Tribal Forest Policy and Firm Behaviour

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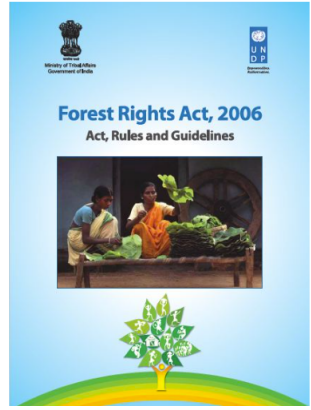
How do firms react to tribal forest policy?

- **Past:** indigenous-managed forests become state-controlled
- **Present:** "Land back" movement (USA/Can, Aus, **India**)
  - Goal: protect indigenous livelihoods and promote conservation
- But, land restrictions have broader economic implications
- **This paper:** Do tribal forest restrictions ↓ firm activity?
  - Does it depend on land intensity of production?
  - What are the implications for **forest conservation**?



Roadmap

- **Question:** How do firms react to tribal forest policy?
- **Idea:** Model aggregate economic response and changes in firm composition
- **Setting:** India Forest Rights Act (2008)
  - Imposes transaction cost on firms
- **Data:** Manufacturing Census (2001-2015); Deforestation permits (2001-2021)
- **Empirical:** Difference-in-differences using policy shift in tribal and non-tribal districts

Roadmap

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Results Preview

1) decline in firm activity, 2) less forest encroachment by industry,
3) larger, but less productive firms survive

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Forest Rights Act (2008)

- Landmark legislation to recognize tribal land claims
- **Goal:** democratize forest governance
  1. formal forest titles to 200 million tribal peoples
  2. devolve forest management to Gram Sabha (tribal council)
  3. **informed consent** b/w developers and tribes
- **Implication:** administrative cost on developers
  - Approvals from potentially hundreds of landowners

Gram Sabha discusses nearby mining, Gadchiroli District (IUCN, 2019)

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What does this mean for industrial activity and conservation?

Model of Firm Behaviour

- If established, firm value: $V(l, z) = zv(l)$, where $z \sim F(z)$
- p = land price; $c(l)$ = administrative cost
- Establish firm if: $zv(l) \geq pl + c(l)$, or:

$$z \geq z^*(l, p)$$

- Aggregate land demand:

$$D(p) = \int_0^{\bar{l}} l \left[1 - F\left(z^*(l, p)\right)\right] dl$$

- Equilibrium price p^* given by $D(p^*) = S(p^*)$

Introduction of Forest Rights Act

- $\kappa > 0$ is fixed cost of approval from tribal council
- New threshold productivity: $z^{**}(l,p) \geq z^{*}(l,p)$
- Aggregate demand $\downarrow$:

$$D^{FRA}(p) = \int_0^{\bar{l}} l\left[1 - F\left(z^{**}(l,p)\right)\right] dl \; < \; D(p)$$

- $z^{**}(l,p^{**}) = z^{*}(l,p^{*}) \Longrightarrow \hat{l} = \frac{\kappa}{(p^{*}-p^{**})}$ (critical size threshold)

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Prediction: Firm Size Composition

- $z^{**}(l,p^{**}) > z^{*}(l,p^{*})$ if $l < \hat{l}$: **smaller mass of small firms**
- $z^{**}(l,p^{**}) < z^{*}(l,p^{*})$ if $l > \hat{l}$: **larger mass of large firms**

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Data (2001-2015)

Annual Survey of Industries

- Firm-level panel of all manufacturers
- N = 36,000 firms in each year
- District identifiers (restricted access)
- Variables: Labor, land, capital, output
- Separate **land purchase** from revaluation

summary statistics

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summary statistics

Deforestation Permits

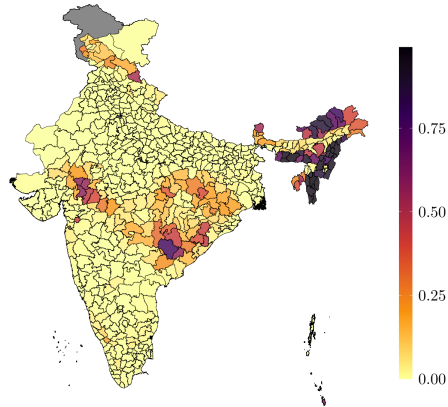
- Permits for infrastructure encroachment
- N = 43,000 projects; mean = 29ha.
- location: district identifiers
- Variables: category, forest area, date
- Panel: District-annual

summary statistics

Treatment: Tribal population share living within 1km of forest

- No data on # of FRA titles
- Instead, we make a proxy:
  1. clump forest grid cells into "patches"
  2. distance from village to nearest patch
  3. calculate tribal pop w/n 1km of forest
  4. aggregate to district

» treatment correlation



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Empirical Strategy: Difference-in-Differences

$$Y_{idst} = \alpha + \beta_1(ForestPop_d \cdot \mathbb{1}_{t>2007}) + \beta_2(TribalPop_d \cdot \mathbb{1}_{t>2007}) + \Gamma X'_{dst} + \mu_i + \delta_o + \omega_n + \theta_t + \epsilon_{idst}$$

- Y_{ist} = outcomes of firm i
- $ForestPop_d$ = forest-dwelling tribal population; $TribalPop_d$ = total tribal population
- $\mathbb{1}_{t>2007}$ = policy shock; switches on in 2008
- μ_i = firm FE; θ_t = year FE; δ_o = ownership FE; ω_n = sector FE

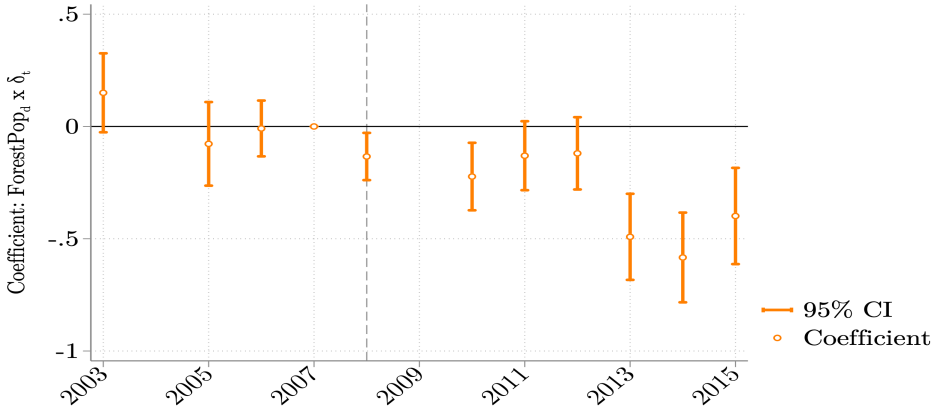
Identifying Variation

Compare firms before/after FRA in districts with high/low forest-dwelling tribal population.

Identifying Assumption: Parallel Trends

outcome: log(land value)

$$Y_{idt} = \sum_{\tau \in \mathcal{T}^{pre}} \beta_\tau ForestPop_d \cdot \delta_t + \sum_{\tau \in \mathcal{T}^{post}} \beta_\tau ForestPop_d \cdot \delta_t + \Gamma X'_{dt} + \mu_i + \theta_t + \delta_o + \omega_n + \epsilon_{idt}$$



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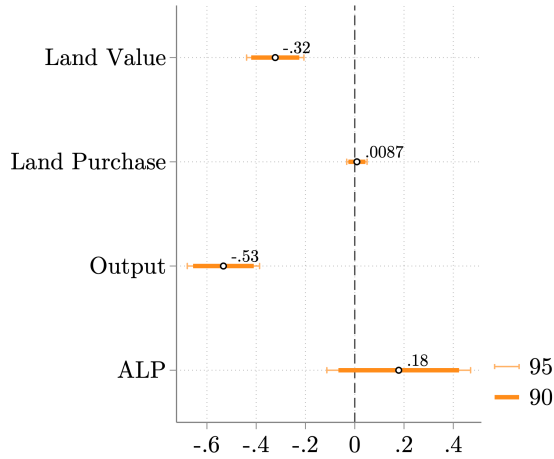
Result 1: FRA reduces industrial activity

- Land Value ($p \times q$) declines
- Output declines
- No change in land purchase
- $\uparrow$ productivity (ALP)



other inputs

Result 2: Large firms less affected by FRA

	(1) Land	(2) New Land	(3) ALP	(4) Output
ForestPop$_d$ x $\mathbf{1}_{t>2007}$	-0.629***	-0.067***	0.763**	-0.205**
	(0.061)	(0.017)	(0.314)	(0.095)
ForestPop$_d$ x $\mathbf{1}_{t>2007}$ x Large$_i$	0.370***	0.123***	-0.619*	0.090
	(0.107)	(0.041)	(0.330)	(0.142)
TribalPop$_d$ x $\mathbf{1}_{t>2007}$	Yes	Yes	Yes	Yes
Firm FEs	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓
Ownership FEs	✓	✓	✓	✓
Sector FEs	✓	✓	✓	✓
Observations	338585	332476	183797	269638
R^2	0.859	0.388	0.801	0.913

Land intensity of production ↓ for large firms by ownership

Consistent with $z^{**}(l, p^{**}) < z^{*}(l, p^{*})$ if $l > \hat{l}$

What does this mean for forest conservation?

- **Data:** Deforestation permits applied for by developers in district d
- Identify conservation induced by behaviour of firms themselves
  - Rather than rely on aggregate satellite forest cover

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We estimate:

$$Y_{dt} = \alpha + \beta_1(ForestPop_d \cdot \mathbb{1}_{t>2007}) + \beta_2(TribalPop_d \cdot \mathbb{1}_{t>2007}) + \Gamma X'_{dt} + \gamma_d + \theta_t + \epsilon_{dt}$$

- Y_{dt} = amount of forest earmarked for deforestation by industry
- Estimate separately by project category (mine, transportation, etc)

Result 3: Less forest diversion for industrial development

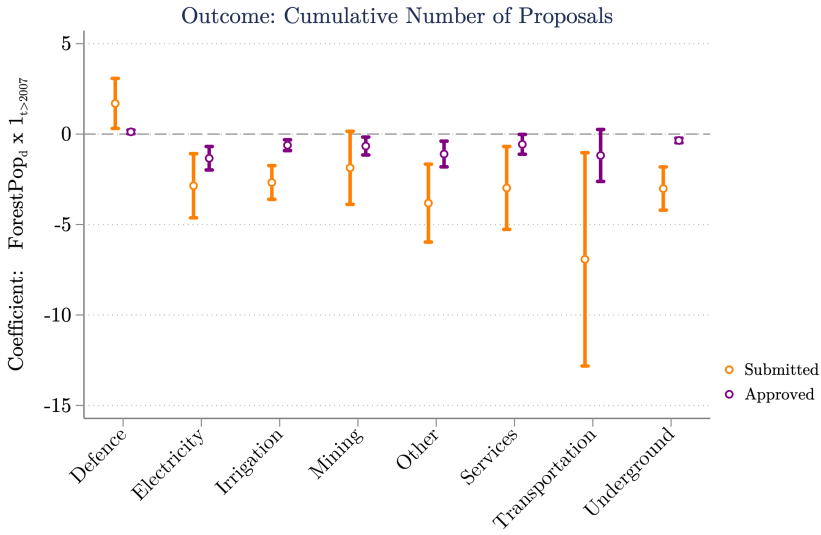
Outcomes in Logs	(1) Num. Submitted	(2) Area Submitted	(3) Area Approved
ForestPop$_d$ x $\mathbb{1}_{t>2007}$	-0.694***	-0.181	-0.564
	(0.151)	(0.448)	(0.416)
TribalPop$_d$ x $\mathbb{1}_{t>2007}$	Yes	Yes	Yes
District FEs	✓	✓	✓
Year FEs	✓	✓	✓
Observations	12264	12264	12264
R^2	0.914	0.839	0.821

Number of deforestation permits applied for by developers declines by 70%

event study

Result 4: Most sectors become more conservation "friendly"

project size



Conclusion

Three Main Findings

1. Tribal forest rights reduce firm activity in tribal areas
2. Less forest encroachment by industrial projects overall
3. Firm composition changes toward land-intensive, less productive firms

- Relevant for other countries considering tribal property rights
- Participatory institutions to govern surviving firms (afforestation, revenue sharing, etc.)

Thank You

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Treatment Correlation

$$ForestPop_{ds} = \beta_1 TribalPop_{ds} + \theta_s + \epsilon_{ds}$$

	(1) ForestPop$_d$	(2) ForestPop$_d$
TribalPop$_d$	0.713***	0.551***
	(0.038)	(0.053)
Outcome Mean	0.093	0.092
State FEs		✓
Observations	584	580
R^2	0.763	0.855

Result: Over half of tribal population is forest-dwelling back

ASI: Summary Statistics

	Observations	Mean	SD
Land	421175	99.06	5254.80
Land Purchase	421175	9.58	287.46
Capital	421175	1446.24	30936.38
Labor	383894	172.22	639.04
Output	322743	4835.14	100565.19

Note: Values are in Thousand USD in contant 2005 dollars. Labor is number of employees

back

Deforestation Permits: Summary Statistics

	Num. Projects	Mean Size (ha.)	SD (ha.)	Total Area (ha.)
Defence	677	197.5	1,877.4	133,690.6
Electricity	5,248	25.3	244.5	132,990.2
Irrigation	3,152	26.6	123.7	83,801.7
Mining	2,445	176.6	1,594.2	431,843.6
Other	6,458	45.5	809.8	294,006.6
Services	4,097	2.3	38.0	9,277.0
Transportation	17,333	9.0	141.3	155,528.6
Underground	4,175	1.4	3.5	5,807.7
Total	43,585	28.6	559.2	1,246,946.0

back result 4

Impacts on Additional Inputs

	(1) Land	(2) New Land	(3) ALP	(4) Capital	(5) Labor	(6) Output
ForestPop$_d$ x $\mathbf{1}_{t>2007}$	-0.323***	0.009	0.179	-0.533***	-0.444***	-0.173**
	(0.059)	(0.021)	(0.149)	(0.075)	(0.060)	(0.082)
TribalPop$_d$ x $\mathbf{1}_{t>2007}$	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓
Ownership FEs	✓	✓	✓	✓	✓	✓
Sector FEs	✓	✓	✓	✓	✓	✓
Observations	338585	332476	183797	338581	322614	269638
R^2	0.857	0.387	0.801	0.913	0.896	0.913

back

Impacts by Ownership Structure

	(1) Land	(2) New Land	(3) ALP	(4) Capital	(5) Labor	(6) Output
ForestPop_d x $\mathbb{1}_{t>2007}$	-0.299***	0.019	0.182	-0.502***	-0.456***	-0.196**
	(0.059)	(0.021)	(0.145)	(0.071)	(0.061)	(0.082)
ForestPop_d x $\mathbb{1}_{t>2007}$ x Public_i	-0.203	-0.102	-0.253	0.193	0.118	0.148
	(0.295)	(0.089)	(0.807)	(0.683)	(0.252)	(0.321)
TribalPop_d x $\mathbb{1}_{t>2007}$	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓
Sector FEs	✓	✓	✓	✓	✓	✓
Observations	338585	332476	183797	338581	322614	269638
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back

Permit Data: Event Study

back

$$Y_{dt} = \sum_{\tau \in \mathcal{T}^{pre}} \beta_\tau ForestPop_d \cdot \delta_t + \sum_{\tau \in \mathcal{T}^{post}} \beta_\tau ForestPop_d \cdot \delta_t + \Gamma X_{dt} + \gamma_d + \theta_t + \epsilon_{dt}$$