# Staple Products, Linkages, and Development
## Evidence from Argentina

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- Do patterns of production at early stages of development affect long-run growth?

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  - Comparative development $\leftarrow$ Historical paths of development

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[Ranching specialization, 1914]

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    - Comparative development $\leftarrow$ Historical paths of development
      [Linkages of agri.production]
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      Deeply-rooted factors
      [Ranching specialization, 1914]

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  - Comparative development   ←   Historical paths of development
    [Income per capita, 1994]     [Linkages of agri.production]
                                  ↑
                        Deeply-rooted factors
                        [Ranching specialization, 1914]

# The Agricultural Roots of Comparative Development

Development economists and economic historians have emphasized the effects of specific specialization patterns

- Crops with increasing returns to scale (Engerman and Sokoloff, 1997, 2002; Nunn, 2008; Bruhn and Gallego, 2012)

- Crops with high seasonality in labor requirements (Earle and Hoffman, 1980; Goldin and Sokoloff, 1984)

- Crops with high labor elasticity (Vollrath, 2011; Eberhardt and Vollrath, 2016)

# The Agricultural Roots of Comparative Development (II)

Staple theory of economic growth (Innis, 1930, 1940; Baldwin, 1956)

- newly settled regions: land abundance $\rightarrow$ comparative advantage in resource-intensive exports

- staple-export production becomes the leading sector and development is essentially the process of diversification around it

- the characteristics of the staple leave an imprint in the whole economy: its production function determines ...

    - demands for factors and intermediate inputs

    - income distribution

    - investment opportunities in related activities

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- Demand linkages
    - development of consumer goods industries
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        level and distribution of income $\leftarrow$ staple's production function

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        ↑
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- Generalized linkages
    - all possible connections between the staple's production and subsequent development

# Argentine Provinces in Our Sample
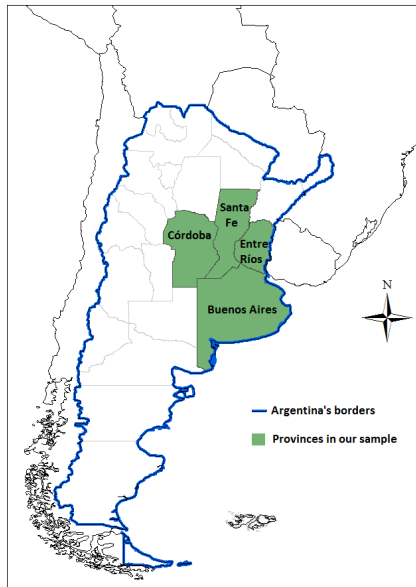
# Ranching specialization across counties in the *Pampas*

Shares of farm land used for different products

| Product | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Ranching | 0.728 | 0.226 | 0.152 | 0.998 |
| Corn | 0.098 | 0.143 | 0 | 0.630 |
| Wheat | 0.090 | 0.113 | 0 | 0.505 |
| Flax | 0.038 | 0.057 | 0 | 0.246 |
| Oats | 0.022 | 0.033 | 0 | 0.222 |
| Alfalfa | 0.010 | 0.013 | 0 | 0.078 |
| Forest | 0.007 | 0.034 | 0 | 0.344 |
| Others | 0.008 | 0.014 | 0 | 0.145 |

*Others* combines 15 products, each less than 0.5% of total land use

# Share of Ranching across *departamentos*, 1914



Legend:
- 0.38 - 0.48
- 0.49 - 0.54
- 0.55 - 0.60
- 0.61 - 0.65
- 0.66 - 0.70
- 0.71 - 0.73
- 0.74 - 0.77
- 0.78 - 0.80
- 0.81 - 0.83
- 0.84 - 0.87
- 0.88 - 0.91
- 0.92 - 0.95
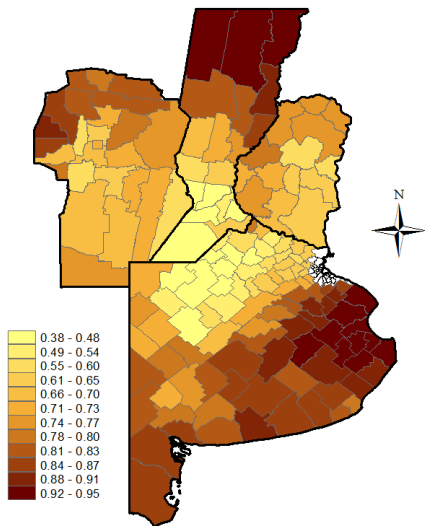
# Income per capita 1994 and Ranching specialization 1914
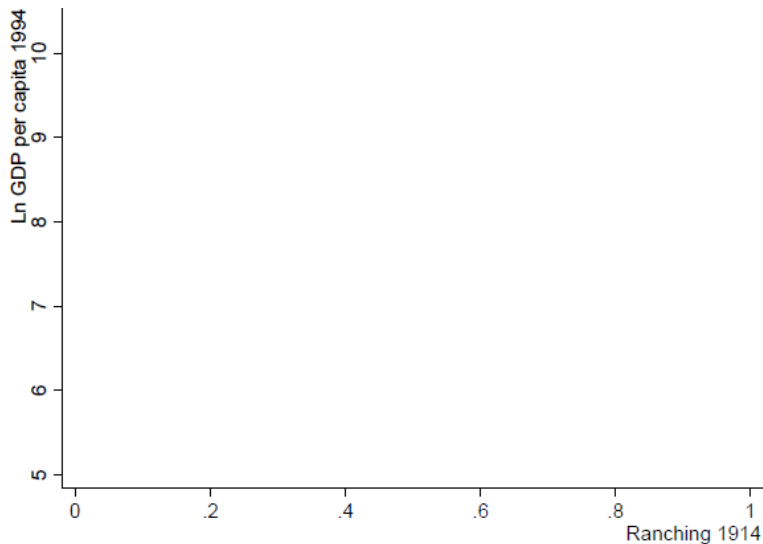
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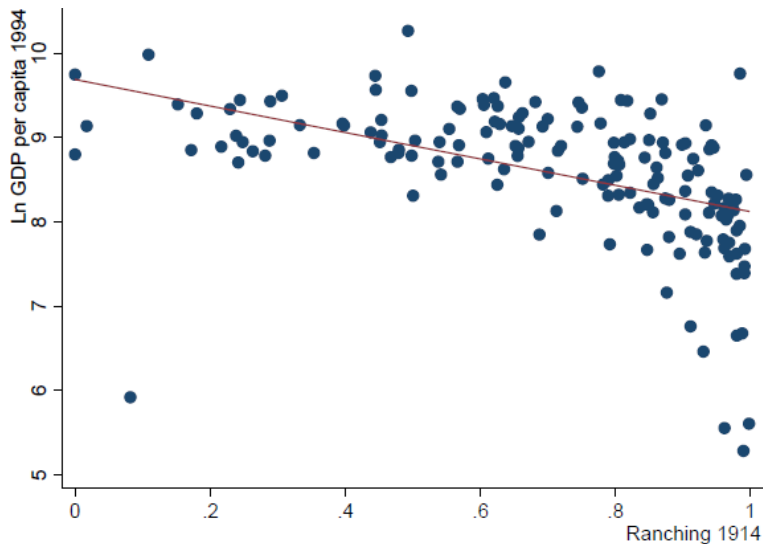
# Roadmap

1. Empirical strategy: OLS and IV

2. Ranching's defining features
   - Forward and backward linkages: demand for railroads and capital goods
   - Demand linkages: land concentration and population density
   - Generalized linkages: Immigration (and Skills)

3. Ranching's effects on long-run development
   - Density and urbanization
   - Industrialization and productivity
   - Income and Human capital in the Long-run

# Estimating Equation

$$y_d = \alpha + \beta \text{ Ranching}_{c,1914} + \delta_p + \gamma' \mathbf{X}_d + \varepsilon_d$$

- $y_d$: development outcomes at different times

- $\delta_p$: *provincia* fixed effect

- $\mathbf{X}_c$: land productivity measures, area, temperature, rainfall, elevation, ruggedness

# Instrumental Variable Strategy

Construct IV using climate-based crop-specific productivity measures

Data from FAO (Global Agro-Ecological Zones Project)

- Climatic data
  - precipitation
  - temperature
  - wind speed
  - sunshine hours
  - relative humidity
- Crop-specific characteristics
  - cycle length (i.e. days from sowing to harvest)
  - thermal suitability
  - water requirements
  - growth and development parameters (harvest index, max leaf area index, max rate of photosynthesis, etc)

$\longrightarrow$ Maximum attainable yield for each crop (tons/ha/year)

# Agro-climatic suitability for Wheat
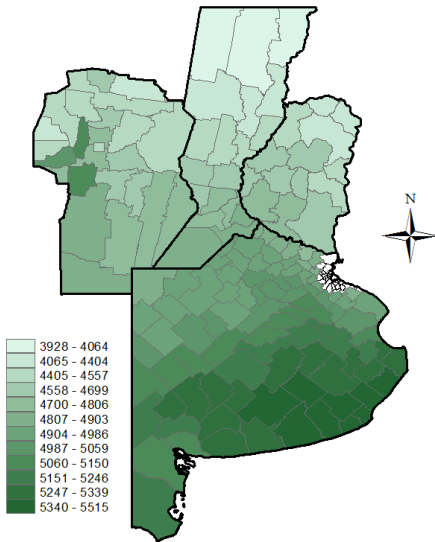
# Agro-climatic suitability for Corn
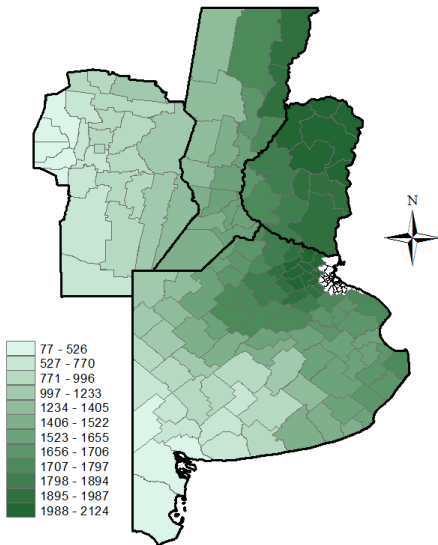
# Agro-climatic suitability for Pastures



| | |
|---|---|
| | 50 - 278 |
| | 279 - 450 |
| | 451 - 559 |
| | 560 - 696 |
| | 697 - 788 |
| | 789 - 845 |
| | 846 - 894 |
| | 895 - 935 |
| | 936 - 989 |
| | 990 - 1031 |
| | 1032 - 1070 |
| | 1071 - 1134 |
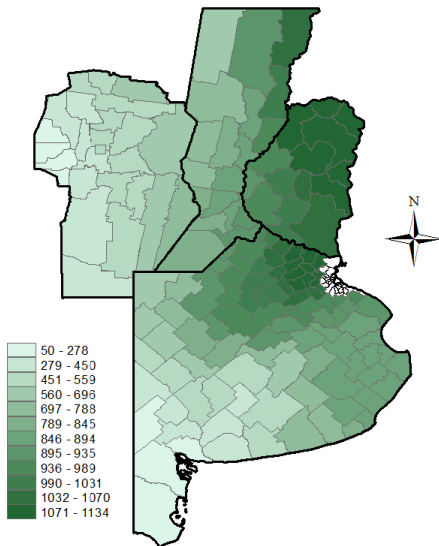
# Constructing an IV using crop-specific productivities

Fractional Multinomial Logit Model

- System of equations estimated by QML

- $\hat{\theta}_{ic} = E[\theta_{ic}|\mathbf{A}_c] = \frac{e^{\beta_i'\mathbf{A}_c}}{1+\sum_{j=1}^{I-1} e^{\beta_j'\mathbf{A}_c}}$

    - $\theta_{ic}$ = share of product $i$ in agricultural output of county $c$
    - $\mathbf{A}_c$ = vector of crop-specific productivities

# Actual and Predicted Ranching Specialization
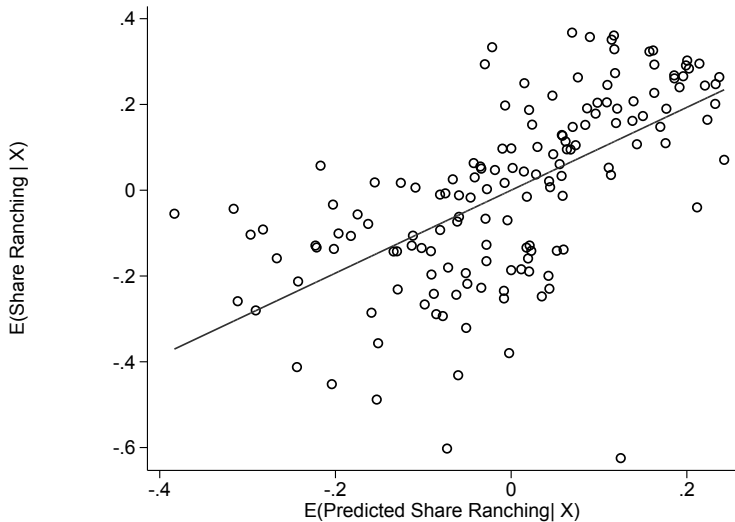
# Ranching's Defining Features

- Backward linkages
  - Low demand for railroads relative to cereals
  - Low demand for capital goods relative to cereals

- Forward linkages
  - Processing industries concentrated around Ciudad de Buenos Aires (in contrast, grain processing was geographically dispersed)

- Demand linkages
  - Extensive production $\rightarrow$ land concentration, low labor intensity $\rightarrow$ low demand for consumption goods (except luxuries)

- Generalized linkages
  - Europeans' human capital & skills (Gerchunoff and Torre 2014)

# Ranching's Defining Features: Backward Linkages

| Dependent Variable: | Capital Intensity (1914) | | | Railroad density | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A. OLS Estimates** | | | | | | |
| Ranching$_{1914}$ | -2.942*** | -2.951*** | -2.685*** | -7.990*** | -7.861*** | -6.228*** |
| | (0.246) | (0.221) | (0.201) | (1.214) | (1.274) | (1.277) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 1.64 | 1.64 | 1.64 | 5.07 | 5.07 | 5.07 |
| $R^2$ | 0.51 | 0.63 | 0.77 | 0.28 | 0.33 | 0.49 |
| **Panel B. IV Estimates** | | | | | | |
| Ranching$_{1914}$ | -3.491*** | -3.365*** | -3.196*** | -7.469*** | -8.067*** | -6.187*** |
| | (0.423) | (0.304) | (0.235) | (1.250) | (1.101) | (1.306) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 1.64 | 1.64 | 1.64 | 5.07 | 5.07 | 5.07 |
| $R^2$ | 0.49 | 0.63 | 0.76 | 0.28 | 0.33 | 0.49 |
| State Fixed Effects | No | Yes | Yes | No | Yes | Yes |
| Land Productivity Measures | No | No | Yes | No | No | Yes |
| Geo-climatic Controls | No | No | Yes | No | No | Yes |

## Ranching's Defining Features: Land Concentration and Labor Intensity

| | Land Concentration (1914) | | | Ln Population Density (1914) | | | Urban Population Share (1914) | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| **Panel A. OLS Estimates** | | | | | | | | | |
| Ranching$_{1914}$ | 0.679*** | 0.706*** | 0.575*** | -2.477*** | -2.603*** | -2.051*** | -0.237*** | -0.255*** | -0.206** |
| | (0.050) | (0.054) | (0.059) | (0.277) | (0.292) | (0.259) | (0.074) | (0.072) | (0.080) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 0.51 | 0.51 | 0.51 | 1.70 | 1.70 | 1.70 | 0.34 | 0.34 | 0.34 |
| $R^2$ | 0.52 | 0.54 | 0.77 | 0.37 | 0.40 | 0.64 | 0.08 | 0.16 | 0.22 |
| **Panel B. IV Estimates** | | | | | | | | | |
| Ranching$_{1914}$ | 0.575*** | 0.639*** | 0.505*** | -2.511*** | -2.589*** | -2.031*** | -0.216** | -0.234** | -0.209** |
| | (0.074) | (0.079) | (0.069) | (0.347) | (0.348) | (0.294) | (0.106) | (0.099) | (0.098) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 0.51 | 0.51 | 0.51 | 1.70 | 1.70 | 1.70 | 0.34 | 0.34 | 0.34 |
| $R^2$ | 0.51 | 0.53 | 0.76 | 0.37 | 0.40 | 0.64 | 0.08 | 0.16 | 0.22 |
| State Fixed Effects | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Land Productivity Measures | No | No | Yes | No | No | Yes | No | No | Yes |
| Geo-climatic Controls | No | No | Yes | No | No | Yes | No | No | Yes |

# Ranching's Defining Features: Immigration

| Dependent Variable: | European Population Share (1914) | | | Italian Share among Foreigners (1914) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A. OLS Estimates** | | | | | | |
| Ranching$_{1914}$ | -0.273*** | -0.245*** | -0.264*** | -0.298*** | -0.270*** | -0.161*** |
| | (0.028) | (0.029) | (0.025) | (0.045) | (0.046) | (0.048) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 0.23 | 0.23 | 0.23 | 0.39 | 0.39 | 0.39 |
| $R^2$ | 0.35 | 0.59 | 0.72 | 0.21 | 0.29 | 0.51 |
| **Panel B. IV Estimates** | | | | | | |
| Ranching$_{1914}$ | -0.362*** | -0.363*** | -0.412*** | -0.300*** | -0.313*** | -0.209*** |
| | (0.044) | (0.040) | (0.034) | (0.061) | (0.063) | (0.065) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 0.23 | 0.23 | 0.23 | 0.39 | 0.39 | 0.39 |
| $R^2$ | 0.32 | 0.53 | 0.64 | 0.21 | 0.28 | 0.51 |
| State Fixed Effects | No | Yes | Yes | No | Yes | Yes |
| Land Productivity Measures | No | No | Yes | No | No | Yes |
| Geo-climatic Controls | No | No | Yes | No | No | Yes |

# Ranching's Effects on Long-run Development

- Density and Urbanization over time

- Industrialization and Productivity over time

- Income and Human Capital in the Long-run

# Long-run Effects: Population Density and Urbanization

| Dependent variable: | | Population density | | | Urban Share | |
|---|---|---|---|---|---|---|
| | 1914 | 1947 | 1991 | 2001 | 1914 | 2001 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel B. IV Estimates** | | | | | | |
| Ranching$_{1914}$ | -2.031*** | -2.025*** | -1.602*** | -1.408*** | -0.209** | -0.261*** |
| | (0.294) | (0.325) | (0.484) | (0.504) | (0.098) | (0.045) |
| Number of Counties | 150 | 150 | 150 | 150 | 150 | 150 |
| Mean of Dependent Variable | 1.70 | 2.14 | 2.37 | 2.46 | 0.34 | 0.87 |
| $R^2$ | 0.64 | 0.57 | 0.48 | 0.48 | 0.22 | 0.43 |
| State Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Land Productivity Measures | Yes | Yes | Yes | Yes | Yes | Yes |
| Geo-climatic Controls | Yes | Yes | Yes | Yes | Yes | Yes |

# Long-run Effects: Industrialization and Productivity

| | Share of Pop. in Mfg. 1947 (1) | Ln Mfg. Output per Worker 1947 (2) | Skill-intensity in Mfg. 1947 (3) | Share of Labor in Mfg. 1970 (4) | Ln Mfg. Output per Worker 1994 (5) | Share of Labor in Mfg. 2001 (6) |
|---|---|---|---|---|---|---|
| **Panel B. IV Estimates** | | | | | | |
| Ranching[1914] | 0.010 | -0.286 | -0.049*** | -0.061* | -2.767*** | -0.084*** |
| | (0.010) | (0.236) | (0.019) | (0.033) | (0.669) | (0.027) |
| | | | | | | |
| Number of Counties | 147 | 147 | 147 | 150 | 145 | 150 |
| Mean of Dependent Variable | 0.03 | 2.42 | 0.09 | 0.13 | 5.47 | 0.17 |
| $R^2$ | 0.07 | 0.34 | 0.24 | 0.43 | 0.44 | 0.45 |
| | | | | | | |
| State Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Land Productivity Measures | Yes | Yes | Yes | Yes | Yes | Yes |
| Geo-climatic Controls | Yes | Yes | Yes | Yes | Yes | Yes |

## Long-run Development

| Dependent variable: | Income per capita 1994 (1) | Non-Agri. Inc. per capita 1994 (2) | Years of Schooling 2001 (3) | Primary School Completion 2001 (4) |
|---|---|---|---|---|
| **Panel B. IV Estimates** | | | | |
| Ranching$_{1914}$ | -3.340*** | -1.549*** | -1.463*** | -0.136*** |
| | (0.434) | (0.305) | (0.272) | (0.018) |
| Number of Counties | 147 | 145 | 150 | 150 |
| Mean of Dependent Variable | | | | |
| $R^2$ | 0.25 | 0.48 | 0.49 | 0.66 |
| State Fixed Effects | Yes | Yes | Yes | Yes |
| Land Productivity Measures | Yes | Yes | Yes | Yes |
| Geo-climatic Controls | Yes | Yes | Yes | Yes |

## Main Takeaways

- We show that primary production patterns can shape the process of development

  - Our findings support the classic staple theory of growth

  - Suggest that production structure affects growth

  - Favor models with finer levels of aggregation

- Economic History of Argentina

  - Suggestive implications about Argentina's "reversal of fortune"