

Capital-Intensive Technology and Local Political Control: Evidence from the Brazilian Cerrado

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Research Proposal

Motivation

Agricultural technology can raise productivity while changing who holds economic and political power. In some contexts like the Indian one, high-yielding crop varieties strengthened agrarian producers and weakened single-party dominance (Dasgupta, 2018). In Chile, landlords controlled their workers' votes until the secret ballot of 1958 (Baland and Robinson, 2008). However, it is less clear what happens when a new technology is capital-intensive and therefore accessible mainly to those who already have land and credit. This proposal studies that question in the Brazilian *Cerrado*. From the mid-1970s, soybean varieties adapted to tropical conditions, soil correction and subsidized credit made large-scale mechanized farming viable on land previously considered unsuitable for crops. The question is whether municipalities more exposed to this shock have, decades later, a larger political presence of agrarian elites in local government, and whether the channel runs through changes in the agrarian structure.

Related Literature and Gap

Three literatures are relevant. The first studies the shock itself. Assunção and Bragança (2015) find that, between 1960 and 1985, municipalities in Central Brazil that were more suitable for soybeans saw more cropland, fertilizer and tractor use after the adapted varieties appeared, which is consistent with farmers being capital-constrained. Kaimowitz and Smith (2001) describe how the technology interacted with government policy. Akerman et al. (2025) show that *Embrapa* raised agricultural productivity, using its staggered expansion and municipal ecological suitability, and Bustos, Caprettini and Ponticelli (2016) study the later genetically engineered soybean and find labor-saving technical change that raised industrial growth. Nevertheless, these papers examine production, land use and structural change, not political outcomes, which is one of the project's potential contributions.

The second literature links agricultural technology to politics and conflict. Dasgupta (2018) is the main reference for a democratizing effect, while Falcone and Rosenberg (2025) find that agricultural modernization increased land conflict in Brazil after the mid-1990s.

Another strand of literature studies agrarian elites in Brazilian local politics. Katovich and Moffette (2025) show that large landholders are strongly over-represented among Amazon mayors and that municipalities, where landholder-financed mayors narrowly win, see more agricultural promotion and soy cultivation. Boas, Hidalgo and Richardson (2014) study campaign donations and government contracts, whereas Novaes and Schiumerini (2022) study how commodity prices affect incumbents. These papers take the

political weight of agrarian elites as given. I am not aware of work that asks whether the 1970s *Cerrado* shock helped create it.

Setting and Hypotheses

The *Programa de Desenvolvimento dos Cerrados* (POLOCENTRO), created by Decree 75.320 in January 1975, aimed at the occupation of *Cerrado* areas and their use at a commercial scale through dedicated credit lines (Banco Central do Brasil, 1975). Much of the frontier land was public, so landholding concentration there may have been formed largely during this period rather than inherited from the colonial era. This is an assumption to be checked against the 1960 and 1970 agricultural censuses.

Given this, two hypotheses, that have different observable implications, can be raised (see Table 1). First, under entrenchment, the capital requirements of the new technology favored holders of land and credit, so exposure raises land concentration and the share of agrarian producers among candidates and office-holders, as well as concentrates campaign funding. Secondly, democratization, following Dasgupta (2018), the technology broadened participation and these outcomes do not rise, or fall. The first hypothesis further predicts that the political effect is larger where the first-stage increase in land concentration is larger.

A result from the first hypothesis would show that a state-directed, capital-intensive technology can generate local political concentration, and a null or second hypothesis-type result would be informative in contrast to the Indian evidence discussed in the motivation of this proposal.

TABLE 1: TESTABLE IMPLICATIONS OF THE CONCEPTUAL FRAMEWORK

Outcome Variable	Entrenchment	Democratization	Null Effect
<i>Structural & Economic Margins</i>			
Agricultural Land Concentration	+	– / 0	0
<i>Electoral & Financial Margins</i>			
Agrarian Candidate Share	+	– / 0	0
Agrarian Office-Holder Share	+	– / 0	0
Campaign Finance Concentration	+	– / 0	0

Notes: (+) indicates an increase or positive effect, (–) indicates a decrease or negative effect, and (0) indicates no effect.

Empirical Strategy

For each municipality m in the *Cerrado* biome, harmonized to minimum comparable areas, exposure is the gap between potential soybean yield under high-input and low-input management in the FAO-IIASA Global Agro-Ecological Zones (GAEZ) data, which incorporate soil constraints such as acidity. This

follows suitability-based logic of Bustos et al. (2016) as well as Assunção and Bragança (2015). The post-period begins in 1975. The first stage exploiting the agricultural censuses of 1960 onward would use the following event study specification:

$$Y_{mt} = \alpha_m + \delta_{s(m),t} + \sum_{\tau \neq 1960} \theta_{\tau} (\text{Gap}_m \times \mathbf{1}[t = \tau]) + \sum_{\tau \neq 1960} (X_m \times \mathbf{1}[t = \tau])' \Gamma_{\tau} + \varepsilon_{mt} \quad (1)$$

where Y could be either the share of area in large establishments, the land Gini, tractors per hectare of fertilizer use, α_m are municipality effects and $\delta_{s(m),t}$ are state-by-year effects wherein $s(m)$ refers to the state to which municipality m belongs to. Gap_m is the exposure measure when X_m are baseline municipality characteristics, each interacted with year indicators. Because 1960 is the base year, θ_{1970} tests whether high-gap municipalities were already on different trends before the shock, as in Assunção and Bragança (2015). This step checks that the shock transformed the agrarian structure.

In the second part of identification, a reduced form for political outcomes, utilizing electoral outcomes from 2000 to 2026, would be specified without a pre-period given political data limitations. The estimate would thus be cross-sectional:

$$P_{mt} = \alpha + \beta \text{Gap}_m + X_m' \gamma + \delta_{s(m)} + \mu_t + \varepsilon_{mt} \quad (2)$$

X_m contains pre-1970 land concentration and agricultural structure, population density, urbanization, rainfall, latitude, and distance to markets, and δ_s are state effects and μ_t are election-year effects. I also control for suitability to the genetically engineered soybean, since the 1990s shock studied by Bustos et al. (2016) correlates with *Cerrado* suitability. Standard errors allow for spatial correlation (Conley, 1999). The coefficient β is the reduced form of the whole post-1975 trajectory and is interpreted that way. Adding variables from the first stage shows whether β shrinks, but this is a descriptive decomposition and not causal mediation.

The design relies on the identifying assumption that, conditional on X_m and state effects, suitability affects political outcomes only through technological change after 1975. Nevertheless, some threats to the identification strategy persist. For instance, suitability may correlate with geography or pre-existing structure that shapes politics directly, such as flat land favoring large farms.

Moreover, selective in-migration of farmers could mean that capture reflects who settled rather than what the shock did. For robustness checks, I control for the share of residents born in other states, using census place of birth, and use it as an alternative outcome.

It is also possible that multiple outcomes raise the risk of false positives. For this, I use standardized indices and family-wise error adjustments. Finally, robustness checks would also benefit from a placebo test. For example, Akerman et al. (2025) find productivity gains concentrated in the targeted staples, which make such crops a meaningful placebo. Thus, a positive placebo result would indicate that the design is picking up geography.

Outcomes

Three dimensions of political capture are measured so that outcomes do not depend on voter composition. Direct capture is the share of candidates and elected mayors and councillors declaring a rural-producer occupation in the electoral court (TSE) records, which is self-reported. Financial capture is the share and concentration (Herfindahl index) of campaign donations from agrarian donors, where donor sector is available. Coercive capture uses the Pastoral Land Commission (CPT) records of land conflict and violence per rural inhabitant. Land structure comes from the IBGE agricultural censuses, whereas suitability and land cover from GAEZ, *Embrapa* soil data and *MapBiomass*.

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