C Results from the Agricultural Census

Here, I exploit two versions of a standard DID estimation equation with county (α_c), year (α_t), and state $\times$ year ($\alpha_{st} \times \alpha_t$) fixed effects. The inclusion of α_c captures all unobservable county characteristics, and $\alpha_{st} \times \alpha_t$ captures any change in state policy that might affect the outcome. In its most basic form, I estimate:

$$\log \mathrm{Y}_{c,t} = \sum_{s=1910}^{T=2007} \beta_s \text{Access rights}_c \times \mathbf{I}[t = s] + \alpha_c + \alpha_t + \alpha_{st} \times \alpha_t + \varepsilon_c \tag{4}$$

where I regress farm values per county and survey period ($Y_{c,t}$) on an indicator variable of whether any part of the grazing district is within the county borders (Access rights$_c$). I allow the coefficient β_s to vary by time to verify the assumption of similar pre-trends. As selection into treatment is potentially endogeneous, identifying a causal effect requires that any unobserved characteristics are linearly additive. Testing this linearity assumption requires $\beta_{1910} = \beta_{1920} = \beta_{1925} = \beta_{1930} = \beta_{1935} = 0$ and ensures that selection is not based on differential pre-trends and any post-treatment difference is due to treatment. In this setup, the point estimates β_{1940} and β_{1945} capture the immediate effects of the reform on farm values.

In this section, I regress the dependent variable on an indicator for post-treatment, assuming no pre-trends.[85]

$$\log \mathrm{Y}_{c,t} = \beta \text{Access rights}_c \times \mathbf{I}[t > 1935] + \alpha_c + \alpha_t + \alpha_{st} \times \alpha_t + \varepsilon_c \tag{5}$$

Table OA.37: Income effect for farmers

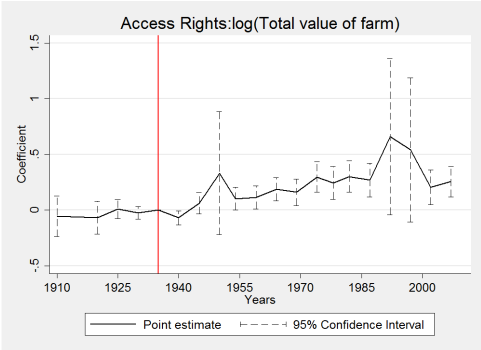
	(1) log(Total value of farm)	(2) log(Average value of farm)	(3) log(Average value of farm land)	(4) log(#Farms)	(5) log(Average Farm Size)	(6) log(Acres)	(7) log(Average farm income)	(8) log(Average farm expenditures)	(9) log(Average farm profits)
Access Rights $\times \mathbf{I}[t > 1935]$	0.272***	0.115***	0.209***	0.075*	0.313***	0.394***	0.295**	0.155	0.183*
	(0.063)	(0.040)	(0.060)	(0.042)	(0.060)	(0.060)	(0.121)	(0.101)	(0.110)
Observations	5,628	5,619	5,608	5,641	5,625	5,628	4,177	4,684	3,455
Adjusted R^2	0.903	0.926	0.887	0.948	0.876	0.858	0.853	0.870	0.885

Wealth effects using for farmers using the agricultural census 1910–2007. Standard errors are clustered by county and are shown in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

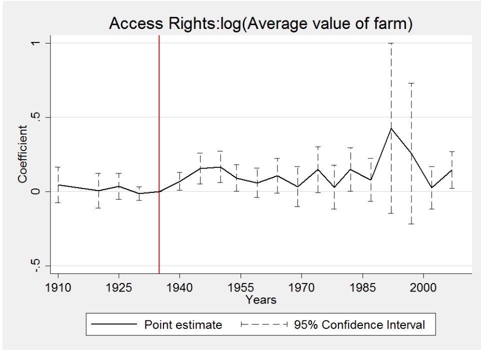
The results in Table OA.37 confirm the initial results using the regression discontinuity design and suggest larger farm values following the implementation of the Taylor Grazing Act. Since I control for county and year fixed effect, a violation of the identification strategy is unlikely and indeed, Figure OA.11 suggests that the assumption of common pre-trends are fulfilled.

[85] Full results of (4) available upon request.

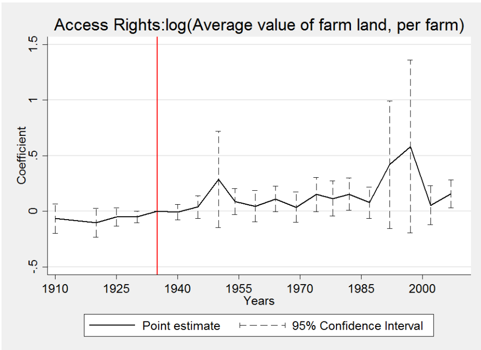
Figure OA.11: Lead-lag graph: Access rights treatment



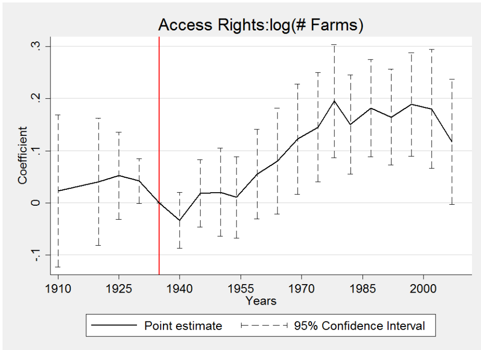
(a) log(Total value of farm)



(b) log(Average value of farm



(c) log(Average value of farm land)



(d) log(#Farms)

Lead-lag graph for the main outcomes from the agricultural census using equation (4).

C.1 Instrumenting Access Rights

To counteract the possibility that counties endogenously select themselves into access rights regimes, I employ identification strategy based on soil erosion. As soil erosion in October 1934 was crucial in determining the location of the grazing borders, soil erosion strongly predicts whether a county was selected to be part of the Taylor Grazing Act. I trace the extend of soil erosion back to the Palmer Drought Severity Index [PDSI], which in turn is affected by rainfall in 1934. I show that the standardized rainfall in October 1934 strongly predicts selection into the Taylor Grazing Act and confirm a downward bias on the initial point estimates.

The natural instrument is soil erosion in October 1934, the point in time when the maps were drawn. Then, the exclusion restriction in equation (5) requires that soil erosion in 1934 only affected farm values through the policies of the Taylor Grazing Act. As soil erosion is greatly affected by weather fluctuations, it is likely that soil erosion maps in any other year would have been drawn to an entirely different extent. However, much like rainfall, soil erosion follows some historical average. As local erosion is influenced by differential rainfall with an unknown functional form, I cannot know the correlations between the average historical soil erosion and its temporary realization in 1934. Thus, I assume that the 1934 version of soil erosion was particularly severe, since it followed a period of relative drought (Figure 5). As rainfall was more beneficial in every year thereafter, even absent the Taylor Grazing Act, soil erosion would not have been as severe as in 1934, and is thus not likely to have influenced other policies or farm values.

As I cannot rule out that soil erosion in 1934 only affected farm values through the Taylor Grazing Act, I document a strong correlation between erosion and treatment status using the standard Palmer Drought Severity Index in October 1934, the month the erosion maps were drawn. I standardize the PDSI using the historical mean and standard deviation of each county and create a standardized index in October 1934 where larger values indicate less drought.[86] I show the first-stage relationship in Figure OA.12a and plot all possible months-year combinations to highlight the importance for treatment assignment in Figure OA.13a and severity of erosion in Figure OA.13c.

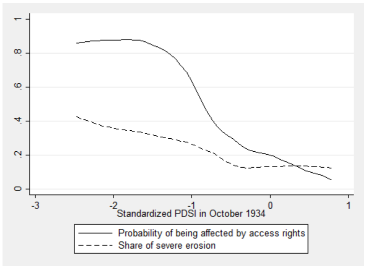
Since droughts are the consequence of missing precipitation, I trace back the PDSI in October 1934 to the standardized amount of rainfall during the same month per county. I first show the first-stage relationship in Figure OA.12b and the relationship between rainfall and the PDSI in Figure OA.12c. Both figures suggest significant relationships, and indeed the placebo estimates in Figure OA.13b suggest high relevance for treatment assignment and the severity of erosion as measured by the erosion maps (Figure OA.13d).

The results are shown in Table OA.38. Instrumenting treatment assignment with rainfall in October 1934 results in significant effects on farm values and fewer farms in the last panel. The first stage F-Statistic is always large, and the point estimates from the instruments × Post TGA suggest significant impacts on the variables of interest. Column (1), (6) and (7) show my preferred estimates, the OLS, the reduced form estimates and the results from instrumenting treatment assignment with having rain in October 1934.

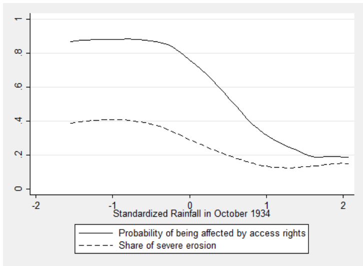
The estimated effects support the initial results from the regression discontinuity design in a different setting with different identification assumptions. In the RDD setting, identification relies on the exact measurement of the boundaries and their exogeneity to local characteristics. In the differences-in-differences design, we could allow for differential selection, as long as this selection is not based on time trends. By showing the point estimates for all years and instrumenting treatment assignment with rainfall, we show that these identification assumptions are indeed valid.

[86] Data description https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi.

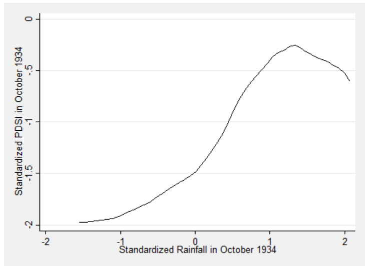
Figure OA.12: First stage relationship to Access Rights



(a) Palmer Drought Severity Index (PDSI) in October 1934



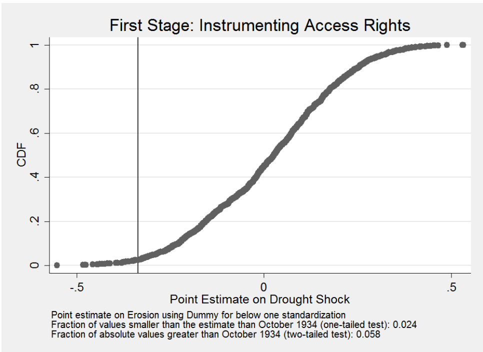
(b) Standardized Rainfall in October 1934



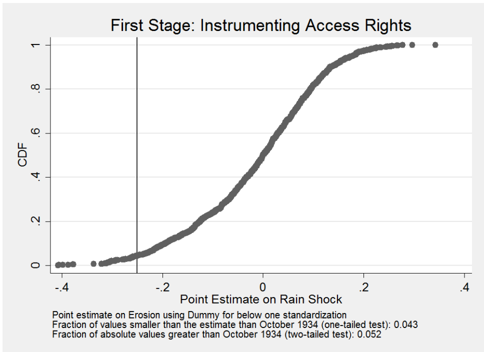
(c) Rainfall and the Palmer Drought Severity Index

The left figure show the first stage relationship between the Palmer Drought Severity Index (PDSI) and the severity of erosion and having access rights. The Figure in the center shows the relationship between rainfall during drawing the grazing districts in October 1934 and having access rights. The right figure shows the relationship between the PDSI and rainfall in October 1934. A one standard deviation increase in rain, increases the PDSI by 0.49 standard deviations.

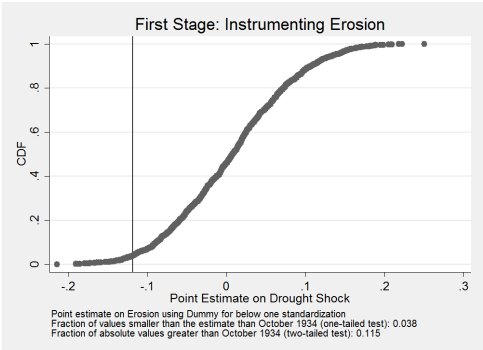
Figure OA.13: Placebo graphs for the Palmer Drought Severity Index and Rainfall



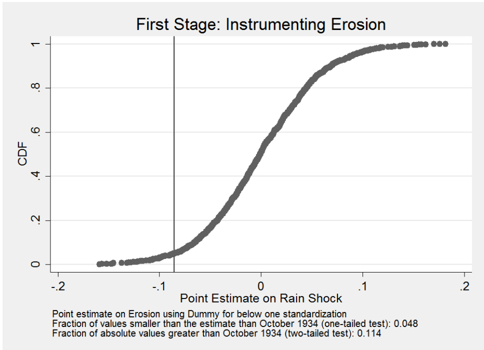
(a) PDSI and Access Rights



(b) Rainfall and Access Rights



(c) PDSI and Severe Erosion



(d) Rainfall and Severe Erosion

Placebo estimates using all months and years between 1900-2015 for the Palmer Drought Severity Index (PDSI) and 1915-2011 for the rainfall. Point estimates show the regression of the instrument in a given month-year combination on the access rights treatment (upper panel) or the severity of erosion (lower panel) including state fixed effects. The line marks the first stage point estimate. Two statistics are show below each figure. The fraction of values smaller than the first stage and the fraction of values that are greater in absolute terms than the first stage.

Table OA.38: The effect of access rights on farm values using the Agricultural census

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				log(Total value of farm)			
Access Rights × Post TGA	0.272***		0.582**		−0.015		0.250*
	(0.063)		(0.289)		(0.142)		(0.132)
Share of Severe Erosion × Post TGA		0.207**					
		(0.102)					
PDSI × Post TGA				0.005			
				(0.048)			
Rainfall × Post TGA						−0.063*	
						(0.032)	
				log(Average value of farm)			
Access Rights × Post TGA	0.115***		0.558**		0.150		0.375***
	(0.040)		(0.271)		(0.098)		(0.113)
Share of Severe Erosion × Post TGA		0.199**					
		(0.082)					
PDSI × Post TGA				−0.051			
				(0.034)			
Rainfall × Post TGA						−0.094***	
						(0.024)	
				log(Average value of farm land)			
Access Rights × Post TGA	0.209***		1.058***		0.262*		0.435***
	(0.060)		(0.404)		(0.137)		(0.133)
Share of Severe Erosion × Post TGA		0.377***					
		(0.116)					
PDSI × Post TGA				−0.088*			
				(0.047)			
Rainfall × Post TGA						−0.109***	
						(0.031)	
				log(# Farms)			
Access Rights × Post TGA	0.075*		−0.313		−0.235**		−0.217**
	(0.042)		(0.237)		(0.096)		(0.105)
Share of Severe Erosion × Post TGA		−0.112					
		(0.073)					
PDSI × Post TGA				0.079***			
				(0.030)			
Rainfall × Post TGA						0.055**	
						(0.025)	
	OLS	RF	IV	RF	IV	RF	IV
First stage F-Statistic			12.821		90.546		41.881
Observations	5,641	5,641	5,641	5,641	5,641	5,641	5,641

In this table I present the main outcomes from the Agricultural Census using the OLS estimates (column 1), and three instruments based on the erosion status in 1934 (column 2 and 3), the standardized Palmer Drought Severity Index in October 1934 (column 4 and 5), and the standardized rainfall in October 1934 (column 6 and 7). Standard errors clustered by county shown in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$