

Geopolitical Mining in Indonesia: Local Environmental and Welfare Costs of the Green Transition

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Introduction

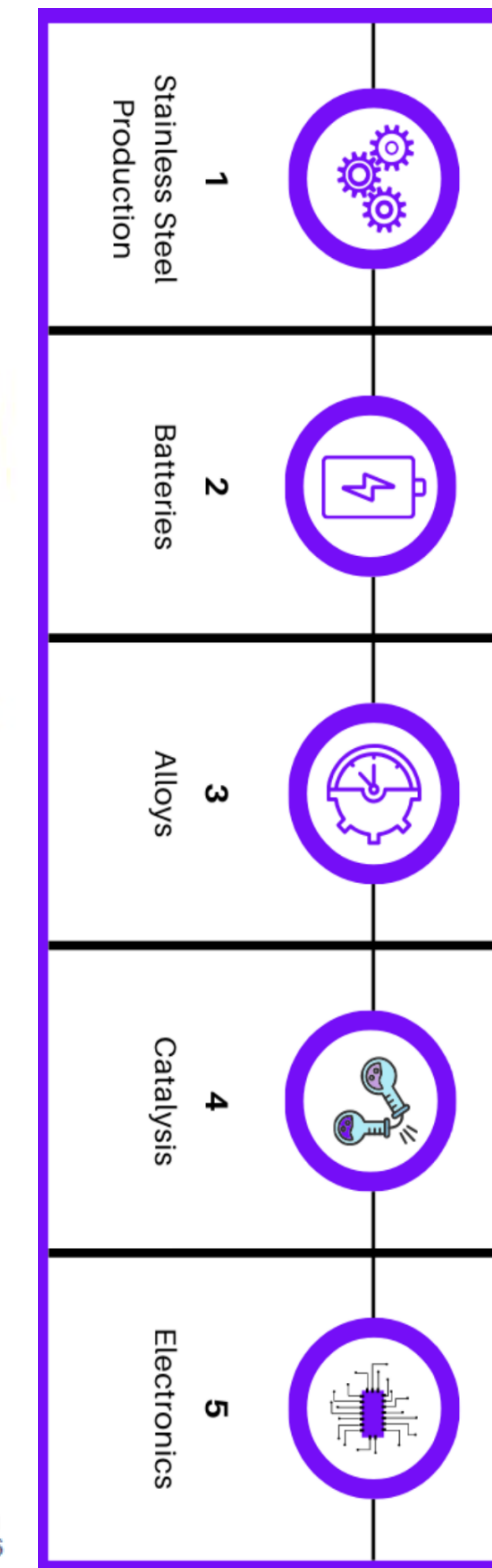
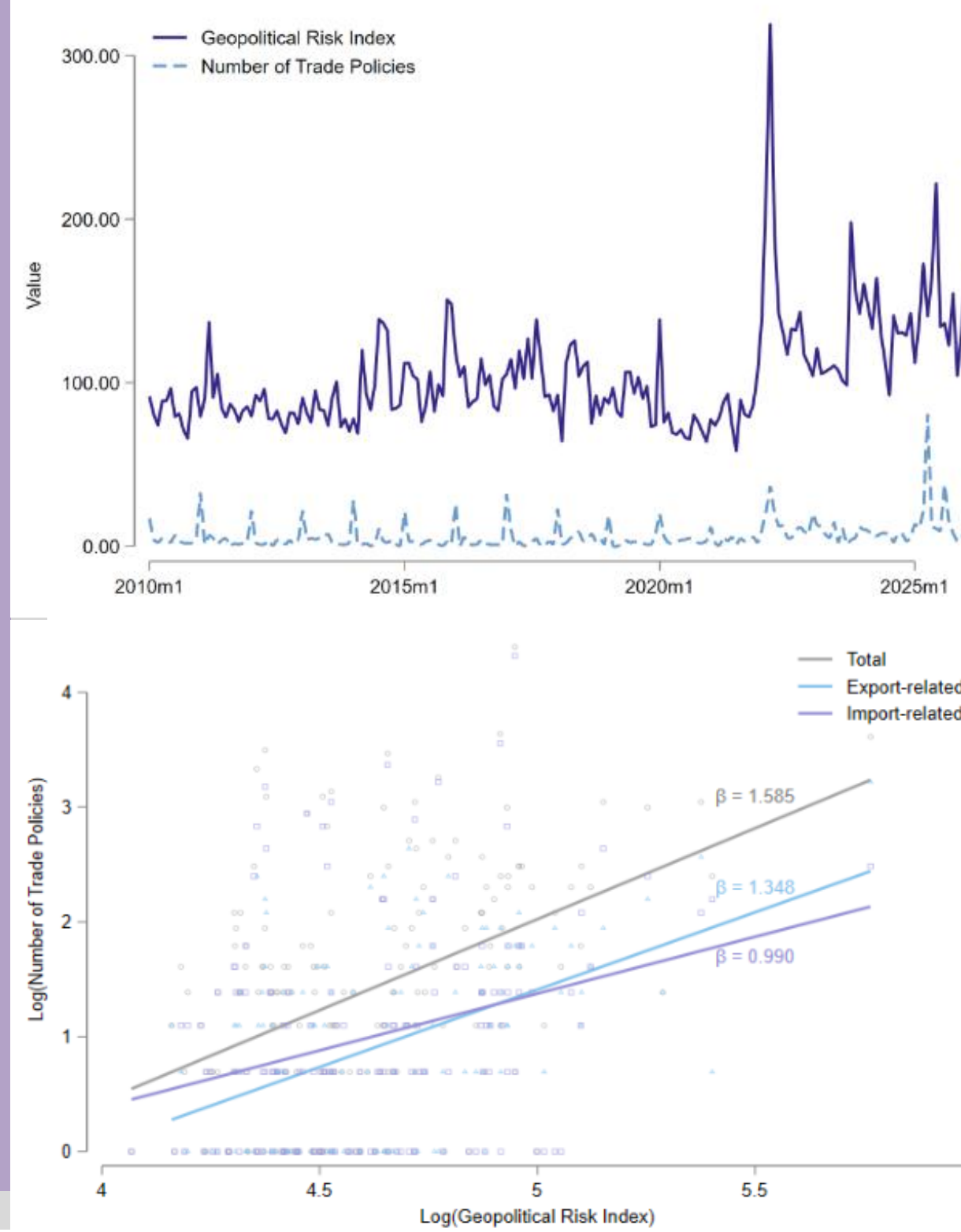
The global transition toward clean energy is reshaping not only energy systems but also the geopolitics of natural resources. Resource countries increasingly deploy export restrictions as strategic tools in response to geopolitical uncertainty. To examine the local geopolitical mining costs, we study:

- **Why nickel:** Nickel is a key input in clean-energy technologies, especially batteries. By 2040, nearly 60% of global nickel demand is projected to come from the clean-energy sector, making it one of the most geopolitically important transition minerals.
- **Why Indonesia:** Indonesia holds the world's largest lateritic nickel reserves and is projected to supply up to 80% of global nickel output. In 2020, Indonesia implemented a ban on raw nickel exports

Existing geopolitics work largely focuses on strategic competition among major powers, trade policy design, and national industrial strategies (Farrell and Newman, 2019; Baldwin and Freeman, 2022; Overland, 2019); "North-South displacement effects" by relocating pollution-intensive activities to developing economies (Copeland, 2000; Levinson and Taylor, 2008; Tanaka et al., 2022)

Research Question:

- How did nickel mining affect deforestation and marine pollution?
- Have nearby rural and fishing communities experienced declines in production, poorer health outcomes, and rising local inequality?
- How do geopolitical forces further amplify these effects?



Data

Mining data: Detailed information on mining activities is obtained from Indonesia's Ministry of Energy and Mineral Resources (MEMR), which provides the geolocation and operational status of metal mining sites.

Vegetation cover is measured using NASA's MODIS Normalized Difference Vegetation Index (NDVI) dataset, which provides monthly vegetation measurements at a 1 km spatial resolution.

Ocean turbidity is measured using the KD490 index from NASA's COPERNICUS Ocean Color product, at a 4 km spatial resolution, capturing variations in coastal water quality.

Agricultural production at yearly level is obtained from the Global Gridded Crop Production Dataset at a 10 km resolution from Harvard Dataverse

Fishing effort is obtained from Global Fishing Watch (GFW), which provides monthly fishing vessel activity at a 10 km spatial resolution, derived primarily from AIS

Village surveys: Socioeconomic outcomes are measured using the Village Potential Survey (PODES), conducted by Indonesia's Central Bureau of Statistics

Methodology

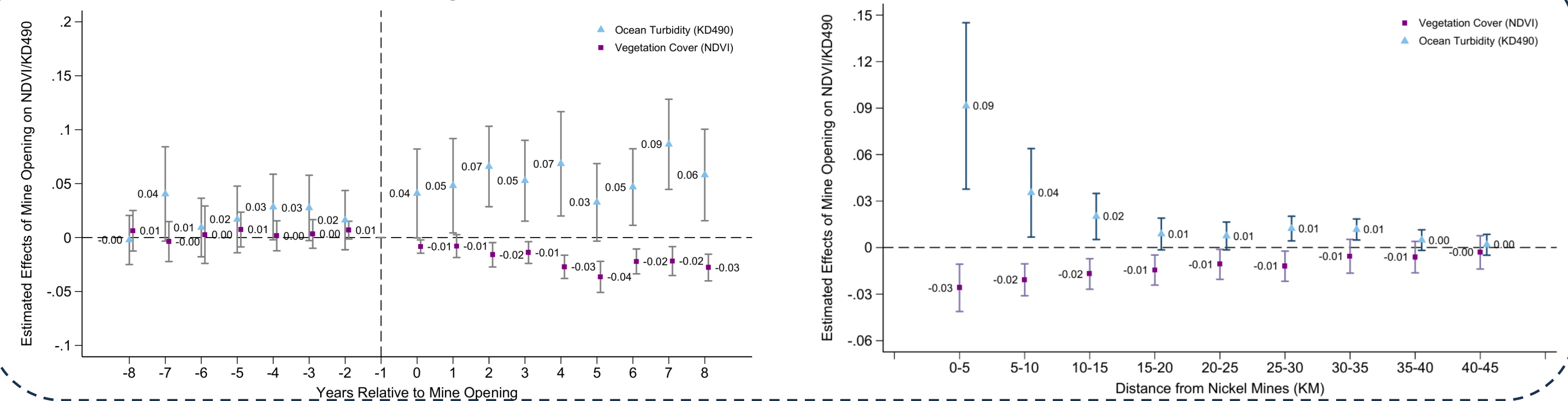
Treatment group: 0-30 km from nickel mining sites
Control group: 30-50 km from nickel mining sites

$$\ln(Y_{imt}) = \beta_0 + \beta_1 \text{Treat}_{im} \times \text{Post}_t + \eta X_{it} + \delta_i + \zeta_m + \tau_t + \gamma_{rt} + \epsilon_{imt}$$

Climate control variables, grid, mine site, year-month, province-year FE included; Standard errors are clustered at grid level



Deforestation & Ocean Turbidity



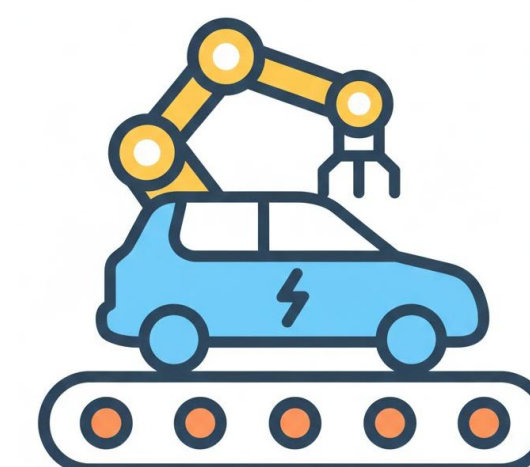
Agriculture & Fishery

	(1)	(2)	(3)	(4)	(5)
	Logarithm of Production			Fishing Variable	
Treat * Post	Maize	Rice	Soybean	Ship density	Total hours
	-0.119*** (0.044)	-0.120** (0.057)	0.112 (0.090)	-0.001** (0.001)	-0.007* (0.004)
Observations	2077	2075	2160	494016	494016
R2	0.90	0.92	0.96	0.04	0.05
Mean Dep Variable	0.78	2.03	0.11	0.00	0.01

Village Labor & Health

	(1)	(2)	(3)	(4)	(5)	(6)
	Source income agriculture	Source income fishing	Source income industry	Pollution from soil/water	Number of diarrhea	Number of leptospirosis/cholera
Treat * Post	0.001 (0.050)	-0.000 (0.017)	0.017 (0.049)	0.200** (0.085)	0.301* (0.173)	0.059** (0.030)
Observations	4889	4889	4889	4889	4889	4889
R2	0.88	0.96	0.51	0.67	0.50	0.97
Mean Dep Variable	0.90	0.01	0.03	0.03	0.30	1.03

1 EV = 43 kg NI
2020
NICKEL EXPORT BAN!



	(1)	(2)	(3)	(4)	(5)
	Ocean turbidity	Forest cover	Port activity	Night light	New mines
Panel A: Global EV Sales					
Treat*Post	0.002 (0.007)	-0.010 (0.007)	-0.098 (0.175)	-0.159 (0.202)	0.400*** (0.150)
Treat * Post * EVsales	0.012*** (0.003)	-0.004*** (0.001)	0.006 (0.060)	0.017 (0.048)	0.115*** (0.030)
Observations	216363	150243	37267	410850	3052
R2	0.74	0.76	0.79	0.66	0.77
Mean Dep Variable	0.05	0.81	8.41	0.33	10.04
Panel B: Export Ban in 2020					
Treat*Post	0.007 (0.007)	-0.012* (0.006)	-0.044 (0.189)	-0.017 (0.173)	0.482*** (0.142)
Treat * Post * Dummy2020	0.060*** (0.012)	-0.023*** (0.005)	0.338** (0.151)	0.582* (0.321)	0.339** (0.139)
Observations	216363	150243	37267	410850	3052
R2	0.74	0.76	0.79	0.65	0.77
Mean Dep Variable	0.05	0.81	8.41	0.33	10.04