Losing Territory: The Effect of Administrative Splits on Land Use in the Tropics

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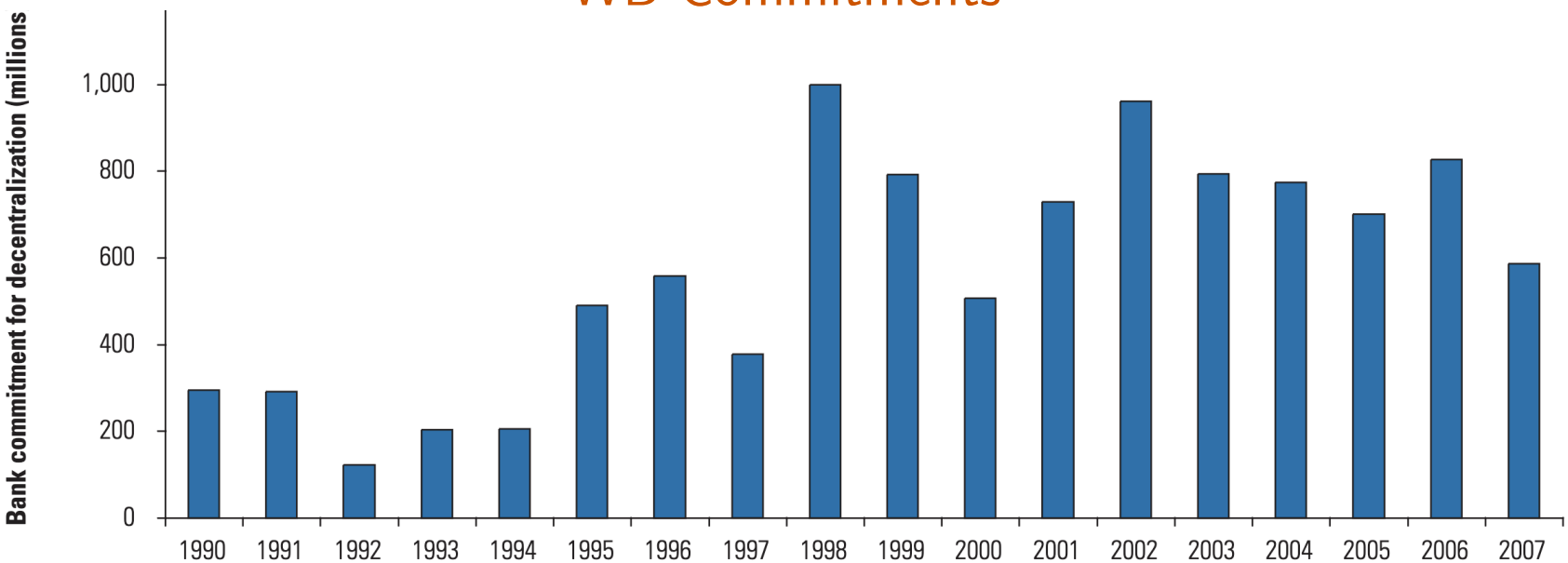
World Bank Land Conference 2024

Donors increase commitments to decentralization . . .

. . . while level of fiscal decentralization increases

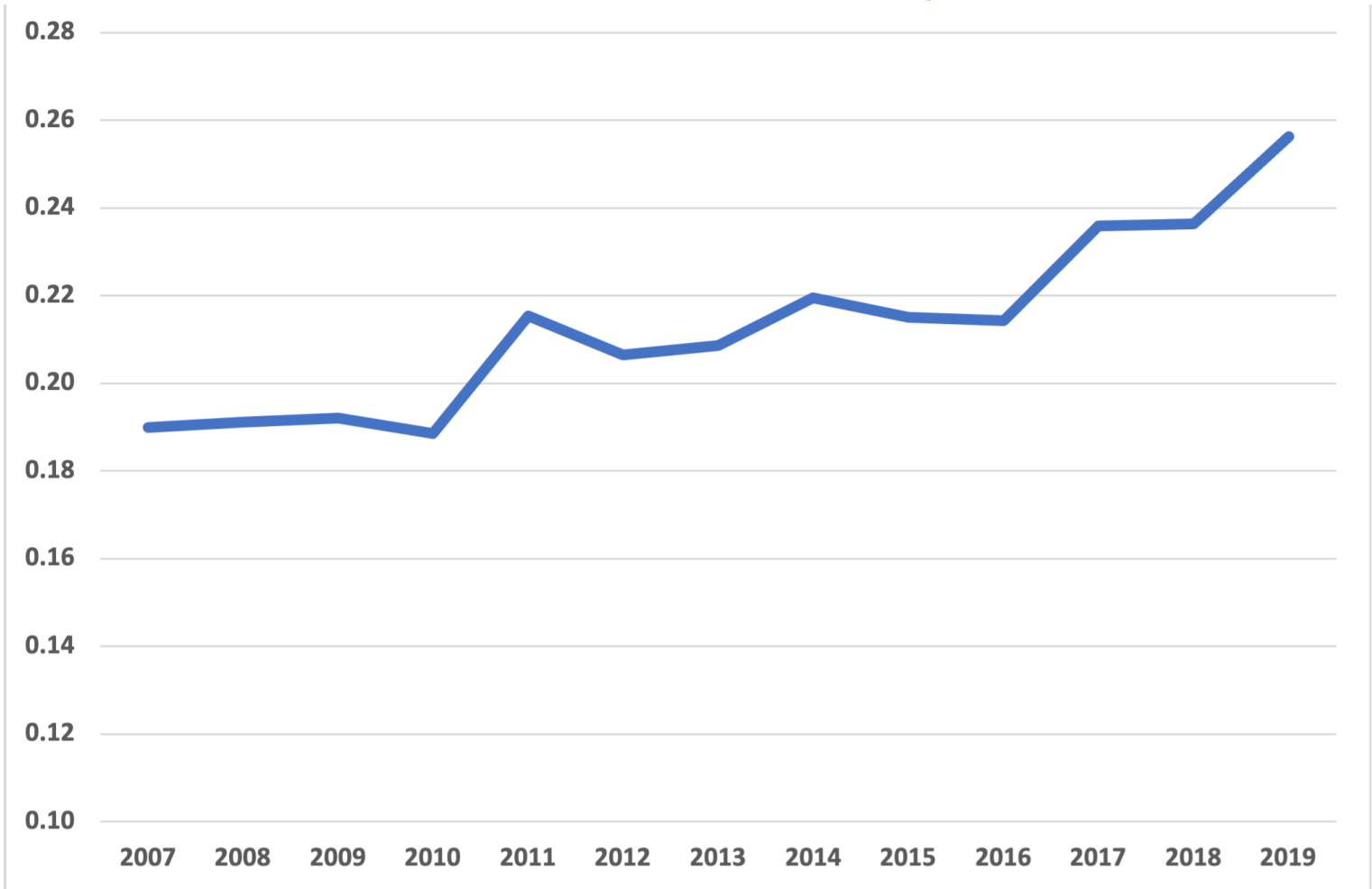
WB Commitments



Source: WB (2008) & own computation based on IMF Fiscal Decentralization Database

Donors increase commitments to decentralization . . .

. . . while level of fiscal decentralization increases



Source: WB (2008) & own computation based on IMF Fiscal Decentralization Database

Empirical evidence is mixed

- Public service delivery
  - Evidence is largely mixed
    (Gadenne and Singhal, 2014)
  - Finding valid counterfactuals remains difficult
    (Canavire-Bacarreza, 2020)

- Forest conservation
  - Political incentives increase deforestation rates
    (Burgess et al., 2012)
  - Higher ethnic diversity decreases deforestation rates
    (Alesina et al., 2019)

Two forms of decentralization

- **Vertical power devolution:** (Litvack and Seddon,2000)
  - Administrative: Handover of public responsibilities and power to lower levels of government
  - Fiscal: Increased financial resources by means of transfers and/or revenue generation authority
  - Political: (Direct) elections of local representatives with increased decision-making power
- **Horizontal devolution:**
  - Proliferation of sub-national administrative units ("government fragmentation")

Research question

How does the horizontal devolution of power shape deforestation dynamics?

Research approach and findings

- Empirical strategy relies on:
  - Indonesia's "big bang"
  - Establishment of *new* spatial boundaries
  - Remotely sensed land-use data
- Findings show:
  - Deforestation rates are relatively lower for child districts
  - Evidence of anticipatory strategic disinvestment
  - No long-term effects

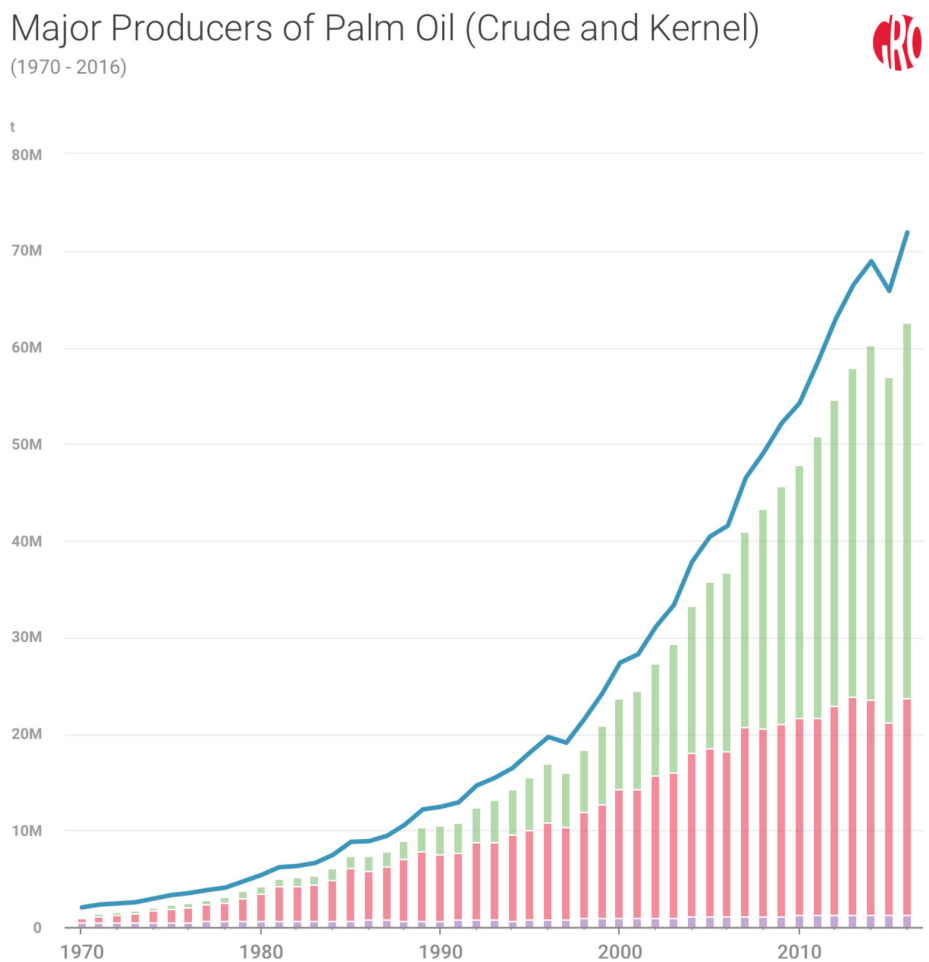
Contribution

- Political economy of deforestation (Burgess et al., 2012; Pailler 2018; Austin et al., 2019; Cisneros et al., 2021)
- Decentralized natural resource management (cf. Blackman and Bluffstone, 2021)
- Unintended outcomes of decentralization (Pierskalla, 2016; Grossman et al., 2017)
- Administrative borders as spatial discontinuities (Michalopoulos and Papaioannou, 2013; Pinkovskiy, 2017; Bonilla-Mejía and Higuera-Mendieta, 2019; Burgess et al., 2019; Cuaresma and Heger, 2019)

Democracy, decentralization, and the palm oil boom in Indonesia

- Fall of Suharto Regime in 1998
  - Democratization
  - Decentralization
  - Trade liberalization

Democracy, decentralization, and the palm oil boom in Indonesia



- Fall of Suharto Regime in 1998
  - Democratization
  - Decentralization
  - Trade liberalization
- Palm oil boom

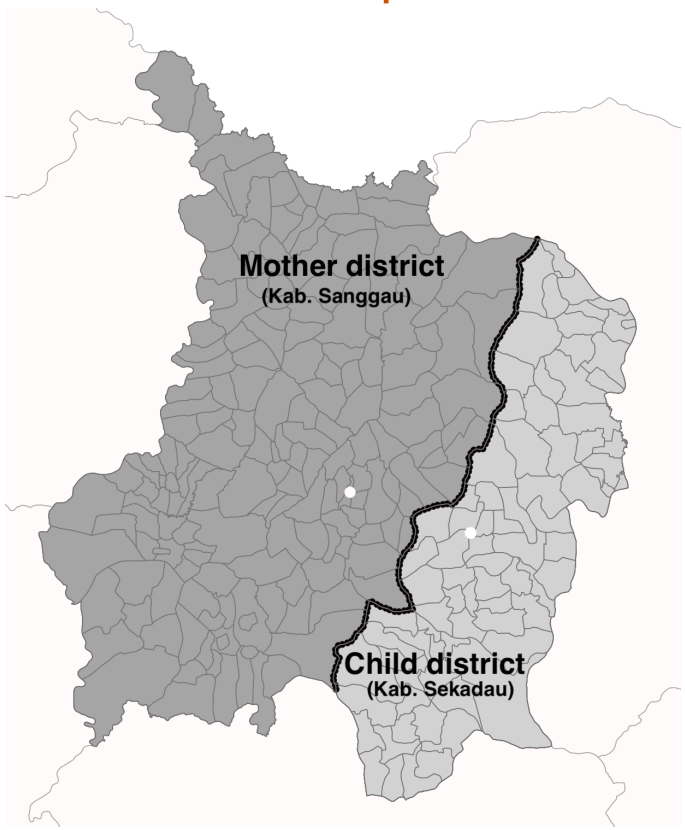
Indonesia's decentralization reforms

- Vertical decentralization
  - Increased fiscal transfers
  - Competencies to levy taxes
  - Deliver public services
  - Right to issue logging licenses
  - Receive 80% of forestry sector revenues
  - Royalties from other natural resource extraction
  - No sharing of oil palm rents
- Horizontal decentralization
  - 341 $\rightarrow$ 511 new districts wihtin 10 years
  - Complex legal process (one to three years)

Exemplary District Split

Pre-split

Post-split



Source: Own computation using WB (2019) INDO-DAPOER

Splits impact administrations' incentives

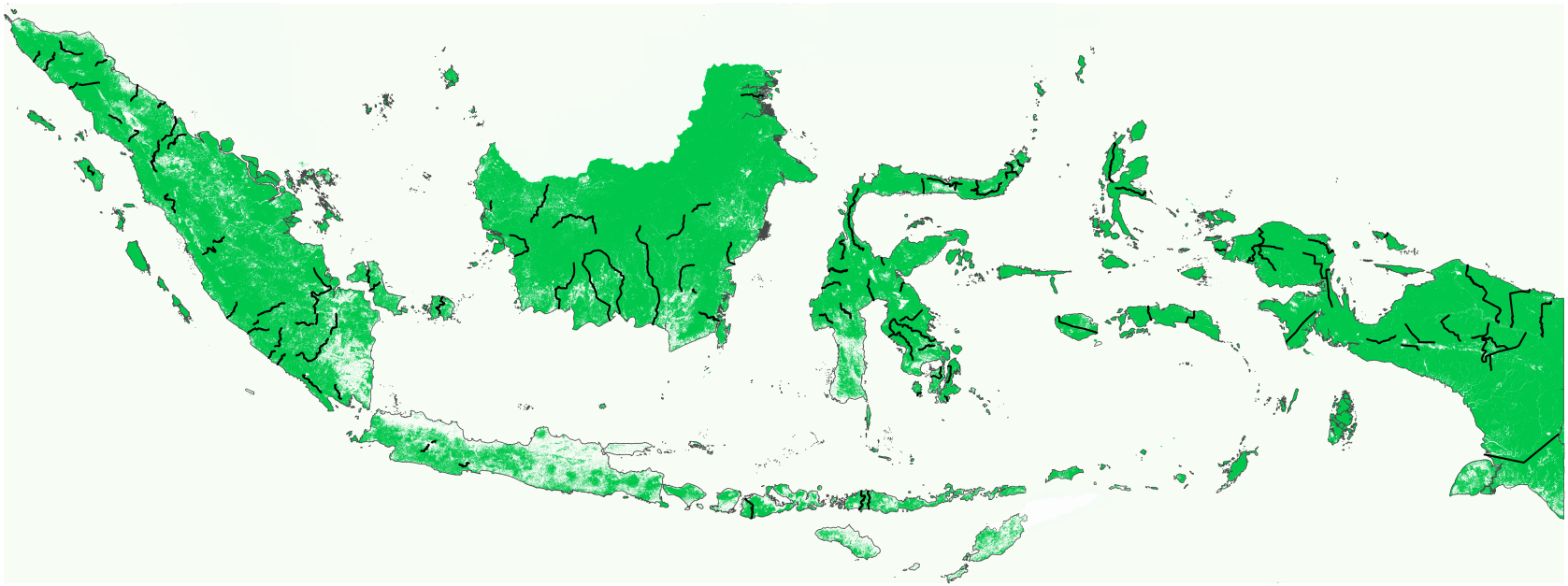
- Cost-benefit consideration:
  - Benefits: Taxes and royalties from forestry and oil palm
  - Costs: Political support among citizen
- Losing territory changes cost-benefit analysis
- Strategic anticipatory action

Potential effects on deforestation

- Before the split (Mother districts)
  - Immediate land-use rents from forestry: $\Uparrow$
  - Medium-term land-use rents from oil palm: $\Downarrow$
- After the split (Child districts)
  - Immediate land-use rents from forestry: $\Uparrow$
  - Constituents' preferences (ethnic homogeneity): $\Downarrow$
  - Administrative (in-)capacity to monitor/develop: $\Uparrow$ & $\Downarrow$
  - Re-location of economic and political center: $\Downarrow$ & $\Uparrow$

New split boundaries

District splits and forest cover across Indonesia



Source: Own computation using Hansen et al. (2012)

- 115 district splits (2002–2014)
  - identify boundaries between mother and child districts
  - select all villages that belong to either district at that time
- 14,000 villages in forested regions

Land-use data

- Land-use data at the village level
  - Deforestation (Hansen et al., 2012)
  - Oil palm expansion (Gaveau et al., 2022)
  - Settlement expansion (Marconcini et al., 2021)
- Socioeconomic data
  - National and village census (Podes)

Empirical strategy

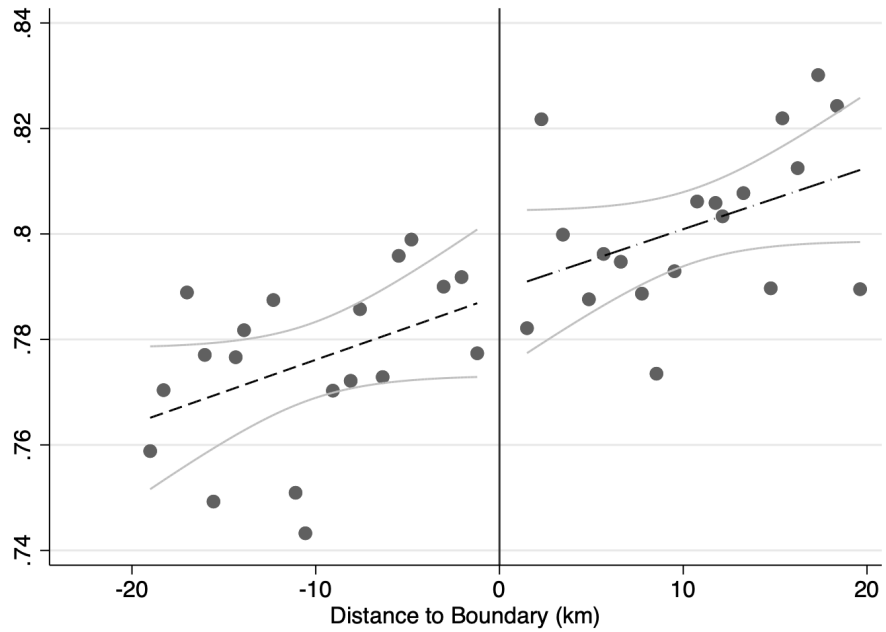
Spatial RDD

$$LU_{vs} = \beta\, Child_{vs} + f(Distance_{vs}, Child_{vs}) + \delta_v + Z'_v + \epsilon_{vs}$$

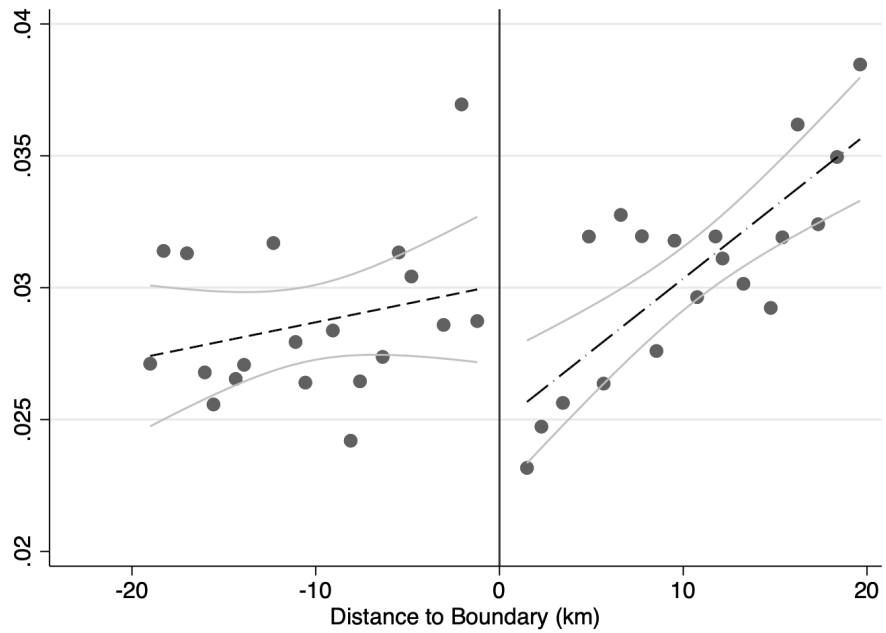
- LU_{vs}: Inv. hyp. sine of Land use in village v before/after split s
- $Child_{vs}$: Location in new district
- $f(Distance_{vs}, Child_{vs})$: Linear/quadratic polynomials
- δ_v: Split boundary FE
- Z'_v: Initial ecological conditions (altitude, forest, oil palm, settlements)
- **Estimation**: Fixed and optimal bandwidths; clustered SEs

Spatial RDD - Visualization

Forest cover in 2000 (%)

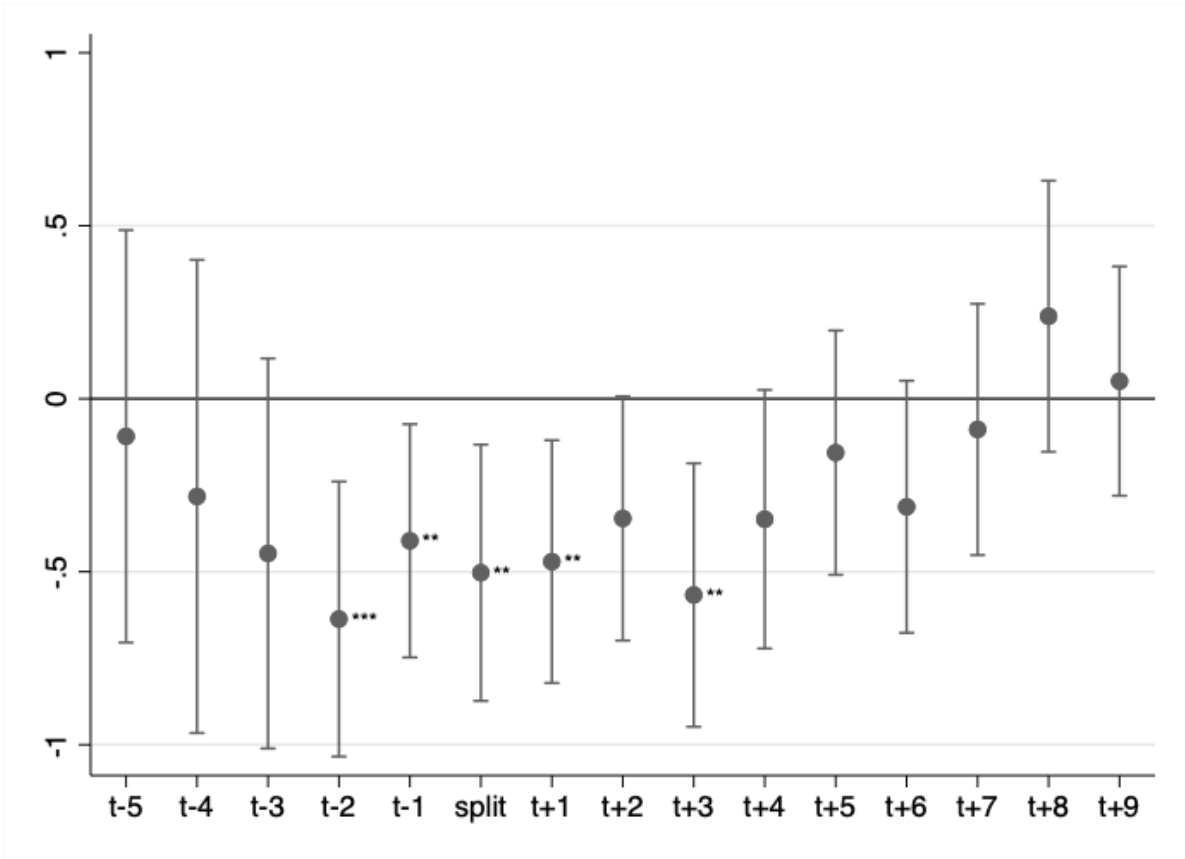


Short-term forest loss post-split (% of 2000 cover)



Dynamic effects

Dependent: *asinh* Deforestation in pre/post split years



⇒ No immediate rent extraction via deforestation before or after split

Aggregated effects

Dependent: *asinh* Av. Deforestation in pre/post 3-year window

	(1)	(2)	(3)	(4)	(5)
	Panel A: Dep.: asinh *Pre-split mean deforestation*				
Child	−0.816***	−0.549***	−0.498***	−0.483***	−0.652***
	(0.271)	(0.199)	(0.187)	(0.166)	(0.175)
Bandwidth	20	20	20	20	15 (42)
Observations	14,320	14,320	14,320	14,319	10,617
Adj. R^2	0.004	0.165	0.297	0.396	
	Panel B: Dep.: asinh *Post-split mean deforestation*				
Child	−0.566**	−0.405*	−0.404**	−0.390**	−0.568***
	(0.237)	(0.211)	(0.200)	(0.151)	(0.172)
Bandwidth	20	20	20	20	13 (35)
Observations	14,320	14,320	14,320	14,319	9,670
Adj. R^2	0.004	0.215	0.355	0.472	
Island-year FE	No	Yes	No	No	No
Split-ID FE	No	No	Yes	Yes	Yes
Controls	No	No	No	Yes	Yes

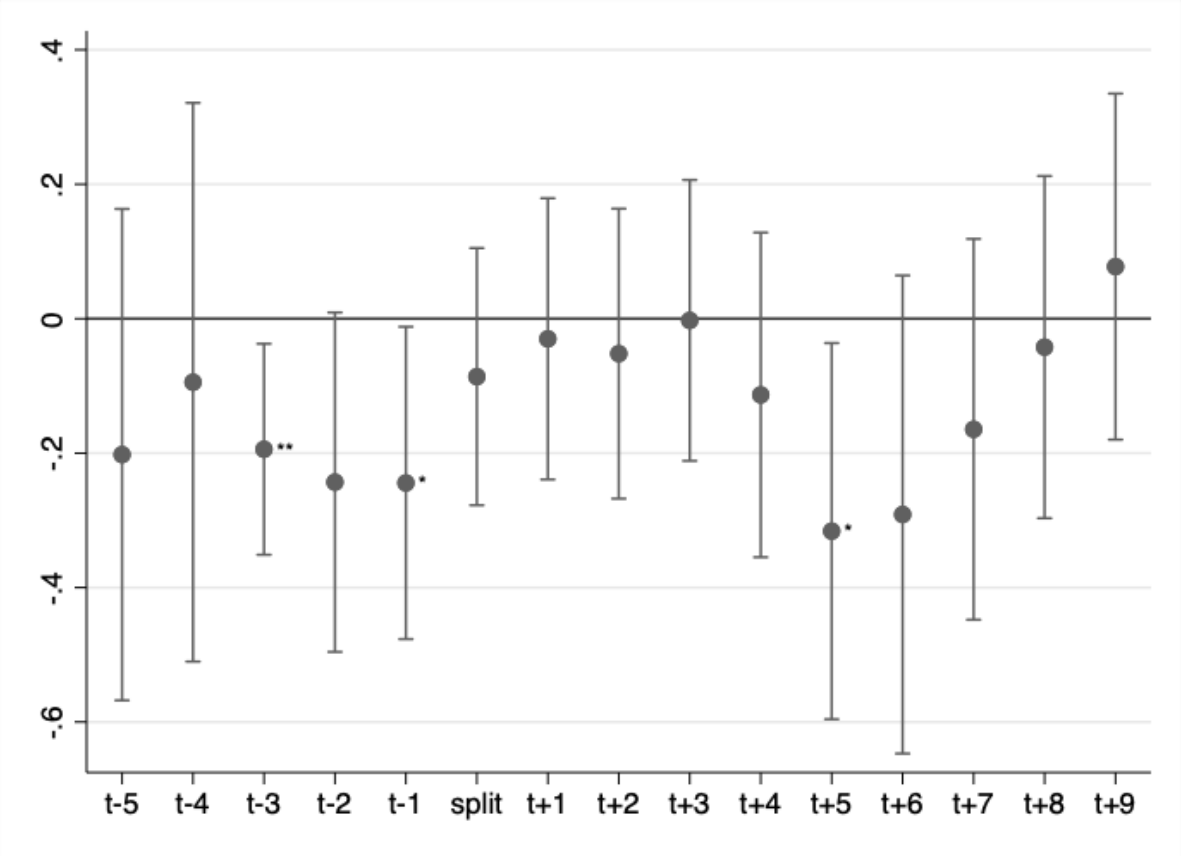
- Deforestation decreases by 32—38% compared to neighboring mother villages (column 4)

Robustness

- Continuity of other characteristics →
- No endogenous sorting →
- Alternative bandwidths →
- Quadratic fit (stronger effects) →
- Placebo test: Artificial boundaries →
- District-level panel regressions: →
  - Short-run effects at the boundary
  - Short-run effects across all villages
  - Effects are driven by the decline of deforestation in children

Medium-term land rents

Dependent: *asinh* New oil palm plantation area



- Oil palm expansion decelerates before split

$\Rightarrow$ Strategic divestment of agricultural development in "lost" areas

Constituents' preferences

Dependent:	*ln Mean deforestation*					*Forest cover*
Period	Pre 6-4	Pre 3-1	Post 0-3	Post 4-6	Post 7-9	in 2018
	(1)	(2)	(3)	(4)	(5)	(6)
Child	−0.148	−0.319	−0.337	0.112	0.101	−0.132
	(0.439)	(0.251)	(0.214)	(0.216)	(0.189)	(0.084)
Child × Decrease in ethnic fractionalization	0.380	−0.226	−0.103	−0.429	−0.333	0.035
	(0.511)	(0.326)	(0.299)	(0.317)	(0.325)	(0.147)
Split ID FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,695	12,822	12,822	12,822	12,822	12,822
Adjusted R^2	0.410	0.385	0.460	0.453	0.462	0.635

⇒ No evidence of Constituents' preferences mechanism

Administrative incapacity & new political centers

Dependent:	*ln Mean deforestation*	
Period	Pre 3-1	Post 0-3
	(1)	(2)
Child	−0.626***	−0.559***
	(0.211)	(0.198)
Child × Large decline in distance to capital	0.278	0.373
	(0.351)	(0.290)
Split ID FE	Yes	Yes
Controls	Yes	Yes
Observations	14,319	14,319
Adj. R^2	0.399	0.474

⇒ No monitoring incapacity argument

Administrative incapacity & new political centers

Dependent:	*ln Mean deforestation*		*ln Mean new settlement area*			
Period	Pre 3-1	Post 0-3	Pre 3-1	Post 0-3	Pre 3-1	Post 0-3
	(1)	(2)	(3)	(4)	(5)	(6)
Child	−0.626***	−0.559***	−0.280	−0.243	−0.510*	−0.521**
	(0.211)	(0.198)	(0.216)	(0.164)	(0.288)	(0.200)
Child × Large decline in distance to capital	0.278	0.373			0.757*	0.893***
	(0.351)	(0.290)			(0.403)	(0.334)
Split ID FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,319	14,319	14,299	14,299	14,299	14,299
Adj. R^2	0.399	0.474	0.398	0.456	0.399	0.456

⇒ No monitoring incapacity argument

⇒ Urbanization close to new political centers

Summary

- Main results
  - District splits slow deforestation in short-, *not* long-run
  - Existing district governments strategically divest from agricultural expansion
  - New district governments foster agricultural expansion once institutional capacity is built up
- Policy implications
  - Temporal rise in forest protection could potentially be sustained by further incentives
  - Other public services could be (negatively) affected by anticipatory strategic action as well

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Summary Statistics I

Samples:	Entire sample		Bandwidth 20km	
	Mother (1)	Child (2)	Mother (3)	Child (4)
Split characteristics				
Number of villages	19,867	13,920	7,369	6,951
Distance to split (km)	39.7	29.1	10.3	9.9
	(37.8)	(31.1)	(5.4)	(5.3)
Distance to capital	39.7	34.0	28.7	26.6
	(38.9)	(31.5)	(26.6)	(23.1)
Distance to capital change (km)	-	42.0	-	22.7
	(-)	(45.8)	(-)	(30.0)
Length of split (km)	108.4	108.4	108.4	108.4
	(72.4)	(72.4)	(72.4)	(72.4)
Land use metrics				
Village size (km2)	40.7	45.1	26.6	27.9
	(109.0)	(128.3)	(76.3)	(75.9)
Forest cover, 2000 (%)	79.2	80.1	77.6	80.1
	(23.0)	(23.4)	(23.0)	(23.1)
Forest cover, 2018 (%)	66.6	69.0	66.1	68.1
	(24.3)	(25.6)	(23.5)	(24.7)
Oil Palm area, 2000 (%)	5.4	7.0	5.8	5.8
	(15.7)	(18.6)	(17.0)	(16.7)
Human footprint area, 2000 (%)	3.5	2.3	4.8	3.0
	(8.9)	(6.1)	(10.5)	(7.4)

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Summary Statistics II

Samples:	Entire sample		Bandwidth 20km	
	Mother (1)	Child (2)	Mother (3)	Child (4)
Village topography				
Altitude (in meters)	396.3	454.7	449.5	537.2
	(598.2)	(670.3)	(592.2)	(720.6)
Located on shore (%)	17.8	18.3	12.4	13.6
	(38.2)	(38.6)	(32.2)	(34.2)
Distance to sub-district capital	20.0	23.6	16.9	18.4
in 2000 (km)	(32.5)	(50.1)	(31.6)	(30.6)
Distance to district capital	169.6	182.3	133.6	150.4
in 2000 (km)	(191.4)	(198.8)	(147.8)	(165.1)
Socio-economic composition (in 2000)				
Population	1,650	1,529	1,763	1,670
	(1,921)	(1,813)	(2,054)	(2,010)
Rural (%)	94.0	96.8	92.7	96.4
	(23.6)	(17.4)	(25.8)	(18.5)
Main income agricultural (%)	96.1	97.7	95.7	97.5
	(19.2)	(14.9)	(20.2)	(15.3)
Ethnic fractionalization	0.511	0.477	0.511	0.477
(at district-level)	(0.19)	(0.20)	(0.19)	(0.20)

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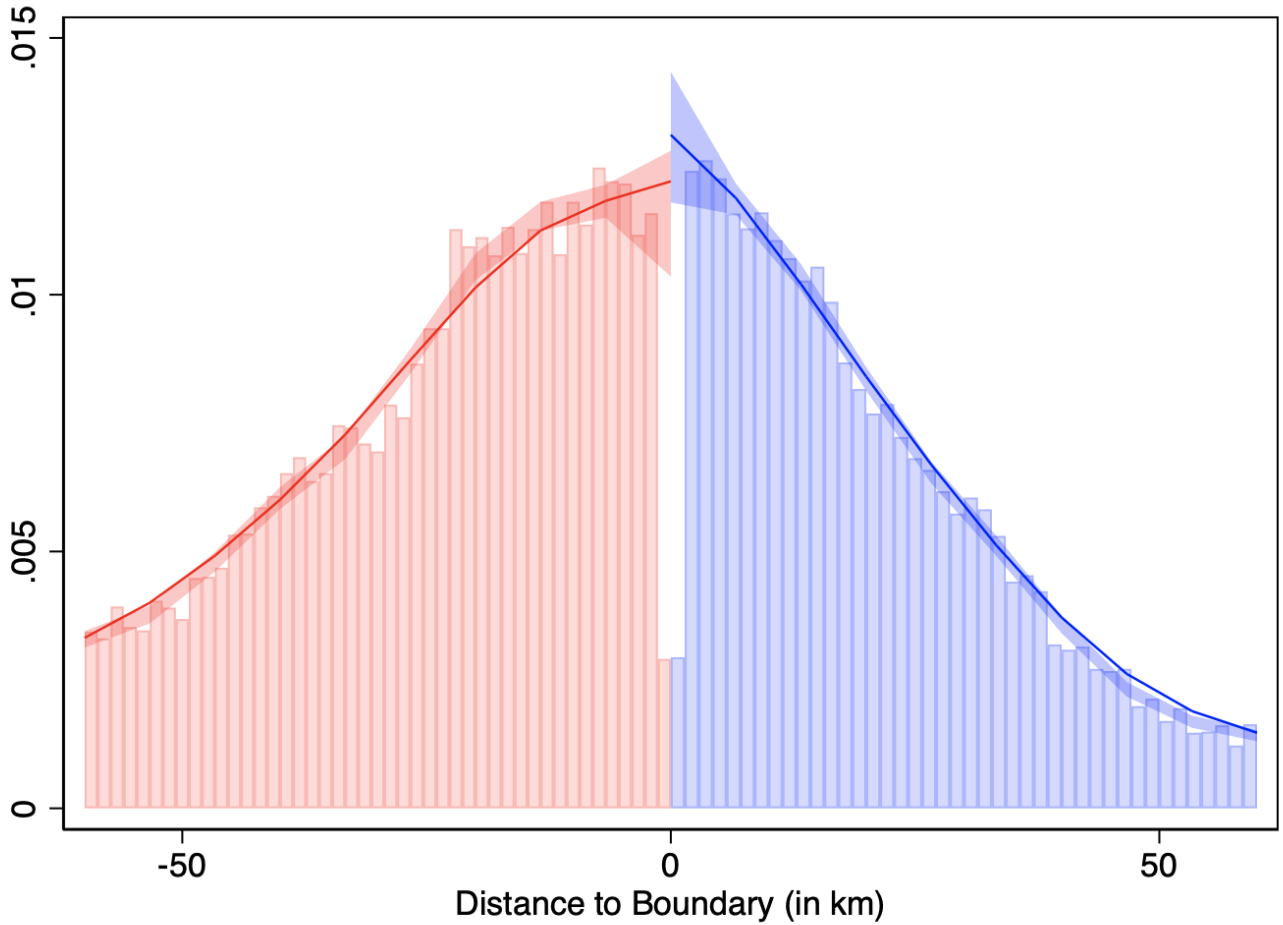
Villages - Density Test



- Computed using *rdrobust* package by Cattaneo et al. (2020)

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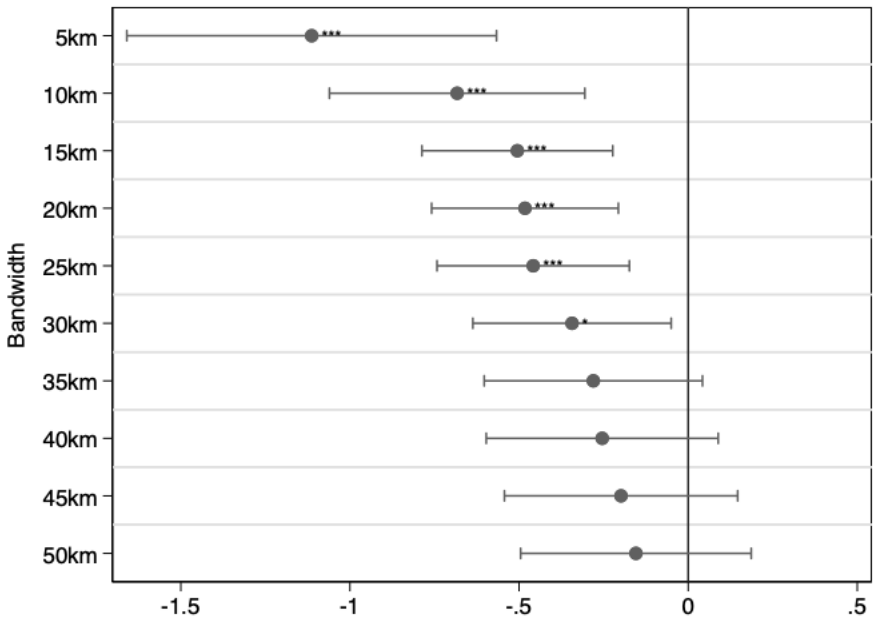
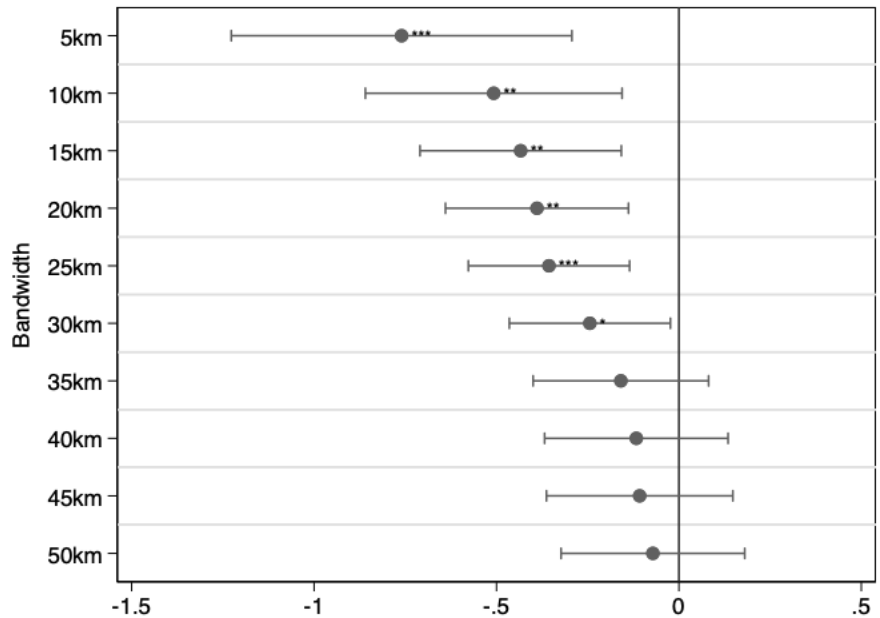
Robustness: Deforestation effects for varying bandwidths

Pre-split



Post-split



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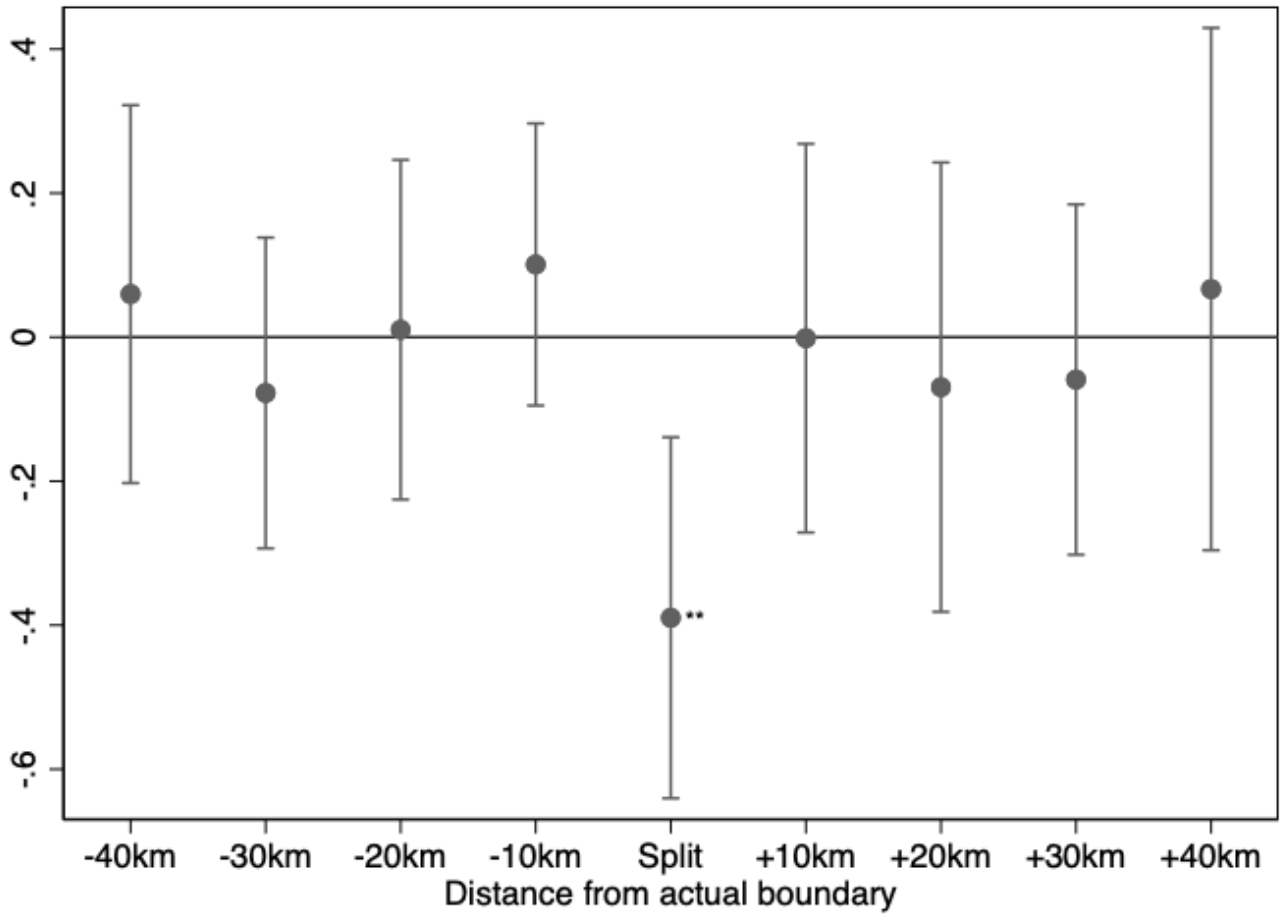
Placebo Test - Artificial Boundaries



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Continuity of other Variables I

	Panel A: Land-use characteristics in 2000		
	Forest cover (1)	Oil palm area (2)	Settlement area (3)
Child	−0.003	−0.004	0.007
	(0.019)	(0.005)	(0.009)
Obs.	14,320	14,300	14,320
Adjusted R^2	0.340	0.267	0.483

	Panel B: Socio-geographic characteristics (in 2000)						
	ln Pop. (1)	% Rural (2)	% Agricult. Income (3)	Subdist. city distance (4)	District city distance (5)	% Coastal location (6)	Altitude (7)
Child	0.038	0.024	0.006	−2.360	7.702	0.025	1.274
	(0.046)	(0.015)	(0.007)	(1.828)	(6.728)	(0.016)	(24.745)
Obs.	13,568	14,227	13,568	13,568	13,568	13,568	14,319
Adjusted R^2	0.503	0.075	0.070	0.166	0.670	0.260	0.787

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Continuity of other Variables II

Panel C: Socio-economic characteristics in 2000 (1)

	No. Poverty card (1)	No. health card (2)	% Phone (3)	% Radio (4)	% Hospital (5)	% Sub-hospital (6)	% Kinder-garten (7)
Child	5.840	8.568	0.002	0.004	–0.003	0.0179	0.006
	(4.916)	(7.207)	(0.005)	(0.021)	(0.004)	(0.005)	(0.002)
Obs.	13,569	13,569	13,569	13,569	13,569	13,569	13,569
Adjusted R^2	0.141	0.271	0.052	0.143	0.007	0.116	0.242

Panel D: Socio-economic characteristics in 2000 (2)

	% Primary school (1)	% Bank index 1 (2)	% Bank index 2 (3)	% Market index 1 (4)	% Market index 2 (5)	# State electr. access (6)	# Private electr. access (7)
Child	–0.005	–0.001	0.003	0.011	0.016	3.979	3.116
	(0.004)	(0.017)	(0.017)	(0.019)	(0.010)	(19.160)	(4.062)
Obs.	13,569	13,569	13,569	13,569	13,569	13,569	13,569
Adjusted R^2	0.251	0.047	0.073	0.065	0.064	0.400	0.149
Split ID FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Aggregated Dynamic Quadratic Fit

	(1)	(2)	(3)	(4)	(5)
	Panel A: Dep.: ln *Pre-split mean deforestation*				
Child	−1.065***	−0.880***	−0.704**	−0.627***	−0.670***
	(0.384)	(0.292)	(0.275)	(0.234)	(0.221)
Bandwidth	20	20	20	20	30 (66)
Observations	14,320	14,320	14,320	14,319	19,848
Adj. R^2	0.004	0.165	0.297	0.396	
	Panel B: Dep.: ln *Post-split mean deforestation*				
Child	−0.743*	−0.704**	−0.610**	−0.530**	−0.558***
	(0.381)	(0.288)	(0.268)	(0.223)	(0.214)
Bandwidth	20	20	20	20	26 (55)
Observations	14,320	14,320	14,320	14,319	17,746
Adj. R^2	0.004	0.215	0.355	0.472	
Island-year FE	No	Yes	No	No	No
Split-ID FE	No	No	Yes	Yes	Yes
Controls	No	No	No	Yes	Yes

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Local vs. average effects

$$
\begin{aligned}
D_{svdt} = & \sum_{\substack{\kappa=-4 \\ \kappa \neq -1}}^{4} \gamma_\kappa \, m_{dt-\kappa} + \gamma_{post} \sum_{\kappa>4} m_{dt-\kappa} \\
& + \sum_{\substack{\kappa=-4 \\ \kappa \neq -1}}^{4} \eta_\kappa \, c_{dt-\kappa} + \eta_{post} \sum_{\kappa>4} c_{dt-\kappa} \\
& + Z_{v0} \, \lambda_t + \alpha_v + \lambda_t + \epsilon_{svdt}
\end{aligned} \tag{1}
$$

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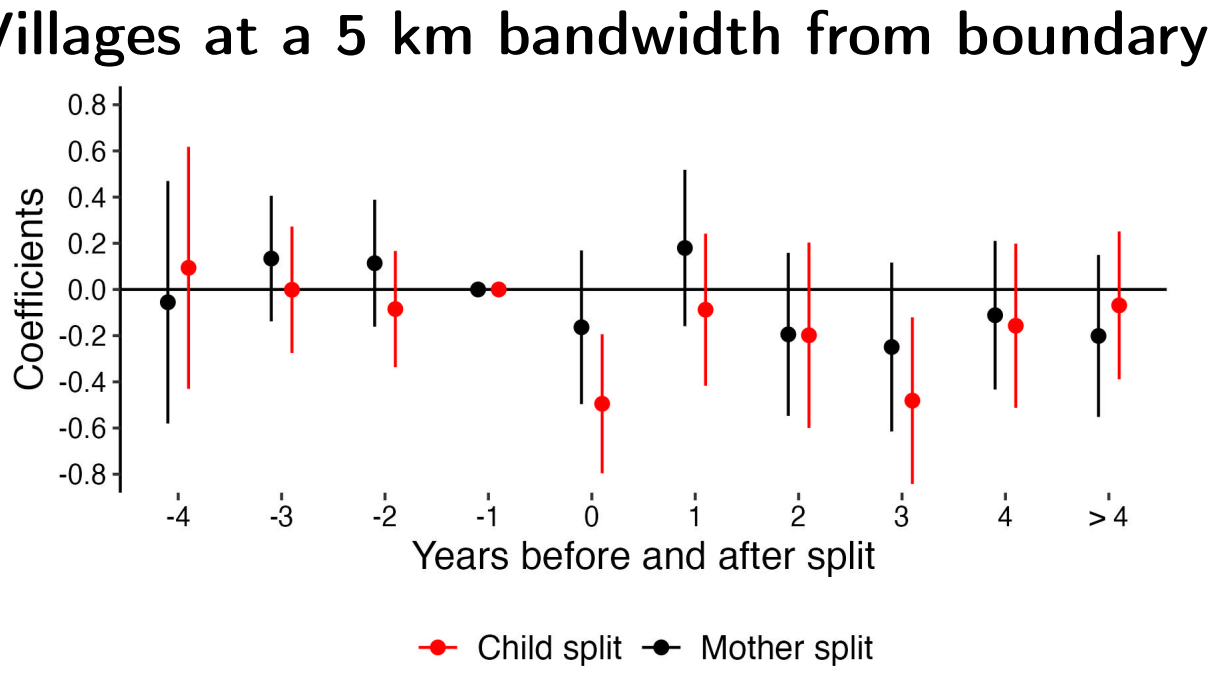
Local vs. average effects



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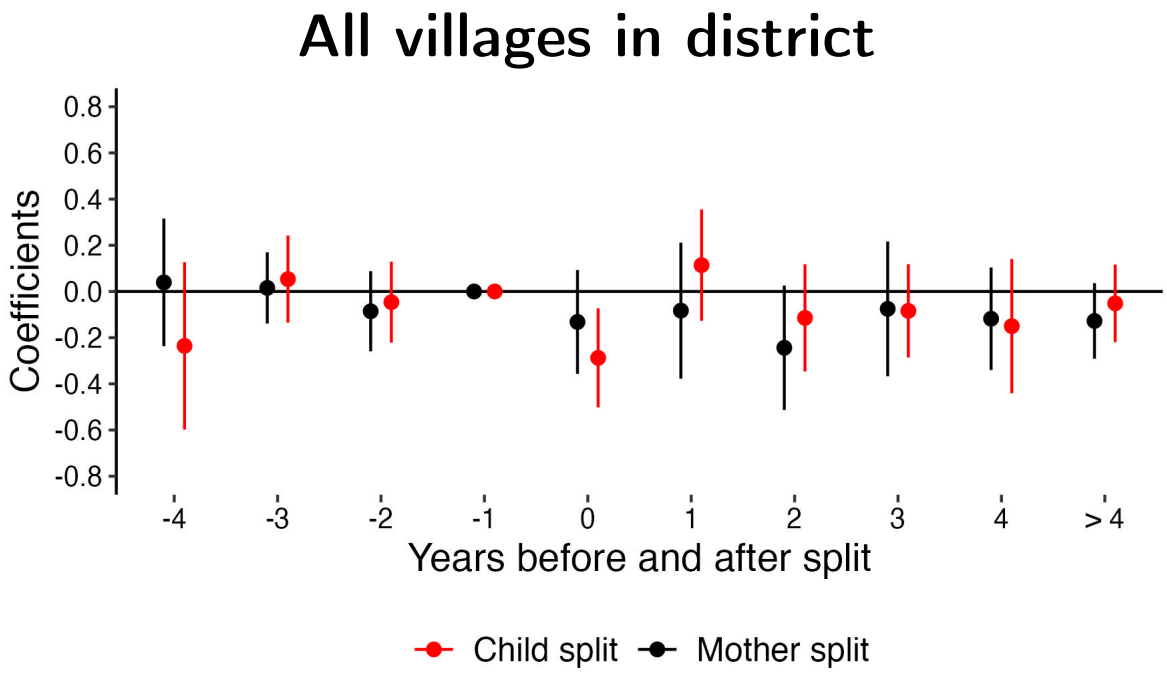
Local vs. average effects



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