Hydrologic Data in Water Economics

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TWEEDS
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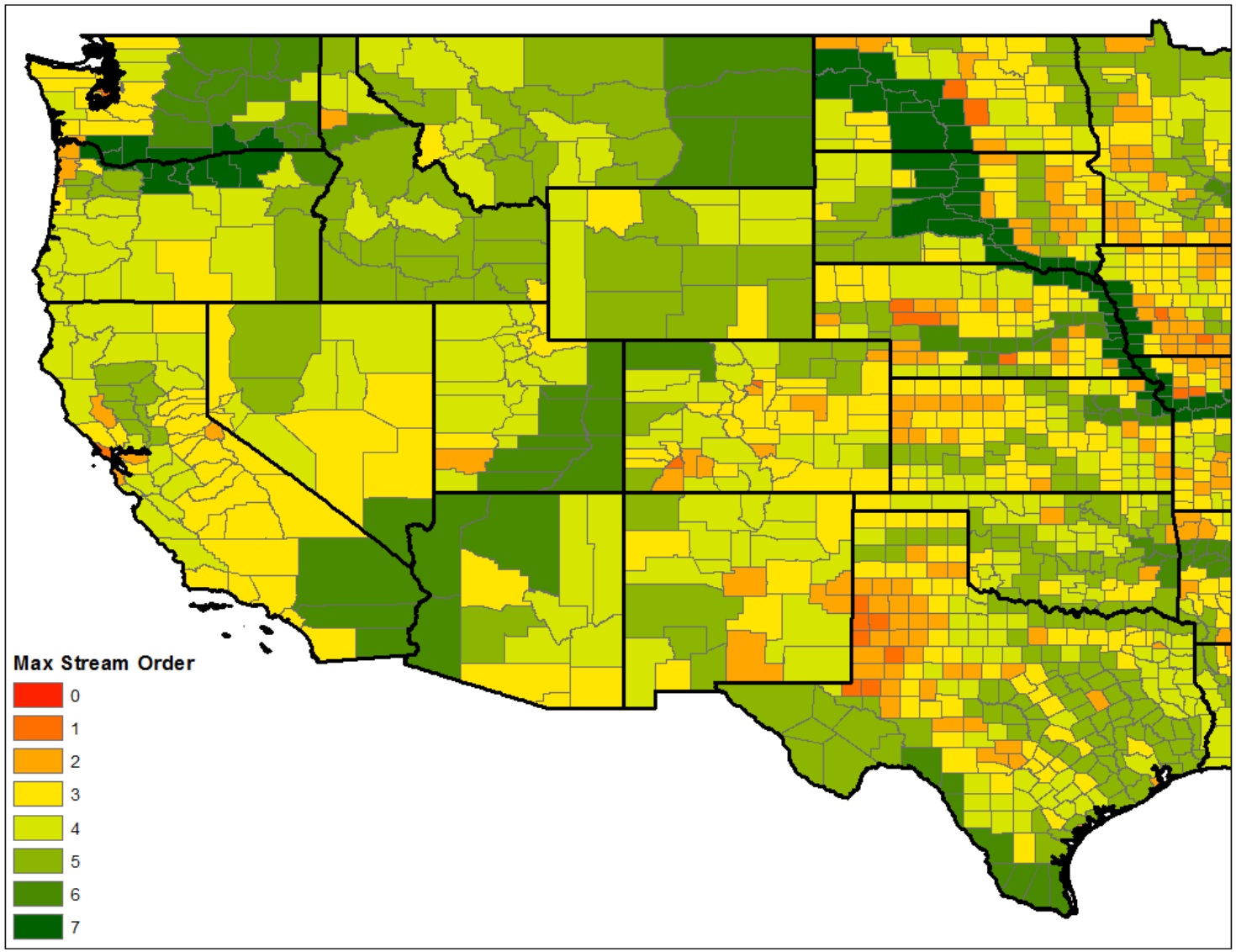
Hypotheses

- Irrigation has been the key driver of agricultural productivity in the western US
  - Hydro Data: Ground and surface water availability
  - Economics: Ag production and land value due to water access
- The benefits of groundwater management are increasing with resource commonality
  - Hydro Data: Hydraulic conductivity
  - Economics: Crop production and land value after management
- Bargaining costs can limit effective groundwater management
  - Hydro Data: Simple hydro-economic model of benefits
  - Economics: Effect of bargaining costs on management status

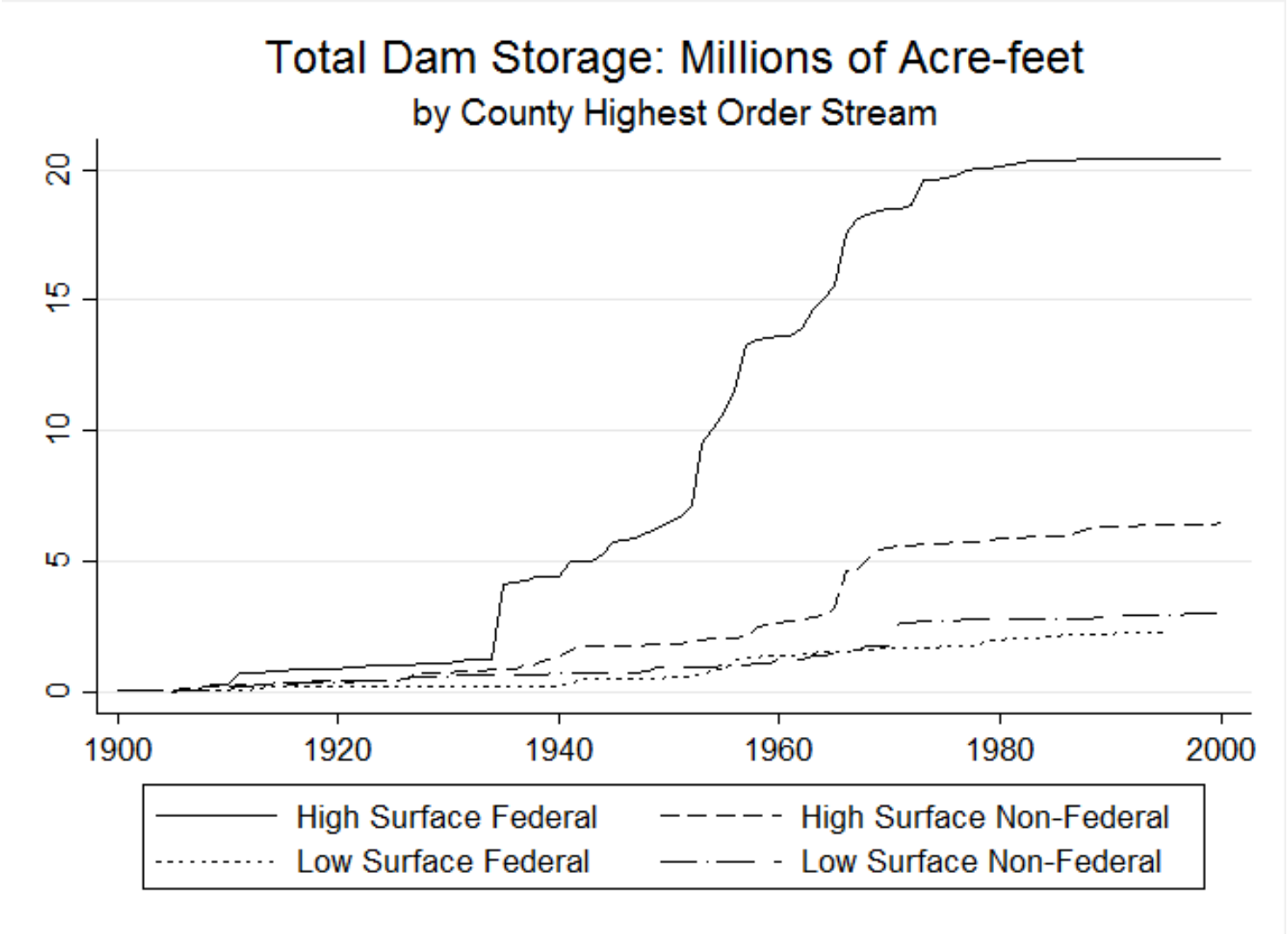
Research Problem: Irrigation

- We categorize all western counties by access to ground and surface water
- What is the impact of expanded access to water for irrigation post-1945 (large dams; center pivots)?
- Counties with higher water access increase irrigated acres, land value, and crop value relative to low-access counties; groundwater access has a larger impact on all categories

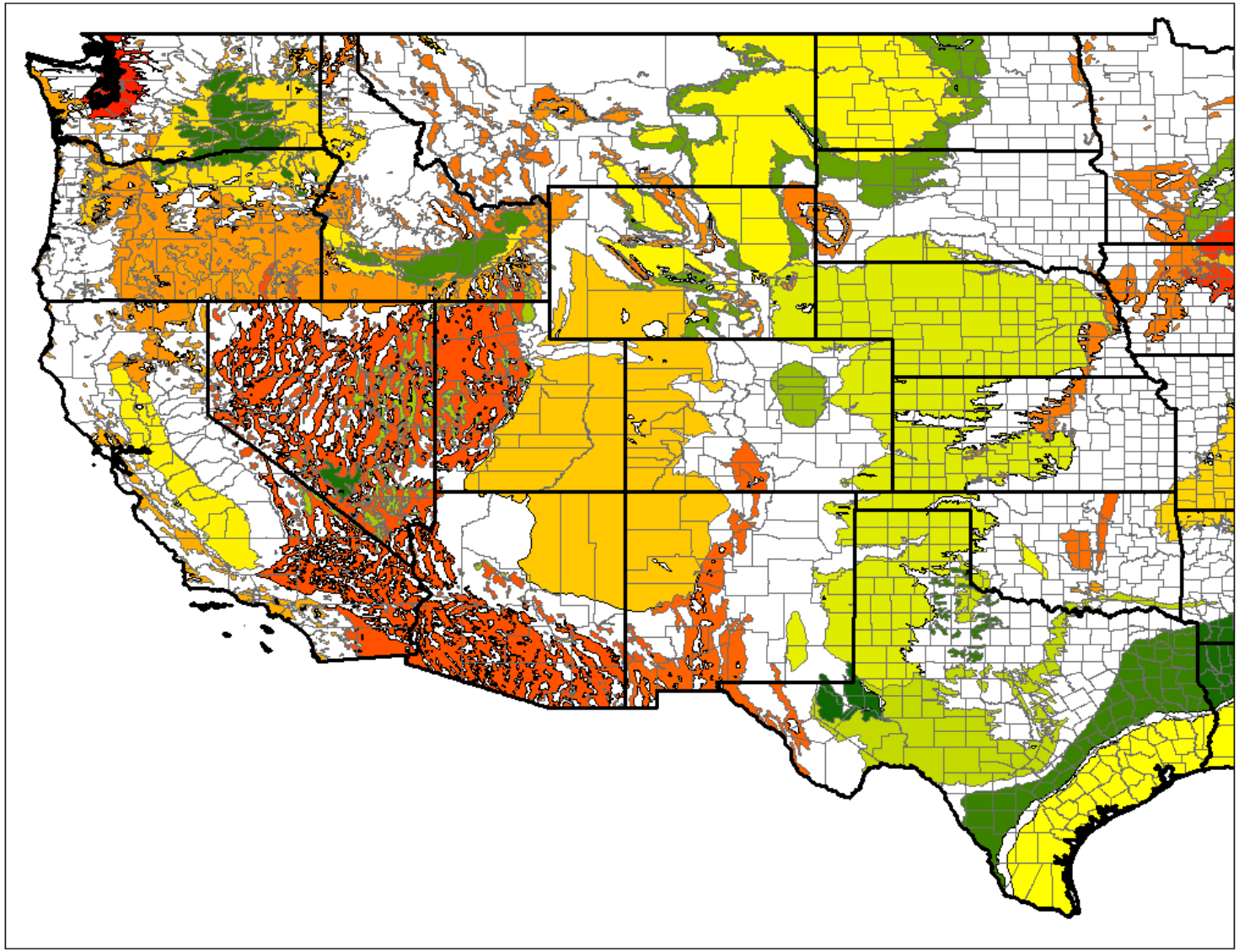
County Max Stream Order



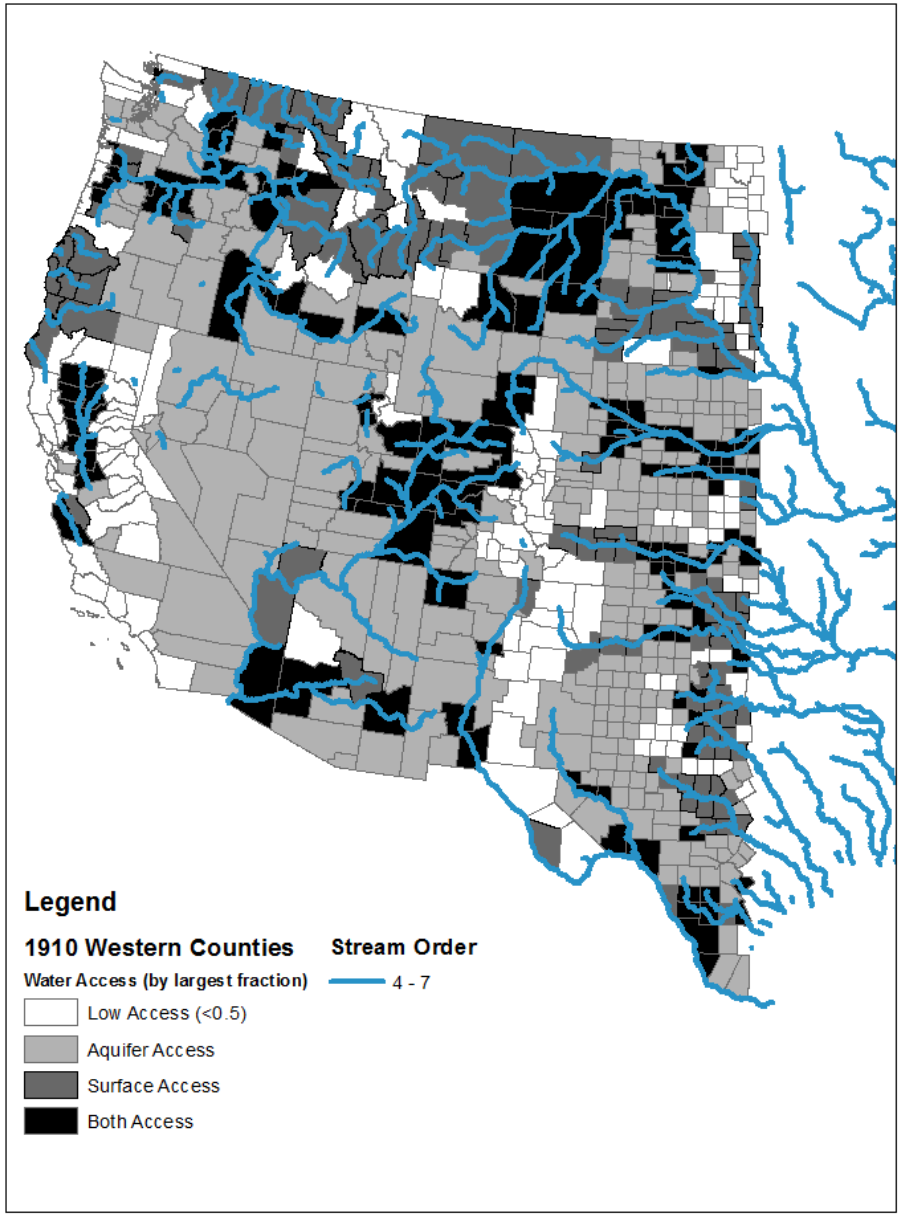
Surface Storage Expansion



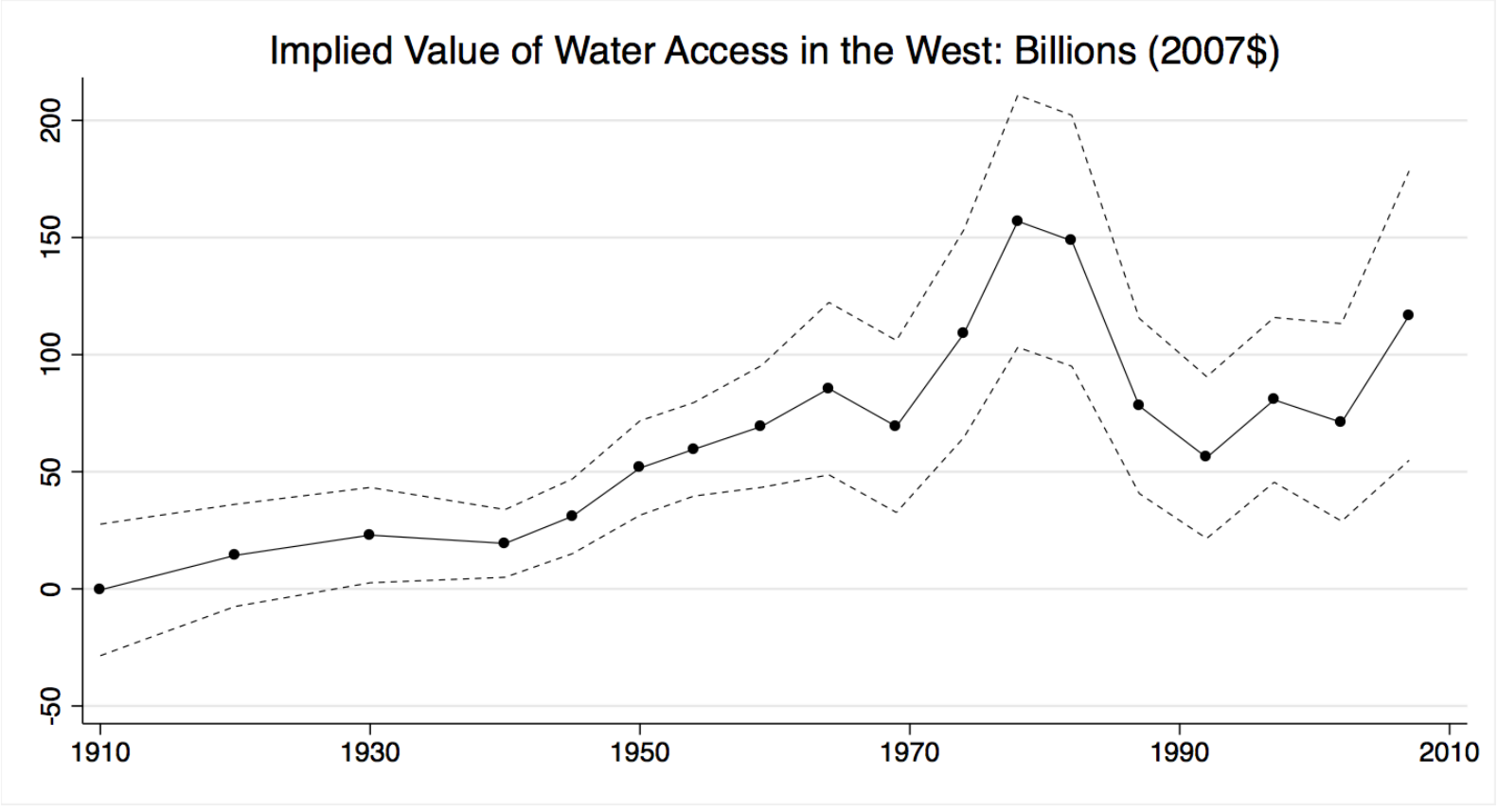
Aquifers and Western Counties



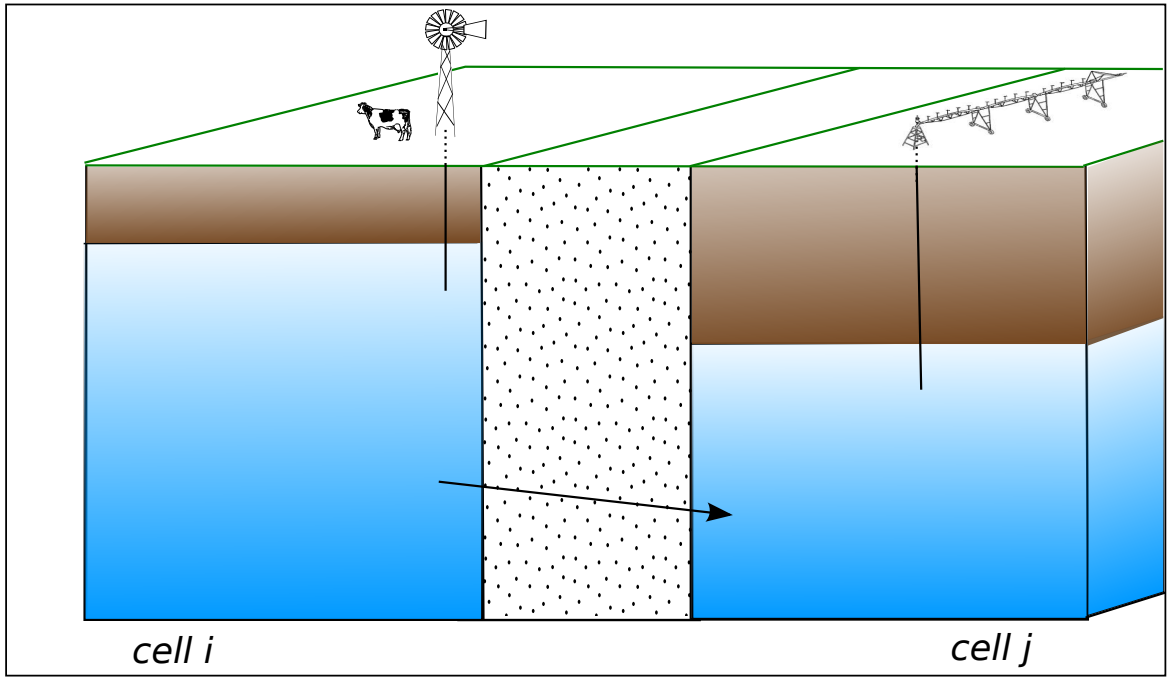
County Water Access



Water Access Drives Ag Land Value

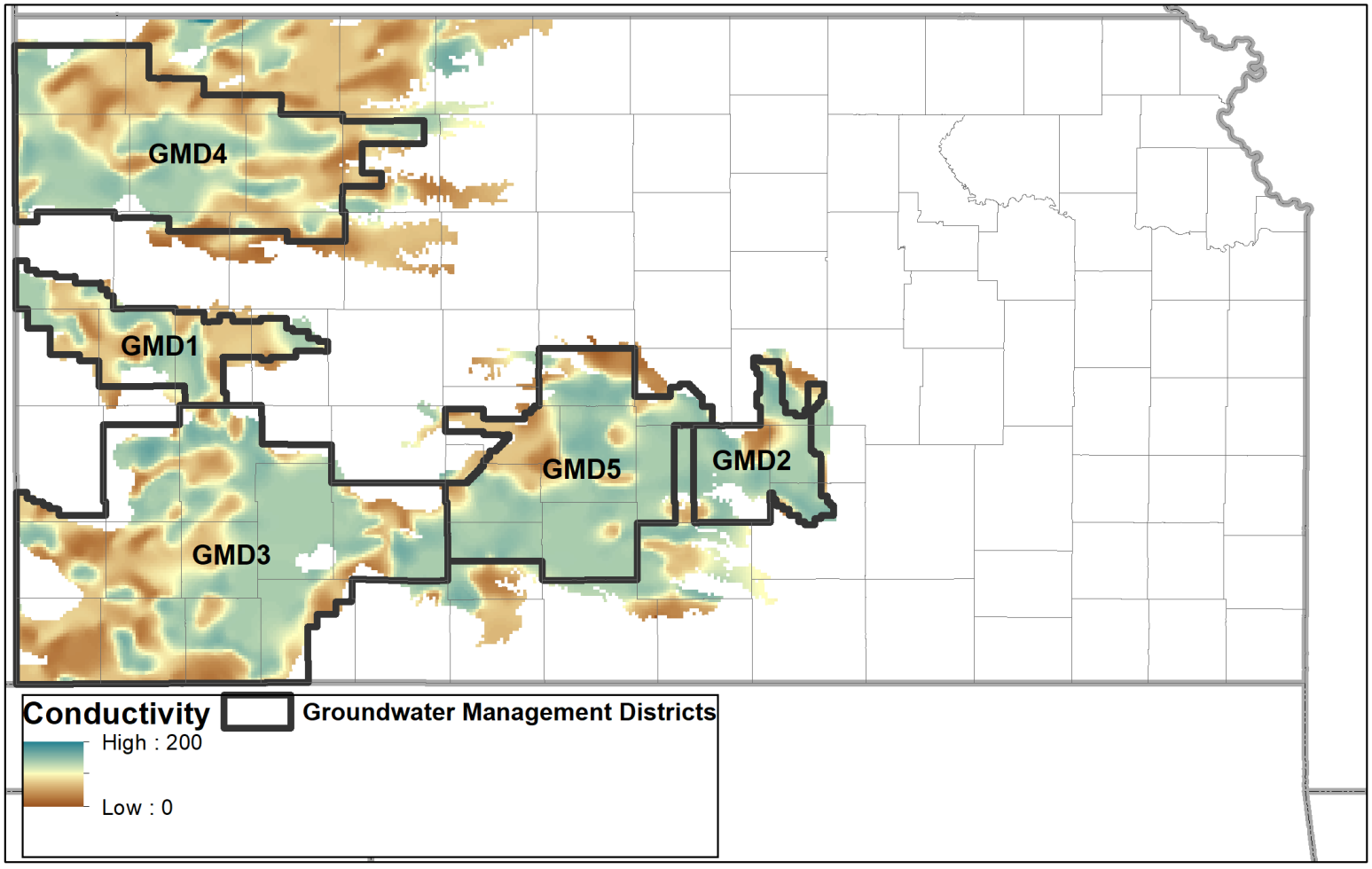


Research Problem: Commonality



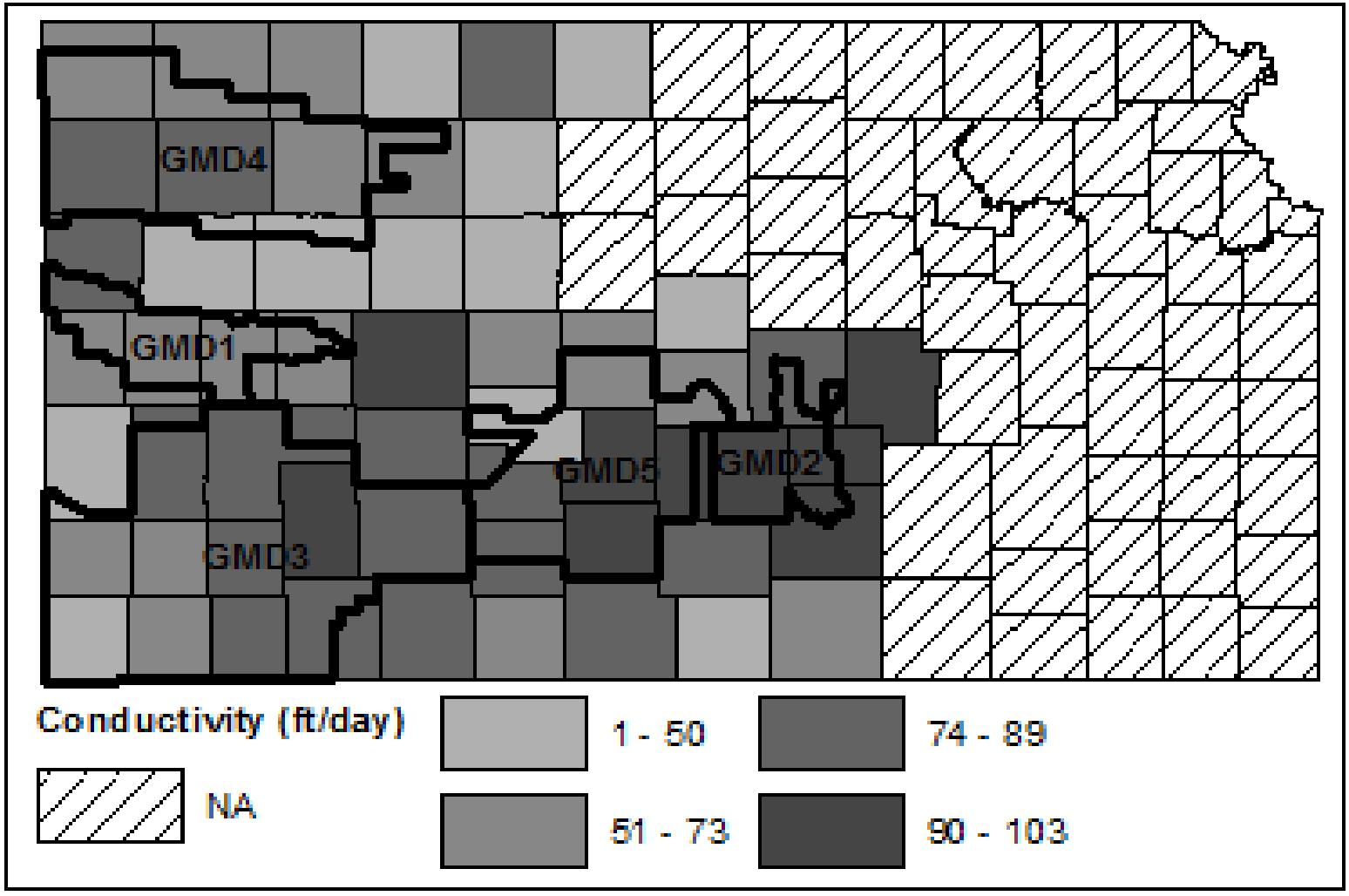
- Effect of management is unequal and depends on conductivity.
- A landowner in a county with hydraulic conductivity one standard deviation higher sees a relative land value increase of 5-8% when management is implemented.

Hydraulic Conductivity



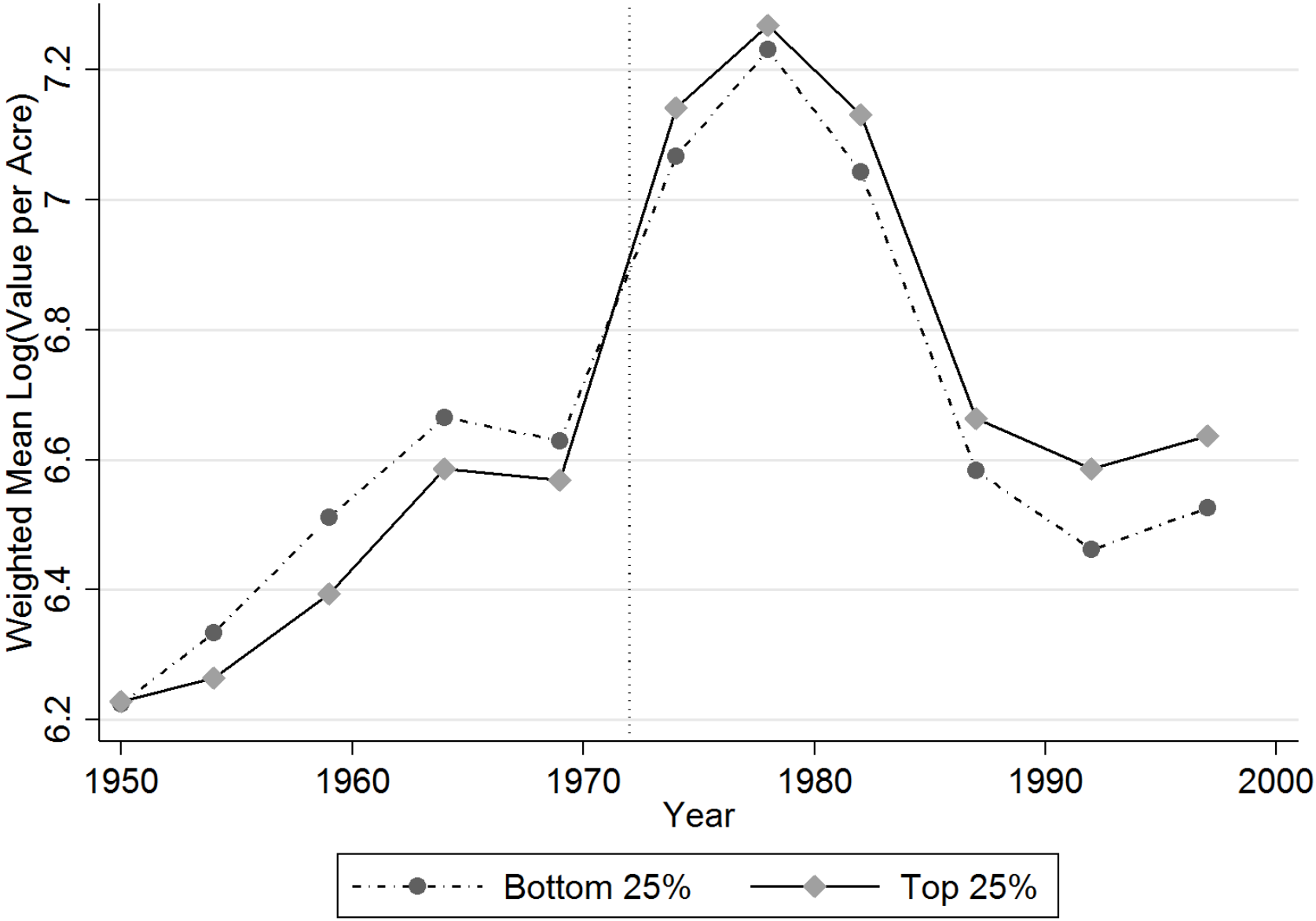
- Hydraulic conductivity - USGS Open-file Report 98-548 - PLSS (mi^2) section-stored data

Conductivity Counties

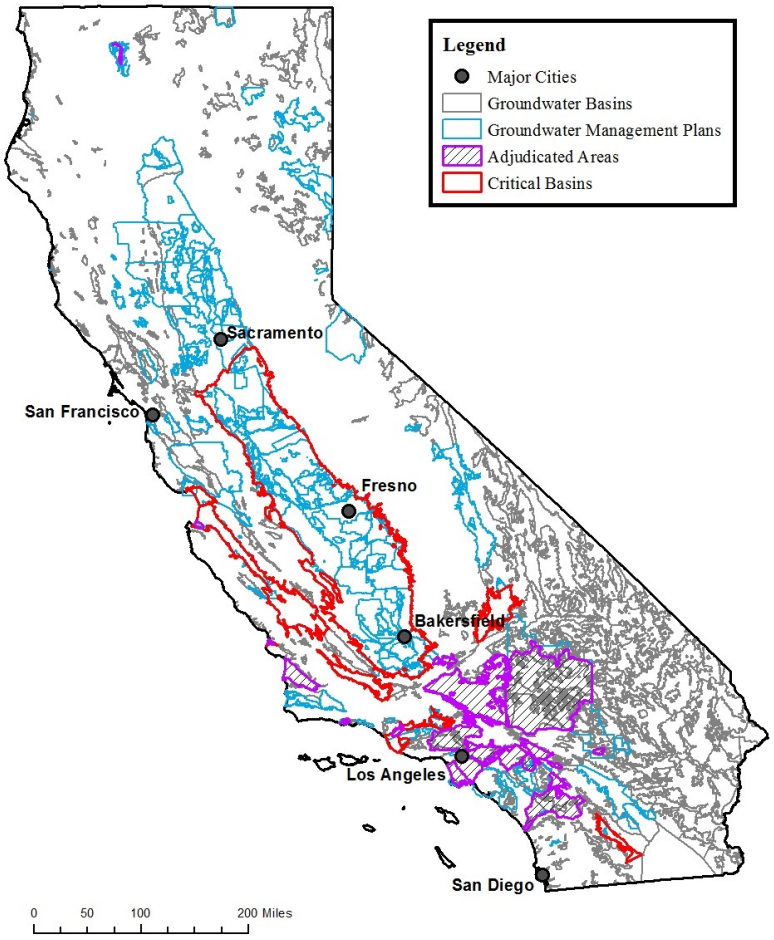


- Area-weighted average for area of county with observations

Conductivity Percentiles, High Recharge Counties



Research Problem: Bargaining Costs



- The cost of coming together to reach and agreement is higher for basins with more users and greater heterogeneity in type of use.

Simple Model of Basin Benefits

	(1) Mgt Type	(2) Mgt Type	(3) Mgt Type
Avg. Well Yield	0.000482*		0.000550*
	(0.00029)		(0.00028)
Mean Precipitation 1950-2014	-0.0543	-0.116***	-0.00707
	(0.054)	(0.031)	(0.056)
Well Density (Exog)	46.52***	46.43***	44.23***
	(14.39)	(15.23)	(14.18)
Average Urban Pop. Growth (1950-2010)	0.0308***	0.0266***	0.0231***
	(0.0078)	(0.0055)	(0.0084)
Coastline Dummy	-0.291	-0.121	-0.646
	(0.43)	(0.35)	(0.52)
State Water Project Connection			1.313***
			(0.37)
Kappa 1	0.839**	0.672***	1.316***
	(0.35)	(0.17)	(0.36)
Kappa 2	2.969***	2.662***	3.576***
	(0.47)	(0.28)	(0.46)
Observations	197	445	197

General Results: Three Basin Types

1. No adoption
   - Low transaction costs, low management benefits
   - Small number of agricultural users, high basin recharge, and no collateral impacts of drawdown
2. Successful collective action
   - Users value the resource highly
   - Returns to management are high and transaction costs comparatively low
3. Collective action breaks down
   - Basins with mixed agricultural and drinking-water users
   - Large basins with many users
   - High transaction costs

Thank you!

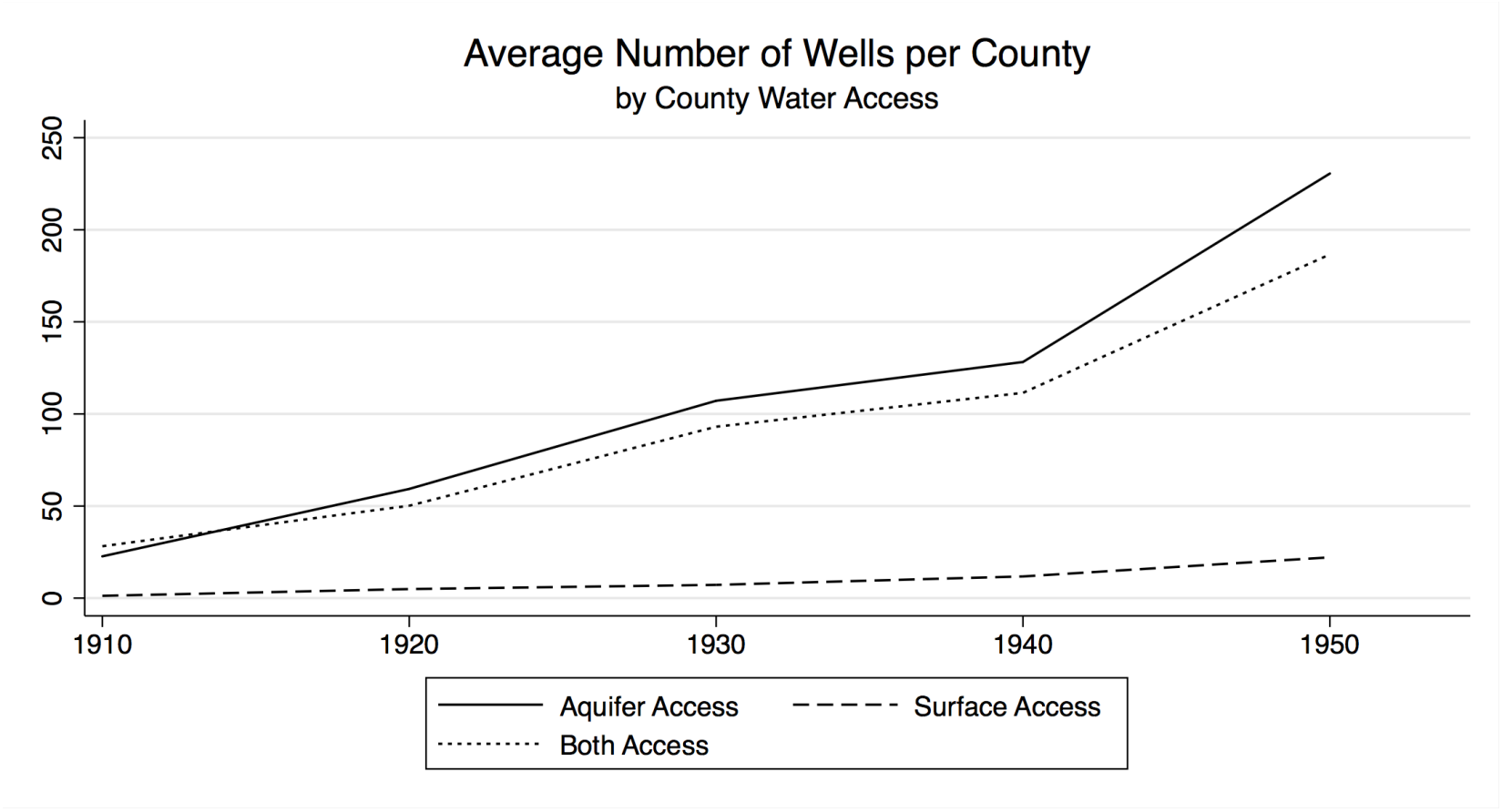
Citations:

1. Edwards, E.C. and Smith, S.M., 2018. The Role of Irrigation in the Development of Agriculture in the United States. *The Journal of Economic History*, 78(4), pp.1103-1141.
2. Edwards, E.C., 2016. What lies beneath? Aquifer heterogeneity and the economics of groundwater management. *Journal of the Association of Environmental and Resource Economists*, 3(2), pp.453-491.
3. Ayres, A.B., Edwards, E.C. and Libecap, G.D., 2018. How transaction costs obstruct collective action: The case of California's groundwater. *Journal of Environmental Economics and Management*, 91, pp.46-65.

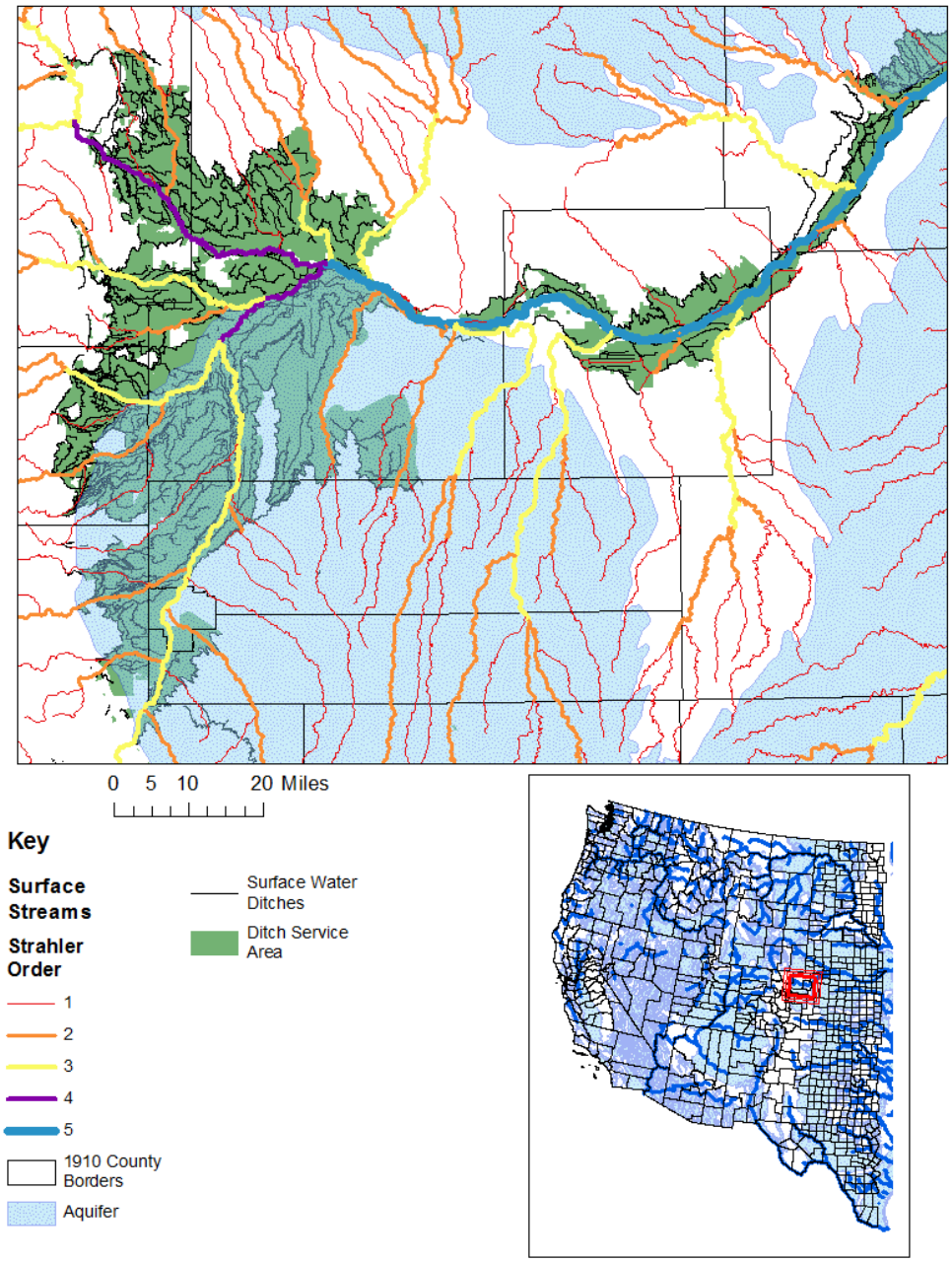
Simple Model of Basin Benefits

Probit (Adjudicated)	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Benefits	0.00371					
	(0.19)					
Log Basin Area (acres)		-0.321**				-0.0106
		(0.15)				(0.31)
Log Number of Wells (Exog)			-0.32***			-0.269
			(0.09)			(0.22)
Well Heterogeneity (Exog)				-6.527**		-4.466
				(3.28)		(3.56)
Mean Precip. Var. 1950-2014					0.141	
					(0.52)	
Constant	0.219	4.151**	2.179***	1.542**	0.333	2.82
	(0.43)	(1.86)	(0.56)	(0.65)	(0.24)	(2.81)
N	39	48	48	48	48	48

Groundwater Well Expansion



Water Access



Kansas Aquifer Measures