Environmental and Development Economics
Module 6 - Political Economy and the Environment

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Lecture 10

Political Economy and the Environment in LMICs

Housekeeping

- **Tuesday Oct. 8th class in Ruttan 230**

- Reviewers will be assigned tonight
  - Referee report due next Thursday

- Next: work on presentation
  - You will present in alphabetical order

- Replication due Oct. 21st
  - You can choose **any** env/dev paper, not just ones on syllabus

- Migration readings posted

Why political economy?

- There is a wedge between private and social value
    - Agents unlikely to volunteer conservation when benefits accrue elsewhere
    - Landowners cut forest for private value, ignore social value (e.g. biodiversity)

- **Government intervenes** to correct externality (regulation or prices)

- Weak governance: De Jure $\neq$ De facto deforestation
    - What drives actual deforestation?
    - Last time: weak monitoring, weak enforcement, spillovers
    - **Today:** political economy (i.e. "non-benevolant" social planner)

Political economy of the environment

▶ In first-best, low e means low $MWTP_e$ or high MC_e

$$MWTP_e = \frac{\partial c_e}{\partial \Delta e}$$

▶ Social planner sets e^* by aggregating over agents
  ▶ Assumption: **no preferences of own**

Recent Work

▶ **Corruption:** Burgess et al. (2012), Oliva (2013)

▶ **Political cycles:** Balboni et al. (2021), Mahadevan (2024), Mahadevan and Shenoy (2023)

▶ **Favoritism:** Madhok and Gulati (2024), Abman and Carney (2020), Gordon et al. (2024)

Burgess et al. (2013): Political Economy of Deforestation

▶ **Question:** How do political incentives affect environmental quality?
  ▶ What is the role of bureaucrates in natural resource extraction?

▶ **Setting:** Deforestation over eight years of institutional change in Indonesia
  ▶ Local bureaucrats can facilitate illegal logging

▶ **Research Design:** Asynchronous district splits
  ▶ changes in election timing and budget allocations

▶ **Results:** new jurisdictions ↑ deforestation and ↓ wood price
  ▶ Deforestation increases even in places where logging is banned

- ▶ National government sets de jure forest rules
    - ▶ Rely on local bureaucrats for enforcement

- ▶ Central monitoring of local officials is costly
    - ▶ Local officials can allow deforestation above sanctioned amount

- ▶ This generates competition between districts:
    - ▶ **Idea:** district heads can sell "permits" to deforest in exchange for bribe
    - ▶ **Demand:** more permits sold, lower P per permit
    - ▶ **Market:** district heads engage in Cournot Competition
    - ▶ **Strategy:** one official in area means high price, few permits, less deforestation
    - ▶ **District split:** many heads, lower price, many permits, more deforestation

- **Oligopoly Setting**: Few firms produce homogeneous goods

- **Quantity Competition**: Firms choose q *simultaneously* to max. profits

- **Market Price**: Determined by total Q produced; firms account for rivals' output

- **Nash Equilibrium**: Each firm's output is optimal, given competitors' output

- **Strategic Substitution**: Firms'q are substitutes; increasing output lowers price

- **Key Outcome**: Q and P are between monopoly and perfect competition levels
  - Firms have *market power*, leading to P>MC

Model of Bureaucrat Behavior

- Logging firms choose where to log
  - Must obtain (legal or illegal) permit from district

- Districts choose number of permits to sell
  - Take # of permits issued by other districts as given

- Bribe is price for permit beyond legal limit

- Generates Cournot competition
  - More districts → more deforestation → lower wood price

Model Setup: Firms

- Downward sloping inverse demand for wood, $p(Q)$

- Firms' profit maximization problem:

$$\max_{q_{fd}} \left[p(Q)q_{fd} - cq_{fd} - b_d q_{fd} \right]$$

- q_{fd}: Quantity of wood logged by firm f in district d

- $p(Q)$: Price of wood, depends on total quantity Q in the province

- c: Constant marginal cost per unit of wood

- b_d: Permit cost per unit of wood in district d

- FOC [q]: WTP for permits: $b_d = p(Q) - c$

▶ Districts sell permits but risk being caught for exceeding legal quotas:

$$\max_{q_d} \left[b(q_d)q_d - \phi(q_d, \bar{q})r_d \right]$$

▶ q_d: Total logging permits issued by district d

▶ $\phi(q_d, \bar{q})$: Prob. of being caught, increasing in illegal logging, $q_d - \bar{q}$

▶ r_d: Rent lost if detected

▶ Substitute firms' marginal bribe: $b_d = p(Q) - c$

Cournot Equilibrium

▶ FOC for optimal logging permits:

$$q_d p' + p - c - \phi'(q_d, \bar{q}) r_d = 0$$

▶ With n districts in wood market s.t. $Q = nq_d$ yields Cournot equilibrium:

$$\frac{p - c}{p} = \frac{1}{n\epsilon} + \frac{\phi'(Q/n, \bar{q}) r}{p}$$

▶ ϵ: Price elasticity of demand for wood
▶ n: Number of districts
▶ Q: Total quantity of wood logged in the province

Model Implications

$$\frac{p - c}{p} = \frac{1}{n\epsilon} + \frac{\phi'(Q/n, \bar{q})r}{p}$$

1. More districts ($\uparrow$ n) leads to $\uparrow$ deforestation, $\downarrow$ wood prices

2. Substitution b/w illegal logging and other forms of rents r
   - If $\phi' > 0$ i.e. $q_d > \bar{q}$, then $\uparrow r$ leads to $\downarrow q_d$

Empirical Analog

- Let $p = \frac{\alpha}{q^\lambda}$ (CES demand), where $\epsilon = \frac{1}{\lambda}$, then effect of districts splits is:

$$\frac{1}{Q}\frac{dQ}{dn} = \frac{1}{n^2 - n\lambda}$$

- In 1998, Suharto's regime ends, leading to rapid decentralization of power
  - Number of districts increased from 292 in 1998 to 483 by 2008

- Natural resource rich regions demand greater control over revenue
  - Forest management shifted to district governments

- District forest offices became the key players in both legal and illegal logging

- Illegal logging, facilitated by district officials, accounts for 60-80% of total logging

- ▶ District splits determined by: 1) geography, 2) ethnicity, 3) public sector size

- ▶ Timing of splits determined by: lots of bureaucracy and red tape...
    - ▶ Not determined by pre-trends in deforestation

- ▶ Wood markets are localized
    - ▶ Raw log exports are banned
    - ▶ Timber first transported to local mills
    - ▶ **Prices vary across regions**

Legend
Number of district splits

- 0
- 1
- 2
- 3
- 4
- 5-7
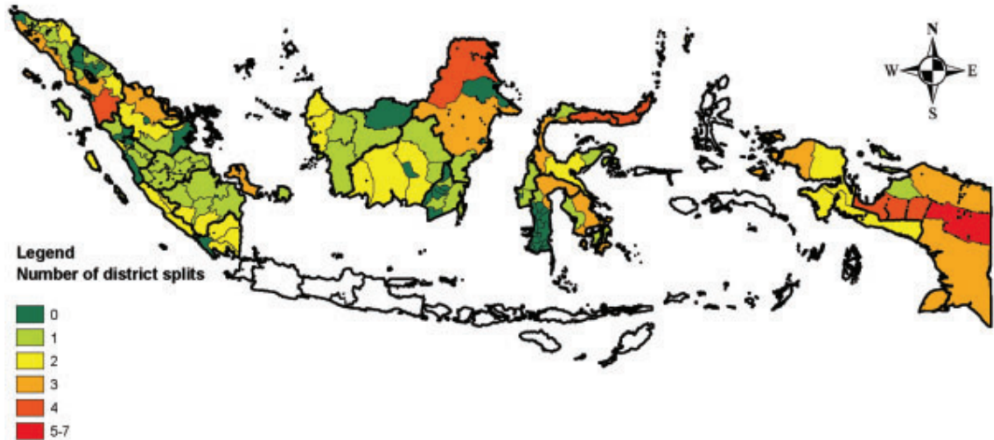
Deforestation Effects

▶ Fixed effects Poisson quasi-maximum likelihood count model:

$$E(deforest_{pit}) = \mu_{pi}exp(\beta NumDistrictsinProv_{pit} + \eta_{it})$$

▶ $deforest_{pit}$: number of deforested pixels in province p, island i, time t

Price Effects

$$ln(y_{pt}) = \beta NumDistrictsinProv_{pit} + \mu_{wpi} + \eta_{wit} + \epsilon_{wpit}$$

▶ y_{wpit}: price of wood type w

▶ μ_{wpi}, η_{wit}: wood-by-province and wood-by-island-year FEs

	(1)	(2)	(3)
		Production/	Conservation/
	All Forest	Conversion	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

▶ District split increases deforestation rate by 3.85%
▶ Similar impacts where logging is legal (production) or illegal (conservation)!
▶ Large medium run effects

	(1)	(2)
		2001–2007	
		All wood observations	
Variables	Log price	Log quantity
Panel A		
Number of districts in province	−0.017	0.084*
	(0.012)	(0.044)
Observations	1003	1003
Panel B: including lags		
Number of districts in province	−0.0336**	0.135**
(sum of L0–L3)	(0.0134)	(0.0561)
Observations	1003	1003

- district split decreases prices by 1.7% (not significant)
- after three years, prices ↓ by 3.4%
- slope of demand curve $= \frac{dLnQ}{dlnP} =$ -2.27 (elastic)

- **New district has less enforcement as it sets up**
  - Initial increase in deforestation, then decline over time

- But, we see initial ↑ in deforestation sustained over three years

- Also, if enforcement driving results, should see ↑ deforestation in new half of district
  - If Cournot competition, no differential effects b/w old and new part
  - **Result: no differential effects!**

Are oil and gas revenues substitutes for logging revenue?

- ▶ If detection removes both corruption opportunities, then they are substitutes
  - ▶ If corruption has fixed costs, then they are complements

- ▶ Share of central oil/gas revenue rebated back to districts
  - ▶ Half goes to producing districts, other half split equally w/n province

- ▶ Since, district splits influence oil/gas prices through the sharing formula, control for splits directly and estimate:

$$E(deforest_{dit}) = \mu_{di} exp(\beta PCOilandGas_{dit} + \gamma NumDistricts_{dit} + \eta_{it})$$

- ▶ $PCOilandGas_{dit}$: per capita oil revenue received by district
- ▶ Could there be other explanations for a significant β?

Variables	(1) All forest	(2) Production/ Conversion	(3) Conservation/ Protection
Panel A			
Oil and gas revenue	−0.00316**	−0.00284*	−0.00597**
per capita	(0.00160)	(0.00165)	(0.00252)
Observations	6464	3064	3400
Panel B: lags			
Oil and gas revenue	−0.00492***	−0.00432**	−0.0113***
per capita	(0.00186)	(0.00190)	(0.00257)
Lag 1	0.000652	8.87e-05	0.00561***
	(0.00103)	(0.00126)	(0.00113)
Lag 2	0.00112	0.00132	0.000731
	(0.00130)	(0.00151)	(0.00138)
Lag 3	0.00519***	0.00530***	0.00574
	(0.00163)	(0.00160)	(0.00372)
Sum of L0–L3	0.00205	0.00240	0.000768
	(0.00134)	(0.00154)	(0.00195)

▶ Evidence of substitution: each $ 1 of oil/gas rents reduce logging by 0.3%
▶ Medium-run effect positive! Explanation: illegal rents attract "bad'' politicians

Negative Selection into Office

Variables	(1) All forest	(2) Production/ Conversion	(3) Conservation/ Protection
Oil and gas revenue per capita	−0.00523***	−0.00457***	−0.0122***
	(0.00143)	(0.00159)	(0.00174)
Postelection	0.0218	0.0240	0.0299
	(0.110)	(0.118)	(0.217)
Oil and gas × Postelection	0.00175*	0.00147	0.00517***
	(0.000989)	(0.000976)	(0.00180)
Oil + Oil * Postelection	−0.00348***	−0.00310**	−0.00698***
	(0.00129)	(0.00140)	(0.00134)
p-value	0.00128	0.0161	<0.001
Observations	6403	3037	3366

▶ negative effect of oil/gas rents attenuates once election is held
▶ 35% of substitution effect disappears after election
▶ Takeaway: change in political equilibrium reverses substitution effect

▶ **Decentralization Increases Deforestation**:
  ▶ district splits increase competition, ↑ deforestation, ↓ timber prices.

▶ **Substitution of Corruption Opportunities**:
  ▶ Illegal logging and oil/gas rents act as substitutes.
  ▶ When alternative rents available, reduce illegal logging, though weakens over time

▶ **Cournot Competition Explains Deforestation Behavior**:
  ▶ The Cournot model explains how bureaucrats incentives drive deforestation.

► Do you buy this story?

► Model extensions?

► Alternative story?

Back to Political Economy

▶ Recall, inefficiency comes from social planner not being "benevolent''
  ▶ Include own utility weights in social welfare function

▶ In Indonesia, this comes in the form of taking bribes
  ▶ Fuels competition b/w bureaucrats for (illegal) logging permits

▶ In Amazon, this comes in the form of rents from supporting ag. lobby
  ▶ Incentives: monetary returns, electoral returns
  ▶ See Katovich and Moffette (2024)

▶ Test: will removing potential rents curb deforestation?
  ▶ We saw this already with pollution (Duflo et al., 2013)

▶ **Research Question:** Does conservation policy change political incentives?

▶ **Setting:** Deforestation policy in Amazon
  ▶ Test effect of policy on "special interest'' farmer politican groups

▶ **Data:** politician characteristics, elections, deforestation

▶ **Design:** 1) Difference-in-differences, 2) close election RDD

▶ **Results:** Corrupt municipalities deforest more before but not after policy
  ▶ **mechanism:** policy reduces rents from illegal deforestation, reducing incentives for farmer politicians to cater to special-interest farmer groups

▶ De jure: unauthorized deforestation is punishable crime
  ▶ De facto: Lack of coordination + high regulatory costs → limited effectiveness

▶ Environmental enforcement is a **federal** responsibility
  ▶ In practice: mayors can indirectly influence deforestation
  ▶ e.g. mayor consent needed for land grabbing or illegal logging

▶ 2004: PPCDAM deforestation policy enacted
  ▶ Satellite based monitoring to identify deforestation hotspots

▶ Bribes/lobbying used to reduce environmental enforcement

▶ Strong farmer lobby: 1/4 of Congress are members of rural caucus

▶ Incentives of "farmer'' politicians depends on conservation policy
  ▶ w/o policy, high returns to deforestation → pro-deforestation lobbying by farmers
  ▶ with policy, low returns from deforestation → less incentive to allow deforestation

Conceptual framework

▶ Farmer politicians promote deforestation through three mechanisms:

▶ **Preferences**:pro-deforestation preferences
  ▶ prediction: electing farmer mayor raises local deforestation
  ▶ policy: will not affect politician preferences

▶ **Monetary Returns**: benefit financially from deforestation
  ▶ prediction: electing farmer mayor raises local deforestation
  ▶ policy: increases cost of deforestation, mitigating negative mayor effect

▶ **Electoral Returns**: gain votes by supporting pro-deforestation policy
  ▶ prediction: electing farmer mayor increases local deforestation
  ▶ policy: unclear, but expect it to decrease electoral returns

  See model in paper

Data (2001-2016)

▶ **Elections:** party, gender, age, occupation, education
  ▶ **farmer politician** = agriculture occuption (18% of sample)

▶ **Deforestation:** Global forest change
  ▶ Number of deforestation pixels in municipality-year

▶ **Land use:** MapBiomas
  ▶ forest, pasture, crops, non-forest

▶ **Public finance:** revenue and expenditures by type and source

▶ **Land conflict:** conflicts, murders, and settlements

▶ Term-specific differences in outcomes b/w farmer and non-farmer places:

$$Y_{it} = \beta_t P_{it} + \gamma_t' X_{it} + \delta_t + \epsilon_{it}$$

▶ Y_{it} = environmental outcome in municipality i during term t
▶ $P_{it} = 1$ if i is governed by a farmer politician during term t
▶ Four terms: 2001-04, 2005-08, 2009-12, 2013-16

▶ Predictions: $\beta_t > 0$, $\beta_t - \beta_{01-04} < 0$
▶ **Note:** β_t is a weighted mean of effects on places where mayor type changes between periods (switchers) and where mayor type constant (stayers)
  ▶ Estimate effect of switchers by adding municipality FEs

▶ How does this differ from difference-in-differences?

▶ Year specific changes in deforesation in farmer vs. non-farmer municipalities:

$$Y_{it} - Y_{i2004} = \sum_{\tau=2001}^{\tau=2016} \beta_\tau P_{it} + \sum_{\tau=2001}^{\tau=2016} \gamma'_\tau X_{it} + \delta_t + \epsilon_{it}$$

▶ β_τ: change in environment b/w t and 2004 in farmer vs. non-farmer places
▶ Prediction: $\beta_t = 0 \quad \forall \tau < 2004, \beta_t < 0 \quad \forall \tau > 2004$

|	Cross Section	Switchers	Constant Selection	RD
	(1)	(2)	(3)	(4)
Panel A: Deforestation (km^2)				
2001-04	94.80***	31.20**	136.58**	153.19**
	(33.68)	(12.21)	(56.69)	(78.11)
2005-08	5.05	-2.12	26.99*	-18.31
	(13.75)	(10.75)	(14.84)	(44.29)
2009-12	26.74**	-41.37	80.09**	63.76
	(12.90)	(33.96)	(31.70)	(72.70)
2013-16	-19.12	-85.78**	39.69	-14.58
	(16.87)	(42.84)	(45.78)	(59.55)
Δ *(2005-08) - (2001-04)*	-89.76**	-33.32***	-109.59**	-171.50*
	(35.82)	(12.90)	(54.55)	(89.02)
Δ *Post - Pre*	-89.19***	-74.29***	-87.66**	-147.61*
	(34.09)	(25.49)	(41.24)	(84.18)

▶ Deforestation was $95 km^2$ higher in farmer politician places pre-policy
▶ Sharp drop in deforestation post-policy $\Delta(2005 - 08) - (2001 - 04)$
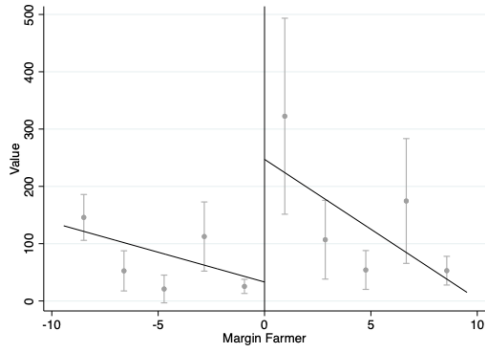
(a) 2001-04   (b) 2005-08
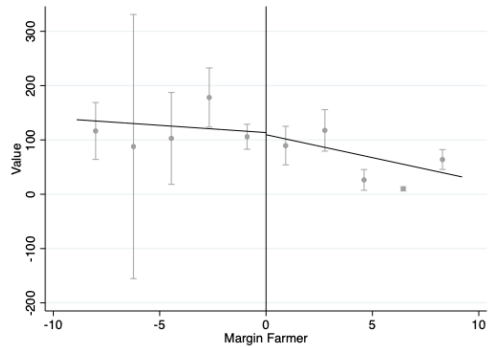
	Deforestation	Inside PA	To Pasture	To Crops
	(1)	(2)	(3)	(4)
Panel A: Cross-Section				
2001-04	94.80***	90.45***	49.67***	0.10
	(33.68)	(33.80)	(14.15)	(0.85)
2005-08	5.05	7.04	10.86	-1.05**
	(13.75)	(12.68)	(8.38)	(0.50)
2009-12	26.74**	22.46**	22.10*	1.29
	(12.90)	(10.58)	(11.57)	(2.58)
2013-16	-19.12	-20.13	18.07	-2.20
	(16.87)	(12.36)	(25.67)	(1.74)
Δ (2005-08) - (2001-04)	-89.76**	-83.40**	-38.81**	-1.15
	(35.82)	(35.42)	(16.18)	(0.95)
Δ Post - Pre	-89.19***	-85.65**	-33.30**	-0.70
	(34.09)	(33.91)	(16.04)	(1.27)

▶ Differences b/w farmer and non-farmer area driven by successful PA policy
▶ Cleared land is converted to (low productivity) pastureland, not cropland

Results: Violence and Conflict

	Homicide Rate	Conflicts	Murders	Settlements
	(1)	(2)	(3)	(4)
Panel A: Cross-section				
2001-04	27.11***	0.08	0.11***	-0.00
	(7.13)	(0.08)	(0.04)	(0.03)
2005-08	6.94	0.04	0.04	-0.03
	(6.53)	(0.10)	(0.04)	(0.02)
2009-12	-6.80	-0.04	0.08	0.02
	(7.51)	(0.11)	(0.05)	(0.03)
2013-16	-9.11			
	(7.74)			
Δ *(2005-08) - (2001-04)*	-20.17**	-0.05	-0.07	-0.02
	(9.65)	(0.13)	(0.06)	(0.04)
Δ *Post - Pre*	-28.83***	-0.09	-0.07	-0.00
	(8.24)	(0.10)	(0.05)	(0.03)

▶ Violent deaths larger in farmer politician places pre-policy, but not after
▶ Similar (but weaker) for land conflict

Mechanisms: Electoral Outcomes

	% Farmer Cand. Next Term	% Vote Farmer Next Term	Farmer Next Term	Incumbent Reelected
	(1)	(2)	(3)	(4)
Panel A: Cross-Section				
2001-04	12.73***	14.13***	0.20***	0.02
	(3.16)	(3.43)	(0.05)	(0.04)
2005-08	10.54***	10.99***	0.10**	-0.07
	(2.82)	(3.08)	(0.04)	(0.05)
2009-12	6.04**	6.60**	0.07*	-0.10**
	(2.72)	(3.00)	(0.04)	(0.05)
2013-16	4.25	6.56*	0.11**	-0.03
	(3.30)	(3.70)	(0.05)	(0.05)
Δ *(2005-08) - (2001-04)*	-2.19	-3.14	-0.10	-0.08
	(4.20)	(4.56)	(0.07)	(0.06)
Δ *Post - Pre*	-5.36	-6.28*	-0.11*	-0.05
	(3.41)	(3.75)	(0.06)	(0.05)

▶ No evidence evidence that electoral incentives affected farmer politician behavior

- Limiting illegal rents from helping special interest groups can break the link between local politics and environmental degradation

- Alternative stories?