

Soybean trade and imported deforestation

PhD Defense

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- Deforestation has **local** and **global negative externalities** (LULCC = 14% of GHG emissions, Friedlingstein et al. 2023) → land sector is key to climate and biodiversity objectives
- **Foreign demand** has been identified as a key driver of deforestation in tropical countries: shared responsibilities (Defries et al. 2010; Pendrill et al. 2019)

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- **Foreign demand** has been identified as a key driver of deforestation in tropical countries: shared responsibilities (Defries et al. 2010; Pendrill et al. 2019)
- **From a local resources management problem to an international policy issue!** Ex: EU Regulation on “deforestation-free products” (Regulation (EU) 2023/1115)

9.6.2023	EN	Official Journal of the European Union	L 150/206
REGULATION (EU) 2023/1115 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL			
of 31 May 2023			
on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010			

Figure: Publication of the EUDR in the Official Journal of the European Union

Soy trade contributes to deforestation (Barona et al. 2010; Song et al. 2021)

- Brazil is the first exporter
- Contributes to 33% of the EU imported deforestation emissions (EPRS, based on Commission IA)
- Targeted in the EU Regulation on deforestation-free products

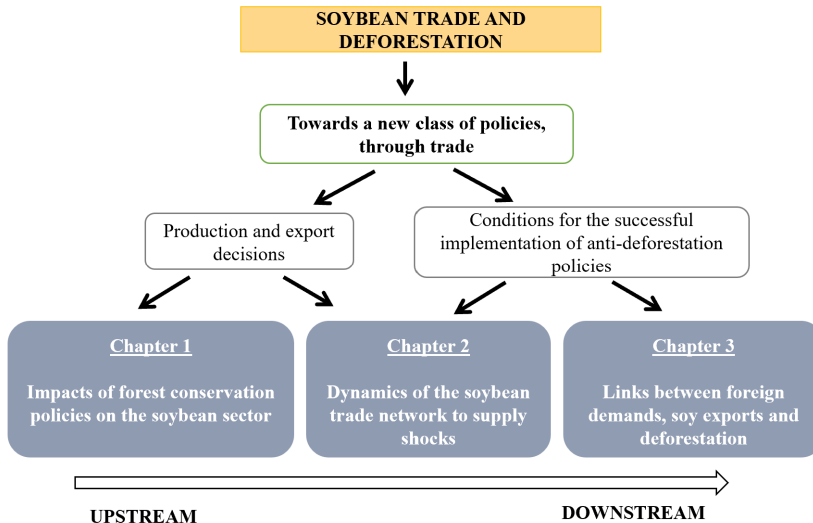


Figure: Soy field in Mato Grosso (Source: Damon Winter/The New York Times)

Main objective: Better understanding the links between soy trade from Brazil and deforestation

Contributions

- Literature on trade and the environment:
 - ▶ Effectiveness of "supply-side" policies and their impact on soy trade → **1st chapter**
 - ▶ Credibility of "demand-side" policies → **2nd and 3rd chapters**
- Intersection of methods and data from international economics, deforestation economics, and agricultural economics
 - ▶ Extensive use of the TRASE database
 - ▶ Use of satellite data



CHAPTER I

DO FOREST CONSERVATION POLICIES UNDERMINE THE SOYBEAN SECTOR IN THE BRAZILIAN AMAZON? EVIDENCE FROM THE PRIORITY LISTING

Forthcoming in *Ecological Economics* in an updated version

Chapter I: Do Forest Conservation Policies Undermine the Soybean Sector in the Brazilian Amazon?

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● **Motivation:**

- ▶ Soybean expansion is both a driver of tropical deforestation and a major source of income for Brazil. (Song et al. 2021)
- ▶ **Trade-offs** between agricultural production and forest conservation (Koch et al. 2019; Moffette, Skidmore, and Holly K. Gibbs 2021)
- ▶ → Case study on the **priority list** implemented in 2008 in the Brazilian Amazon. (Assunção and Rocha 2019; Cisneros, Zhou, and Börner 2015; Assunção, Gandour, et al. 2020; Assunção, McMillan, et al. 2019; Harding, Herzberg, and Kuralbayeva 2021)

Research question: What are the impacts of this forest conservation policy on the soybean sector?

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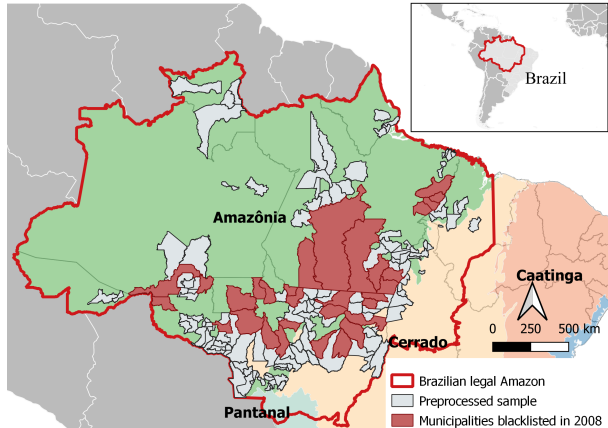
Research question: What are the impacts of this forest conservation policy on the soybean sector?

● Method:

- ▶ Difference-in-differences
- ▶ Generalized synthetic control (Xu 2017)

161 municipalities in the Legal Amazon in Brazil from 2004 to 2012

- Deforestation (INPE)
- Agricultural production and yields (IBGE, MapBiomas)
- Exports (TRASE)

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- The priority list **curbed deforestation rates** of 36% to 41% compared to the other municipalities.
- Our analysis finds that **the soybean sector benefited from the policy** in terms of land use, production and exports.
- Shrinkage of the production of some staple food production areas, suggesting a **reallocation inside the agricultural sector towards more capital intensive activities**.
- Possible explanations: change in the production portfolio, land transfer towards soybean producers, role of local politics in reaction to the priority list.

CHAPTER II

SOY EXPORTERS' NETWORK AND LOCAL PRODUCTION SHOCKS

Chapter II: Soy Exporters' Network and Local Production Shocks

● **Motivation:**

- ▶ Risks of disruption of global supply chains (Boehm, Flaaen, and Pandalai-Nayar 2015; Barrot and Sauvagnat 2016; Inoue and Todo 2019) + the agricultural sector is heavily vulnerable to **droughts** (Rattis et al. 2021; Silva et al. 2023; Dou et al. 2023)
- ▶ Regulatory-induced shocks (e.g. EU Regulation) and leakages (N. B. Villoria and Hertel 2011; Meyfroidt et al. 2018; Stokeld et al. 2023)

Research question: How do the soy supply chains in Brazil respond to local supply shocks?

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Research question: How do the soy supply chains in Brazil respond to local supply shocks?

● **Method:** empirical approach

- ▶ Leveraging the temporal and spatial variability of droughts
- ▶ Regressions on network variables at municipality, transaction and exporter level

● **Data:** 5570 municipalities in Brazil from 2004 to 2018

- ▶ Standardized Precipitation Index and other weather variables (Worldclim 2.1.)
- ▶ Trade network measures (TRASE)

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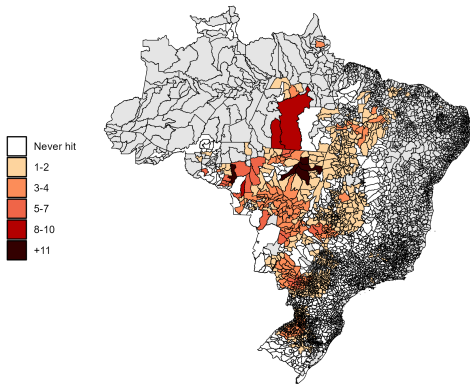


Figure: Frequency of droughts in Brazilian municipalities (2004-2018)

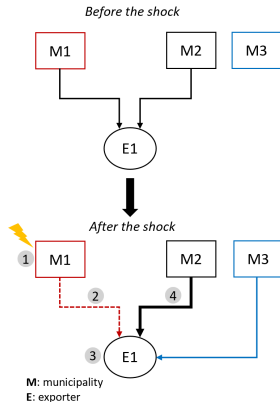


Figure: Tested effects of a supply shock

● Municipality-level:

- ▶ Droughts **negatively** affect soybean yields, leading to a decline in production and exports

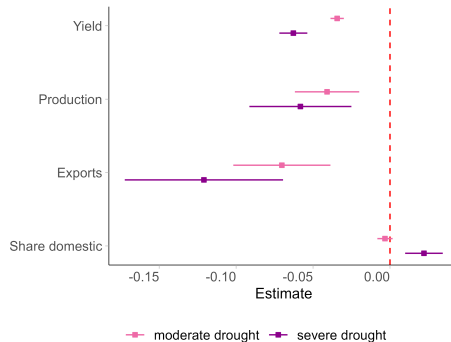


Figure: Estimated direct effects on municipalities

Main results

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● Municipality-level:

- ▶ Droughts **negatively** affect soybean yields, leading to a decline in production and exports

● Downstream effects:

- ▶ **Negative impact on the transactions** between hit municipalities and exporters, but mostly at the **intensive margin**
- ▶ Exporters engage in **strategies to cope with the shocks**: they draw on established relationships
- ▶ But **frictions** in the supply chain

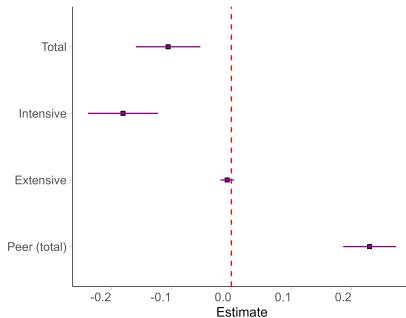


Figure: Estimated direct effects on transactions and peer transactions

1 **Distinction between large and smaller firms**

- ▶ Larger trading firms can switch sourcing patterns more easily

2 **Coping strategies of exporters relying on other sourcing locations**

- ▶ Diversified vs non-diversified portfolios

3 **Existence of network frictions**

- ▶ Due to network frictions, the regulations could pose problems even for large companies in the short term if they source from high-risk suppliers.

CHAPTER III

FOREIGN DEMAND AND SOY EXPORTS: EVIDENCE AND IMPLICATIONS FOR DEFORESTATION

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Chapter III: Foreign Demand and Soy Exports: Evidence and Implications for Deforestation

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• **Motivation:**

- Most of the deforestation policies **supply-side policies** (Heilmayr et al. 2020; H. K. Gibbs et al. 2015; Assunção, Gandour, et al. 2020)
- Recent political willingness to go towards **demand-side policies** (Harstad 2022; Busch et al. 2022; N. Villoria et al. 2022)

Research question: Are these policies credible? What would be their heterogeneous effects?

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Research question: Are these policies credible? What would be their heterogeneous effects?

- **Method:** Estimation of a gravity equation at the municipality-firm-destination-year level to find an elasticity of exports to demand, and explore its heterogeneity.
- **Data:**
 - Measures of foreign demand (BACI)
 - Soy firm and municipality-level exports: 14 years of transaction data between municipalities, exporters and destination countries (TRASE Godar 2018)
 - Changes in natural vegetation (MapBiomas Souza and Azevedo 2017)

Main results: elasticities

- Average elasticity: **0.2** ([0.125, 0.255])
- Highly **heterogeneous** across exporters and cities.
 - ▶ Margins: bigger for larger firms, in places with lower past deforestation, with fewer competitors.

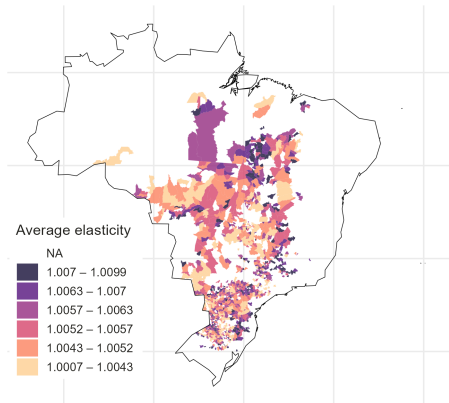


Figure: Average elasticities of exports in municipalities

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Main results: implications for deforestation

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- Approach

- ▶ Main metric: **avoided deforestation**
- ▶ Combination of predicted elasticity of exports to demand (given observables) and potential soy expansion

- **Positive correlation** between avoided exports and potential soy expansion

- Main effects are in the Amazon. In Cerrado, low elasticity.

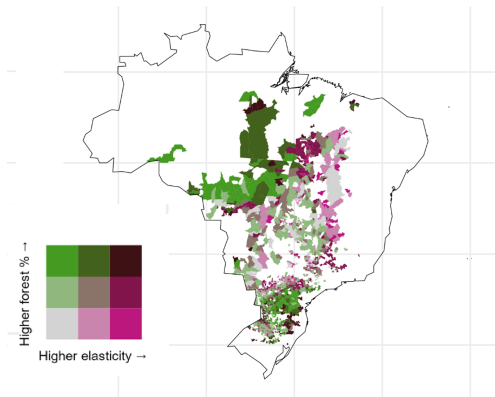


Figure: Potential of demand-side policies to avoid deforestation

Main takeaways

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- ➊ Demand-side policies are **credible**, and would/will have an aggregate effect on deforestation.
- ➋ These policies would also have some **differential effects across space and across firms**.
- ➌ **Market forces** (firm size, competition, location...) are going to shape the response.
- ➍ **Demand policies will curb deforestation, but not everywhere.**

CONCLUDING REMARKS

Transversal policy implications

- Supply-side policies are not always detrimental to trade (Chapter 1) → suggests the possibility of combining increasing production while preserving natural resources.
- Demand-side policies could contribute to curbing deforestation rates (Chapter 3). But there are challenges regarding network dynamics and leakages (Chapter 2).

Transversal policy implications

- Supply-side policies are not always detrimental to trade (Chapter 1) → suggests the possibility of combining increasing production while preserving natural resources.
- Demand-side policies could contribute to curbing deforestation rates (Chapter 3). But there are challenges regarding network dynamics and leakages (Chapter 2).

Research perspectives

- Coordination and leakage between countries in demand-side policies.
- Social justice dimension of environmental / trade policies.
- Generalizability of the results to other contexts and other commodities.
- Instruments to alleviate the pressure on global soy demand.
- Macroeconomic level: addressing food, agricultural and trade policies as a whole.

Thank you for your attention

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