Portuguese Colonial Land Grants in Brazil: Long-term Effects on Inequality and Economic Development

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What I'm Looking for

- What's the best way to proceed with the project, given the data and a timeline for graduation.
- Some of the issues with each identification strategy I've thought about.
  - Paper itself would not just be one identification but a combination of multiple of them.
- Possible interesting section to analyze how they were distributed.

Motivation

- Inequality, in both land and income, is high in Brazil.
  - "**Brazil has one of the highest levels of inequality of land distribution in the world** [...] **An estimated 1% of the population owns 45% of all land in Brazil**." (USAID, 2016)

Motivation

- However, land inequality is nothing new[1]:

TABLE 1. Ratios of Occupied Land to Total Land (in percentages)

	Total Area in Farms						
	1920	1940	1950	1960	1970	1980	1985
Brazil	20.6	23.2	27.2	29.3	34.6	42.9	44.1
North	6.0	7.1	6.5	6.6	6.5	11.6	12.6
Northeast	23.2	27.6	37.6	40.6	47.9	57.0	59.3
Southeast	49.4	62.1	66.4	68.8	75.2	79.5	79.2
South	47.7	54.9	61.6	67.8	79.0	83.3	83.3
Center-West	23.6	21.4	28.5	31.9	43.4	60.3	61.9

Source: Fundação Instituto Brasileiro de Geographia e Estatístico (IBGE), Censo Agropecuário, 1920–85.

TABLE 2. Gini Coefficient of Landownership Distribution in Brazil

Region	1960	1970	1975	1980	1985
Brazil	0.842	0.844	0.850	0.853	0.854
North	0.944	0.839	0.865	0.830	0.795
Northeast	0.846	0.855	0.858	0.858	0.865
Southeast	0.771	0.761	0.754	0.763	0.766
South	0.727	0.727	0.725	0.735	0.744
Center-West	0.845	0.856	0.851	0.840	0.836

Source: Hoffman 1982 and C. C. Mueller 1987.

[1] Table obtained from Alston et al. (2010)

Research Question

- How much of it can be traced to colonial institutions?
  - Goal of this research would analyze the effects of colonial Portuguese land grants (*sesmarias*) on long-term inequality in Brazil.
- Proposed Identification:
  - Exploit **exogenous** variation on where the *sesmarias* could be granted during early colonization because of a treaty between Portugal and Spain (Laudares et al., 2022).
  - Generate **placebo land grants** and compare the effects with the actual ones (Dell et al., 2019).
  - Exploit **variation of soil quality** for different types of production across colonial Brazil (Wigton-Jones, 2020).
  - Exploit the **contents of the letters themselves** and how they might have changed through different events.

Background

- Historical and anecdotal evidence of the land grants having permanent effects in Brazilian economic structure:
  - Early studies argued it led to the development of the "**economic aristocracy of the colonial society**" and the "**principal cause of the [large estates]**" in Brazil (Lima, 2002, p. 36; Costa Porto, 1979, p. 48).
  - "Today the system of ownership and use of land is a **continuation of the colonial system, with the sesmaria becoming [large estate] property**" (Andrade, 1980, p. 18).

Possible Channels

- What are the long-term economic effects of colonial Portuguese land grants in Brazil?
  - Economic Development ⇒ the lands granted were (supposed to be) developed by the owners, leading to the early economic development of an area (possible conflict with extractive institutions though). **[Hard to measure for 1872 though]**
  - Land inequality ⇒ only those with sufficient financial conditions were granted *sesmarias*, and were often granted vast plots of land.
  - Income inequality ⇒ land was associated with wealth, fewer people with land lead to wealth accumulation by the few.
  - Demographic Differences ⇒ *Sesmarias* often required African slaves, which could skew the demographics of a location.
  - Political dominance ⇒ Dominance by aristocrats often hampered efforts for local reform and investment.[1]

[1] "If the land was concentrated by a few owners, [large estates] are created and it limits the number of settlers and the possibility of them entering the social class of [land owners] or farmers (Bandecchi, 1963, p. 40)

Literature Review

- Role of colonization and land tenure in present outcomes:
  - Institutional Origins: Acemoglu et al., 2001 (AER), Sokoloff et al., 2000 (JEP).
  - United States: Smith, n.d. (WP)
  - Brazil and Latin America: Naritomi et al., 2012 (JEH), Musacchio et al., 2014 (JEH), Wigton-Jones, 2020 (JEG), Laudares et al., 2022 (WP), Sellars et al., 2018 (JDE).
  - India: Banerjee et al., 2005 (AER).
  - Africa: Lowes et al., 2020 (WP).

Data

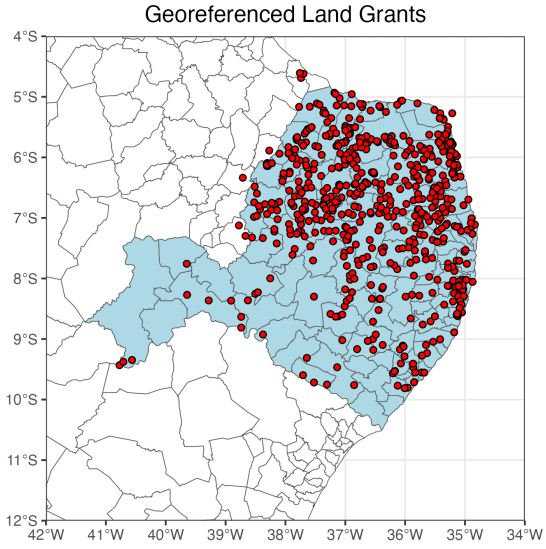
- Information of *sesmarias* from the Sesmarias of the Luso-Brazilian Empire Database [**Partially Added, In Progress**].
- Brazilian Censuses (1872-2010)
- Brazilian Agricultural Censuses (First one in 1920).
- LandSat data to measure land usage from MapBiomas (begins in 1985).
- Nightlight data from Li et al. (2020)
- Brazilian election results from 1889-1937 History of Political Institutions (To be released).
- FAO GAEZ dataset for crop suitability. [**Added for sugarcane**]

Data

Information extracted from the letters:

- Location.
- Year of Concession (In 1697 they were limited to 3 **leagues** by 3 **leagues**).
- Type of Settler to whom it was granted.
- What purpose was the land requested (cattle, sugar plantation/factory, etc.).
- Who granted the request.

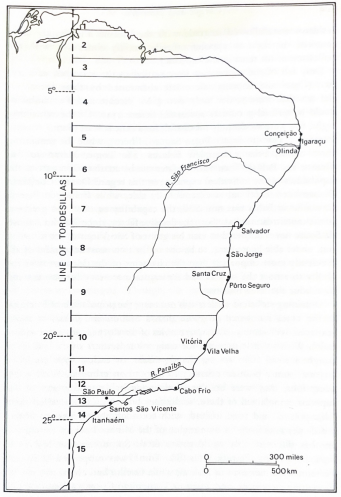
Georeferenced Data



Selection

- Agglomeration: Effects on Neighboring Grids

Treaty of Tordesillas (1494)

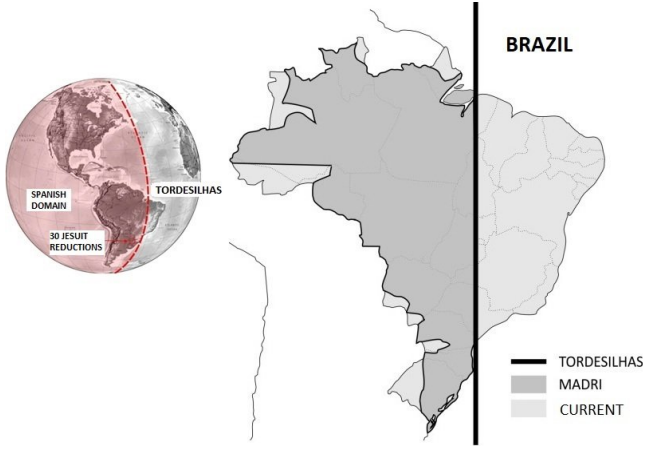


Key to Captaincies

1. João de Barros e Aires da Cunha (Pará), 2nd Part 2. Fernão Alvares de Andrade (Maranhão) 3. Antônio Cardoso de Barros (Piauí) 4. João de Barros e Aires da Cunha, 1st Part 5. Pero Lopes de Sousa (Itamaracá), 3rd Part 6. Duarte Coelho (Pernambuco) 7. Francisco Pereira Coutinho (Bahia) 8. Jorge Figueiredo Correia (Ilheus) 9. Pero do Campo Tourinho (Pórto Seguro) 10. Vasco Fernandes Coutinho (Espírito Santo) 11. Pero de Goís (São Tomé) 12. Martim Afonso de Sousa (Rio de Janeiro), 2nd Part 13. Pero Lopes de Sousa (Santo Amaro), 1st Part 14. Martim Afonso de Sousa (São Vicente), 1st Part 15. Pero Lopes de Sousa (Sant'Ana), 2nd Part

Captaincies of Brazil in the sixteenth century

Treaty of Madrid (1750)



Identification

Fuzzy RDD Design

- Estimate a Fuzzy RDD in which the probability a municipality has a *sesmaria* is a function of whether it is located to the Portuguese side of the Treaty of Tordesillas (follows Laudares et al., 2022 (WP)).

First Stage:

$$Sesmarias_{m,s} = \delta \cdot TT_{m,s} + f(D_{m,s}) + \mu_s + X_{m,s} + \epsilon_{m,s}$$

Second Stage:

$$Y_{m,s} = \beta \cdot \widehat{Sesmarias}_{m,s} + f(D_{m,s}) + \mu_s + X_{m,s} + \epsilon_{m,s}$$

- **Issue:** For now I only have georeferenced data along the Northeast, which would require pushing the georeferencing to states alongside the coast. Also, since a RDD would requires a lot of observations for power.

Identification

Dell et al., 2019

- Follow Dell et al., 2019 (REStud) in generating placebo land grants based on similar characteristics as the actual granted ones and estimate differential effect of both.
- **Idea:** "Propensity Score Matching" + randomization inference, but not on unit of observation but instead on the location of the land grants

$$Y_{i,s} = \alpha + \sum_{j=1}^{D} \delta_1 \cdot dgrant_{i,s}^{j} + \beta X_{i,s} + \epsilon_{i,s}$$

Identification

Instrumental Variable

- Exploit exogenous land quality for certain types of requests, following Wigton-Jones, 2020 (JEG).

First Stage:

$$Sesmarias_{m,s} = \delta \cdot Suitability_{m,s} + \mu_s + X_{m,s} + \epsilon_{m,s}$$

Second Stage:

$$Y_{m,s} = \beta \cdot \widehat{Sesmarias}_{m,s} + \mu_s + X_{m,s} + \epsilon_{m,s}$$

- **Issue:** Tried with potential sugarcane output, and there is no first stage in 1872, but there is in 2010 FS FS - 2010
- (Not a lot of Obs. $\Rightarrow$ I can double it if needed)

Identification

Exploring the Content of the Letters

- Focus on the letters and their contents.
- Make the unit of observation a state by year.
- **Example Research Question:** How would a change in state governorship affect the contents of the letter:
  - **Channel:** New governor, not enough information on how strict he would be enforcing the land grants $\Rightarrow$ the letters are longer and more specific.

Descriptive Maps

- Description of the Land Grants: Economic Activity | Discovery | Discovery by Year | Claimed no land | Year of Request
- 1872 Census Maps: Slavery | Sugarcane Output | Gender Ratios
- Graphs: Size Distribution | Size Distribution Pre and Post 1697

Descriptive Maps - Grid Level

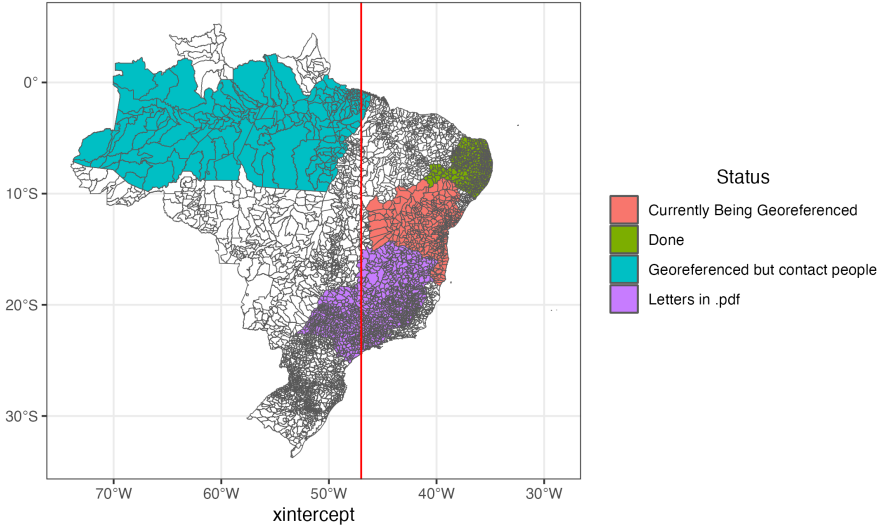
- Sugarcane: Potential Sugarcane Sugarcane Land Usage
- Pasture: Pasture Land Usage
- Nightlight: Nightlight

Tables and Results

- Summary Tables: Municipality Summary | Land Grant Summary
- OLS Results: Economic Activity | Economic Development Proxies | Land Usage by Year of Grant

Future Steps

Data Collection



Future Steps

To Do List

- Add more data!
- Add the information on the data about the people to whom the land grant was requested.
  - In some cases, there is some information **which city/location** the petitioner lived.

References I

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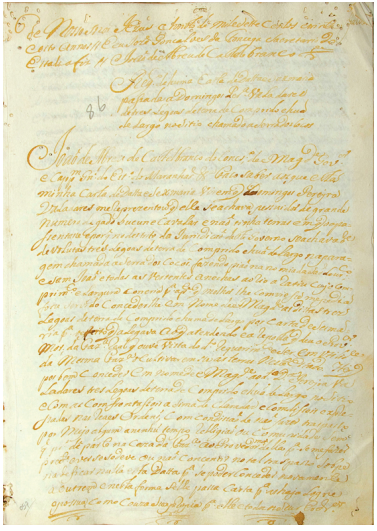
Other Relevant (?) Information to Add

- *Sesmarias* caused economic uncertainty in colonial times as often poor people would settle, develop land, and then lose the right of the land because a richer person would claim it (Costa Porto, 1979, p. 142).

Manueline Ordinances 1511-1512

"Na petição por uma carta de sesmaria, o requerente devia justificar seu pedido, e quando recebesse a carta de concessão havia uma serie de obrigações entre as quais estava a necessidade do cultivo"

Example of Document



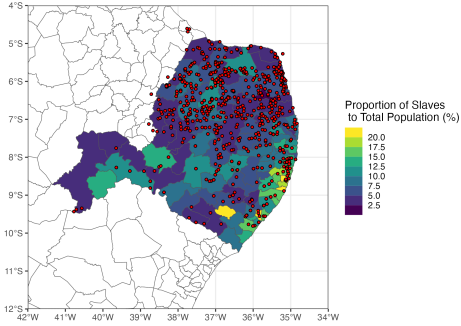
PA 0001
Carta de concessão a Domingos Pereira Valadares - 19/06/1738

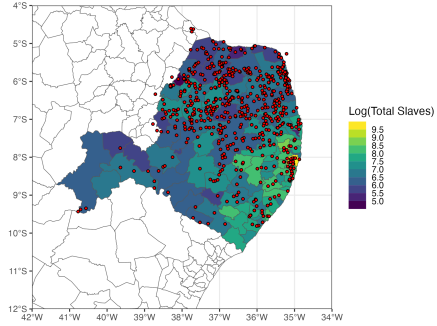
Registro de uma carta de data e sesmaria passada a Domingos Pereira Valadares de 3 léguas de terra de comprimento e uma de largura, no sitio chamado a Serra dos Cocos.

João de Abreu Castelo Branco, do Conselho de Sua Majestade, governador e capitão-general do estado do Maranhão, etc. Faço saber, aos que esta minha carta de data e sesmaria virem, que Domingos Pereira Valadares me representou que ele se achava possuidor de grande número de gado vacum e cavalar, e não tinha terras em que apascentasse, e porque no distrito da jurisdição deste governo se achavam devolutas 3 léguas de terra de comprido e uma de largo, na paragem chamada a Serra dos Cocos, fazendo pião na nomeada São Lourenço e São João, e todas as vertentes anexas ao Rio Araticu, cujo comprimento e largura correria para a parte que melhor lhe conviesse; me pedia fosse servido conceder-lhe, em nome de Sua Majestade, as ditas 3 léguas de terra de comprido e uma de largo, por carta de sesmaria, para efeito que alegava; ao que atendendo, e a resposta que deu o provedor-mor da Fazenda Real, que houve vista do dito requerimento, e ser em utilidade da mesma Fazenda o cultivarem-se as terras neste estado. Hei, por bem, conceder, em nome de Sua Majestade, ao dito Domingos Pereira Valadares, 3 léguas de terra de comprido e uma de largo, no sitio e com as confrontações acima declaradas e condições expressadas nas Reais Ordens, com condição de não fazer trespasse, por meio algum, em nenhum tempo, religião ou comunidade, sem que primeiro dê parte na Casa da Fazenda ao provedor-mor dela, para se me fazer presente e ver se se deve ou não consentir no tal trespasse, sob pena de ficar nula esta data para se poder conceder novamente a outrem. E, nesta forma, se lhe passa carta para as haja, logre e possua como coisa sua própria, para ele e todos os seus herdeiros, ascendentes e descendentes, sem pensão, nem tributo algum mais que o dizimo a Deus, Nosso Senhor, dos frutos que nelas tiver; a qual concessão lhe faço não prejudicando a terceiro nem a Sua Majestade, se no dito sitio quiser mandar fundar alguma vila, reservando os paus Reais que nelas houver para embarcações, com declaração que mandará confirmar esta data por Sua Majestade dentro de 3 anos primeiros seguintes, e cultivará as ditas terras de maneira que dê fruto; e dará caminhos públicos e particulares aonde forem necessários para pontes, fontes, portos e pedreiras; e se demarcará, ao tempo da posse, por rumo de corda e braças craveiras, como é estilo e o dito senhor ordena. E, outrossim, não sucederão nelas religiões ou pessoas eclesiásticas por nenhum título; e, acontecendo, possui-las será com o encargo de pagar delas dizimos a Deus como se fossem possuídas por seculares; e, faltando a qualquer destas cláusulas, se haverão por devolutas e se darão a quem as denunciar. Pelo que mando ao provedor-mor da Fazenda Real, e mais ministros e pessoas a que tocar, que, na forma referida, deixem ter e possuir ao dito Domingos Pereira Valadares as ditas terras, para ele e todos os seus herdeiros, ascendentes e descendentes, como coisa sua própria. Cumpram e guardem esta carta de data e sesmaria tão inteiramente como nela se contém, a qual lhe mandei passar por mim assinada e selada com o sinete de minhas armas, que se registrará aonde tocar e se passou por duas vias. Dada na cidade de São Luís do Maranhão, aos 19 dias do mês de junho do ano do nascimento de Nosso Senhor Jesus Cristo de 1738. E eu, José Gonçalves da Fonseca, secretário do estado, a fiz // João de Abreu Castelo branco//.

1872 Census - Slavery Distribution

Back





1872 Census - Potential Sugarcane Output

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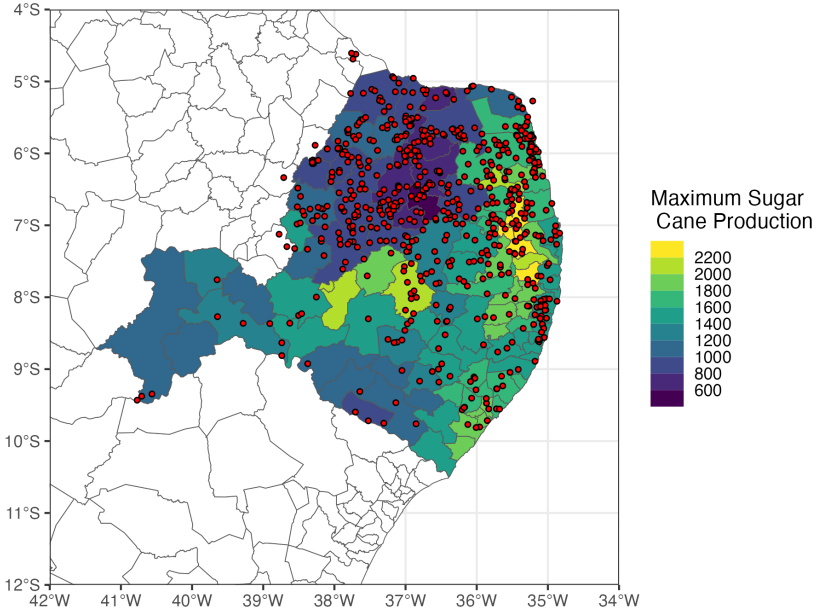

2010 Census - Potential Sugarcane Output

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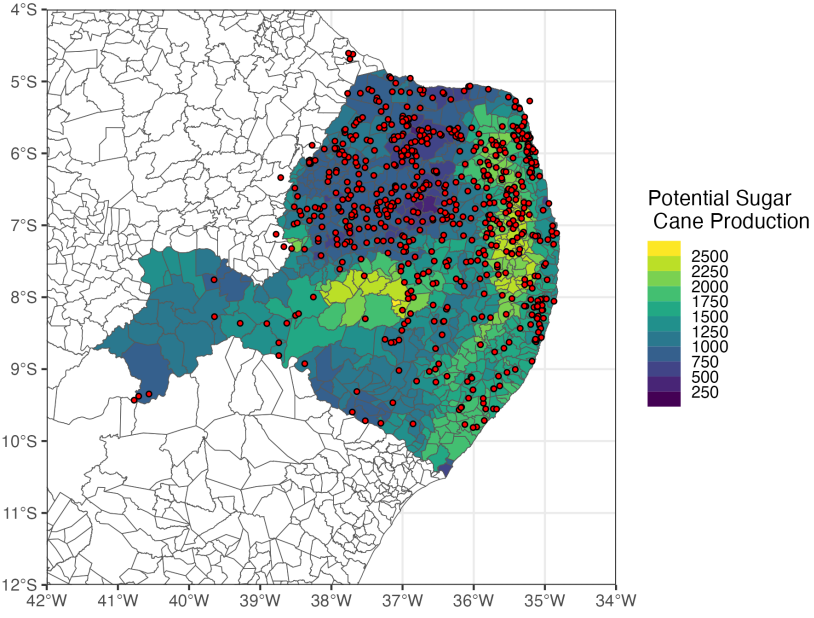

1872 Census - Gender Distribution

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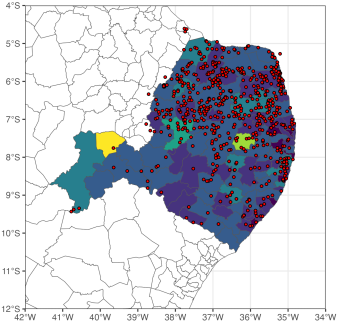
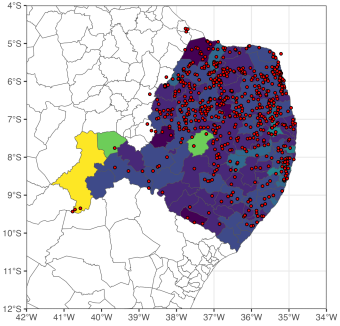
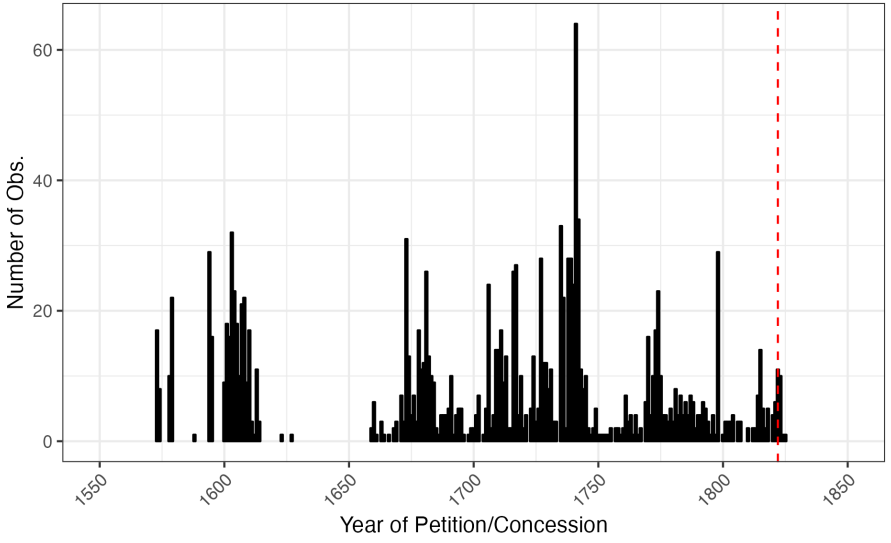




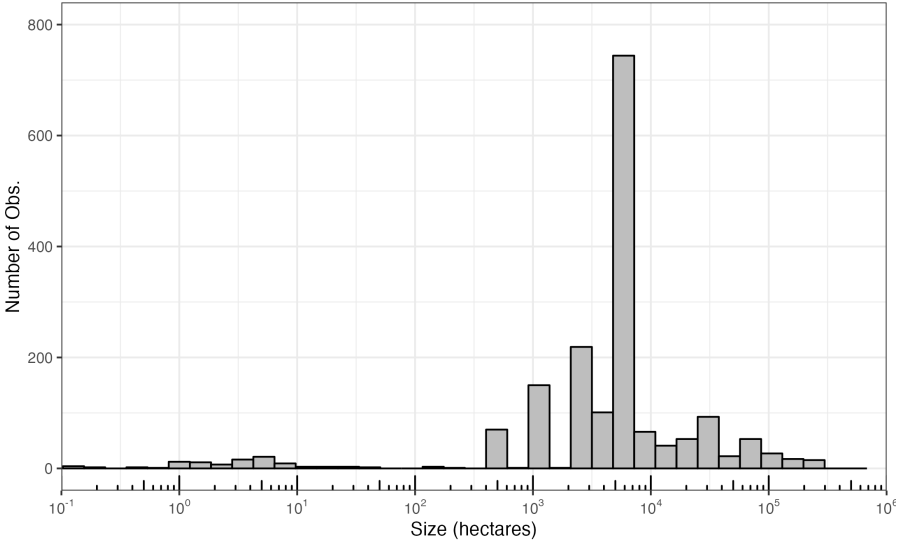
Basic Descriptive Statistics

Year Dist. Back



Basic Descriptive Statistics (1 hec = 2.5 Football Fields)

Size Dist. Back



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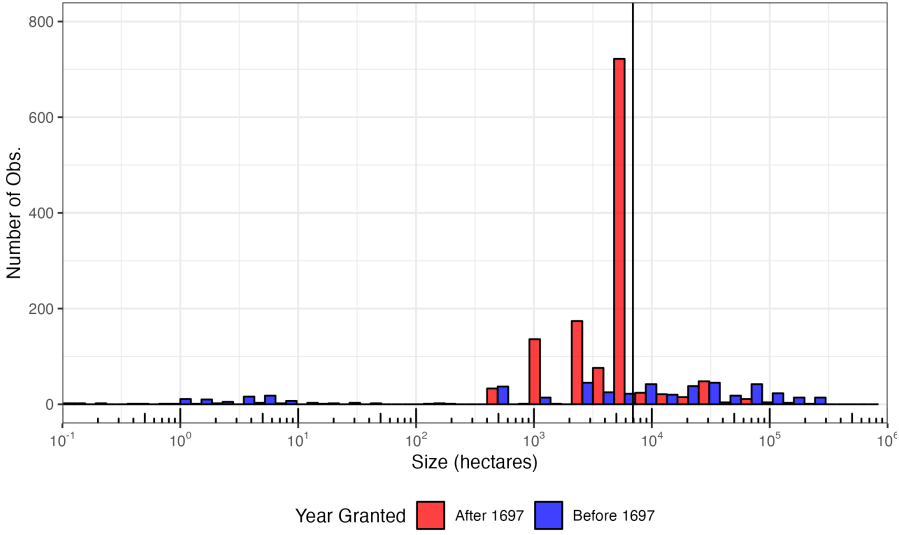
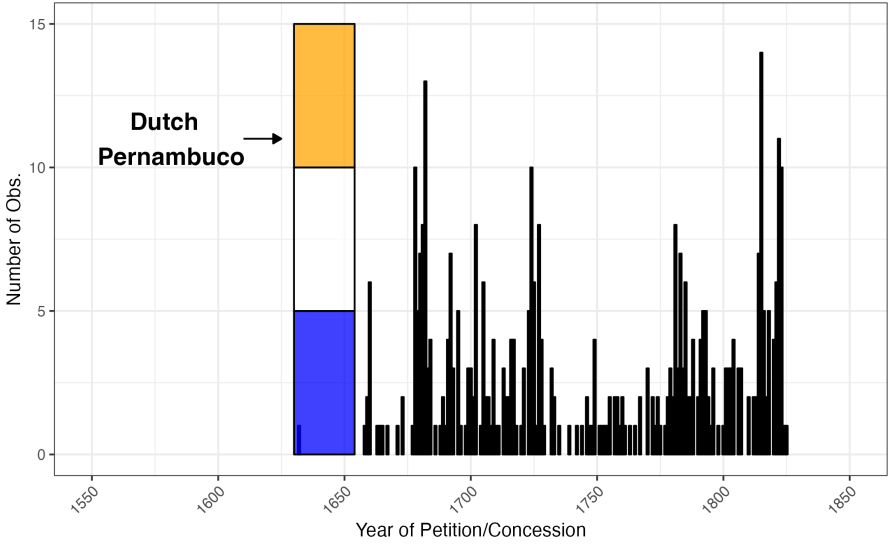


Smallest Land Grant

- The smallest land grant we have in the dataset is from 1603, in Rio de Janeiro (RJ0118). The petitioner asked for some land to build a house in the city of São Sebastião, which explains why in hectares it is so small.

Basic Descriptive Statistics

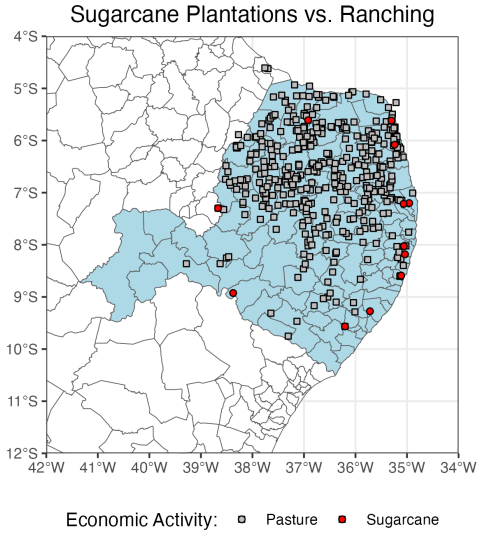
No Obs. in Pernambuco



Georeferenced Land Grants

Back

Sugarcane vs. Ranching



Georeferenced Land Grants

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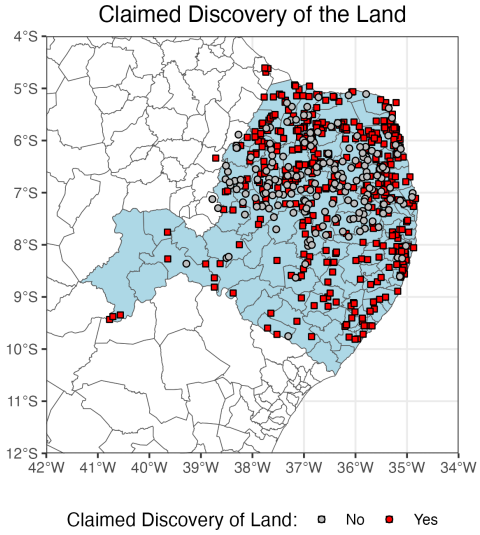
Alleged Discovery of the Land



Georeferenced Land Grants

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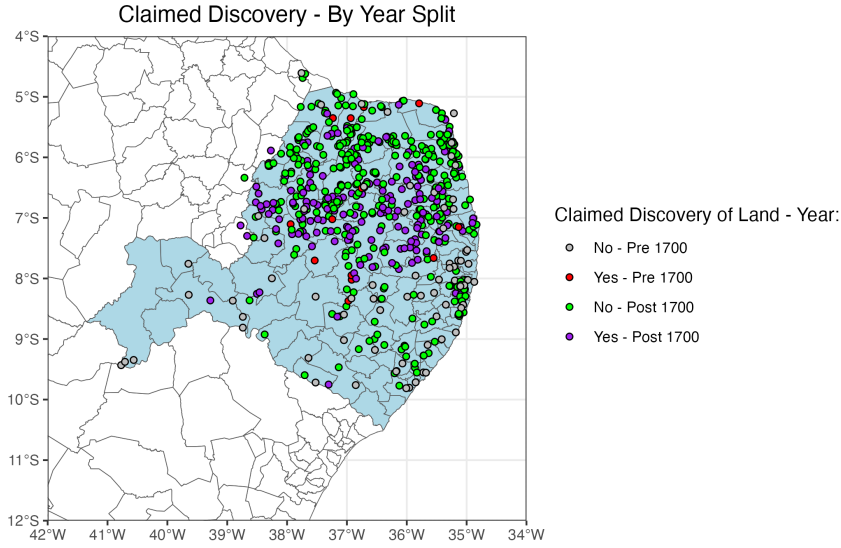
Alleged Discovery of the Land



Georeferenced Land Grants

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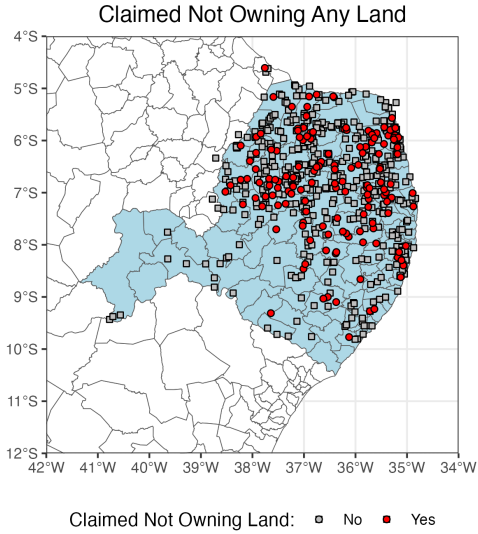
Alleged Discovery of the Land



Georeferenced Land Grants

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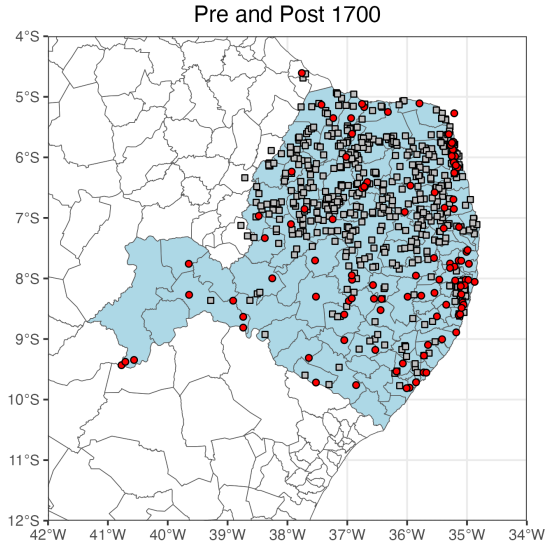
Year of the Land Grant



Georeferenced Land Grants

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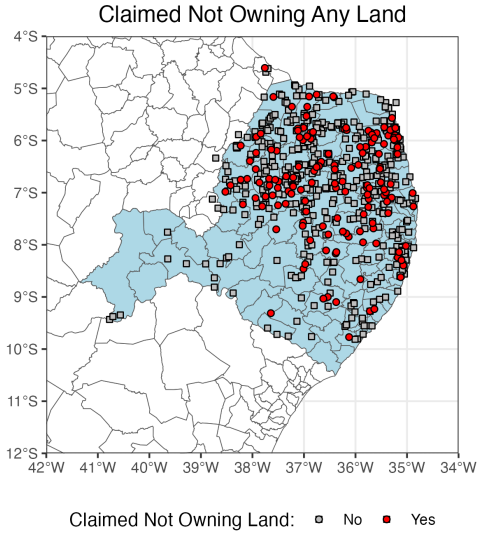
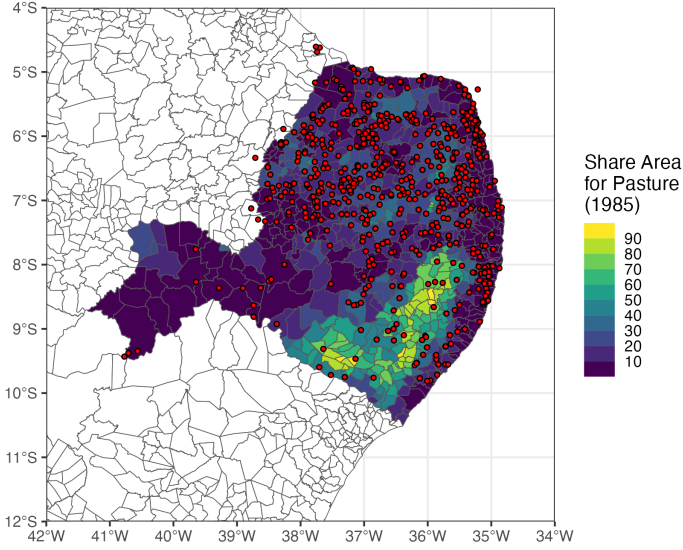
Alleged Discovery of the Land



Georeferenced Land Grants

Back

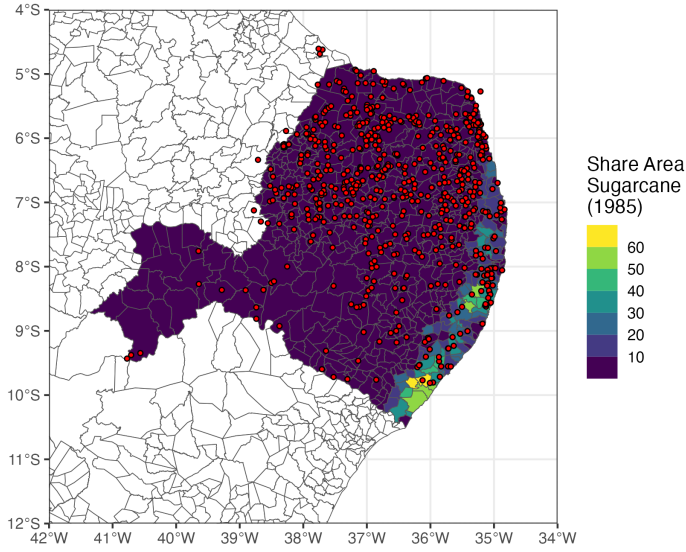
Alleged Discovery of the Land



Georeferenced Land Grants

Back

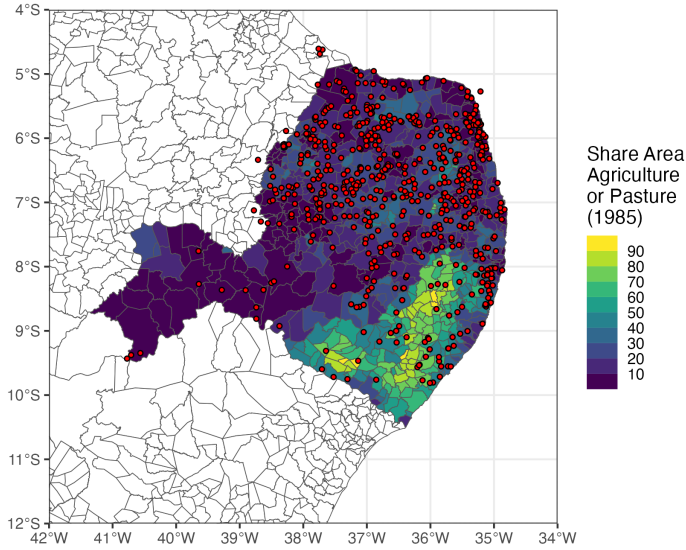
Alleged Discovery of the Land



Georeferenced Land Grants

Back

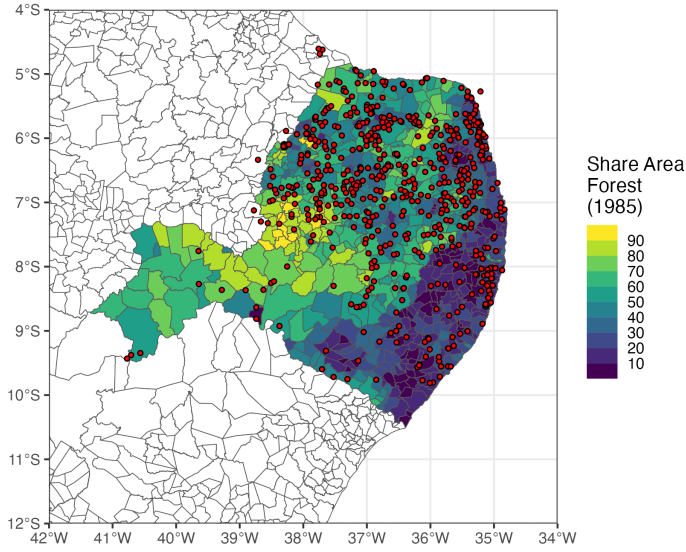
Alleged Discovery of the Land



Georeferenced Land Grants

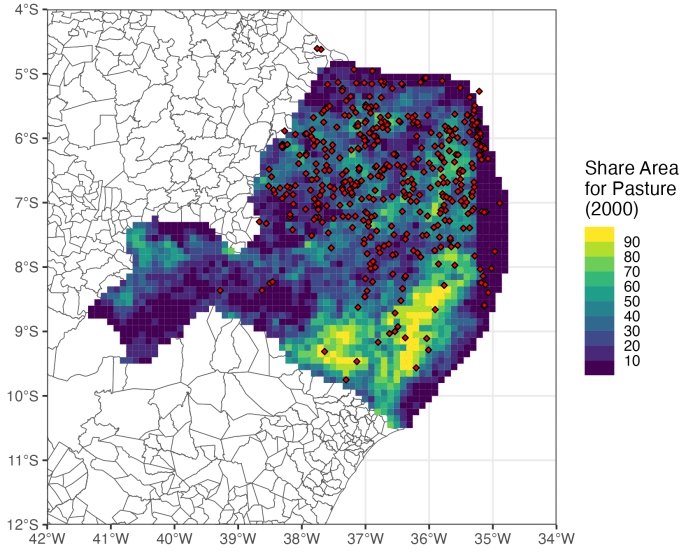
Back

Alleged Discovery of the Land



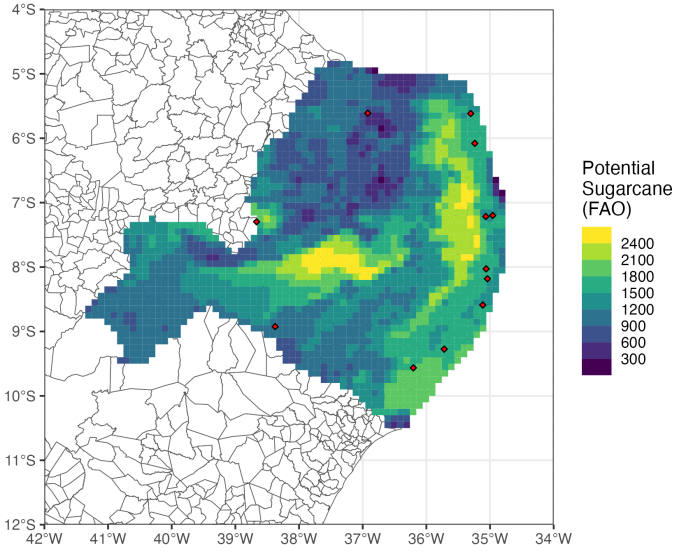
Georeferenced Land Grants Back

Pasture request + Land Usage in 2000



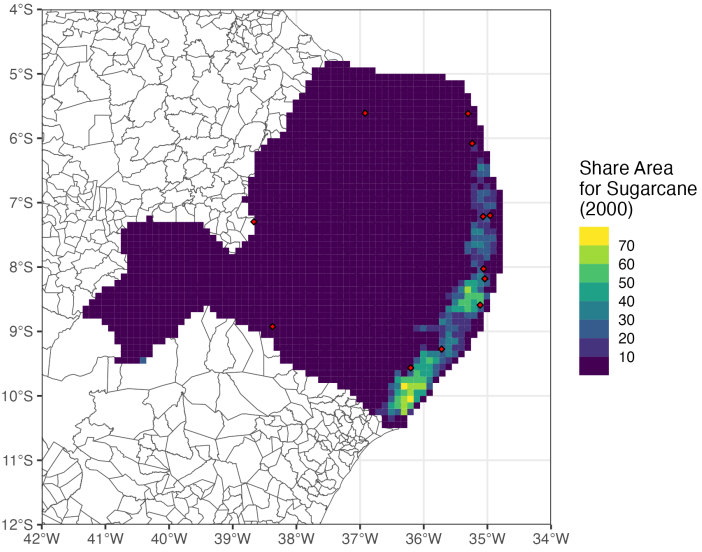
Georeferenced Land Grants Back

Sugarcane request + Potential Sugarcane Production



Georeferenced Land Grants Back

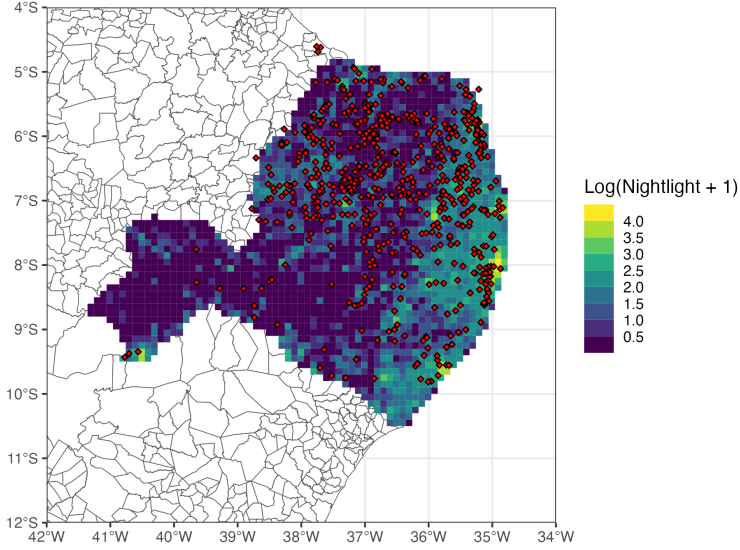
Sugarcane request + Area used for Sugarcane (2000)



Georeferenced Land Grants

Back

All requests + Nightlight data (2000)



First-Stage Estimates - 1872 Back

Table: Effects of Potential Sugarcane Output on Land Grants

	Any Land Grants		Sugar Land Grants	
	(1)	(2)	(3)	(4)
Maximum Sugarcane Output (Thousand of Tons per hectare)	-0.085	-0.068	0.027	-0.041
	(0.079)	(0.109)	(0.064)	(0.073)
N	104	104	104	104
Geographical Controls		✓		✓
R^2	0.15	0.23	0.02	0.12

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

First-Stage Estimates - 2010 Back

Table: Effects of Potential Sugarcane Output on Land Grants - 2010

	Any Land Grants		Sugar Land Grants	
	(1)	(2)	(3)	(4)
Maximum Sugarcane Output (Thousand of Tons per hectare)	-0.039	-0.093**	0.001	-0.019*
	(0.038)	(0.042)	(0.006)	(0.010)
N	677	677	677	677
Geographical Controls		✓		✓
R^2	0.09	0.19	0.00	0.04

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

First-Stage Estimates - Grid

Back

Table: Effects of Potential Sugarcane Output on Land Grants

	Any Land Grants		Sugar Land Grants	
	(1)	(2)	(3)	(4)
Maximum Sugarcane Output (Thousand of Tons per hectare)	0.054***	-0.009	0.002	-0.005*
	(0.020)	(0.023)	(0.003)	(0.003)
N	2083	2083	2083	2083
Geographical Controls		✓		✓
R^2	0.11	0.13	0.00	0.01

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

OLS - Economic Activities

Back

Table: OLS of Land Grants on Present Day Economic Activity

	Area dedicated to Sugarcane		Area dedicated to Livestock	
	(1)	(2)	(3)	(4)
Sugar Land Grants	10.132**	4.022	-15.872***	-10.327**
	(4.810)	(3.827)	(5.837)	(5.139)
Livestock Land Grants	-0.051	-0.609*	7.505***	6.052***
	(0.389)	(0.328)	(1.366)	(1.330)
Geographical Controls		✓		✓
DV Mean	2.79	2.79	30.96	30.96
N	2083	2083	2083	2083
R^2	0.15	0.34	0.11	0.27

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

OLS - Economic Development

Back

Table: OLS of Land Grants on Economic Development

	Ln(Nightlight + 1)		Urban Area (%)	
	(1)	(2)	(3)	(4)
Sugar Land Grants	2.308***	0.623**	1.283	0.395
	(0.539)	(0.315)	(0.989)	(0.928)
Livestock Land Grants	0.658***	0.425***	0.203	0.108
	(0.158)	(0.137)	(0.182)	(0.180)
Geographical Controls		✓		✓
DV Mean	4.25	4.25	0.57	0.57
N	2083	2083	2083	2083
R^2	0.11	0.34	0.00	0.06

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

OLS - Land Usage

Back

Table: OLS of Land Grants by Year of Grant on Land Usage

	Sugarcane Area (%)		Pasture Area (%)		Urban Area (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Grants Pre-1697	5.223***	1.605	-7.529***	-7.339***	2.302**	1.824**
	(1.511)	(1.260)	(2.613)	(2.378)	(0.953)	(0.887)
N	2083	2083	2083	2083	2083	2083
Geographical Controls		✓		✓		✓
DV Mean	2.79	2.79	30.96	30.96	0.57	0.57
R^2	0.16	0.34	0.10	0.27	0.03	0.07

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

OLS - Agglomeration

Back

Table: OLS of Land Grants on Surrounding Grids

	Surrounding Grids Land Grant Presence (0/1)		Surrounding Grids Number of Land Grants			
	(1)	(2)	(3)	(4)	(5)	(6)
At Least One Land Grant	0.147***	0.084***	1.195***	0.921***		
	(0.021)	(0.021)	(0.164)	(0.153)		
Total Land Grants					0.770***	0.620***
					(0.116)	(0.106)
Geographical Controls		✓		✓		✓
DV Mean	0.6	0.6	1.93	1.93	1.93	1.93
N	2083	2083	2083	2083	2083	2083
R^2	0.30	0.41	0.33	0.39	0.34	0.40

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Balance Tables

Back

Grid Level

Table: Summary Statistics for the Land Grants - Grid Level

	At least 1 Land Grant (N=427)		No Land Grants (N=1656)			
	Mean	Std. Dev.	Mean	Std. Dev.	Diff. in Means	Std. Error
Geographical						
Distance to Nearest River (km)	296.0	115.0	182.3	140.7	-113.7**	6.6
Distance to the Coast (km)	105.9	86.9	187.7	144.3	81.9**	5.5
Mean Slope (m)	2.3	1.6	2.4	1.6	0.1	0.1
Mean Elevation (m)	267.8	206.4	347.3	208.8	79.5**	11.2
Latitude	-36.6	1.1	-37.5	1.6	-0.9**	0.1
Longitude	-7.0	1.1	-7.8	1.3	-0.8**	0.1
Agriculture						
Potential Sugarcane Output (FAO)	1318.8	542.8	1320.0	447.9	1.2	28.5
Maximum Calories Pre-1500 (Galor, 2016)	11331.1	1568.6	11022.0	2253.7	-309.0**	94.0
Maximum Calories Post-1500 (Galor, 2016)	11567.7	1320.4	11186.7	2166.6	-381.0**	83.2
Satellite Data						
Sugarcane Area (%)	2.9	9.2	2.8	9.7	-0.2	0.5
Livestock Area (%)	31.9	22.0	30.7	24.4	-1.2	1.2
Urban Area (%)	1.1	4.8	0.4	2.0	-0.7**	0.2
Ln(Nightlight + 1)	744.4	1155.1	394.2	685.6	-350.2**	58.4

Balance Tables

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1872 Municipality Level

Table: Summary Statistics for Municipalities in 1872

	At least 1 Land Grant (N=86)		No Land Grants (N=18)			
	Mean	Std. Dev.	Mean	Std. Dev.	Diff. in Means	Std. Error
Geographical						
Distance to Nearest River (km)	230.3	129.7	136.8	115.9	-93.6**	30.7
Distance to the Coast (km)	79.3	90.2	83.9	134.8	4.6	33.2
Mean Slope (m)	2.7	1.1	3.1	1.5	0.4	0.4
Mean Elevation (m)	259.0	199.8	193.2	207.2	-65.9	53.4
Agriculture						
Potential Sugarcane Output (FAO)	1436.2	422.4	1647.6	333.9	211.4**	90.9
Maximum Calories Pre-1500 (Galor, 2016)	11061.2	1506.3	9963.2	1514.2	-1098.0**	392.1
Maximum Calories Post-1500 (Galor, 2016)	11494.7	1054.4	10714.4	1300.4	-780.3**	326.9
Demographics						
Total Population	17591.1	14256.7	15940.1	11420.2	-1650.9	3099.8
Enslaved Population as Total (%)	8.0	4.3	10.8	6.1	2.8***	1.5
Ratio of Free Men to Free Women	1.0	0.1	1.0	0.1	0.0***	0.0
Ratio of Enslaved Men to Enslaved Women	1.1	0.3	1.0	0.1	-0.1***	0.0
Labor						
Proportion of Industrial Workers (%)	0.9	0.8	1.3	1.4	0.4	0.3
Proportion of Enslaved People working in Farming (%)	36.5	20.4	38.8	18.6	2.3	4.9
Proportion of Farmers (%)	31.6	15.3	27.5	13.4	-4.1	3.6
Proportion of Free Men Farmers (%)	44.3	16.9	39.2	17.6	-5.0	4.5
Proportion of Free Women Farmers (%)	17.4	17.8	12.5	12.5	-5.0	3.5
Human Capital						
Literacy Rate (%)	16.3	8.3	13.5	6.2	-2.8	1.7

Balance Tables

Back

Table: Summary Statistics for the Land Grants

	Granted between 1624-1696 (N=101)		Granted between 1697-1750 (N=531)			
	Mean	Std. Dev.	Mean	Std. Dev.	Diff. in Means	Std. Error
Distance to Nearest River (km)	359.6	873.8	342.9	345.6	-16.7	88.2
Distance to the Coast (km)	183.7	926.9	119.9	342.8	-63.9	93.4
Mean Slope (m)	2.2	2.1	2.2	2.5	0.0	0.2
Mean Elevation (m)	200.5	224.9	253.2	201.8	52.7**	24.1
Potential Sugarcane Output (FAO)	1413.0	522.1	1281.0	549.0	-132.0**	57.6
Maximum Calories Pre-1500 (Galor, 2016)	10473.6	1993.8	11482.7	1316.7	1009.1**	208.4
Maximum Calories Post-1500 (Galor, 2016)	11022.9	1754.8	11660.0	1073.5	637.2**	182.4