# Political Economy and Conservation

Ben Olken, MIT

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# Introduction

- Today's topic: conservation in low and middle-income countries, with a focus on forests
- What's the issue? Externalities.
  - There is a wedge between private and social value
  - Private landowners would like to deforest, gaining value from timber and from the land
  - But, forest has social benefits that these landowners don't take into account - e.g. vast quantities of stored carbon, biodiversity, watershed protection
  - So government policy needs to intervene to correct the externality, through regulation or prices
- Today's lecture explores two challenges to doing so
  - *Political economy*. Weak governance means that actual deforestation levels are not necessarily the same as what the law says. What drives actual deforestation?
  - *Poverty as a barrier to conservation.* What does the fact that people are poor imply for conservation levels and policies? Should we pay people to conserve?

# De Jure vs. De Facto: National Borders in the Amazon

# Deforestation in Brazil

- The Amazon rainforest is the largest in the world
  - World's largest tropical forest covering more than 2 million square miles
  - The size of the contiguous United States west of the Mississippi River; larger than the European Union
  - Between 2000-2020, 55% of global forest loss comes the Brazilian Amazon (FAO 2020)
- Deforestation in Brazil had been limited for some time, but penalties remained weak
  - For example, deforestation in the Amazon outside of Protected Areas was an infraction, not a felony, until 2005
  - Likewise, private properties in the Amazon were required to have 80 forest cover, but this was an infraction and not seriously enforced
- Starting in 2005, Brazil increased enforcement of these policies, strengthening fines and increasing enforcement in a variety of ways, including satellites
- What is the net effect of this increased enforcement? And is it stable?
- We study this by studying what happens at the border

# The border

Burgess, Costa, and Olken (2023): "National Borders and the Conservation of Nature"

- Idea: comparing deforestation at the border captures the effect of state policy per se, holding other aspects, like profitability, soil, etc constant
- So we compare deforestation on both sides of the border to capture the effect of Brazilian state policy
  - Level differences indicate the difference for being in Brazil
  - Sharp changes over time measure the tightening up of enforcement
- This is a border regression discontinuity design
- Suppose that land use in a region is given by $l_d = g + \epsilon_d$, where $g$ is government policy and $\epsilon$ captures other aspects that determine land use. $d$ is distance to the border
- Regression discontinuity assumption

$$\lim_{d \to 0_-} \epsilon_d = \lim_{d \to 0_+} \epsilon_d$$

- We estimate the Brazil effect using an RD design, using distance to the border as running variable

# Regression discontinuity

- RD assumption:

$$\lim_{d \to 0_-} \epsilon_d = \lim_{d \to 0_+} \epsilon_d$$

- So estimate:

$$Y_i = \alpha + \gamma Brazil_i + f\left(DistBorder_i\right) + \delta X_i + \varepsilon_i$$

  - $Y_i$ is forest cover or annual forest loss
  - $f\left(DistBorder_i\right)$ is a polynomial of distance from the border, linear
  - $X_i$ are geographic controls (slope, distance to water)

- Zoom in close to the border (17km)
- Cluster the errors in blocks of size 50km by 50km
- Covariates (slope, distance to urban area, water, and roads) are all continuous at border
- Data: Annual 30 meters satellite data that measures deforestation uniformly throughout the globe (Hansen et al 2013). Aggregate to 120m level for computational simplicity.

# The border

Example of a border crossing between Bolivia and Mato Grosso

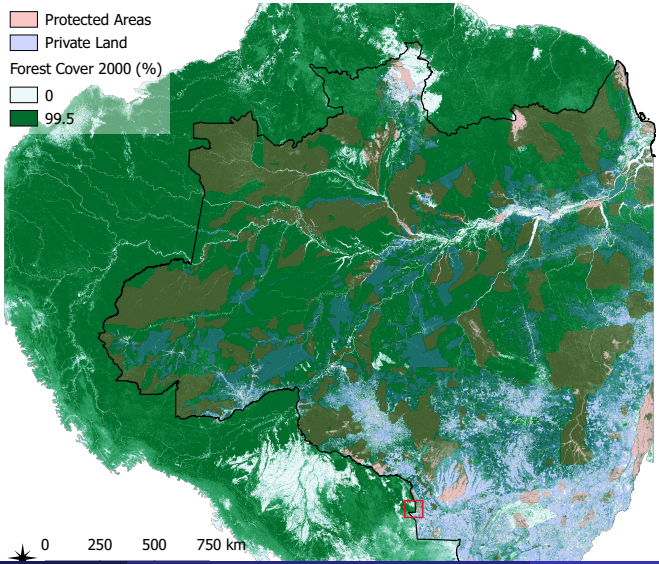
# Deforestation at the border

Example of a border segment Brazil (RO) – Bolivia

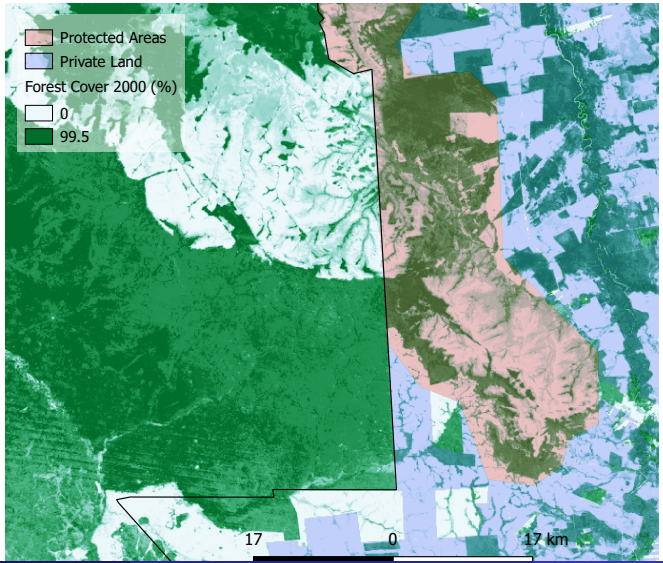
# Deforestation at the border

Example of a border segment Brazil (MT) – Bolivia

# We zoom in on the border systematically

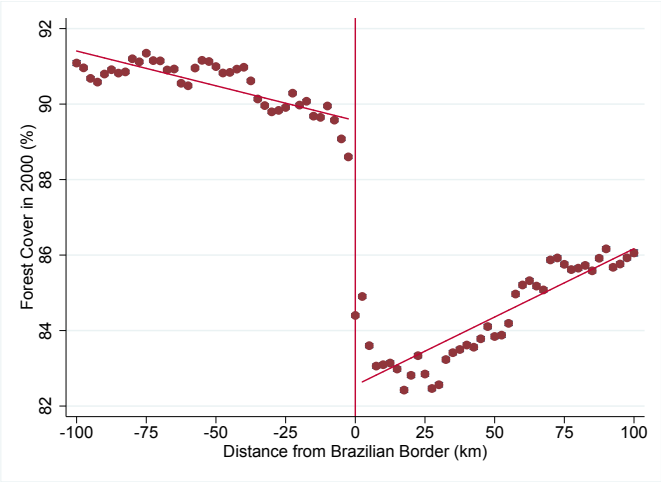


# We zoom in on the border systematically



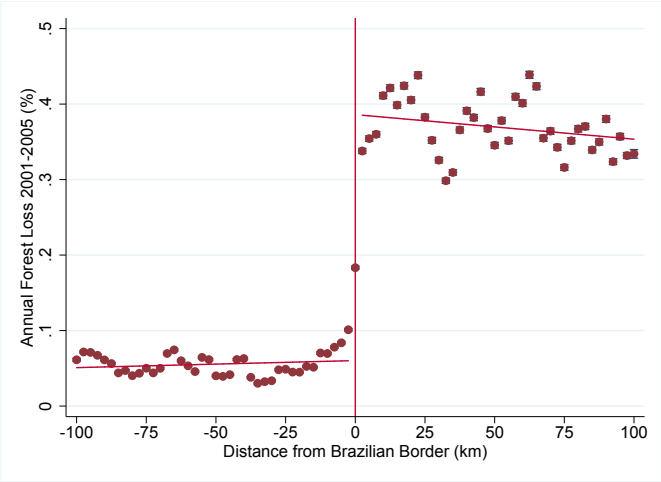
# Results: Deforestation as of 2000

## Percentage of Forest Cover in 2000



# Annual forest loss 2001-2005

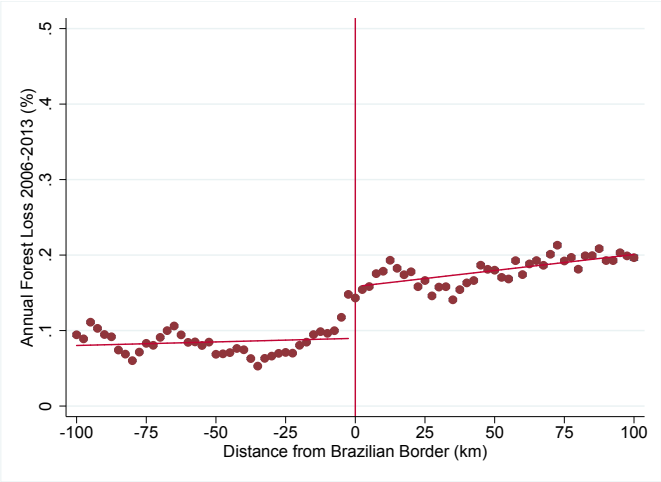
## Percentage of Forest Cover Lost




Distance from Brazilian Border (in 100 km)

# Annual forest loss 2006-2013

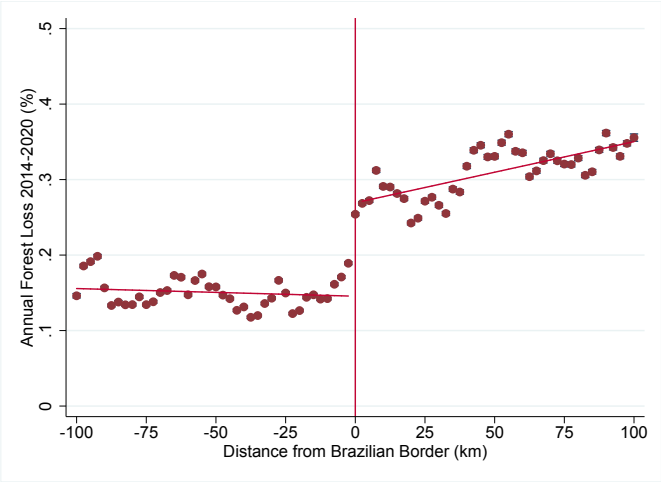
## Percentage of Forest Cover Lost




Distance from Brazilian Border (in 100 km)

# Annual forest loss 2014-2020

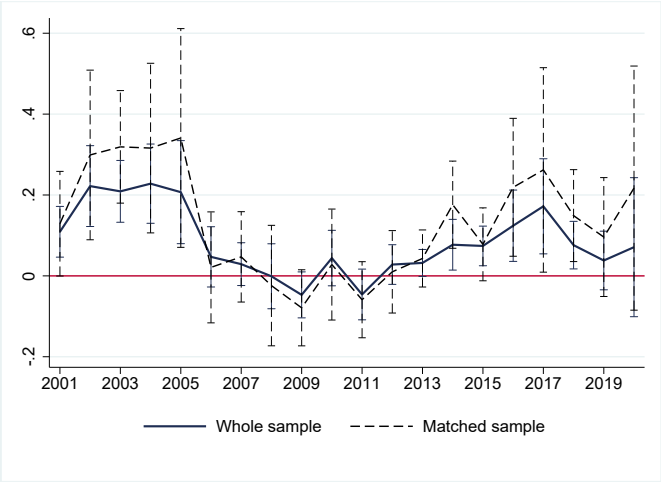
## Percentage of Forest Cover Lost




Distance from Brazilian Border (in 100 km)

# Results

## RD coefficients over time



# Moving forward

- This paper says: there is a role for *something* in state policy to determine the wedge between de jure and de facto conservation policy
- The question is: what? That is, what are the political forces that drive these wedges?
- This is an active area of research, but we'll explore two today:
  - *Bureaucratic* incentives: Decentralization and competition between political actors
  - *Political* incentives: Electoral cycles in deforestation

# Decentralization in Indonesia

# Decentralization in Indonesia

Burgess, Hansen, Olken, Potapov, and Sieber (2012): "The Political Economy of Deforestation in the Tropics"

- In Indonesia - as in many countries - national governments set de jure forest rules, but rely on local officials for enforcement
  - Central government still retains control over final permit issuance (in negotiation with districts) and conservation zones
  - District forest offices -- which help propose cutting plans in legal zones and enforce logging throughout -- become responsible to district heads
  - District government thus plays a key role
- Competition between districts:
  - Idea: each district head gets to sell 'permits' to deforest in exchange for a bribe
  - Downward sloping demand curve: the more permits he sells, the lower the price per permit
  - But district heads compete against one another in the 'market' for these illicit permits
  - One district head in an area: he is the monopolist: high 'price', few permits, less deforestation
  - If districts split, then many district heads in an area $\rightarrow$ low 'price', lots of permits, more deforestation

# Empirical setup

- 1999 law decentralizes many domestic functions to districts
- Exploit asynchronous splitting of districts
  - from 292 districts (1998) $\rightarrow$ 483 (2008)
  - Forest islands [Sumatra, Kalimantan, Sulawesi, Papua]: from 146 districts (1998) $\rightarrow$ 311 (2008)

# Empirical setup

Number of New Districts Established by Province and Year

| | | Number districts in... | | Number of new districts introduced in... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Island | Province Name | 2000 | 2008 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
| Sumatra | NAD (Aceh) | 13 | 23 | 2 | 5 | 1 | 0 | 0 | 0 | 2 | 0 |
| Sumatra | N. Sumatra | 19 | 33 | 1 | 0 | 5 | 0 | 0 | 0 | 3 | 5 |
| Sumatra | W. Sumatra | 15 | 19 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 |
| Sumatra | Riau | 11 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sumatra | Jambi | 10 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sumatra | S. Sumatra | 7 | 15 | 3 | 1 | 3 | 0 | 0 | 0 | 1 | 0 |
| Sumatra | Bengkulu | 4 | 10 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 1 |
| Sumatra | Lampung | 10 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| Sumatra | Bangka Belitung | 3 | 7 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| Kalimantan | W. Kalimantan | 9 | 14 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 0 |
| Kalimantan | C. Kalimantan | 6 | 14 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kalimantan | S. Kalimantan | 11 | 13 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Kalimantan | E. Kalimantan | 12 | 14 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| Sulawesi | N. Sulawesi | 5 | 15 | 0 | 1 | 3 | 0 | 0 | 0 | 4 | 2 |
| Sulawesi | C. Sulawesi | 8 | 11 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| Sulawesi | S. Sulawesi | 21 | 24 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| Sulawesi | SE Sulawesi | 5 | 12 | 1 | 0 | 4 | 0 | 0 | 0 | 2 | 0 |
| Sulawesi | Gorontalo | 3 | 6 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| Sulawesi | W. Sulawesi | 3 | 5 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Papua | W. Papua | 4 | 11 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 2 |
| Papua | Papua | 10 | 29 | 0 | 9 | 1 | 0 | 0 | 0 | 1 | 8 |

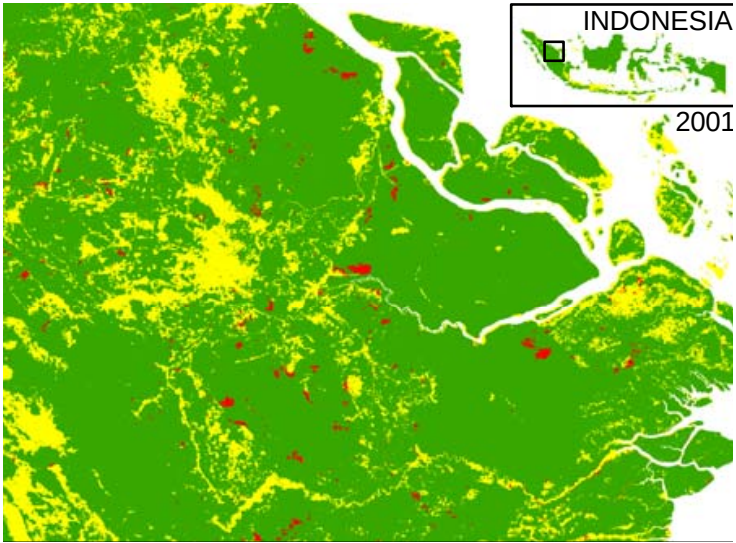
# Data and Estimation

- We estimate the relationship between rate of deforestation and number of districts in each province
- Given many zeros, we use a count data for satellite data
- Estimate fixed-effects Poisson Quasi-Maximum Likelihood count model:

$$\mathrm{E}\left(deforest_{pit}\right) = \mu_{pi} \exp\left(\beta NumDistrictsInProv_{pit} + \eta_{it}\right)$$

  - where $deforest_{dit}$ is the number of 250m X 250m pixels cleared in province $p$ (located on island $i$) between year $t-1$ and $t$
  - $NumDistrictsInProv_{pit}$ counts the total number of districts in province $p$ in year $t$
  - $\mu_{pi}$is a province fixed-effect, $\eta_{it}$is an island$\times$year fixed effect
  - Poisson QMLE model is robust to distributional assumptions -- just requires conditional mean
- Use 250m MODIS satellite data on annual forest change
  - Note: this is an older dataset; if doing it today, would use Hansen (2013) data
  - Since we have pixel level data, we can overlay with GIS information on Indonesia four (fixed) forest zones -- production, conversion, conservation, protection $\rightarrow$ enables us to look directly at illegal logging

# Example



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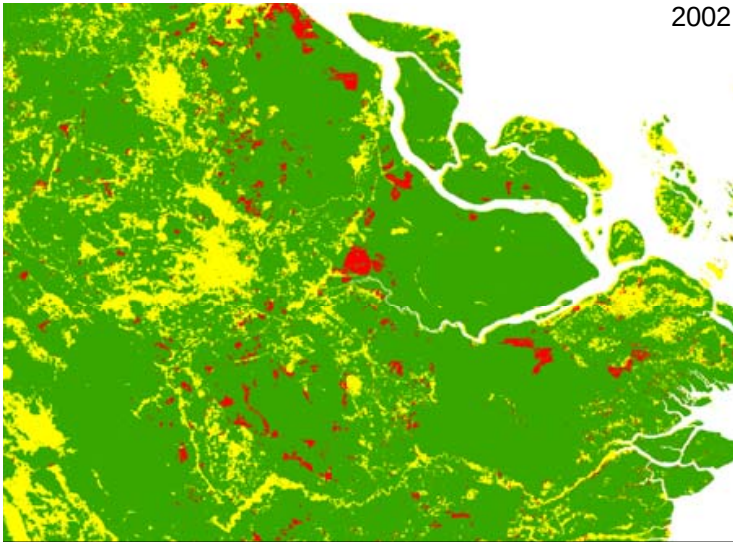

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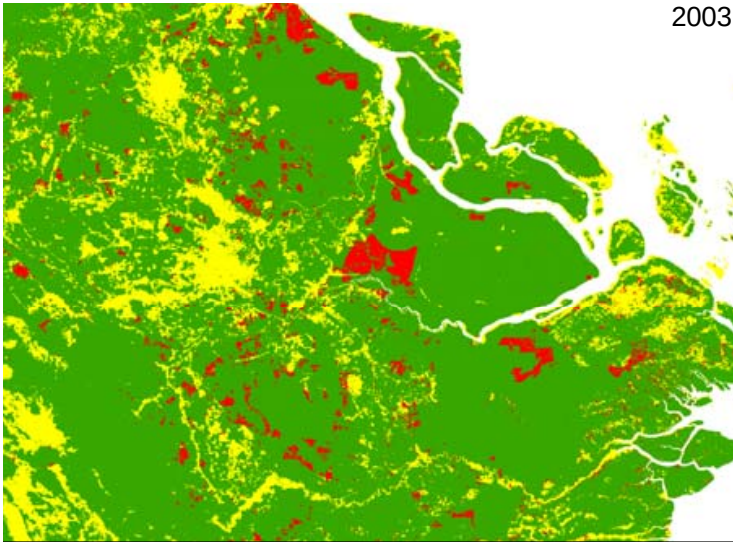

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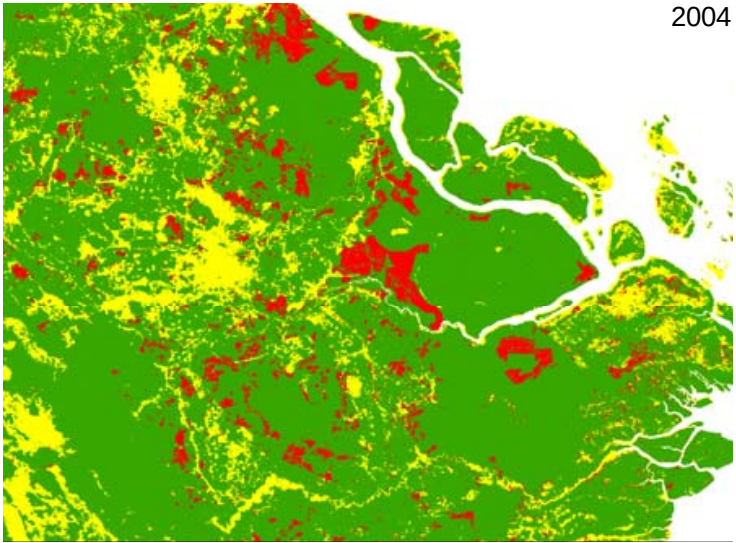

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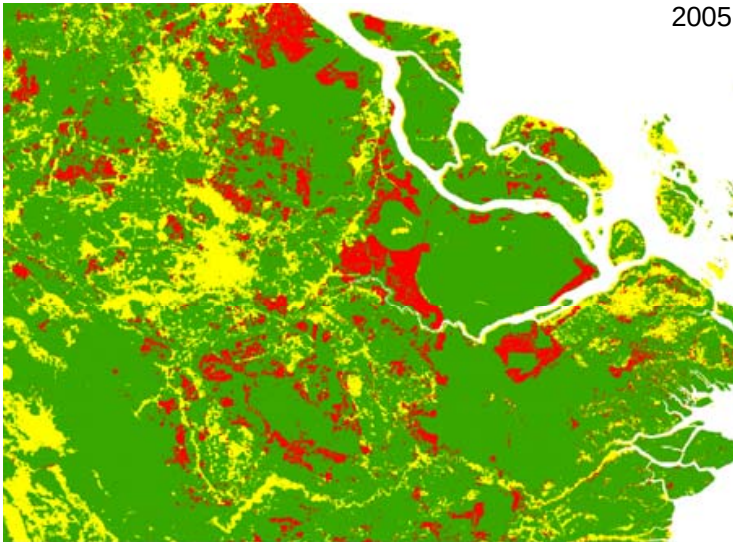

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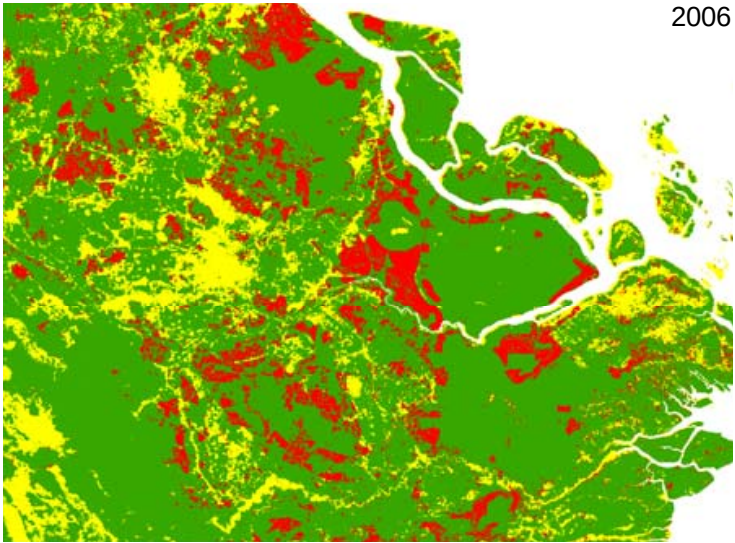

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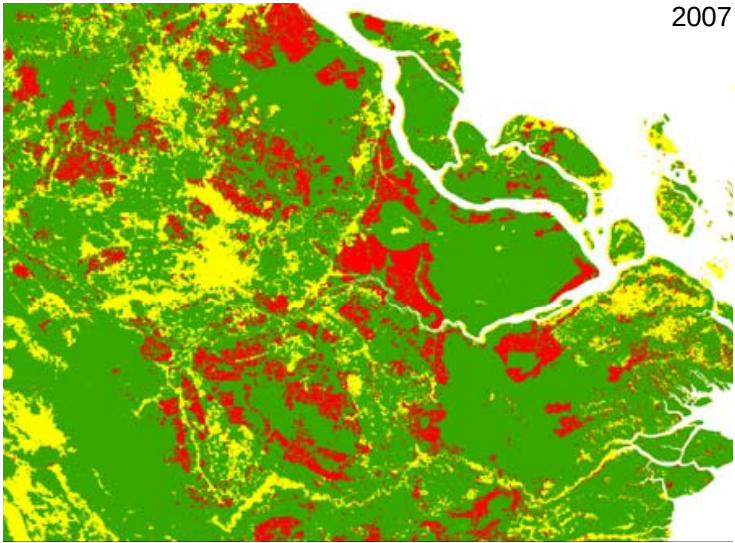
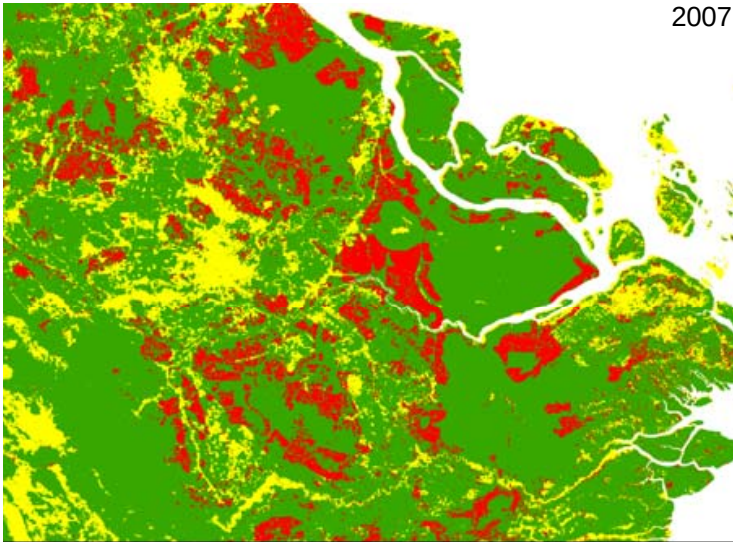


# Example



# Results

- Deforestation increases by 3.61 pp if an additional district is formed within a province - 7.83 pp in long run

| | (1) All Forest | (2) Production/ Conversion | (3) Conservation/ Protection |
|---|---|---|---|
| **Panel A** | | | |
| Number of districts in province | 0.0385** | 0.0443** | 0.0472 |
| | (0.0160) | (0.0179) | (0.0331) |
| Observations | 608 | 296 | 312 |
| **Panel B: including lags** | | | |
| Number of districts in province (sum of L0–L3) | 0.0822*** | 0.0809*** | 0.101** |
| | (0.0204) | (0.0193) | (0.0426) |
| Observations | 608 | 296 | 312 |

- Also find local wood prices fall by 1.7 - 3.6 percent - results consistent with Cournot theory

# Political Cycles

# Political Cycles

## Balboni, Burgess, Heil, Old, and Olken (2021): "Cycles of Fire? Politics and Forest Burning in Indonesia"

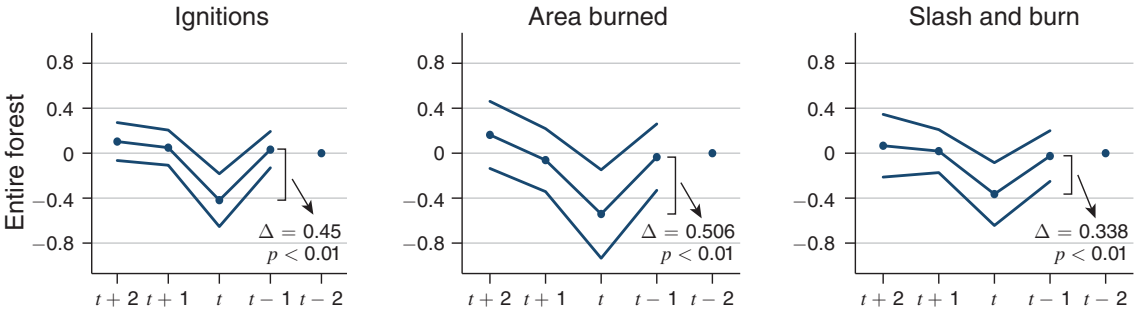
- Politics may also affect enforcement levels. Why?
  - Need (potentially illicit) campaign contributions → allow more deforestation in the years before elections
  - Voters dislike deforestation (especially when linked to forest fires) → less deforestation at the election
- Explore this in Indonesia
  - District heads are on 5 year-terms, but different terms in different districts
- Estimation

$$\mathbb{E}[y_{it}] = \gamma_i \exp\left(\sum_{\tau=-2}^{1} \beta_\tau \text{Election}_{i,t-\tau} + \delta_t\right)$$

- Outcomes:
  - Annual deforestation, from Hansen (2013)
  - Forest fires, from MODIS hotspots. Link hotspots day-by-day to find individual fires (Balboni, Burgess, and Olken 2023)

# Results

## All forest



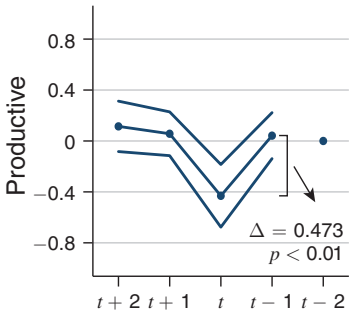

Mean of dependent variable: 17.63 pixels
Joint $p$-value for cycle: $< 0.01$

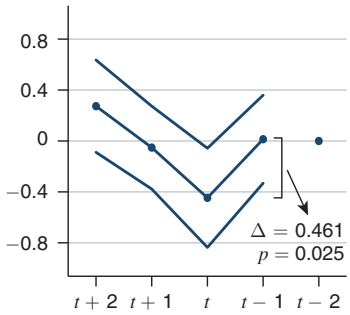
75.61 pixels
$< 0.01$

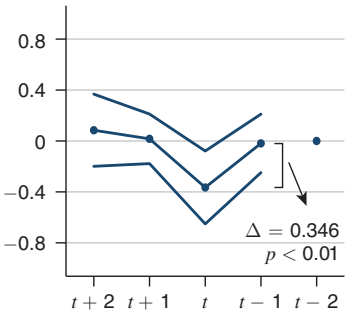
3.46 pixels
$< 0.01$

# Results

## Production forest



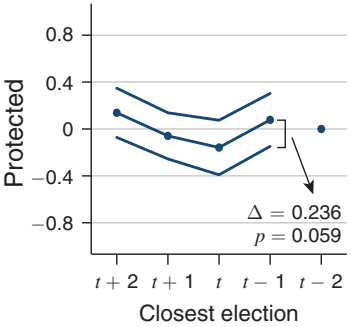

Mean of dependent variable: 13.67 pixels
Joint $p$-value for cycle: $< 0.01$

57.65 pixels
$< 0.01$

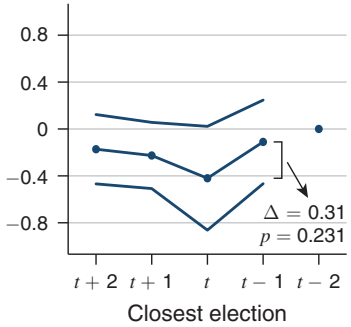
3.26 pixels
$< 0.01$

# Results

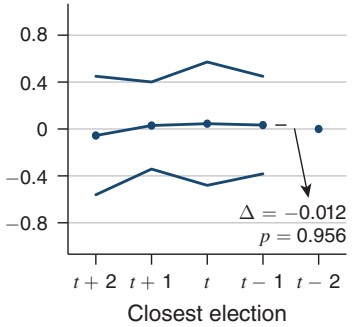
## Protected forest




Mean of dependent variable: 3.37 pixels
Joint $p$-value for cycle: 0.149




14.39 pixels
0.331




0.11 pixels
0.973

# Key Results

- Dip in deforestation in election year
- Substantial rise in deforestation just after the election
- Suggests enforcement when it is politically salient, but not otherwise
- Primarily in productive forest, where landowners may be interacting with government officials

# Summing up

- Conservation requires government action, because of the gap between private and public incentives
- But there is a gap between *de jure* rules and *de facto* action
- This gap is influenced by political economy factors
  - Overall deforestation in the Amazon rates highly sensitive to Brazilian policy, as identified from looking at the national border
  - Increasing fractionalization of control leads to more deforestation in Indonesia
  - Political cycles influence amount of deforestation in Indonesia