On the other side of the fence

Property rights and productivity in the United States

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Motivation

- Subtractible yields: Farmers compete for returns
- Non-excludable: Farmers use resource simultaneously

Solution to the Tragedy of the Commons:

1. Private ownership: **Sell** property rights to farmer A or B
2. Public management: **Rent access** to farmer A and B

Research Question

- Which solution is more efficient in solving the Tragedy of the Commons?

Cliven Bundy: 'I know better how to manage my land'

Montana's Ranchers: 'profitable because of public management'

Theoretical Concerns

- Private ownership bundles optimal incentives
  - \+ Resource extracted at efficient rate with high discount factors
- Public management has more ambiguous effects and incentives
  - \- Regulated quantity
  - \- No investment incentives
  - \+ Insurance mechanism

Research Question

- Which solution is more efficient in solving the Tragedy of the Commons?

Empirical Challenge

- Best lands usually privately owned, public owns ‘the rest’

This Paper

- Major land reform in the United States, the Taylor Grazing Act (1934):

- 142,000,000 acres placed under public management
- Distributed permits to nearby farmers

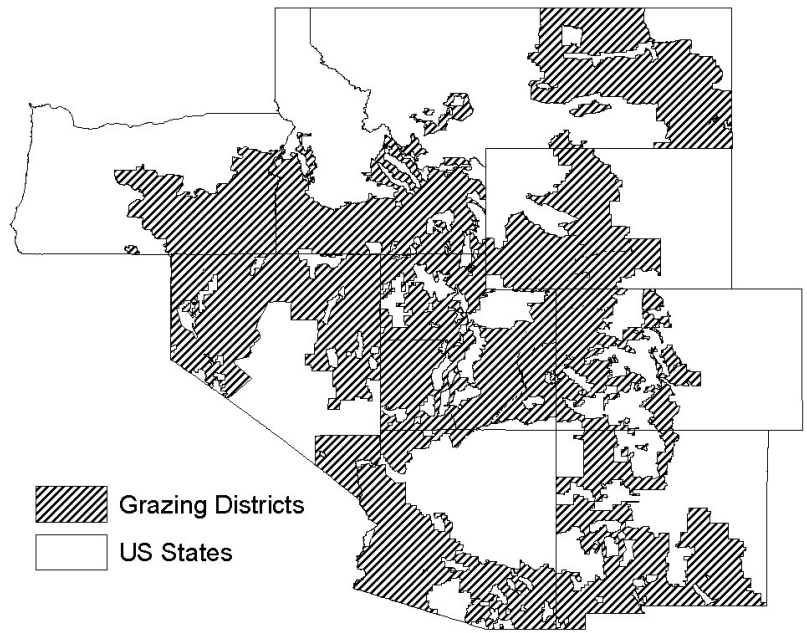


Figure 2: Publicly managed grazing districts in the US

Research Question

- Which solution is more efficient in solving the Tragedy of the Commons?

This Paper

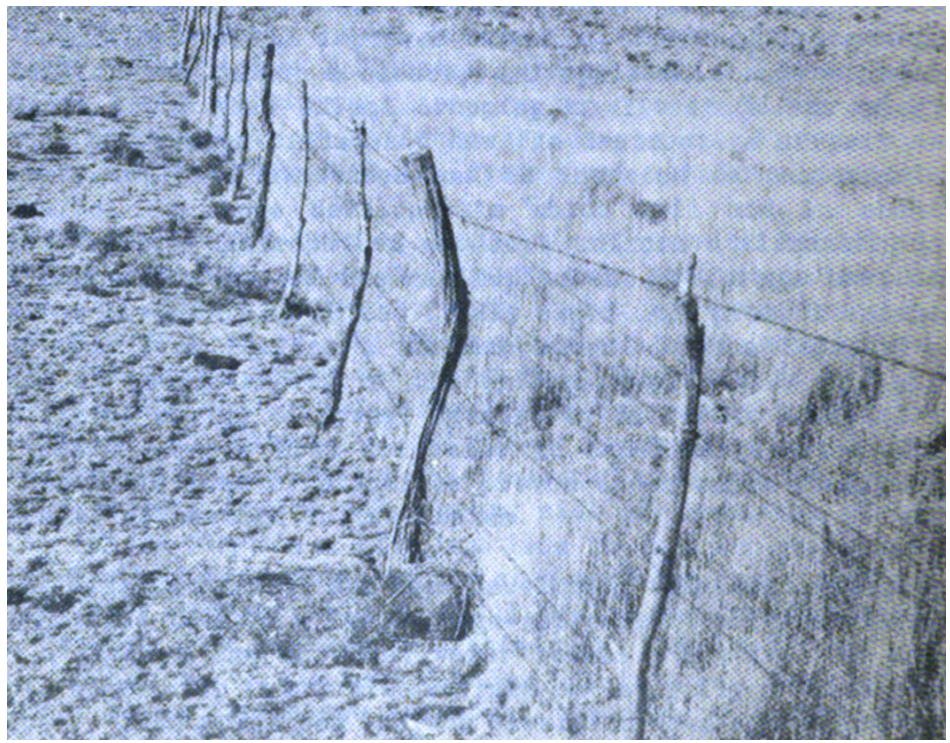


Figure 3: Open access vs public land (right)

→ Compare vegetation *across* the grazing boundary that defines property rights regimes

Research Question

- Which solution is more efficient in solving the Tragedy of the Commons?

Empirical Challenge

- Best lands usually privately owned, public owns 'the rest'

Empirical Strategy

- Compare vegetation *across* the grazing boundary that defines property rights regimes

Findings

1. Public management increases long-term vegetation by 10% compared to no management
2. Effect similar in magnitude to privatization of pre-treatment equivalent lands
3. Public management increases wealth of farmers and non-farmers alike
4. Enforcement crucial to success of public management

Literature

1. Managing common-pool resources
   - Survey evidence:

     Calef 1960, Foss 1960, Cheung 1968, Libecap 1981, Ostrom 1990
   - Coping strategies:

     Walker & Gardner 1992, Fehr & Leibbrandt 2011, Cardenas 2000/2011
   - Effect of privatization on productivity:

     Banerjee et al 2002, Goldstein & Udry 2008, De Janvry et al 2015, Leonard & Libecap 2017, Chen et al 2017
   - Effect on wealth:

     Ayres, Meng & Plantinga 2020

   → **Provide first causal evidence on relative effectiveness**

- Property rights and long run economic development
  - Insecure property rights and investments:

    Besley 1995, Svensson 1998, Acemoglu et al 2001/2005, Field 2005/2007, Hornbeck 2008, Rodrik 2008, Besley & Ghatak 2009, Besley et al 2012, Christensen et al 2017
  - Property rights and education/income/health/violence :

    Galiani et al 2005, Galiani & Shargrodsky 2010, Libecap and Lueck 2011, Bleakley & Ferrie 2016, Vinez 2017, Montero 2017

  → **Provide causal evidence for the link: public management → wealth**

1. Identification strategy

2. Data and empirical specification

3. Property rights and resource extraction

4. Property rights and wealth

Historical Background

Pre-1934: Public land sold in the western United States

- Plots privatized based on quality
  - Same fixed price & size for all plots
- 10x plot size needed for profitable living *(Powell, 1880)*
  - Farmers exploit public land around plots

1934: 50% of vacant, unappropriated land severely damaged

$\longrightarrow$ Congress enacts the Taylor Grazing Act to restore lands:

- 142,000,000 acres in districts with 24,000 miles of boundaries
- Issue access rights in districts to ranchers in proximity
  - With prior use of public lands (self-reported)
  - Fixed price ($0.05 per cattle) for fixed quantity
  - Exclusive, long-term, and automatically renewed
- 50% of revenue per district used to actively manage land

Historical boundaries from archives

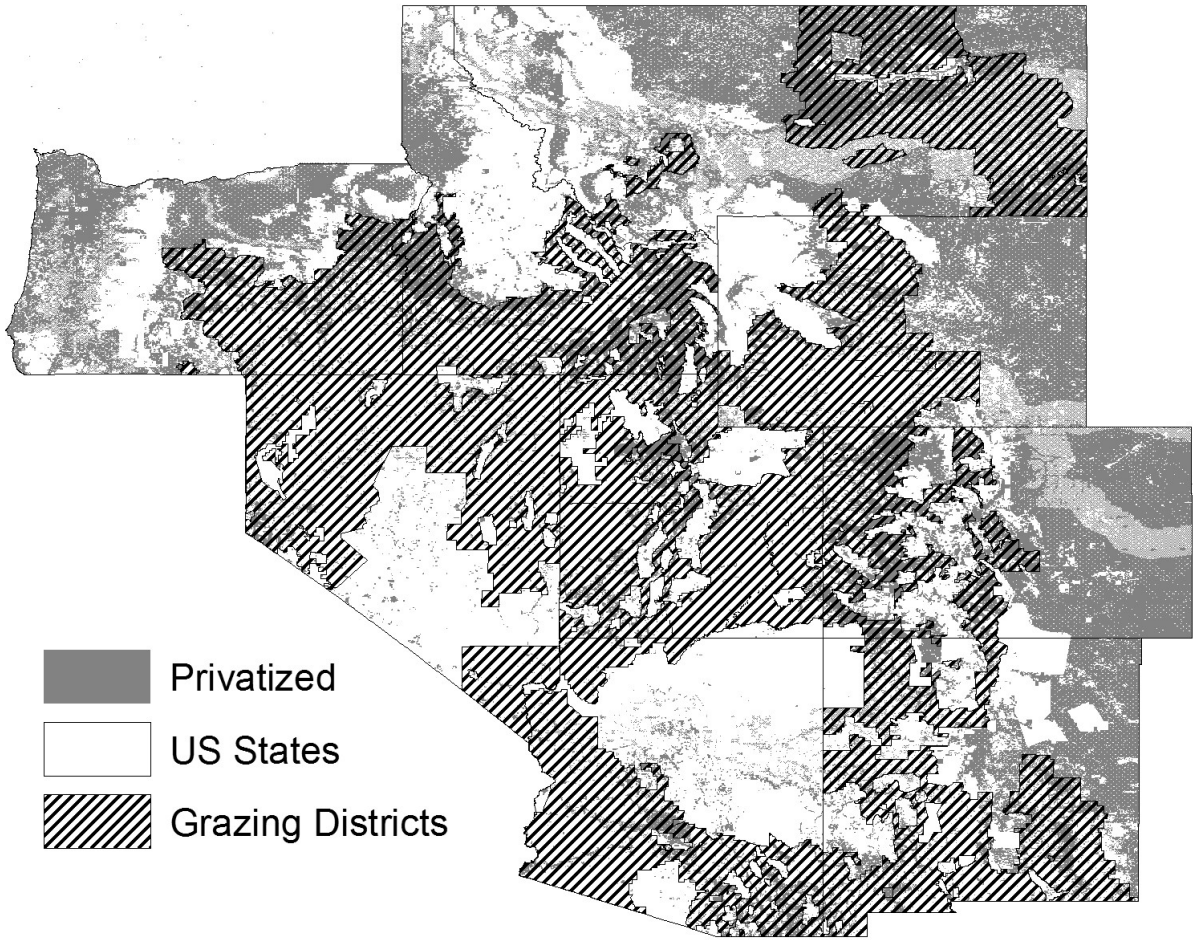


Figure 4: Grazing Districts in nine states (shaded). Privatized areas in grey.

Historical boundaries from archives

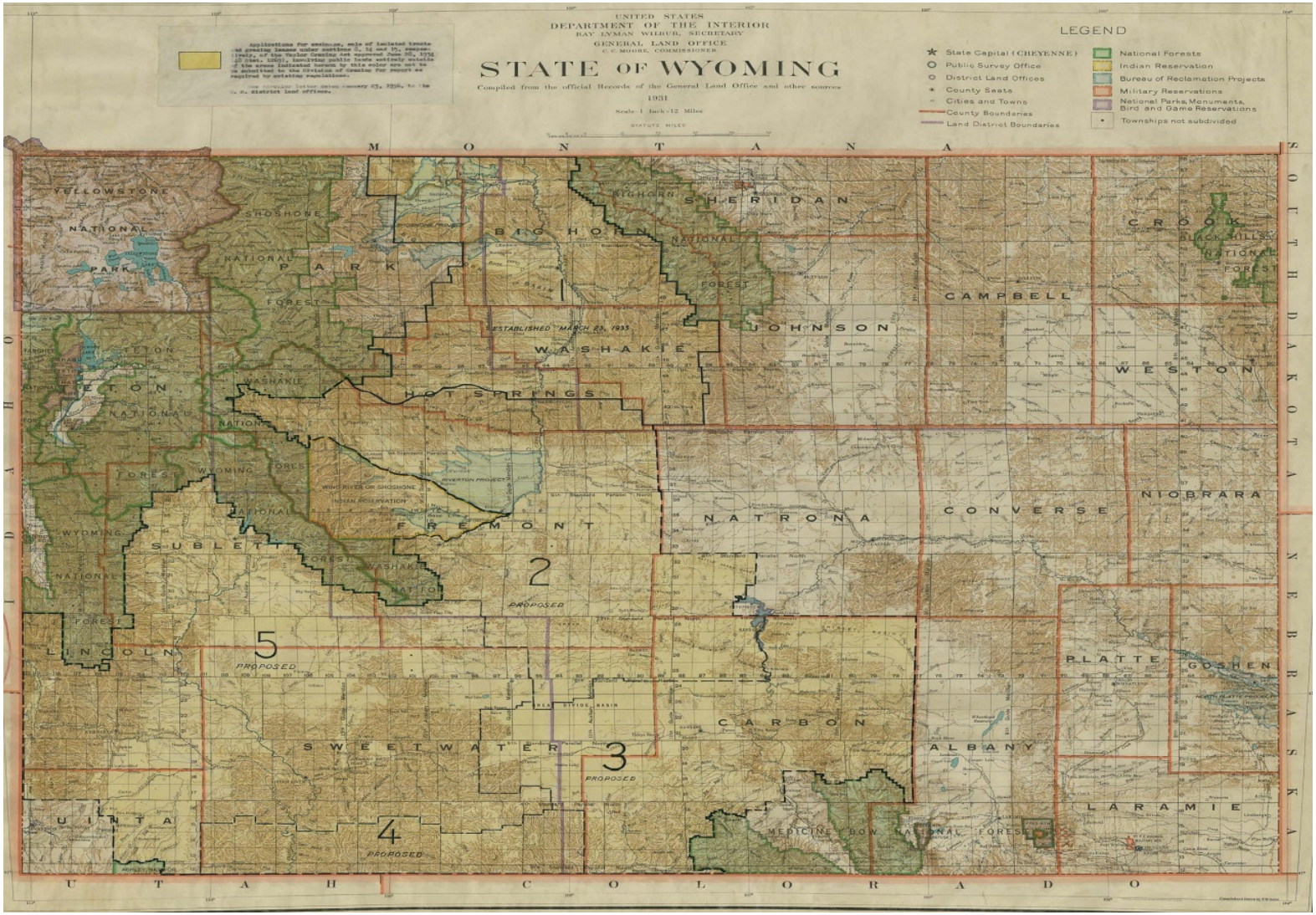


Figure 5: Example for the state of Wyoming. Resolution 1:750,000

Identify potentially treated areas

Grazing boundaries determined by Public Land Survey System (1785)

- Web scrape universe of land transactions 1860–1935
  - Contains geo-code and timing of purchase

6	5	4	3	2	1
7	1926	9	10	1926	12
18	17	16	15	14	13
19	1916	21	22	1916	24
30	29	28	27	26	25
31	32	33	34	35	36

Figure 5: PLSS Township: 36 sections to identify land transactions and the boundary of the Taylor Grazing Act (red). Publicly owned lands are divided into unmanaged lands (gray) and managed lands (green).

Data

Outcome Data

- Vegetation from satellite imagery
  - AVHRR (1km), MODIS (250m), Landsat (30m)
- Census block group 1990 / 2000 / 2010
- Agricultural census 1910 – 2007

Necessary data for identification

- Grazing boundaries from maps (1934)
- Land transaction 1862–1934

Data to test identification assumption

- Severity of erosion from maps (1934)
- Minor civil divisions from maps (1930)
- Full count census and 5% sample (1930)

Empirical Specification

Use regression discontinuity design with satellite imagery:

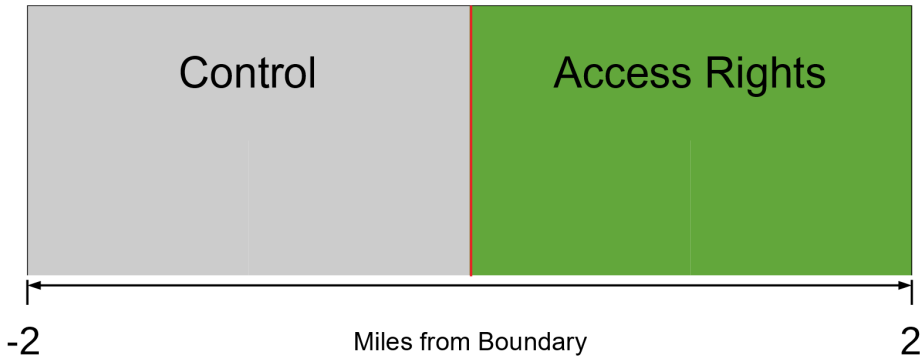
$$\ln Y_i = \beta \times \text{Property rights}_i + dist_{b(i)} + \delta_{b(i)} + \Gamma_i + \varepsilon_{b(i)}$$

- Y_i: Normalized difference vegetation index (NDVI) for pixel i
  - Measure to identify vegetation from space: $\frac{NIR-Red}{NIR+Red}$
- $dist_{b(i)}$: Linear distance to boundary $b(i)$
- $\delta_{b(i)}$: Boundary segment fixed effects (60 miles)
- Γ_i: Covariates and 2^{nd} order polynomial in lat&lon

Outcome data: Satellite Imagery

- Time frame: Average from 1989–2016

Access rights



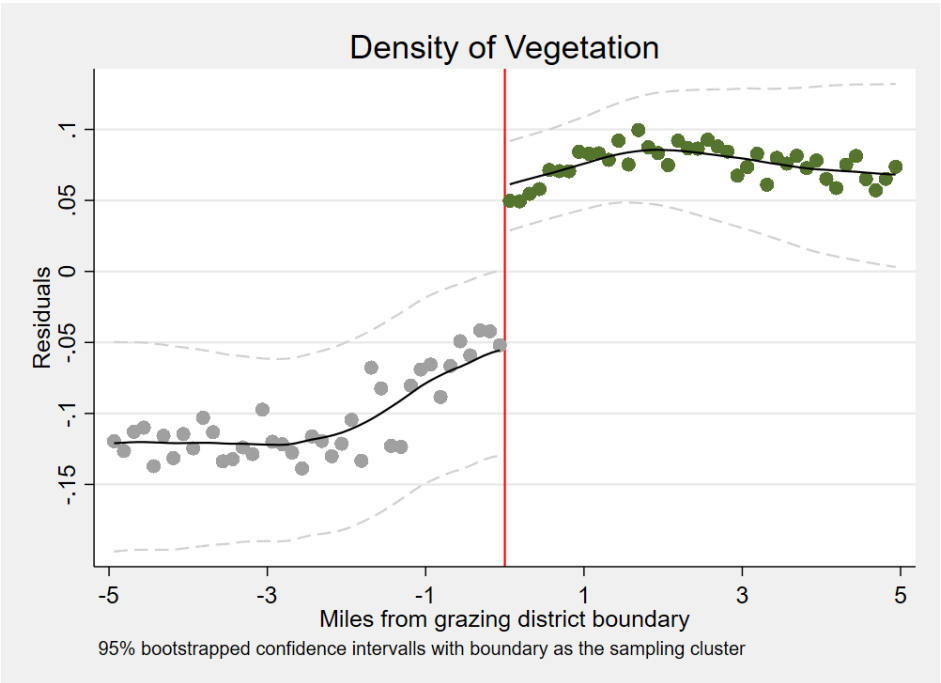
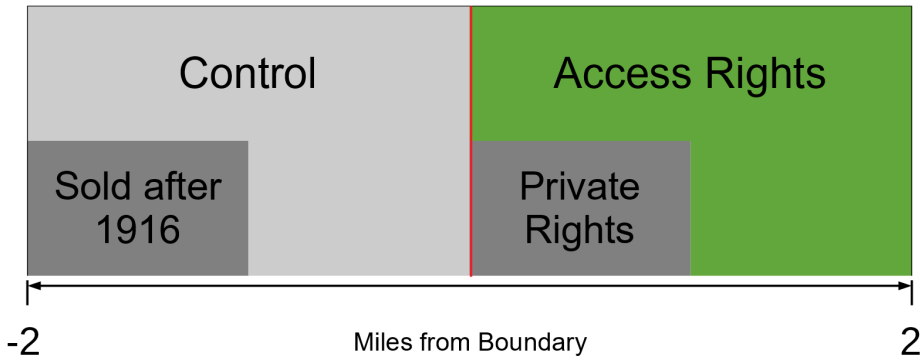
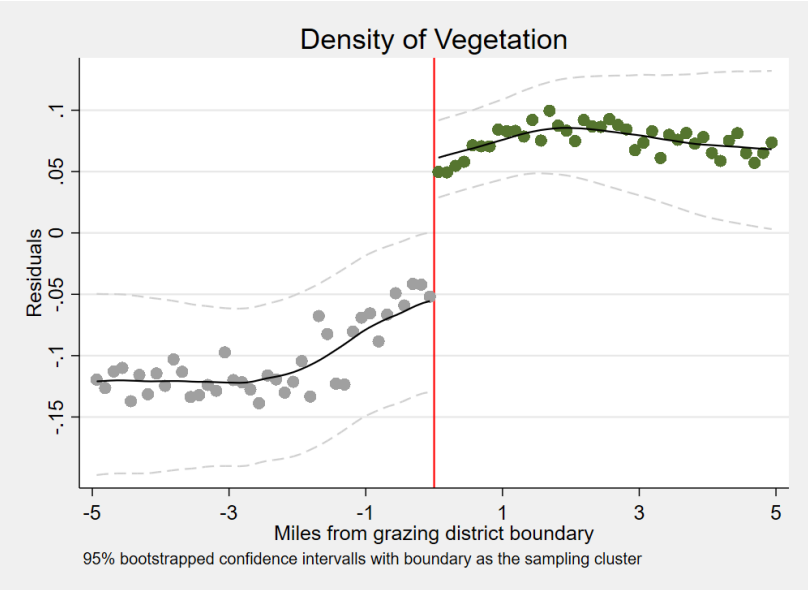


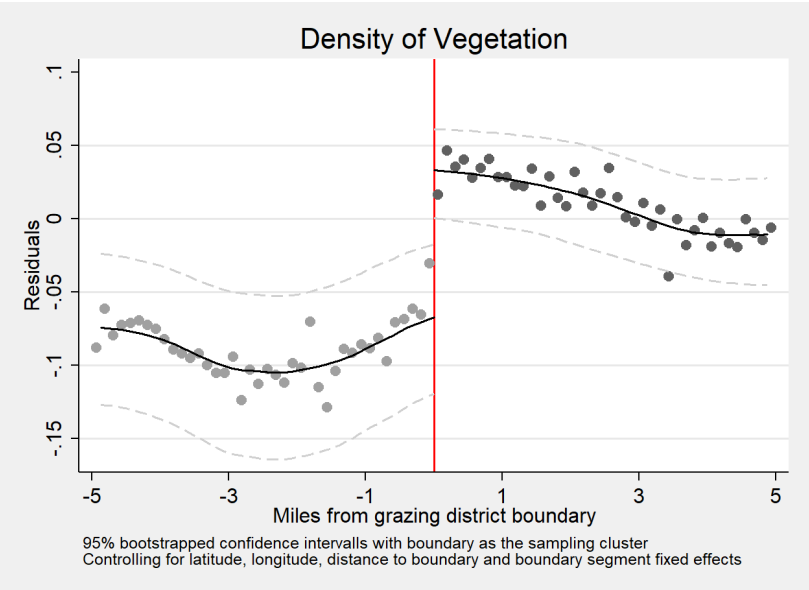
Figure 6: RD graph for vegetation

Private rights





(a) Access rights



(b) Private rights

Main regression - Table

	log(NDVI)		
	(1)	(2)	(3)
Bandwidth	1/2 mile	1 mile	2 miles
Access rights	0.109***	0.134***	0.167***
	(0.029)	(0.032)	(0.037)
	[0.031]	[0.034]	[0.040]
Private rights	0.105***	0.123***	0.130***
	(0.042)	(0.040)	(0.031)
	[0.041]	[0.040]	[0.032]
p-value (AR=PR)	0.893	0.743	0.121
N	9,026	17,642	34,098

This table regresses the RDD specification on the log(NDVI) index. Private rights treatment defined as plots bought between 1916 and 1934. Border segment fixed effects are 60m segments of the 24,000m long border. Standard errors clustered by the border segments shown in parenthesis. Standard errors corrected for spatial correlation within 0.5 degrees shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Wealth effects - Table

$$\ln Y_{i,t} = \beta \times \text{Inside grazing district}_i + dist_{b(i)} + \delta_{b(i)} + \delta_t + \Gamma_i + \varepsilon_{b(i)}$$

	(1) log(Median Family Income)	(2) Share Below Poverty Line	(3) High School Graduate	(4) log(Median Value Housing)
Treatment	0.160**	-0.020***	0.025**	0.172**
	(0.079)	(0.008)	(0.012)	(0.089)
	[0.074]	[0.009]	[0.014]	(0.087)
Observations	2,049	2,003	2,005	2,029
Control Mean	10.250	0.120	0.850	11.23

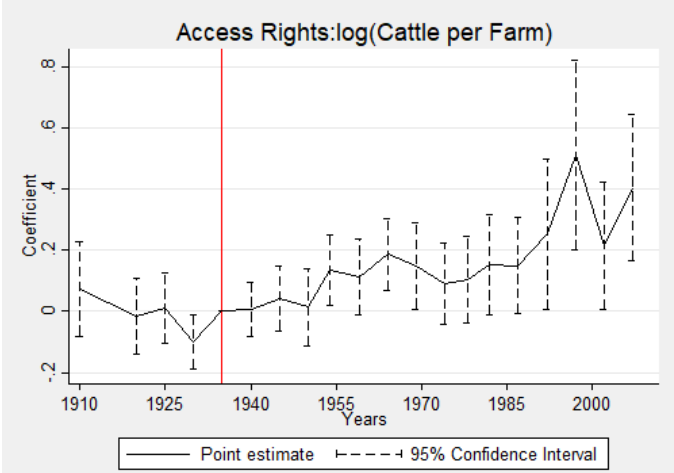
Wealth effects using census-block groups in 1990, 2000, and 2010. Every cell is a separate regression of the treatment indicator on the variable in the first using the model in the header. A census-block is treated if its center is within the grazing districts with control observations being blocks outside the grazing districts. All columns control for the size of the census-block and year fixed effects. Standard errors clustered by the boundary segments shown in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

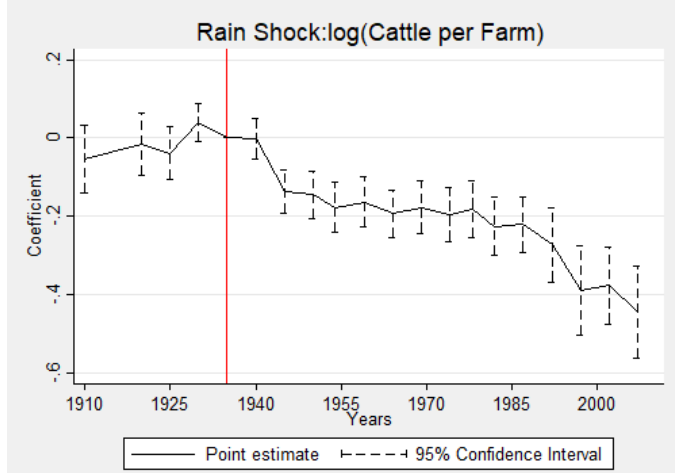
Mechanisms focusing on farmers

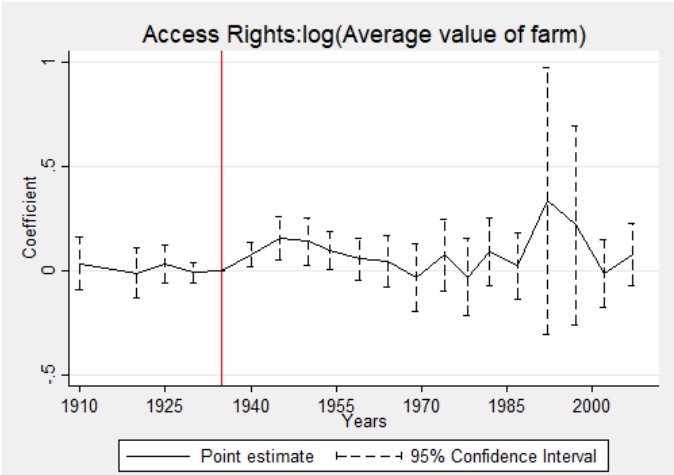
- Farmers were targeted by reform - potentially largest effects
- Use agricultural census (1910–2007) to estimate:

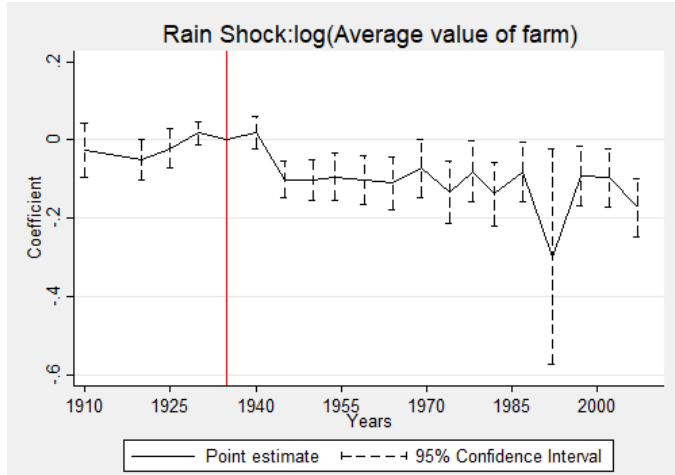
$$Y_{c,t} = \sum_{s=1910}^{T=2007} \beta_s \text{Access rights} \times \mathbf{I}[t = s] + \alpha_c + \alpha_t + \varepsilon_c$$

- β_s: Access rights $\in \{0, 1\}$ in every year with $\beta_s = 0$ $\forall s \leq 1935$:
  - OLS: county overlaps with grazing districts
  - IV: Rainfall in October 1934 $\rightarrow$ severity of erosion $\rightarrow$ grazing district
- α_c, α_t: 283 county and 20 survey year fixed effects









- Counties with Grazing districts have more cattle and higher farm values
- Having more rain in October 1934:
  severity of erosion ↓ prob. of grazing district ↓ cattle, farm values ↓

Conclusion

Effects on resource management

- Both policies have equal impact on resource management
- Access rights policy valid alternative for many gov't

Wealth effects

- Access rights benefit a larger share of people
  - 18% reduction in poverty rates
  - Evidence that least productive farmers switch occupations
- Policy implications for Gov't:
  - Distribute permits to resources
  - **Enforce permits and recognize them as property rights**
  - Substitute customary rights systems with formal access rights