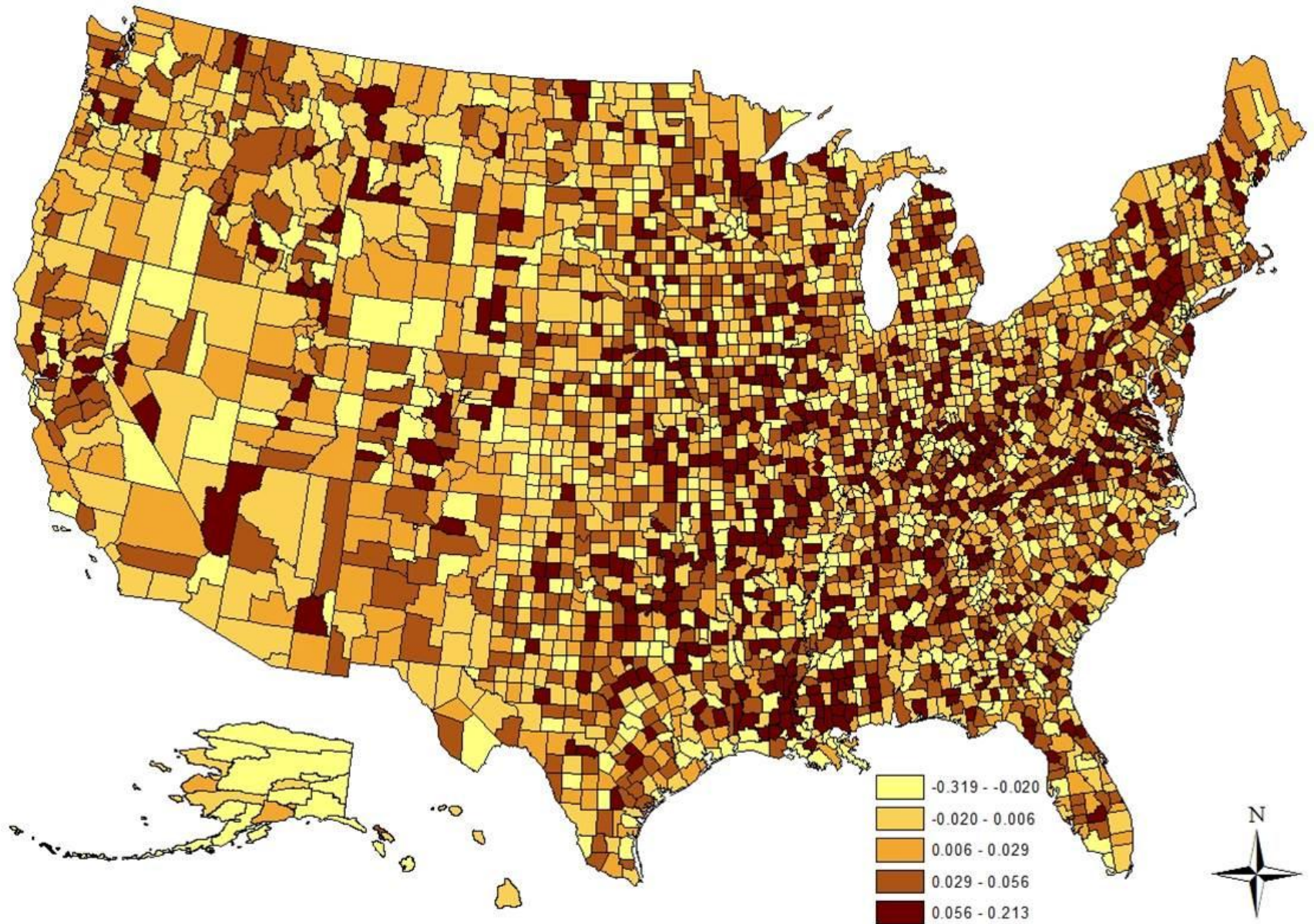
Map of net-entropy of migrants



Map of out-entropy of commuters



Map of net-entropy of commuters



Regression results

Dep var = change in poverty rate	All Counties	Rural Counties
Initial poverty	-0.415***	-0.372***
population	0.068**	-0.025
pop_density	-0.029*	0.101***
%age_15-24	0.310***	0.260***
%age_65+	0.093***	0.059**
%edu_college+	-0.196***	-0.209***
%race_african	-0.127***	-0.112***
%race_hispanic	-0.164***	-0.182***
%emp_agri	0.023	0.034
%emp_manucon	0.130***	0.147***
%unemployment	0.157***	0.158***
%female_householder	0.506***	0.463***
in-migrants per pop	0.130***	0.153***
out-migrants per pop	-0.115***	-0.055**
in-commuters per emp	0.030	0.000
out-commuters per emp	-0.083***	-0.013
<i>SOC: Social Capital stocks</i>	-0.124***	-0.124***

Regression results: interactions

	All counties	Rural counties
social capital	-0.124***	-0.124***
mig_entropy-in	0.134***	0.061*
mig_entropy-out	-0.147***	-0.105***
com_entropy-in	0.065	0.014
com_entropy-out	0.141***	0.075
mig_entropy-in*SOC	-0.418**	-0.217
mig_entropy-out*SOC	0.569***	0.517**
com_entropy-in*SOC	0.107*	-0.056
com_entropy-out*SOC	-0.184***	-0.070

Regression results: net and ratio effects

	All counties			Rural Counties		
mig_net (out-in)	-0.077***			-0.046**		
com_net (out-in)	0.092***			0.030		
mig_net*SOC	0.048***			0.039*		
com_net*SOC	-0.068***			-0.027		
mig_ratio (out/in)			-0.081***			-0.030
com_ratio (out/in)			0.078***			0.054
mig_ratio*SOC			0.370***			0.557***
com_ratio*SOC			-0.130***			-0.042

Shares of counties benefitting from social capital

	All counties				Rural counties			
	α	β	<i>thres.</i>	%	α	β	<i>thres.</i>	%
migration								
entropy-in	4.73	-3.88	1.22	3.77	2.78	-2.01	1.39	2.37
entropy-out	-5.05	5.43	0.93	92.20	-4.50	4.97	0.91	91.85
entropy-net	-4.61	4.47	1.03	93.92	-3.41	3.67	0.93	92.20
entropy-ratio	-2.03	1.71	1.19	96.13	-0.95	2.55	0.37	74.50
commuting								
entropy-in	4.20	3.90	-1.08	2.66	1.07	-2.17	0.49	19.95
entropy-out	7.53	-5.97	1.26	3.38	4.36	-2.29	1.90	0.52
entropy-net	5.49	-6.10	0.90	8.38	2.08	-2.52	0.82	9.78
entropy-ratio	0.50	-0.47	1.07	5.46	0.36	-0.14	2.51	0.16

Social capital threshold

$$\frac{\partial \Delta p_{ov}}{\partial entropy} = \alpha + \beta SOC$$

Conclusion: Effect of information flows

- Strong Network Ties: Consistent evidence that social capital is associated with less poverty
- Weak Network Ties: More network effects from migration compared to commuting
- Social capital reinforces benefits of in-migration *and* out-commuting network effects, but nine out of ten counties benefit from out-migration
- One-in-five *rural* counties benefits from in-commuting information entropy

Policy Conclusions

- Raise awareness of poverty-reducing effects of social capital
- Mobility has additional benefits (network effects)
- Conundrum: effect of strong ties positive for in-migration, but negative for out-migration entropy
- Consider beneficial effects of commuting information entropy *into* rural counties from urban counties

Variable	Definition	No.	Mean	st.dev	Max.	Min.
initial pov.	Poverty percent all ages, 2001	3,078	13.75	5.77	43.50	2.10
population (x10 ³)	Resident total population, estimated, 2001	3,078	91	296	9,635	0.06
pop_density(x10 ³)	Resident population per square mile, 2001	3,078	0.23	1.69	68.433	0.00
%age_15-24	Resident population 15 to 24 years, percent, 2001	3,078	13.67	3.38	46.20	6.45
%age_65+	Resident population 65 years and over, percent, 2001	3,078	14.88	4.13	34.67	1.65
%edu_college+	Persons 25 years and over, percent college's degree or higher, 2000	3,078	42.56	11.17	85.39	16.91
%race_african	Resident population, Black alone, percent, 2001	3,078	8.88	14.48	86.00	0.00
%race_hispanic	Resident population, Hispanic or Latino Origin, percent, 2001	3,078	6.43	12.17	97.40	0.10
%female_householder	Female householder, no husband present with own children under 18 years, percent, 2000	3,078	8.89	3.32	28.20	0.96
%emp_agri	Employment in farming, agriculture, forestry, fishing, and hunting, percent, 2001	3,078	9.90	9.22	64.94	0.00
%emp_manucon	Employment in manufacturing and construction, percent, 2001	3,078	16.73	9.57	59.08	0.00
%unemployment	Civilian labor force unemployment rate, 2001	3,078	5.00	1.77	17.70	1.60
in-migrants per pop	In-migrants per 100 resident population, 1996-2000	3,078	18.67	6.35	65.17	0.00
out-migrants per pop	Out-migrants per 100 resident population, 1996-2000	3,078	18.21	5.99	103.13	0.00
in-commuters per emp	In-commuters per 100 employees who work in a given county, 1996-2000	3,078	23.80	11.33	100.0	1.89
out-commuters per emp	Out-commuters per 100 employees who reside in a given county, 1996-2000	3,078	32.62	17.68	86.13	0.00
SOC	Social Capital 1997	3,078	0.00	0.63	3.54	-1.94
mig_entropy_in	In-entropy centrality in migration network, 1996-2000	3,078	0.49	0.08	0.78	0.00
mig_entropy_out	Out-entropy centrality in migration network, 1996-2000	3,078	0.48	0.08	0.75	0.00
com_entropy_in	In-entropy centrality in commuting network, 1996-2000	3,078	0.12	0.04	0.32	0.02
com_entropy_out	Out-entropy centrality in commuting network, 1996-2000	3,078	0.14	0.05	0.33	0.00
mig_entropy-net	Difference between migration out-entropy and in-entropy	3,078	0.01	0.05	0.20	-0.27
com_entropy-net	Difference between commuting out-entropy and in-entropy	3,078	0.02	0.05	0.21	-0.32
mig_entropy_ratio	Ratio of migration out-entropy to in-entropy	3,078	0.99	0.11	1.96	0.00
com_entropy_ratio	Ratio of commuting out-entropy to in-entropy	3,078	1.20	0.44	5.39	0.00

Definitions of variables and descriptive statistics

	std. coeff.	std. coeff.	std. coeff.	std. coeff.
const		**		
Initial pov.	-0.415***	-0.458***	-0.465***	-0.459***
population	0.068**	0.076**	0.073**	0.074**
pop_density	-0.029*	-0.034**	-0.030**	-0.029**
%age_15-24	0.310***	0.305***	0.311***	0.314***
%age_65+	0.093***	0.075***	0.070***	0.072***
%edu_college+	-0.196***	-0.164***	-0.194***	-0.201***
%race_african	-0.127***	-0.139***	-0.120***	-0.119***
%race_hispanic	-0.164***	-0.130***	-0.140***	-0.140***
%emp_agri	0.023	0.020	0.018	0.010
%emp_manucon	0.130***	0.117***	0.119***	0.119***
%unemployment	0.157***	0.164***	0.154***	0.154***
%female_householder	0.506***	0.529***	0.521***	0.518***
in-migrants per pop	0.130***	0.120***	0.121***	0.125***
out-migrants per pop	-0.115***	-0.107***	-0.111***	-0.117***
in-commuters per emp	0.030	-0.041	0.093***	0.078**
out-commuters per emp	-0.083***	-0.186***	-0.156***	-0.130***
SOC	-0.124***	-0.210*	-0.098***	-0.370***
mig_entropy-in		0.134***		
mig_entropy-out		-0.147***		
com_entropy-in		0.065		
com_entropy-out		0.141***		
mig_entropy-in*SOC		-0.418**		
mig_entropy-out*SOC		0.569***		
com_entropy-in*SOC		0.107*		
com_entropy-out*SOC		-0.184***		
mig_net (out-in)			-0.077***	
com_net (out-in)			0.092***	
mig_net*SOC			0.048***	
com_net*SOC			-0.068***	
mig_ratio (out/in)				-0.081***
com_ratio (out/in)				0.078***
mig_ratio*SOC				0.370***
com_ratio*SOC				-0.130***
Adj. R square	0.388	0.407	0.403	0.400

Regression parameter estimates
(all Continental counties)

	std. coeff.	std. coeff.	std. coeff.	std. coeff.
const				
Initial pov.	-0.372***	-0.393***	-0.390***	-0.379***
population	-0.025	0.001	-0.011	-0.024
pop_density	0.101***	0.112***	0.094***	0.110***
%age_15-24	0.260***	0.259***	0.263***	0.259***
%age_65+	0.059**	0.054**	0.053**	0.051*
%edu_college+	-0.209***	-0.210***	-0.214***	-0.214***
%race_african	-0.112***	-0.115***	-0.105***	-0.100***
%race_hispanic	-0.182***	-0.169***	-0.173***	-0.171***
%emp_agri	0.034	0.026	0.033	0.028
%emp_manucon	0.147***	0.134***	0.137***	0.137***
%unemployment	0.158***	0.163***	0.157***	0.155***
%female_householder	0.463***	0.474***	0.471***	0.464***
in-migrants per pop	0.153***	0.153***	0.147***	0.154***
out-migrants per pop	-0.055**	-0.040	-0.051**	-0.054**
in-commuters per emp	0.000	-0.019	0.024	0.040
out-commuters per emp	-0.013	-0.089*	-0.045	-0.062*
SOC	-0.124***	-0.302*	-0.097***	-0.632***
mig_entropy-in		0.061*		
mig_entropy-out		-0.105***		
com_entropy-in		0.014		
com_entropy-out		0.075		
mig_entropy-in*SOC		-0.217		
mig_entropy-out*SOC		0.517**		
com_entropy-in*SOC		-0.056		
com_entropy-out*SOC		-0.070		
mig_net (out-in)			-0.046**	
com_net (out-in)			0.030	
mig_net*SOC			0.039*	
com_net*SOC			-0.027	
mig_ratio (out/in)				-0.030
com_ratio (out/in)				0.054
mig_ratio*SOC				0.557***
com_ratio*SOC				-0.042
R square	0.421	0.428	0.425	0.426

Regression parameter estimates
(Rural counties only)