

# Little Farm on the Prairie

Railroad Land Sales, Homesteading, and Long-Run Agricultural  
Productivity

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## Research Question

*Do initial capital endowments — independent of institutions —  
determine long-run agricultural productivity?*

- ▶ Wealth, institutions, and land tenure security typically co-vary
- ▶ Isolating the capital channel from the institutional channel is empirically hard
- ▶ Concentrated ownership  $\Rightarrow$  suppressed credit access  $\Rightarrow$  persistent productivity gaps

# This Paper

**Natural experiment:** Canadian Prairies checkerboard (Dominion Lands Act, 1872)

- ▶ Odd sections → CPR grant; even sections → homestead
- ▶ Parity assigned by administrative snaking rule, not land characteristics
- ▶ CPR resold primarily to *neighboring, capital-screened* homesteaders
- ▶ Same property law, survey system, and public goods on both sides of the boundary

**What I add:**

- ▶ Section-level granularity ( $\approx 950,000$  parcels)
- ▶ Capital endowments isolated from institutions
- ▶ Novel match: CPR SANDS land-sale records  $\times$  DLS checkerboard

## Preview of Findings

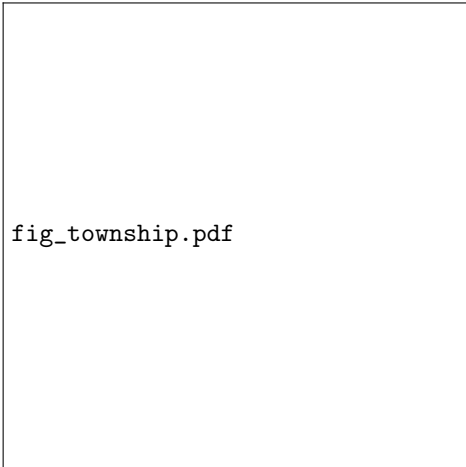
**Design:** 2SLS; instrument = odd/even section parity; township FE absorb geography

- ▶ CPR land sale  $\Rightarrow$  cropland coverage +0.052 SD (pooled)
- ▶ CPR land sale  $\Rightarrow$  cultivation intensity +0.061 SD (pooled)
- ▶ Effects concentrated in Alberta; Manitoba near-zero
- ▶ Precisely estimated **nulls** for industrial and petroleum outcomes

*Mechanism:* early capital  $\rightarrow$  investment + settler selection  $\rightarrow$  credit frictions (Galor & Zeira 1993) prevent convergence

# Historical Background

- ▶ Dominion Lands Act (1871/72): 200M acres; world's largest integrated survey grid
- ▶ Each 6×6-mile township → 36 one-square-mile sections
- ▶ East-west snaking numbers: odd → CPR; even → Crown/homestead
- ▶ **CPR:** \$2.50/acre, cultivation clause, quality-screened buyers
- ▶ **Homesteads:** \$10 filing fee, 3-year requirement, weakly enforced
- ▶ CPR sold to neighboring settlers — not speculators (contrast: Union Pacific)



fig\_township.pdf

Figure 1: 6×6 township, 36 sections

## What Am I Studying?

- ▶ **Unit of analysis:** DLS section (1 sq. mile, 640 acres)
- ▶ **Treatment:** CPR land sale to a better-capitalized neighboring homesteader
- ▶ **Control:** adjacent even (homestead) section in the same township

*The comparison is within the same farming population:  
those who could vs. could not afford to purchase additional land.*

- ▶ No institutional divergence: identical property law, no differential public goods
- ▶ Productivity differences must reflect capital and selection, not institutions

# Data I

Variable	Level	Source
Checkerboard grid (Alberta)	Section	AltaLIS ATS v4.1
Checkerboard grid (Manitoba)	Section	Manitoba Land Initiative
CPR land sales	Transaction	SANDS, U of Calgary (2025)
Land use (is_cropland, is_annual_crop)	Section centroid	AAFC ACI 2020 (30m raster)
Industrial facilities	Section	CanVec NRCan 1:50,000

CPR sales match to section checkerboard via legal land description key.  
Match rate > 99.9%.

## Data II

Control variable	Level	Source
Log section area	Section	AltaLIS / MBI polygons
Mean elevation	Section	CDEM, NRCan (30m)
Stream length (km)	Section	CanVec 50K watercourses
Soil quality (CLI class 1–7)	Section	AAFC CLI (1:1M scale)
Centroid latitude, longitude	Section	Derived

- ▶ **Final dataset:**  $\approx$ 946,000 sections; Alberta + Manitoba; 17,476 townships
- ▶ Saskatchewan omitted: no public section shapefile; no geo-referenced SANDS records

▶ Balance table

# Model

**First stage:**

$$D_i = \pi \cdot \text{CPR}_i + X_i \gamma + \mu_{t(i)} + \varepsilon_i \quad (1)$$

**Second stage:**

$$\bar{y}_i = \delta \hat{d}_i + \bar{X}_i' \beta + u_i \quad (2)$$

$\text{CPR}_i$  = 1 if section  $i$  bears an odd DLS number (*instrument*)

$D_i$  any CPR land sale on section  $i$  (indicator)

$\hat{d}_i$  within-township demeaned fitted sale probability

$\mu_{t(i)}$  township fixed effect

$\delta$  LATE for complier sections ( $\approx$  ATT: CPR sections  $\approx$  all compliers)

Standard errors: Conley (1999) spatial HAC, 100-mile bandwidth.

► First stage

# Economic Assumptions

Relevance Odd sections are CPR-owned by construction;  $\hat{\pi} = 0.063$  (pooled); first-stage  $F > 900$  (clustered)

Exclusion Conditional on township FE, odd/even parity affects outcomes only through the CPR land-sale channel; township FE absorbs soil, climate, distance to rail

Balance CPR and homestead sections balanced on all pre-treatment geographic covariates; standardized differences near zero throughout

**Main threat:** CPR irrigation block (southern Alberta)

- ▶ Geographically concentrated  $\Rightarrow$  absorbed by township FE
- ▶ Consistent magnitudes in Manitoba (no CPR irrigation)  $\Rightarrow$  ownership channel, not irrigation

**Policy connection:** LATE = extensive-margin response — did a section ever enter commercial agriculture through the CPR sale mechanism?

▶ Balance

▶ First stage

# Results

	Cropland (Panel A)			Annual Crop (Panel A)			Industrial (Panel A)		
	Pool.	AB	MB	Pool.	AB	MB	Pool.	AB	MB
<i>CPR Odd</i>	0.052*** (0.019)	0.059*** (0.019)	0.006 (0.032)	0.053*** (0.019)	0.059*** (0.020)	0.002 (0.014)	0.002 (0.007)	0.002 (0.008)	-0.002 (0.000)
<i>N</i>	946,314		<i>N</i>	946,314		<i>N</i>	946,314		
	Table 7			Table 8			Table 10		

Outcomes z-scored. Township FE and controls included. Conley SEs (100-mile bandwidth). \*\*\* $p < 0.01$ . Instrument:  $CPR_i$  (odd section indicator). Panels B–C (sales count, years since first sale) confirm.

► Clustered SEs

## Takeaway

- ▶ CPR land sales generate a persistent agricultural productivity premium — detectable over 100 years later
- ▶ Effect is **agricultural only**: precisely estimated nulls for industrial and petroleum outcomes rule out industrial co-location
- ▶ Concentrated in Alberta, consistent with CPR's deeper colonization apparatus there

### Mechanism:

- ▶ Early capital → investment secured ownership (Besley 1995) → ownership encouraged further investment
- ▶ Credit market frictions (Galor & Zeira 1993) prevented adjacent homesteaders from closing the gap

*Canada* ≠ *US*: CPR sold to active farmers, not speculators ⇒ productivity premium, not landlordism

## Conclusion

- ▶ The Canadian Prairies checkerboard holds institutions constant, isolating capital endowments as the driver of divergent agricultural productivity
- ▶ Modest within-group wealth stratification — operating through investment and selection, not formal institutions — generates century-long productivity differences
- ▶ Prairie wheat productivity was shaped by the initial sorting of capital and human capital onto land, not only by soil quality or world prices
- ▶ The CPR premium is sector-specific: no diffusion into industrial or petroleum development

# Appendix

## Balance: Pre-Treatment Characteristics

Variable	Even	Odd	Std. Diff	(SE)
Log section area	11.763	11.756	-0.002***	(0.001)
Mean elevation (m)	656.9	657.2	-0.001**	(0.001)
Stream length (km)	0.443	0.444	0.000	(0.001)
Wetland fraction	0.154	0.154	0.000	(0.001)
<i>N</i> (control / treated)	503,301	448,773		

Within-township FE regression of standardized covariate on  $CPR_i$ . Conley SEs (100-mile bandwidth); parentheses: township-clustered. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ .

Source: Table 6.

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## First Stage

	Pooled	Alberta	Manitoba
<i>Panel A: Any sale (indicator)</i>			
CPR <sub><i>i</i></sub>	0.063*	0.072*	0.036
	(0.034)	(0.044)	(0.029)
<i>F</i> (Conley)	3.4	2.7	1.5
<i>Panel B: Sales count</i>			
CPR <sub><i>i</i></sub>	0.347*	0.389*	0.214
	(0.184)	(0.233)	(0.173)
<i>Panel C: Years since first sale</i>			
CPR <sub><i>i</i></sub>	7.46*	8.33	4.68
	(3.99)	(5.07)	(3.82)
<i>N</i>	946,314	721,909	224,405
Township FE	✓	✓	✓
Controls	✓	✓	✓


Conley SEs (100-mile bandwidth). \* $p < 0.10$ . Source: Table 5.

## Robustness: Clustered Standard Errors

- ▶ **Preferred:** Conley (1999) spatial HAC, 100-mile bandwidth — accounts for spatial autocorrelation along the CPR corridor
- ▶ **Divergence from clustered:** Clustered  $F > 900$  (pooled); Conley  $F \approx 3-4$
- ▶ Conley inflates  $\widehat{\text{Var}}(\hat{\pi})$  by aggregating spatial covariance across the 100-mile window; clustered SEs treat townships as independent
- ▶ Conley results are therefore *conservative*; clustered specifications qualitatively identical and reported in the paper
- ▶ Main conclusions do not depend on SE choice


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# Alberta Checkerboard and CPR Sales



fig\_checkerboard\_alberta.pdf

Figure 3: Alberta checkerboard (AltaLIS ATS  
v4.0)



fig\_cpr\_sales.pdf

Figure 4: CPR sales by decade (SANDS database)  
Warm ramp = early to late sale