Spatial Climate Policies: Labor mobility, structural change, and welfare.

Michael Tueting
University of St.Gallen

Swiss Macro Workshop

January 10, 2025

Motivation

- Fundamental question for place-based policies in the face of climate change:
  - invest in vulnerable regions to alleviate welfare losses of climate change?
  - incentivize reallocation of factors (and consumers) to less vulnerable regions?

Motivation

- Fundamental question for place-based policies in the face of climate change:
  - invest in vulnerable regions to alleviate welfare losses of climate change?
  - incentivize reallocation of factors (and consumers) to less vulnerable regions?

- This paper:
  - **How large are the welfare gains of reducing migration barriers in the face of climate change?**
    - **Case study Brazil:** Study optimal migration incentives.
  - Climate change is a location- and crop-specific shock to **agricultural productivity**
  - Welfare losses are non-uniform in space

Motivation

- Fundamental question for place-based policies in the face of climate change:
  - invest in vulnerable regions to alleviate welfare losses of climate change?
  - incentivize reallocation of factors (and consumers) to less vulnerable regions?

- This paper:
  - **How large are the welfare gains of reducing migration barriers in the face of climate change?**
    - **Case study Brazil:** Study optimal migration incentives.
  - Climate change is a location- and crop-specific shock to **agricultural productivity**
  - Welfare losses are non-uniform in space

- Methods:
  - Quantitative model with **spatial linkages in goods markets** (trade) and **factor markets** (migration)
    - Sufficient statistic for welfare changes in response to changes in migration costs
    - Investigate optimal migration incentives (work in progress)

Roadmap

- Background
- A brief history of the Brazilian Northeast
- Model
- Preliminary calibration
- Outline of counterfactual analysis
- Outlook

Background

- Brazil is one of the largest exporters of agricultural goods worldwide
- Agriculture accounts for around 5-7.5%[1] of GDP

[1] In 2010 and 2021 respectively.

Background

- Brazil is one of the largest exporters of agricultural goods worldwide
- Agriculture accounts for around 5-7.5%[1] of GDP
- Large regional disparities; with crop cultivation being the primary source of income in many regions ⇒ especially **Northeast**

Table: Agricultural employment share by mesoregion

Mesoregion	Agriculture (%)	Crop cultivation in agriculture (%)
Sertão Alagoano - AL	41.26	90.91
Sertão Sergipano - SE	38.64	79.60
Sudoeste Amazonense - AM	35.67	95.93
Agreste Alagoano - AL	34.92	91.19
...	...	...
Distrito Federal - DF	1.29	66.72
Metropolitana de Recife - PE	0.99	66.17
Metropolitana do Rio de Janeiro - RJ	0.56	61.34
Metropolitana de São Paulo - SP	0.40	61.89

[1] In 2010 and 2021 respectively.

Background

- Brazil is one of the largest exporters of agricultural goods worldwide
- Agriculture accounts for around 5-7.5%[1] of GDP
- Large regional disparities; with crop cultivation being the primary source of income in many regions ⇒ especially **Northeast**
- Soy, sugarcane, and maize are important crops

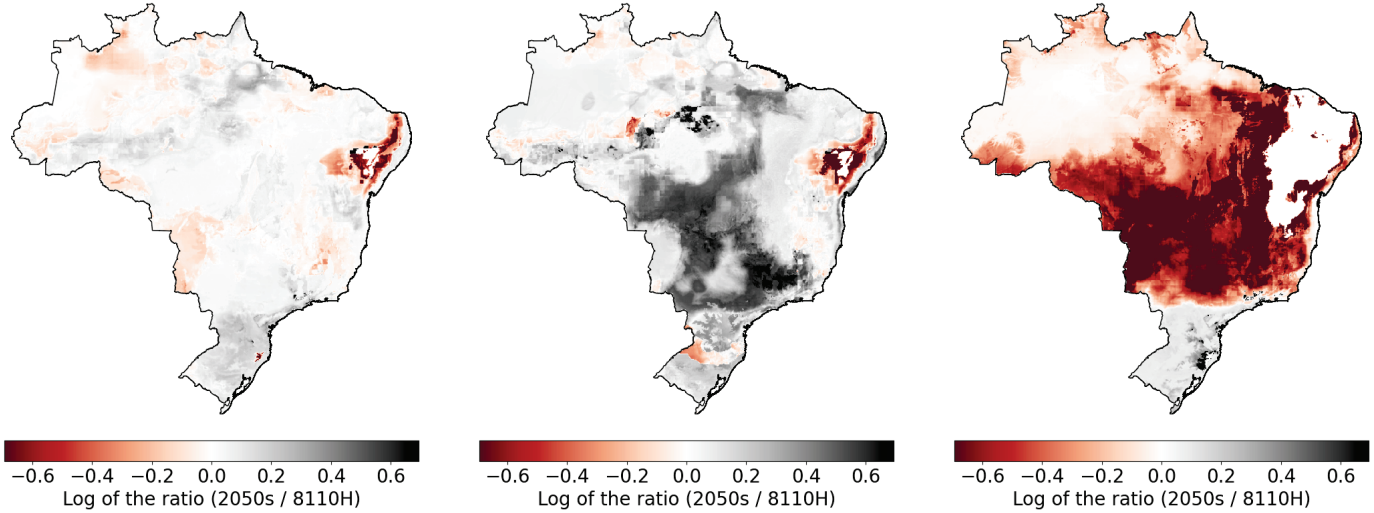
Table: Top three crops by value of production in 2010.

	Value (in 1000 Reais)		Harvested Area (in ha)	
Crop	Value	% of total	Value	% of total
Soybean	37,332,776	24.21%	23,327,296	36.14%
Sugarcane	28,309,230	18.36%	9,076,706	14.06%
Maize	15,181,235	9.85%	12,678,875	19.64%
Top 3 crops	80,823,241	52.42%	45,082,877	69.84%

[1] In 2010 and 2021 respectively.

Background

- Brazil is one of the largest exporters of agricultural goods worldwide
- Agriculture accounts for around 5-7.5%[1] of GDP
- Large regional disparities; with crop cultivation being the primary source of income in many regions ⇒ especially **Northeast**
- Soy, sugarcane, and maize are important crops
- Climate change is projected to make the **Northeast unsuitable** for all three crops.



(a) Soy (b) Maize (c) Sugarcane

[1] In 2010 and 2021 respectively.

A brief history of the Brazilian Northeast

- The Northeast of Brazil is semi-arid (Sertão)
  - World's most densely populated dry land region (Marengo 2008), with more than 53 million inhabitants[2] and a population density of $\approx$ 34 inhabitants per square kilometer (IBGE 2010)

[2] Around 29% of Brazil's total population

A brief history of the Brazilian Northeast

- The Northeast of Brazil is semi-arid (Sertão)
  - World's most densely populated dry land region (Marengo 2008), with more than 53 million inhabitants[2] and a population density of $\approx$ 34 inhabitants per square kilometer (IBGE 2010)
- Poorest region in Brazil with GDP per capita 53% lower than national average (IPEA 2010)
- Historically been vulnerable to droughts and future climate projections indicate:
  - significant temperature increases and reduced rainfall
  - longer consecutive dry periods suggest more frequent/intense dry spells and droughts (Franchito et al. 2014; Marengo and Bernasconi 2015; Vieira et al. 2015)
- Likely trending toward aridification (Marengo and Bernasconi 2015)

[2] Around 29% of Brazil's total population

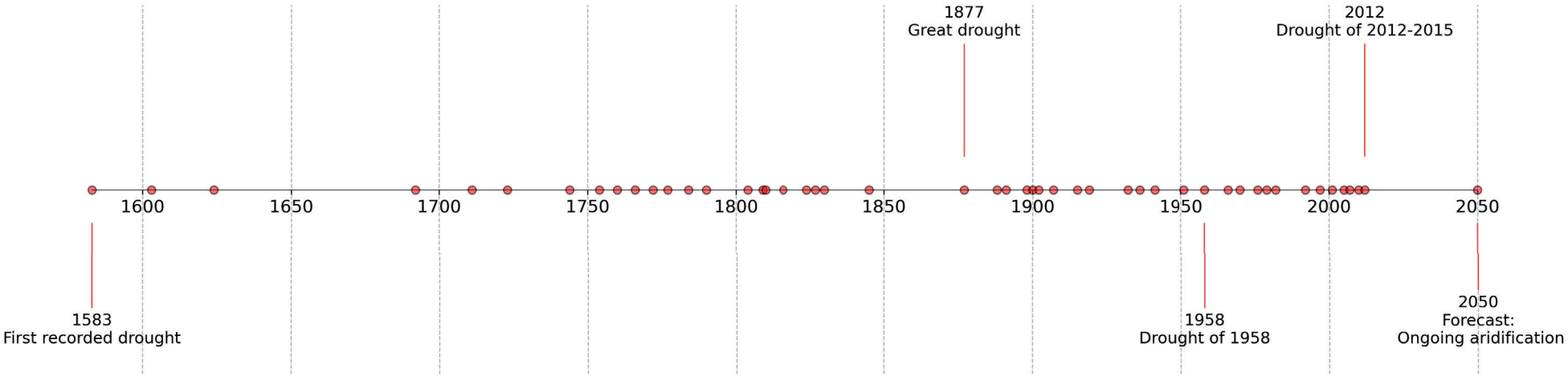
A brief history of the Brazilian Northeast

- The Northeast of Brazil is semi-arid (Sertão)
  - World's most densely populated dry land region (Marengo 2008), with more than 53 million inhabitants[2] and a population density of $\approx$ 34 inhabitants per square kilometer (IBGE 2010)
- Poorest region in Brazil with GDP per capita 53% lower than national average (IPEA 2010)
- Historically been vulnerable to droughts and future climate projections indicate:
  - significant temperature increases and reduced rainfall
  - longer consecutive dry periods suggest more frequent/intense dry spells and droughts (Franchito et al. 2014; Marengo and Bernasconi 2015; Vieira et al. 2015)
- Likely trending toward aridification (Marengo and Bernasconi 2015)

$\Rightarrow$ **one of the world's most vulnerable regions to climate change (IPCC 2012, 2014)**

[2] Around 29% of Brazil's total population

A brief history of the Brazilian Northeast

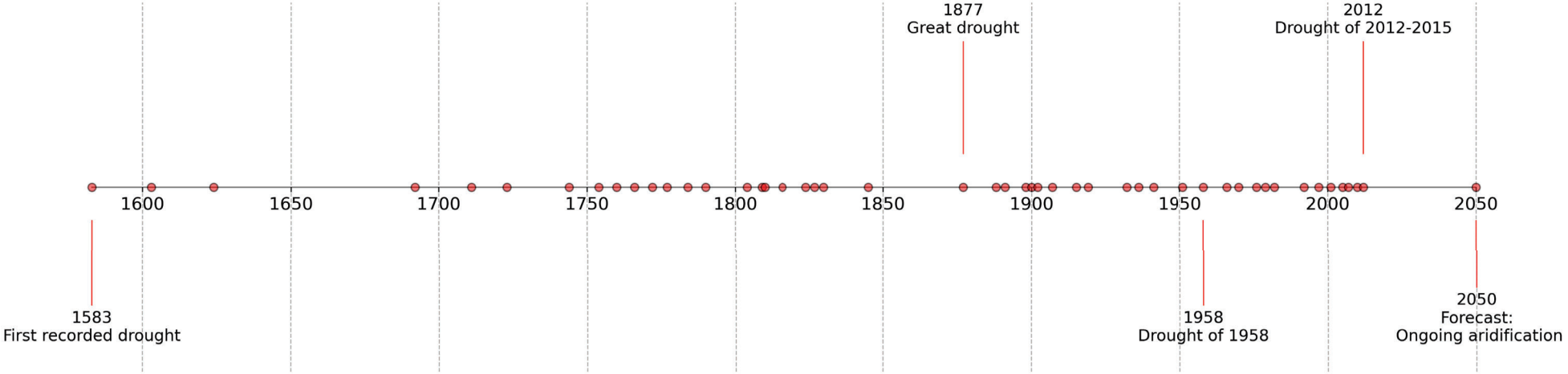


First recorded drought in 1583

- Jesuit Priest Fernão Cardim writes:

  In 1583, there was such intense drought and sterility in the Province [that there] was a great famine [...] and **four or five thousand Indians** *uprooted from sertões due to starvation* **moved to the coast**

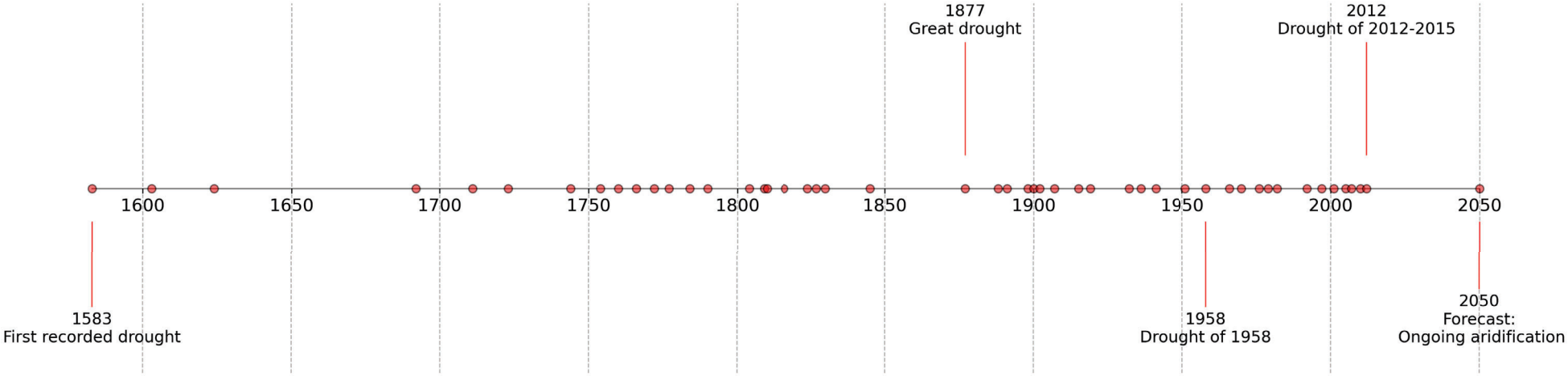
A brief history of the Brazilian Northeast



"Great drought" of 1877-1879

- An estimated 500,000 people died in Ceara State as a result of the 1877–1879 drought, representing roughly half of the state population (Smith 1879)
- Large population movements to the Amazonas (coincides with onset of first rubber boom)
- Introduction of the first drought relief programs

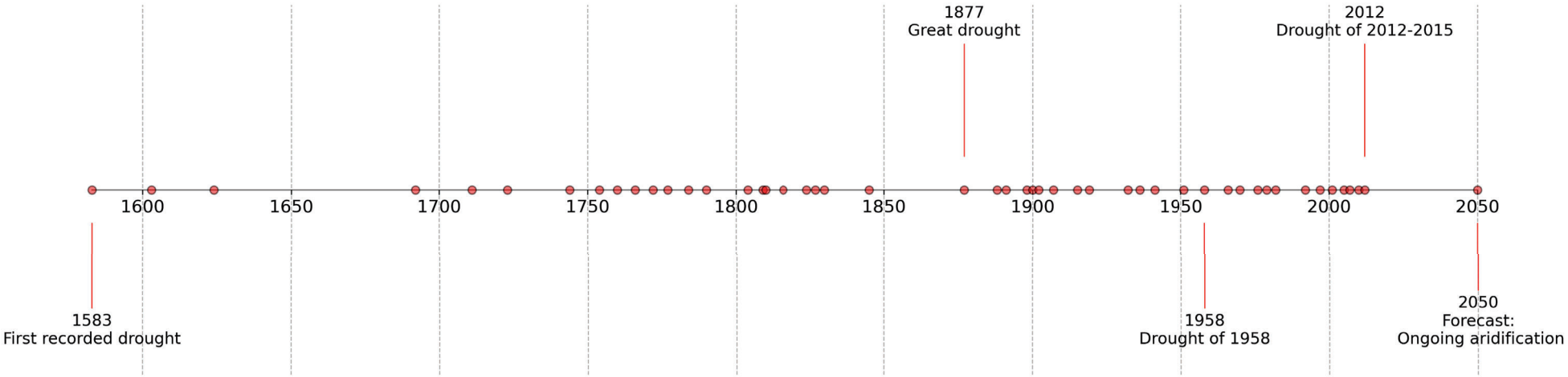
A brief history of the Brazilian Northeast



Drought of 1958

- An estimated **10 million people fled** from Northeast Brazil as a result of a drought (Namias 1972; Hastenrath and Heller 1977).

A brief history of the Brazilian Northeast



Drought in 2012-2015

- Civil unrest emerged in some affected areas
- State of emergency in 997 of the 1794 districts in the region due to severe drought.

Recurring theme: Migration

- Out migration as a form of disaster adaptation is common.
- Migration can provide several benefits for migrants and their families.
  - A large share of households in drought-stricken areas receive income from relatives outside the region.
  - 31% of all households in Northeast Brazil frequently receive some form of remittances (Lemos 2007).