The Effectiveness of Environmental Provisions in Regional Trade Agreements

Ryan Abman, Clark Lundberg, and Michele Ruta

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Ryan Abman[1] Clark Lundberg[1] Michele Ruta[2]

[1]San Diego State University

[2]IMF

Summary

Main Findings

- Trade agreements increase net forest loss by approximately 23%
- Provisions in trade agreements aimed at protecting forests and biodiversity **completely offset** these increases
- Effects concentrated in "high-risk" countries: tropics, developing, high biodiversity
- Mitigation appears to be attributable to limiting agricultural extensification: trade agreements increase net area under cultivation by 5.5% which is **entirely offset** by provision inclusion.
- Still gains in total output attributable to intensification and net increases in agricultural exports.

Introduction

Trade and the Environment

Gains from trade are not universal—growing evidence that opening trade can lead to negative environmental impacts:

- Natural resources (e.g. Erhardt, 2018; Taylor, 2011; Copeland and Taylor, 2009)
- Deforestation (e.g. Abman and Lundberg, 2020; Leblois et al., 2017; Alix-Garcia et al., 2018)
- Pollution (e.g. Shapiro, 2020; Baghdadi et al., 2013; Managi et al., 2009; Antweiler et al., 2001)

Regional Trade Agreements

- Arguably the most important trade policy tool: 350 RTAs in the past 30 years (nearly every country in the world)
- Bilateral/multilateral trade liberalization: include free trade agreements, customs unions, partial scope agreements, and economic integration agreements
- Since the 1990s RTAs have deepened to include policy areas well beyond tariffs (Mattoo, Rocha, Ruta, 2021)

Environmental Protection Provisions in RTAs

- RTAs increasingly include provisions aimed at mitigating environmental impacts
- Are these provisions mitigating environmental degradation or are they a form of veiled protectionism (Frankel, 2009)?
- Specifically, do environmental provisions related to forest conservation mitigate deforestation arising from trade liberalization?

Data

Environmental Provisions and Deforestation

We focus on *deforestation* as a measurable environmental outcome:

- one of the most urgent environmental challenges of the modern era (e.g. biodiversity, climate change)
- spatially explicit and attributable (vs. e.g. emissions), non-administrative
- satellite-derived annual forest loss at 30 m^2 resolution (Hansen et al., 2013)

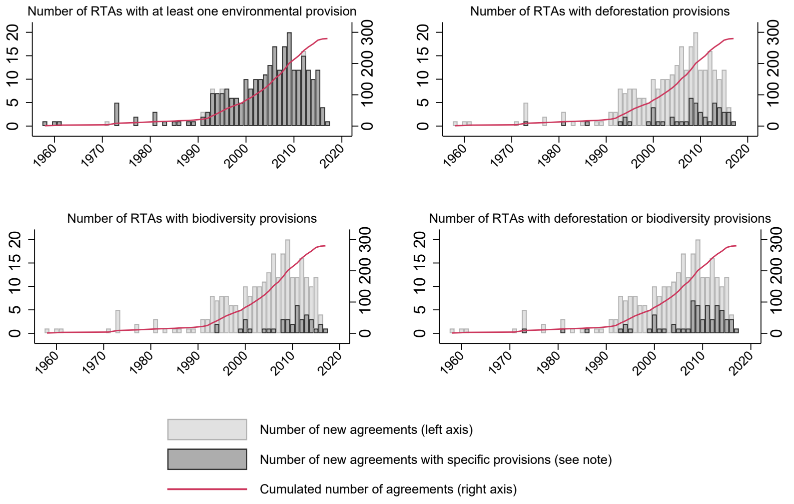
Kenya Example

Environmental Provisions and Deforestation

Identify provisions germane to deforestation using the Environmental Laws chapter (Monteiro and Trachtman, 2020) of the new World Bank DTA database (Mattoo et al., 2020):

- "Does the agreement require measures to prevent deforestation and/or require sustainable trade practices in forest products?"
- "Does the agreement require states to promote and protect biodiversity?"

Environmental Provisions in RTAs over time



Econometric Approach

Identification Challenges

Are these provisions effective? Answering presents challenges:

- Agreement content is not exogenous
- Existing approaches in trade literature not well-equipped to address this type of endogeneity (e.g. three-way FE gravity model, country-pair matching, etc.)
- We develop a new approach: a matched RTA-level panel analysis

RTA-level Panel

- Agreement level panel: aggregate outcomes to the RTA level by summing over signatory countries by year:

$$y_{gt} = \sum_{i=1}^{n} y_{it} \mathbb{1}[i \in G] \tag{1}$$

  for RTA g in year t, where i indexes countries and $\mathbb{1}[i \in G] = 1$ if country i is in the set of countries G that are signatories to RTA g (and 0 otherwise)

- y_{gt} measures *net* outcomes among signatories. i.e. it will account for shifting economic activity, especially in response to RTAs.

Matched Triple Difference

- Two-way FE Triple difference model on panel of RTAs:

$$y_{gt} = \beta_1 \mathbb{1}[Post\_RTA_{gt}] + \beta_2 \mathbb{1}[Post\_RTA_{gt}] \times \mathbb{1}[Enviro\_RTA_{gt}] + \alpha_g + \gamma_t + \varepsilon_{gt} \quad (2)$$

  where g indexes RTA and t indexes year.

Match treated units (RTAs with environmental provisions) to similar untreated units—appropriate counterfactuals allow for causal identification (ATT)

Matching Details

Main Results

Matched Triple Difference Results — Deforestation

Table 1: Aggregate Forest Loss

	Dependent variable:			
	Log Forest Loss		Deforestation Rate	
	(1)	(2)	(3)	(4)
Post RTA	0.236***	0.019	0.001***	0.00004
	(0.046)	(0.044)	(0.0004)	(0.0001)
Post × Enviro RTA	−0.230***	0.067	−0.001†	0.001**
	(0.048)	(0.045)	(0.001)	(0.0003)
Observations	630	1,918	630	1,918
R^2	0.983	0.990	0.823	0.768
Matched	✓	–	✓	–

Penalty Sensitivity Event Studies Control Composition Sensitivity

Matched Triple Difference Results — Higher/lower Risk Countries

Table 2: Log Forest Loss by High-risk Country Categories

	Higher Risk			*Lower Risk*		
	Tropical	Developing	High Biodiv	Non tropical	Developed	Lower Biodiv
	(1)	(2)	(3)	(4)	(5)	(6)
Post RTA	0.257***	0.233***	0.228***	0.048	0.094	0.219
	(0.062)	(0.065)	(0.079)	(0.111)	(0.125)	(0.216)
Post × Enviro RTA	−0.188***	−0.212***	−0.212**	−0.092	−0.099	−0.268
	(0.057)	(0.057)	(0.090)	(0.151)	(0.150)	(0.286)
Observations	630	630	630	630	630	630
R^2	0.997	0.994	0.998	0.998	0.997	0.996

Matched Triple Difference Results — Intermediate Mechanisms

Table 3: Trade and Production of Agricultural Output and Forest Products (log)

	Dependent variable:				
	Ag (Ha)	Ag (Ton)	Ag Exports	Timber	Forest Exports
	(1)	(2)	(3)	(4)	(5)
Post RTA	0.055**	0.061*	0.137**	0.037	0.070
	(0.022)	(0.036)	(0.054)	(0.027)	(0.089)
Post × Enviro RTA	−0.055**	−0.043	−0.100†	−0.030	−0.107
	(0.025)	(0.054)	(0.074)	(0.035)	(0.086)
Observations	616	616	616	602	616
R^2	0.999	0.998	0.995	0.997	0.988
Matched	✓	✓	✓	✓	✓

Conclusion

- Provisions aimed at protecting biodiversity and forests **are** effective at mitigating forest loss from trade liberalization
- Provisions appear to limit agricultural extensification in high-risk countries
- Provisions reduce, but do not eliminate, gains to total agricultural output: suggests increases at the intensive margin too (environmental costs to intensification)
- Important insights for effective policy formation at the nexus of trade, agriculture, and the environment

Thank you!

Questions/comments/suggestions all very welcome!

- Ryan Abman: rabman@sdsu.edu
- Clark Lundberg: clundberg@sdsu.edu
- Michele Ruta: mruta@imf.org

Alternative Identification Strategy

- Country-level analysis, allows for *country* fixed effects
- Countries enter into multiple RTAs in sample, some have environmental provisions, some do not (identification of provision effects from **within country** variation in RTA content)
- Multiple overlapping treatment precludes DiD or Triple Difference models. Focus on estimating dynamics around entry into force of RTAs: multiple event study

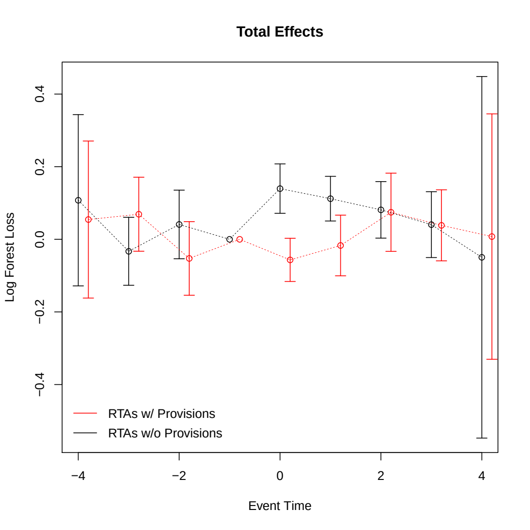
Multiple Event Study

- Exogenous timing of entry into force (Abman and Lundberg, 2020)
- Allows for multiple overlapping treatments (entry into force of RTA)
- Dummies for leads/lags of entry into force with country and year FE
- Reference unit is year before entry into force at the country level

$$y_{it} = \delta_{LR-}\mathbb{1}[RTA_{(<-3),it}] + \sum_{\substack{s=-3, \\ s\neq -1}}^{3} \delta_s \mathbb{1}[RTA_{s,it}] + \delta_{LR+}\mathbb{1}[RTA_{(>3),it}]$$

$$+ \xi_{LR-}\mathbb{1}[enviro_{(<-3),it}] + \sum_{\substack{s=-3, \\ s\neq -1}}^{3} \xi_s \mathbb{1}[enviro_{s,it}] + \xi_{LR+}\mathbb{1}[enviro_{(>3),it}] + \alpha_i + \gamma_t + \varepsilon_{it} \tag{3}$$

Multiple Event Study Coefficient Plot



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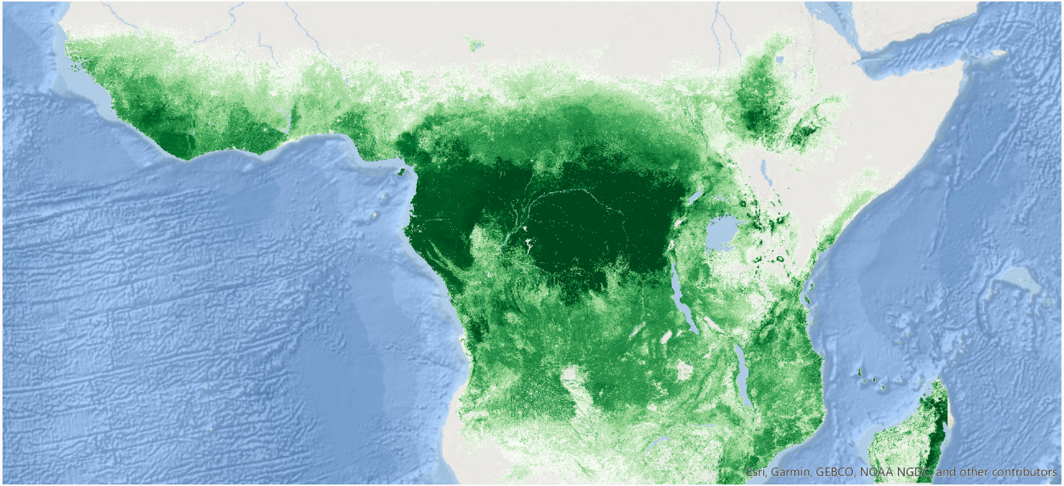
Matched Triple Difference Results — Specialized DS

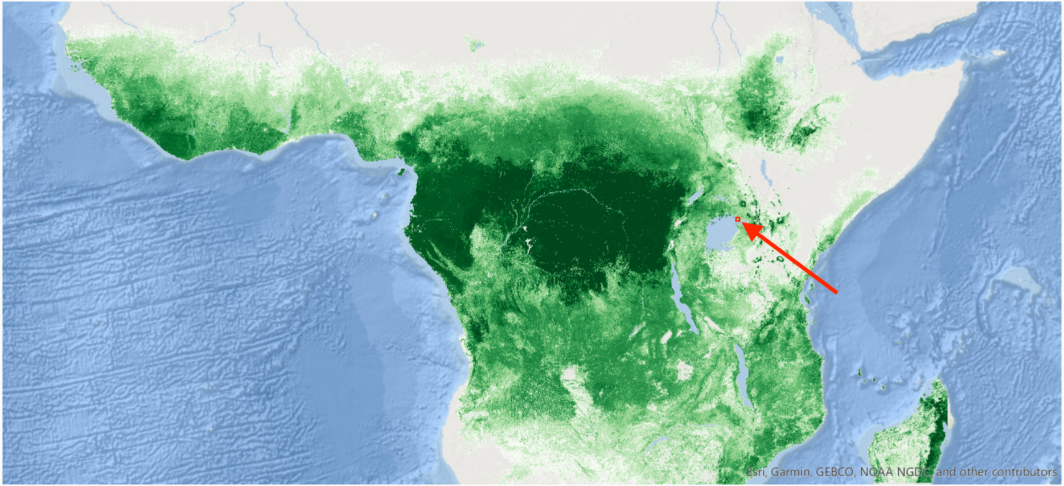
Table 4: Provision-specific Dispute Settlement Mechanisms and Aggregate Forest Loss

	Dependent variable:			
	Log Forest Loss		Deforestation Rate	
	(1)	(2)	(3)	(4)
Post RTA	0.236***	0.019	0.001***	0.00004
	(0.046)	(0.044)	(0.0004)	(0.0001)
Post × Enviro RTA	−0.230***	0.064	−0.001	0.001*
	(0.051)	(0.059)	(0.001)	(0.0004)
Post × Enviro RTA × Dispute	−0.001	0.009	−0.001	−0.001
	(0.089)	(0.130)	(0.0005)	(0.001)
Observations	630	1,918	630	1,918
R^2	0.983	0.990	0.832	0.809
Matched	✓	–	✓	–

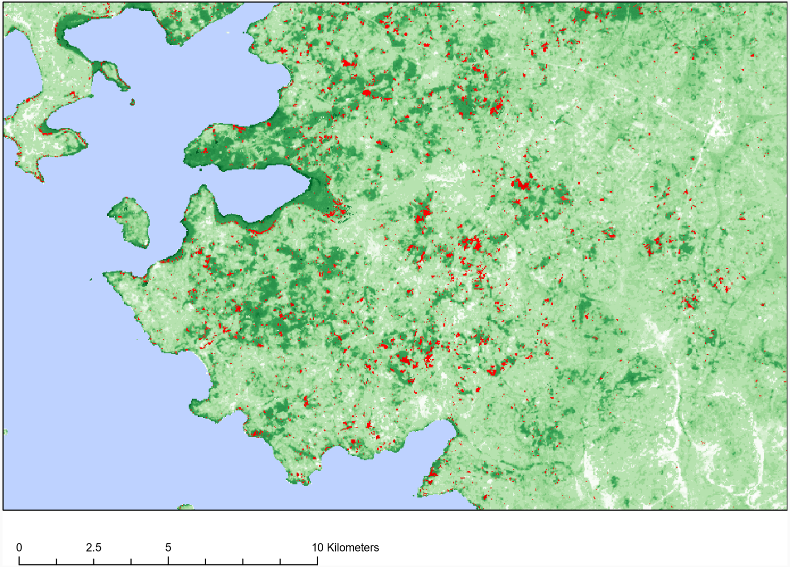
Deforestation Data – underlying remote-sensing data



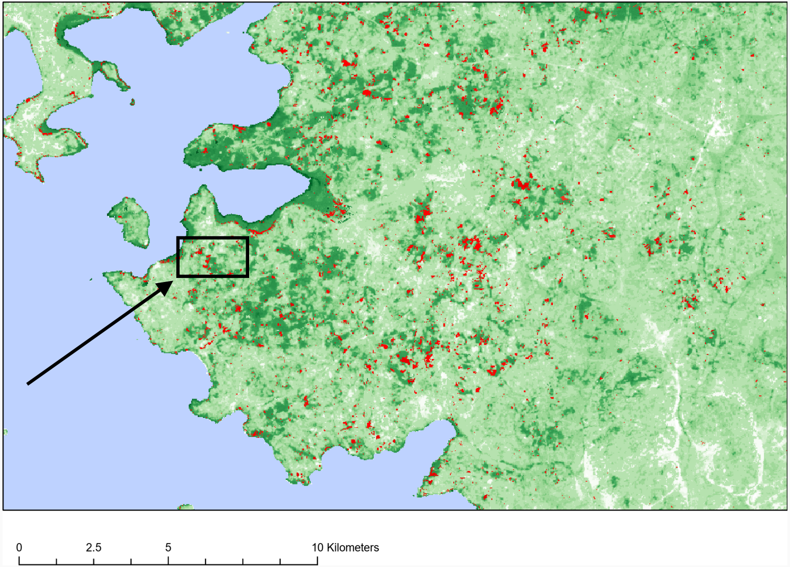
Deforestation Data – underlying remote-sensing data



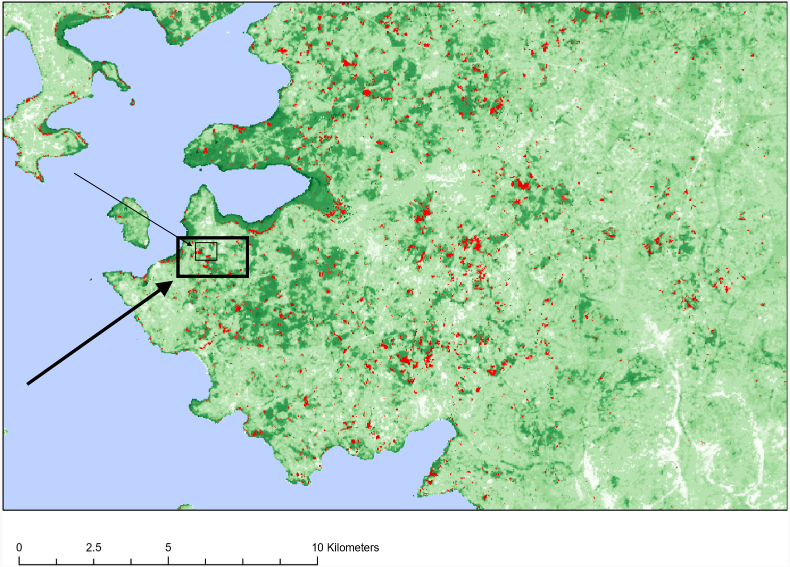
Deforestation Data – underlying remote-sensing data



Deforestation Data – underlying remote-sensing data



Deforestation Data – underlying remote-sensing data



Deforestation Data – underlying remote-sensing data

(a) 2001

(b) 2014

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Propensity Score Matching — Logit LASSO

- LASSO is a *penalized MLE*. Formally, the logit LASSO solves:

$$\max_{\beta_0,\boldsymbol{\beta}} \left\{ \frac{1}{n} \sum_{g=1}^{n} \ell(\mathbb{1}[Enviro\_RTA_g], \beta_0 + \boldsymbol{\beta}\boldsymbol{X_g} \mid \beta_0, \boldsymbol{\beta}) - \lambda \|\boldsymbol{\beta}\|_1 \right\} \tag{4}$$

  where $\ell(\cdot)$ is the logit log-likelihood function, g indexes RTAs, $\boldsymbol{X_g}$ is the set of candidate regressors, $\boldsymbol{\beta} = \{\beta_1, \beta_2, \ldots, \beta_k\}$ and $\|\boldsymbol{\beta}\|_1$ denotes the ℓ_1-norm of $\boldsymbol{\beta}$ (i.e. $\sum_{j=1}^{k} |\beta_j|$).

- Penalty term λ ensures that many coefficients are set to zero, omitting those variables from the fitted regression

- λ is exogenous in LASSO — endogenize it: use λ that minimizes mean k-fold cross-validation error

Reduced-form Empirical Political Economy Model of Provision Inclusion

- Relevance: Measures of forest stocks, biodiversity, tropical locations
- Bargaining power & enforcement: Indicators for developed/developing signatory combinations, individual country indicators
- Contracting costs: Number of signatories, individual country indicators, templating indicators, etc.

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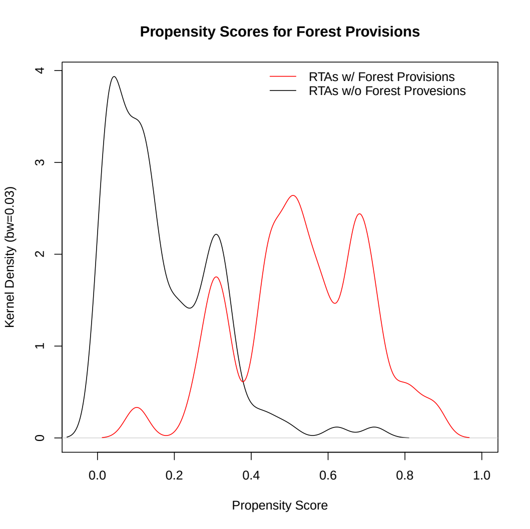
Estimated propensity score distributions



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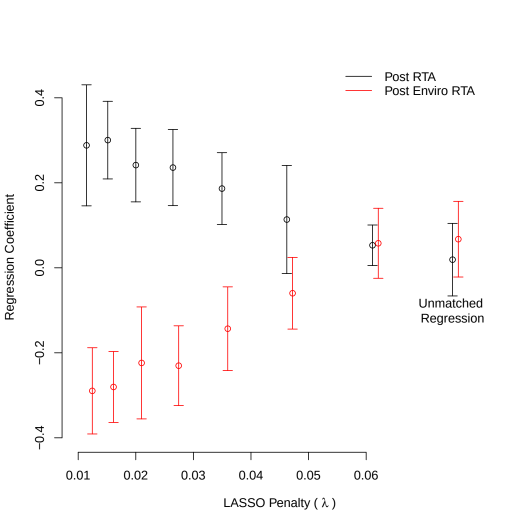
Sensitivity Analysis of LASSO Penalty (λ)



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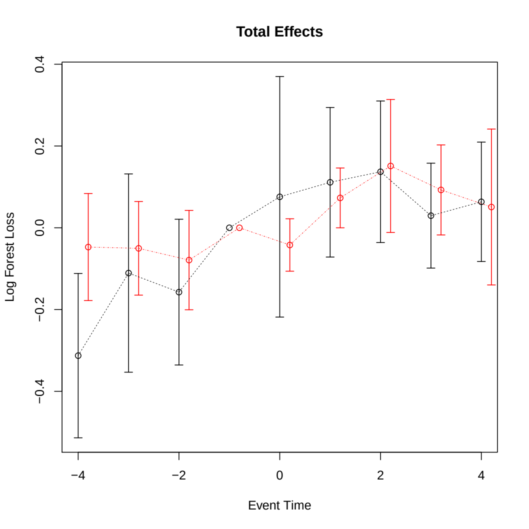
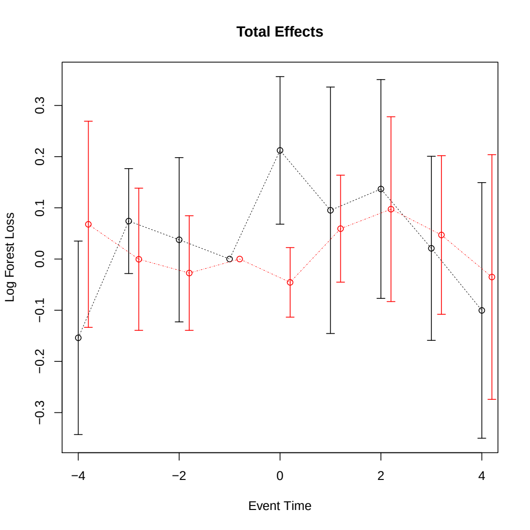
Triple-difference Event Study

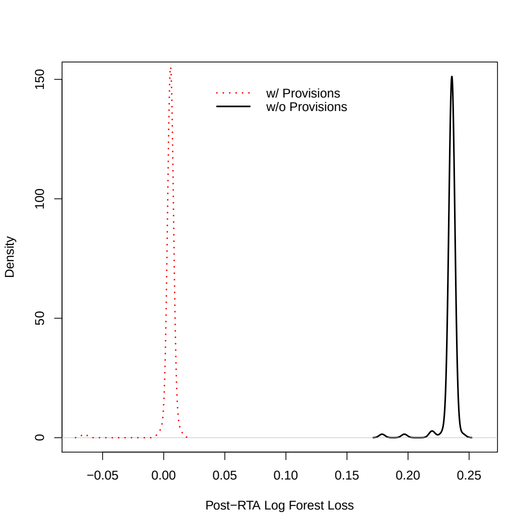


No ASEAN-Korea RTA Back

Triple-difference Event Study omitting ASEAN-Korea



Distribution of Effects from Sequentially Omitting RTAs from Matching Candidates (β_1, $\beta_1 + \beta_2$)



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SUTVA Discussion

- Shifts in deforestation among RTA signatories would not violate SUTVA, but potential displacement of deforestation outside an RTA trading bloc would
- Ag mechanisms: Asymmetric nature of forest loss from land conversion means that possible spillovers in agricultural trade flows would not violate deforestation SUTVA
- Timber mechanisms: RTAs might cause the import prices of non-member timber exports to rise *relative* to member countries (potentially affecting trade flows), but they should not (strongly) affect the actual *producer price levels* that harvest would respond to
- RTA-level overlap: attenuation towards zero

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