Can reminders of rules induce compliance?

Experimental evidence from a common pool resource setting

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Motivation

Image source: carbonbrief.com

- Behavioural interventions as a (low cost) opportunity to reduce deforestation?
- RCT in 110 community managed forests in Uganda
- Intervention: SMS reminders of forest use rules

Research question

Can SMS reminders of communal forest use rules induce compliance with those rules?

Channels

- Attentiveness and knowledge
- Scrutiny and sanctioning

Image source: depositphoto.com

Preview of results

- Increase in self-reported knowledge of forest use rules

- Increase in the *perceived* probability of penalties
- Actual scrutiny and sanctioning are largely unchanged

- Little evidence of reductions in forest use

Contributions to the literature

- Behavioural interventions in environmental economics
  - Allcott (2011), Allcott (2014), Grasmick (1991), reviews by Carlsson and Johansson-Stenman, 2012; Brent et al., 2017; Schubert, 2017

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  - Ostrom (1990) and related work
- Changes in scrutiny and sanctioning as intermediate outcomes
  - Bateson et al., 2013; Nettle et al., 2013

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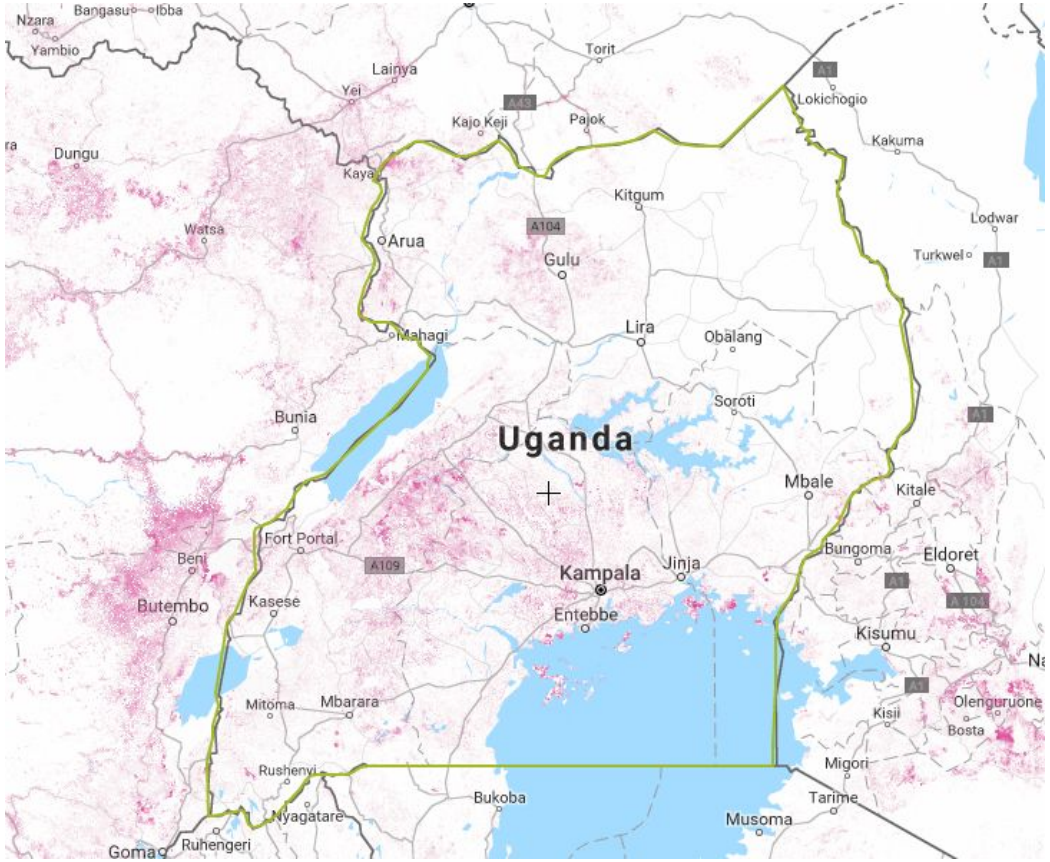
- Insights on common pool resource management from an RCT
  - Ostrom (1990) and related work
- Changes in scrutiny and sanctioning as intermediate outcomes
  - Bateson et al., 2013; Nettle et al., 2013
- Use text messages to change contribution to a public good
  - Dale and Strauss (2014); Karlan et al. (2016); Schoar (2011); Larochelle et al., (2019)

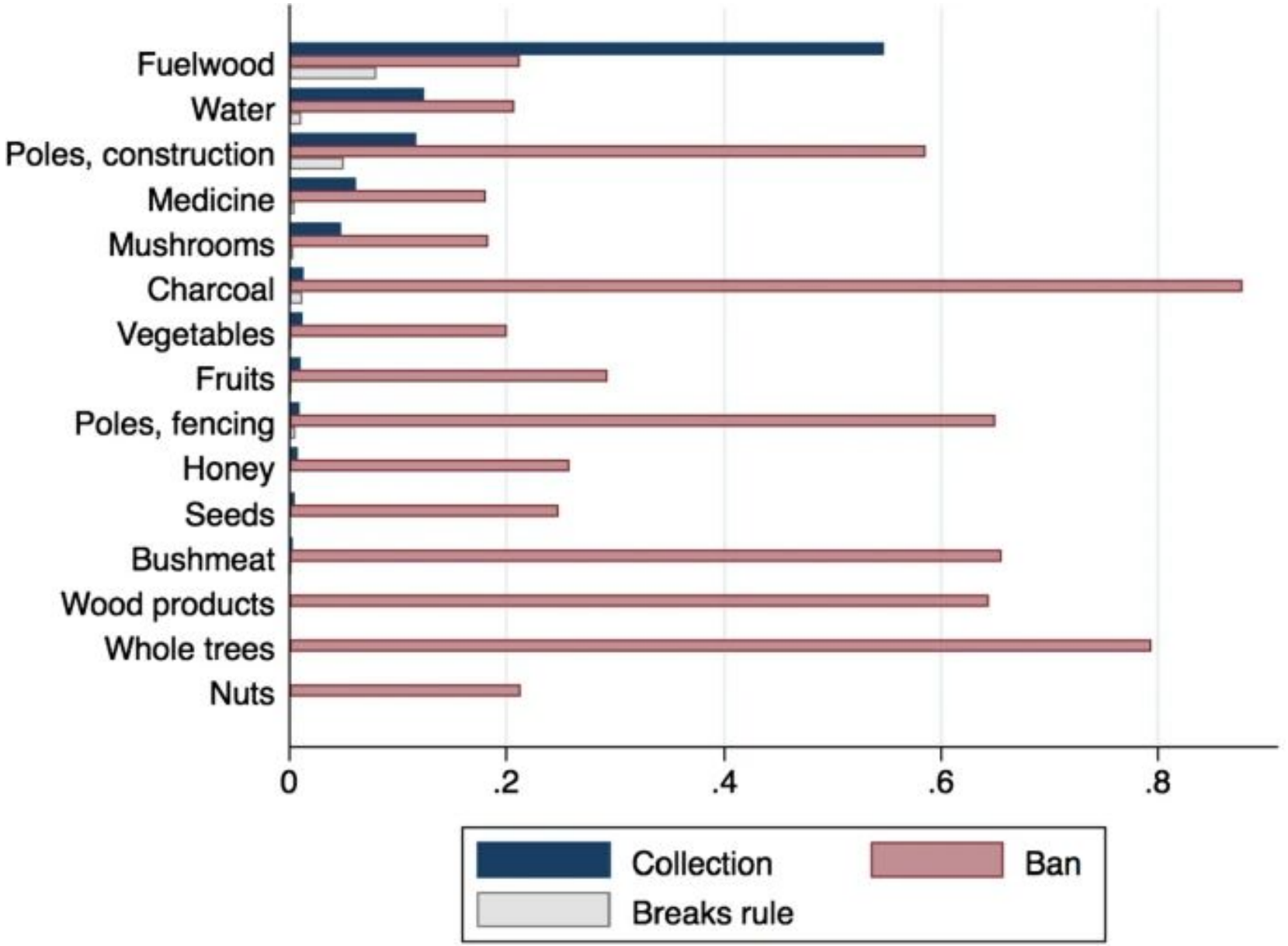
Setting



- Study set in 110 villages in Central, West and South-West Uganda
- Community managed forest
- Rules and sanctioning mechanisms in place
- Infringements are frequent

Image source: Global Forest Watch

Forest use and forest use rules at baseline



Pre-registered hypotheses

SMS reminders of forest use rules:

- increase knowledge of forest use rules
- increase attentiveness to forest use rules

- increase **actual** scrutiny and the willingness to sanction other forest users
- increase the **perceived** scrutiny and the perceived probability of sanctions by others upon breaking forest use rules

- increase compliance with forest use rules
- reduce forest use

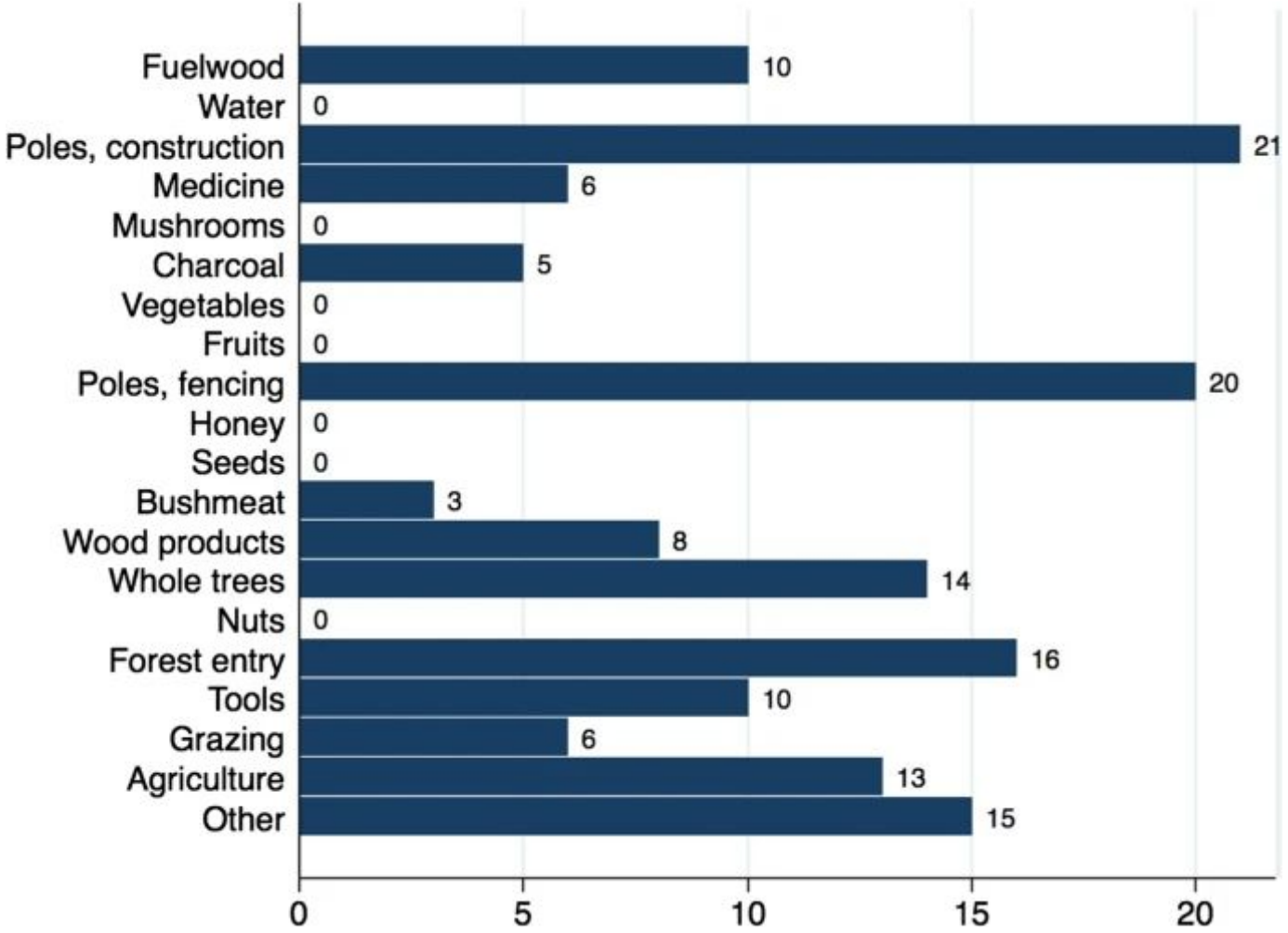
Experimental design

The treatment – SMS text message reminders

- Monthly reminders
- Community-specific rules
- 10 treatment villages
- 70 SMS recipients

Dear [name], please remember **that community members can only collect firewood on Wednesdays and Saturdays.** Thank you for obeying your community's rules.

Number of SMS reminders by type of forest use rule



Community forest monitoring as additional treatment

- 6 community members measure forest use and threats to the forest on a monthly basis
- Report findings of collective forest use in village meeting
- Display findings on a poster in a public place in the village

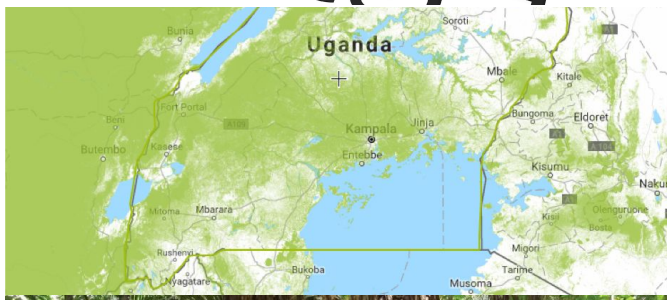
Sample and randomization

- 110 villages that do not border each other
- 11 forests

	Villages	Survey respondents (endline)	Attrition
Control	50	533	4.9%
Monitoring	50	527	4.0%
Monitoring & Rules	10	207	6.0%
Total	110	1,267	

- Block randomization based on forest cover, forest cover loss and forest ID
- Attrition is strongly balanced across treatments

Measurement of outcomes



- Knowledge of forest use rules and attentiveness to rules
- Actual and perceived scrutiny and sanctioning
- Non-compliance and self-reported forest use
- Normalized outcomes (z-scores) or indices of z-scores

- Household level forest cover loss rate (satellite)

- Villages level forest use (on-the-ground measures, robustness)

Estimating equation

- $$Y_{ijm1} = \alpha_m + \beta_1 \text{Monitoring}_j + \beta_2 \text{Monitoring}_j * \text{Rules}_j$$

$$+\gamma Y_{ijm0} + \delta X_{ij0} + \epsilon_{ijm1}$$

- Y_{ijm1} = Outcome for household *i* in village *j* in randomization block *m* at time t=1 (endline)

- Standard errors clustered at the village level

Effect of treatment on SMS recipients

$$Y_{ijm1} = \alpha_m + \beta_1 \text{ Monitoring}_j + \beta_2 \text{ Monitoring}_j * \text{Rules}_j +$$

$$\beta_3 \text{ Monitoring}_j * \text{Rules}_j * \text{SMS recipient}_{ij} + \gamma Y_{ijm0} + \delta X_{ij0} + \epsilon_{ijm1}$$

- $\text{SMS recipient}_{ij}$=1 if household received the SMS reminder
- Not causal since SMS recipients were not randomized within rules treatment villages

Table 1: Summary statistics and balance tests

Variable	(1) Mon, t=0	(2) Rules, t=0	(3) Mon, t=1	(4) Rules, t=1	(5) Diff. t=0	(6) Diff. t=1
Knowledge and attentiveness						
Knowledge			0.079	0.090		0.011
			(0.569)	(0.495)		(0.046)
Attentiveness			0.036	-0.008		-0.044
			(0.998)	(0.984)		(0.083)
Scrutiny and sanctioning						
Scrutiny of others			-0.008	-0.082		-0.073
			(0.859)	(0.807)		(0.071)
Sanctioning of others			-0.010	-0.046		-0.036
			(0.730)	(0.699)		(0.060)
Scrutiny by others			0.076	0.034		-0.042
			(0.985)	(0.973)		(0.083)
Sanctioning by others			-0.028	-0.041		-0.013
			(0.623)	(0.612)		(0.052)
Non-compliance and forest use						
Non-compliance	0.009	-0.005	0.033	0.048	0.003	0.015
	(0.283)	(0.189)	(0.321)	(0.273)	(0.267)	(0.026)
Non-compliance 2	-0.026	0.032	0.053	0.075	-0.006	0.022
	(0.319)	(0.588)	(0.512)	(0.491)	(0.398)	(0.042)
Forest use	-0.025	0.017	0.011	-0.063	-0.008	-0.074**
	(0.319)	(0.592)	(0.413)	(0.334)	(0.384)	(0.032)
Forest use (village)	0.389	0.063	0.091	0.010	-0.326	-0.081
	(1.015)	(0.378)	(0.543)	(0.754)	(0.327)	(0.201)

The table reports average outcomes for households receiving only the monitoring treatment (mon) and villages receiving both the community monitorinig and rules SMS reminder treatment (rules) at baseline (t=0) and at endline (t=1). Columns (5) and (6) report differences in means at baseline and endline, respectively. The values in parentheses show standard deviations for the means (Column 1-4) and standard errors for differences (Columns 5-6). * p<0.1, ** p<0.05, *** p<0.01

Results

Effect of SMS reminders on HH in treatment communities

- Raise knowledge of, but not attentiveness to forest use rules
- No evidence of an increase in scrutiny or sanctioning of others
- Significant increase in the **perceived** probability of sanctions by others
- No increase in compliance or systematic reduction in forest use

Effect on SMS recipients

Within treatment communities SMS recipients have:

- Better self-reported knowledge of forest use rules
- Higher attentiveness to forest use rules
- Are more likely to scrutinize or sanction others for violations of forest use rules
- Feel more closely scrutinized by others
- No evidence that SMS reminders increased compliance or reduced forest use amongst users.

Effect of community monitoring
Eisenbarth et al. (2021) PNAS

- Community monitoring did not reduce forest use overall
- Displacement from monitored to unmonitored areas
- Likely driver: Fear of sanctions

Conclusion

RCT to test the effectiveness of rules reminders on compliance with rules and forest use

- Increase knowledge of forest use rules but not attentiveness

- Increase in the *perceived* likelihood of penalties

- Limited evidence of reduction in forest use

Lessons for policy-makers

- Program needs to ensure take-up
- Nudges can be context-specific
- Program design should reduce leakage risk

Open research question

- Can nudges work in a developing country or communal resource use context?
- (How) can we best improve management of communal resources through external interventions?
- What are the constraints that prevent successful conservation in a developing country context and how can we alleviate those along with conservation interventions?

Thank you for your attention!

Contact: s.eisenbarth@exeter.ac.uk

Effects on knowledge and attentiveness

Measuring knowledge and attentiveness through household surveys

- Knowledge index capturing
  - Self-reported knowledge of forest use rules
  - 5 point Likert scale where higher values indicate better knowledge
  - Objective knowledge of forest use rules
  - Index based on a household's ability to identify whether rules limit the collection of forest products or entry into the forest
- Attentiveness
  - proxied by the frequency with which households discuss forest use rules

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Table 2: Knowledge of and attentiveness to forest use rules

	(1) Knowledge	(2) Self-reported	(3) Objective	(4) Attentiveness
Monitoring	0.124*	0.142**	0.138	0.143**
	(0.067)	(0.065)	(0.090)	(0.067)
Monitoring × Rules	0.221	0.267*	0.225	-0.124
	(0.147)	(0.144)	(0.192)	(0.152)
$\beta_1 + \beta_2$	0.345	0.409	0.363	0.019
$\beta_1 + \beta_2$ p-value	0.024	0.007	0.070	0.897
Control mean	0.002	0.101	-0.009	-0.019
Lag dep. var.	No	Yes	No	No
Controls	Yes	Yes	Yes	Yes
Observations	915	570	915	916

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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Effects on scrutiny and sanctioning

Measuring scrutiny and sanctioning of others

- Scrutiny of others
  - Households patrolled the forest frequently
  - Households consider it likely that they would notice infringements by neighbours

- Sanctioning of others
  - Hypothetical: Imagine your neighbor broke a forest use rule. How likely is it that you would scold them/report them to authorities?
  - Actual: Have you scolded/reported someone for breaking forest use rules.

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Measuring scrutiny and sanctioning of others

Outcome variable	Component household survey questions	
Scrutiny of others		In the past 12 months, have you or members of your household voluntarily patrolled the common pool forest? [Yes=1]
		Imagine your neighbour broke a rule relating to forest use. How likely is it that you would notice that your neighbour did this? (Likert scale, very likely=5)
Sanction others	Hypothetical	Imagine your neighbour broke a rule relating to forest use. How likely is it you would scold your neighbour? (Likert scale, very likely=5)
	Hypothetical	Imagine your neighbour broke a rule relating to forest use. How likely is it you would report your neighbour to (i) the local government (ii) a community-based organisation responsible for common pool forest (iii) the NFA? (Likert scale, very likely=5)
	Actual	At times, people in this village may break the rules relating to forest use. In the past year, have you personally (i) scolded someone in the villages for breaking the rules? [Yes=1] (ii) reported someone in the village to the LC1, the CFM or CLA or the NFA, for breaking the rules? [Yes=1]

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Table 3: Scrutiny and sanctioning of others

	(1) Scrutiny of others	(2) Sanctioning others	H
Monitoring	0.040	0.027	
	(0.046)	(0.042)	
Monitoring × Rules	-0.131	-0.023	
	(0.116)	(0.095)	
$\beta_1 + \beta_2$	-0.091	0.004	
$\beta_1 + \beta_2$ p-value	0.410	0.964	
Control mean	-0.034	-0.017	
Lag dep. var.	No	No	
Controls	Yes	Yes	
Observations	914	916	

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Table 3: Scrutiny and sanctioning of others

	(1) Scrutiny of others	(2) Sanctioning others	(3) Hypothetical	(4) Actual
Monitoring	0.040	0.027	0.016	0.046
	(0.046)	(0.042)	(0.049)	(0.048)
Monitoring × Rules	-0.131	-0.023	-0.054	0.043
	(0.116)	(0.095)	(0.116)	(0.110)
$\beta_1 + \beta_2$	-0.091	0.004	-0.038	0.089
$\beta_1 + \beta_2$ p-value	0.410	0.964	0.731	0.429
Control mean	-0.034	-0.017	-0.022	-0.005
Lag dep. var.	No	No	No	No
Controls	Yes	Yes	Yes	Yes
Observations	914	916	915	916

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Measuring perceived scrutiny and sanctions by others

- **Perceived** scrutiny by others
  - Imagine you broke a rule relating to forest use. How likely is it that your neighbour would notice that you did this? [very likely=5]
- **Perceived** probability of sanctions by others
  - Hypothetical:
  - If a household in this village breaks a rule about forest use, how likely is it that they will receive a penalty? [very likely=5]
  - Actual:
  - In the past 12 months, have you or members of your household been scolded/received penalties for violating forest use rule. [Yes=1]

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Table 4: Scrutiny and sanctioning by others

	(1) Scrutiny by others	(2) Sanctioning by others
Monitoring	0.112	0.004
	(0.069)	(0.039)
Monitoring × Rules	-0.159	0.149**
	(0.151)	(0.072)
$\beta_1 + \beta_2$	-0.048	0.153
$\beta_1 + \beta_2$ p-value	0.732	0.040
Control mean	-0.002	-0.010
Lag dep. var.	No	No
Controls	Yes	Yes
Observations	907	916

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Table 4: Scrutiny and sanctioning by others

	(1) Scrutiny by others	(2) Sanctioning by others	(3) Hypothetical	(4) Actual
Monitoring	0.112	0.004	-0.077	0.042
	(0.069)	(0.039)	(0.059)	(0.048)
Monitoring × Rules	-0.159	0.149**	0.393***	0.033
	(0.151)	(0.072)	(0.132)	(0.076)
$\beta_1 + \beta_2$	-0.048	0.153	0.316	0.075
$\beta_1 + \beta_2$ p-value	0.732	0.040	0.022	0.374
Control mean	-0.002	-0.010	4.401	-0.020
Lag dep. var.	No	No	Yes	No
Controls	Yes	Yes	Yes	Yes
Observations	907	916	876	916

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Effect on compliance and forest use

Measuring non-compliance and forest use

- Non-compliance index
  - Higher values if households self-report collection of (several) forest products even though collection is completely banned
- Non-compliance index 2
  - Compliance with those forest use rules that were specifically targeted by the SMS reminders
- Forest use
  - Self-reported and forest loss from satellite images

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	(1) Non-compliance	(2) Non-compliance 2	(3) Forest use
Monitoring	0.015	0.017	0.026
	(0.020)	(0.036)	(0.022)
Monitoring × Rules	0.074*	0.081	-0.065
	(0.040)	(0.081)	(0.064)
$\beta_1 + \beta_2$	0.089	0.098	-0.038
$\beta_1 + \beta_2$ p-value	0.027	0.208	0.554
Control mean	0.001	0.009	0.011
Lag dep. var.	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	910	960	963

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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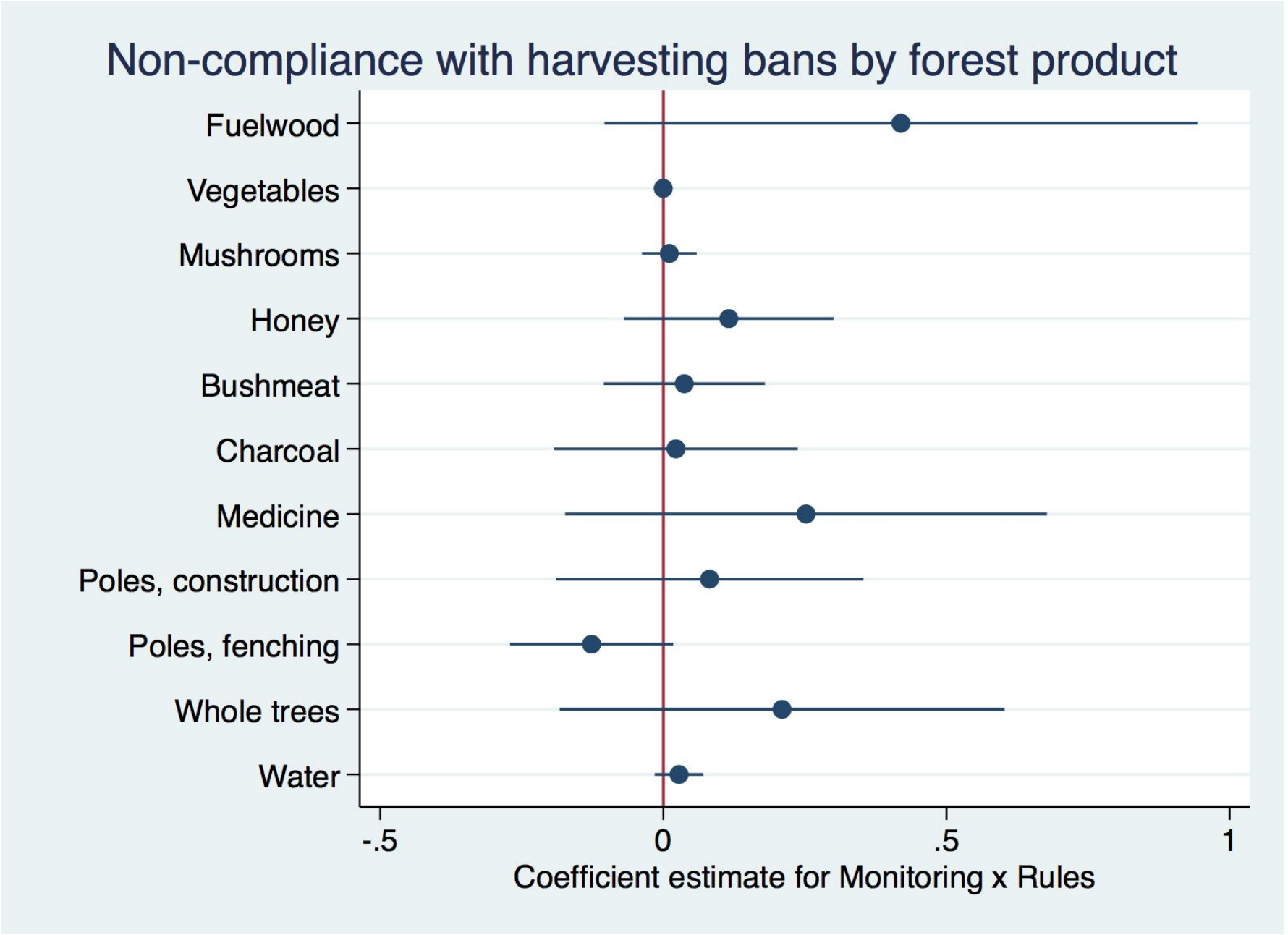

Note: Figure shows the coefficient estimate for the treatment indicator “Monitoring x Rules”

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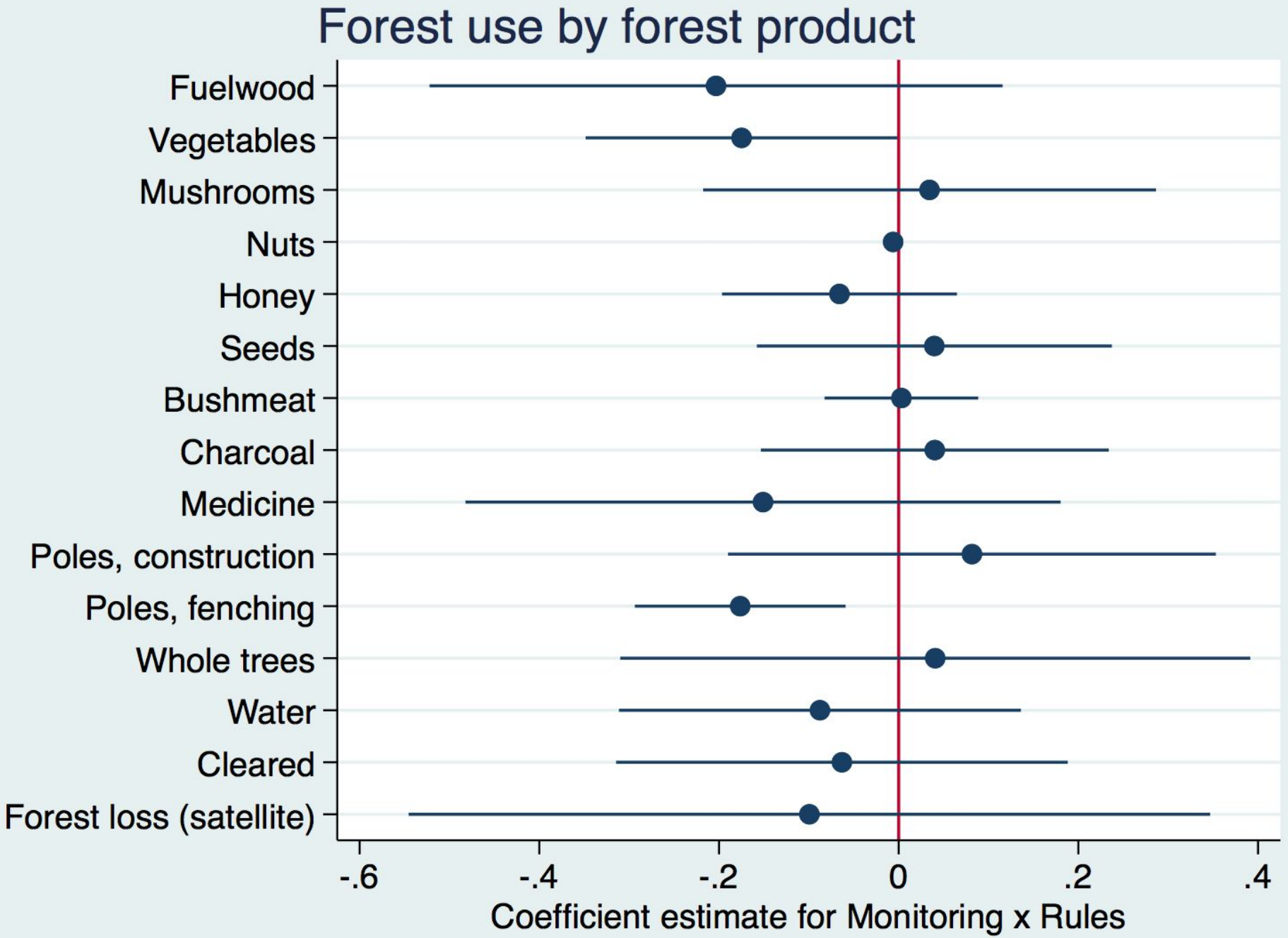
Forest use by forest product
Fuelwood
Vegetables
Mushrooms
Nuts
Honey
Seeds
Bushmeat
Charcoal
Medicine
Poles, construction
Poles, fenching
Whole trees
Water
Cleared
Forest loss (satellite)
-.6
-.4
-.2
0
.2
.4
Coefficient estimate for Monitoring x Rules

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Village level forest use

	(1) Forest use
Monitoring	0.095
	(0.101)
Monitoring*Rules	-0.078
	(0.229)
Control mean	.012
$\beta_1 + \beta_2$	0.017
$\beta_1 + \beta_2$ p-value	0.939
Lagged dependent variable	Yes
Controls	Yes
Observations	110

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Village level forest use

	(1) Forest use	(2) Cut trees	(3) Animals	(4) Kilns	(5) Cut branches	(6) Forest loss 1	(7) Forest loss 2
Monitoring	0.095	0.947**	-0.018	-0.024	0.047	-0.002	0.016
	(0.101)	(0.449)	(0.015)	(0.038)	(0.043)	(0.006)	(0.028)
Monitoring*Rules	-0.078	-2.037**	-0.119	-0.003	0.032	-0.003	-0.013
	(0.229)	(0.907)	(0.104)	(0.045)	(0.052)	(0.019)	(0.058)
Control mean	.012	1.66	.045	.041	.034	.013	.032
$\beta_1 + \beta_2$	0.017	-1.090	-0.137	-0.027	0.079	-0.005	0.003
$\beta_1 + \beta_2$ p-value	0.939	0.215	0.204	0.327	0.230	0.785	0.960
Lagged dependent variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	110	102	102	102	102	97	98

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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Results for SMS recipients

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Table D.7: Knowledge and attentiveness - SMS recipients

	(1) Knowledge	(2) Self-reported	(3) Objective	(4) Attentiveness
Monitoring	0.110*	0.097	0.134	0.034
	(0.062)	(0.062)	(0.083)	(0.065)
Monitoring × Rules	0.239	-0.070	0.302	-0.066
	(0.148)	(0.112)	(0.190)	(0.126)
SMS recipient	0.086	0.700***	-0.083	0.623***
	(0.087)	(0.180)	(0.123)	(0.198)
$\beta_1 + \beta_2 + \beta_3$	0.434	0.728	0.353	0.591
$\beta_1 + \beta_2 + \beta_3$ p-value	0.011	0.001	0.131	0.004
Control mean	-0.031	0.000	-0.053	-0.000
Lag dep. var.	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	1205	1184	1205	1206

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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Table D.8: Scrutiny and sanctioning of others - SMS recipients

	(1) Scrutiny of others	(2) Sanctioning others	(3) Hypothetical	(4) Actual
Monitoring	0.015	-0.010	-0.015	-0.001
	(0.048)	(0.046)	(0.055)	(0.047)
Monitoring × Rules	-0.127	-0.108	-0.096	-0.129*
	(0.081)	(0.068)	(0.092)	(0.075)
SMS recipient	0.520***	0.507***	0.470***	0.579***
	(0.150)	(0.103)	(0.107)	(0.161)
$\beta_1 + \beta_2 + \beta_3$	0.408	0.390	0.359	0.449
$\beta_1 + \beta_2 + \beta_3$ p-value	0.004	0.000	0.000	0.011
Control mean	-0.029	-0.002	-0.001	-0.000
Lag dep. var.	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	1204	1206	1205	1206

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Table D.9: Scrutiny and sanctioning by others - SMS recipients

	(1) Scrutiny by others	(2) Sanctioning by others	(3) Hypothetical	(4) Actual
Monitoring	0.070	-0.029	-0.051	-0.017
	(0.060)	(0.042)	(0.064)	(0.044)
Monitoring × Rules	-0.034	0.005	0.165	-0.072
	(0.134)	(0.070)	(0.130)	(0.065)
SMS recipient	0.348***	0.050	0.166	-0.002
	(0.100)	(0.078)	(0.129)	(0.090)
$\beta_1 + \beta_2 + \beta_3$	0.384	0.026	0.280	-0.090
$\beta_1 + \beta_2 + \beta_3$ p-value	0.012	0.805	0.132	0.377
Control mean	0.000	-0.001	4.388	-0.005
Lag dep. var.	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	1195	1206	1193	1206

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01

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Table D.10: Compliance and household forest use - SMS recipients

	(1) Non-compliance	(2) Non-compliance 2	(3) Forest use
Monitoring	0.033*	0.034	-0.011
	(0.019)	(0.037)	(0.028)
Monitoring × Rules	0.061*	0.044	-0.101
	(0.035)	(0.084)	(0.062)
SMS recipient	0.027	0.070	0.013
	(0.040)	(0.064)	(0.045)
$\beta_1 + \beta_2 + \beta_3$	0.122	0.148	-0.099
$\beta_1 + \beta_2 + \beta_3$ p-value	0.023	0.188	0.116
Control mean	-0.000	0.017	0.018
Lag dep. var.	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	1205	1265	1266

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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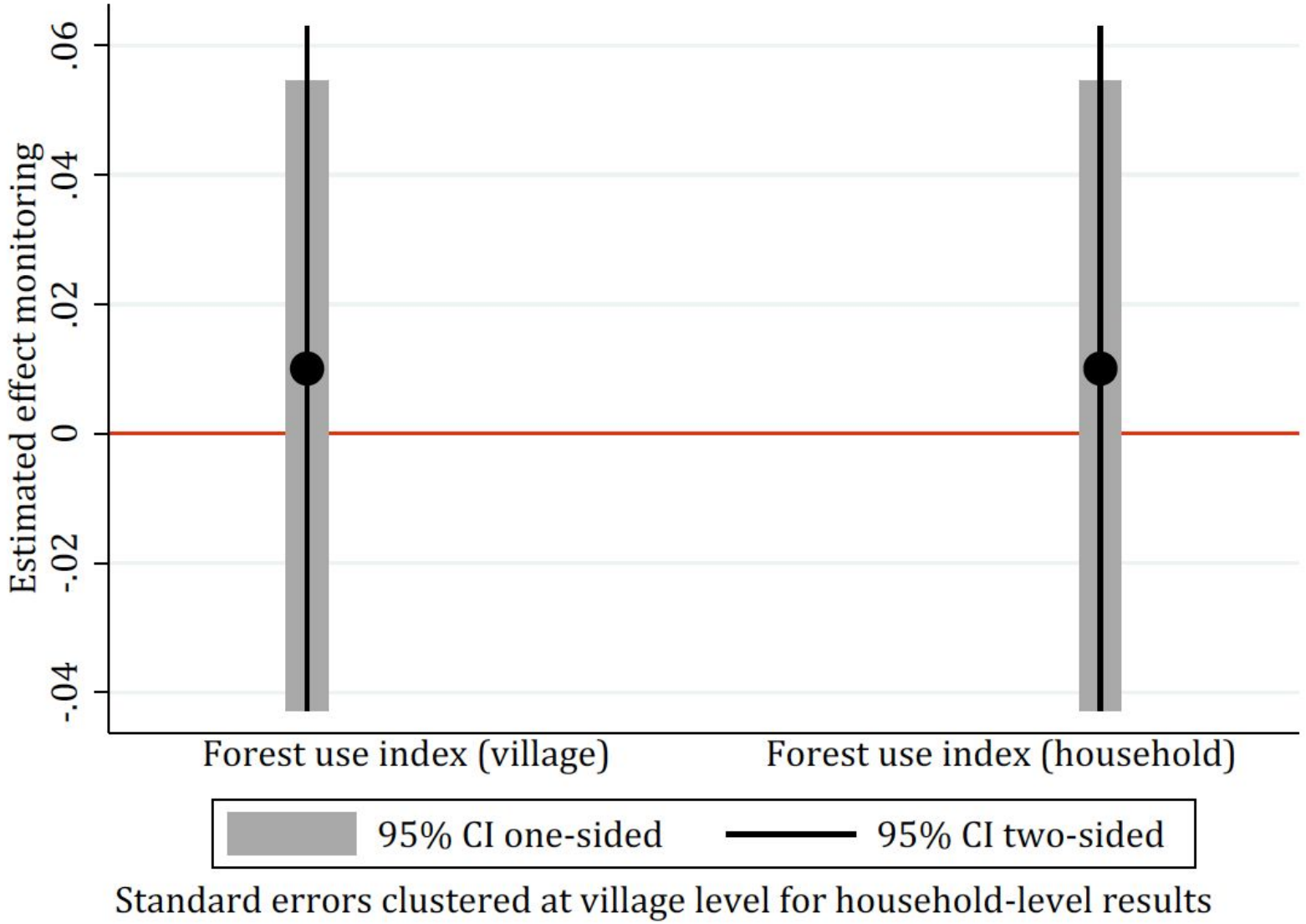
Effect of community monitoring treatment


Estimated effect monitoring
.06
.04
.02
0
-.02
-.04
Forest use index (village)
Forest use index (household)
95% CI one-sided
95% CI two-sided
Standard errors clustered at village level for household-level results

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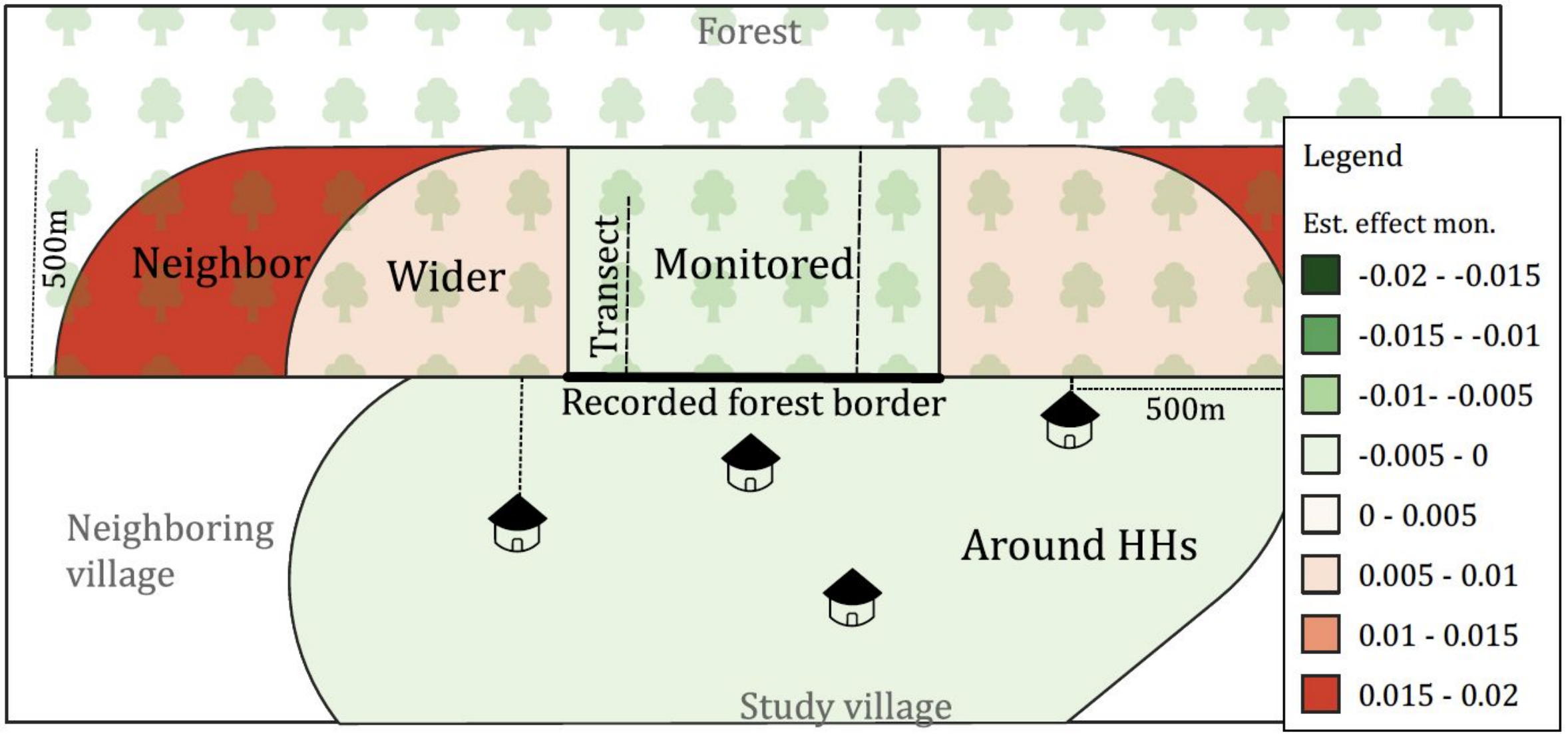
Effect on forest loss



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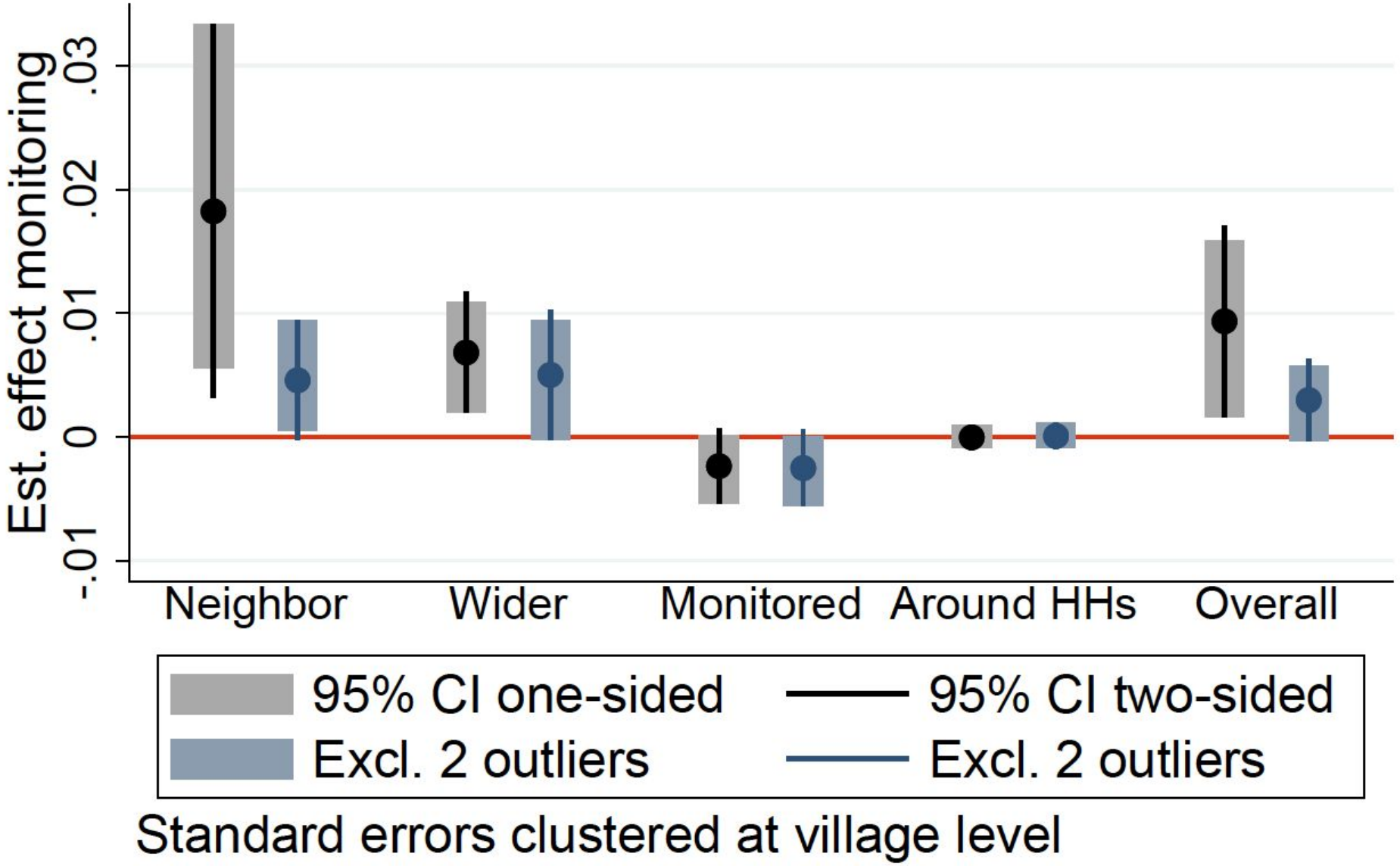
Effect on forest loss



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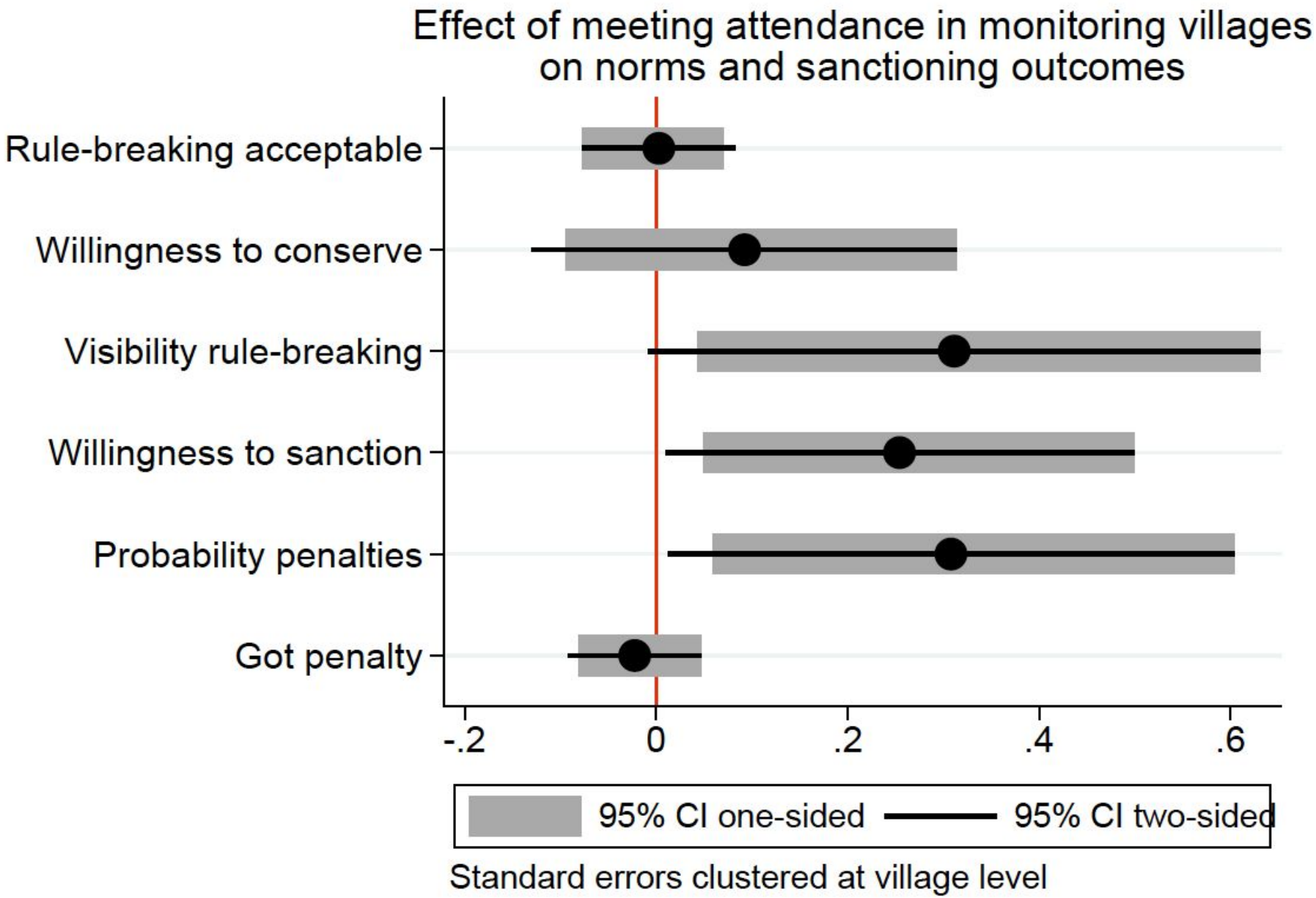
Effect of meeting attendance in monitoring villages
on norms and sanctioning outcomes
Rule-breaking acceptable
Willingness to conserve
Visibility rule-breaking
Willingness to sanction
Probability penalties
Got penalty
-.2
0
.2
.4
.6
95% CI one-sided
95% CI two-sided
Standard errors clustered at village level

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