Can Audits Shift the Battleground?
Supply Chain Certifications and Conflict Dynamics in the Congo

ASSA – January 2025

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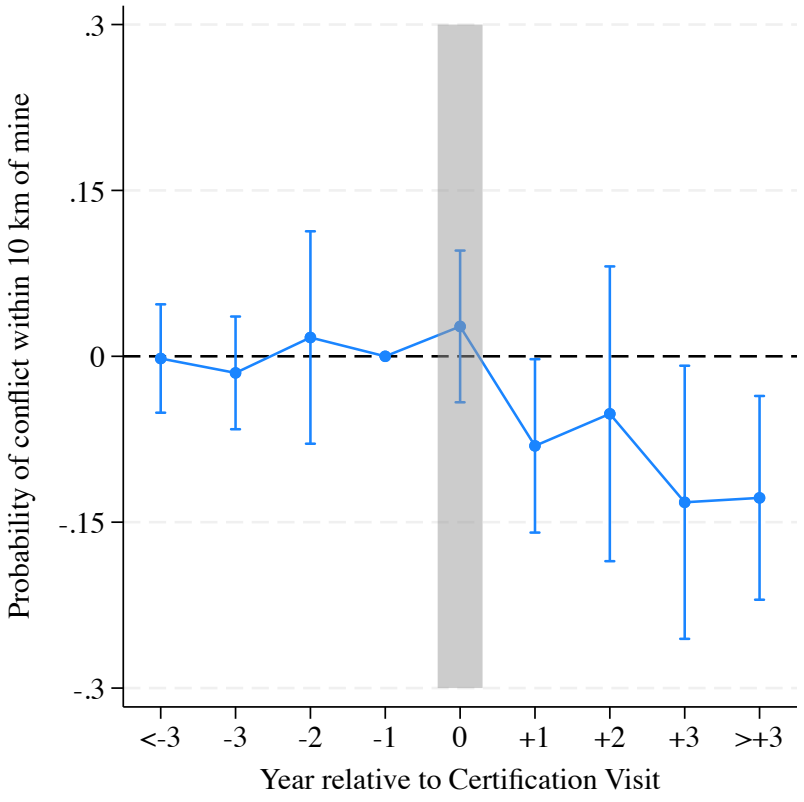
Motivation

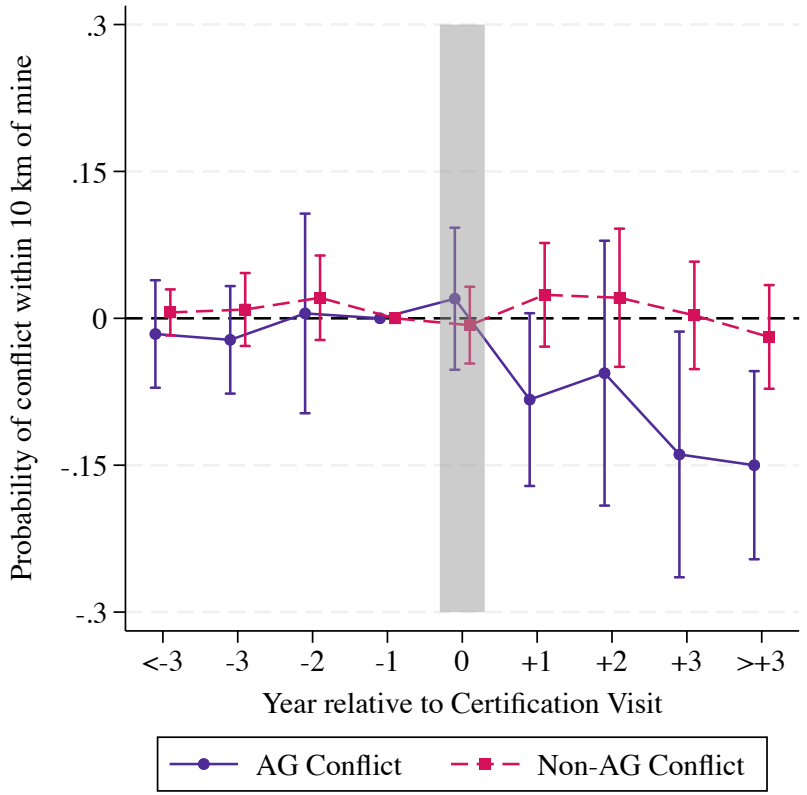
- Policy initiatives in developed countries seek to use global corporate supply chains to address human rights abuses in developing regions
  - Such issues have persisted due to weak public governance
- Notable example is Dodd-Frank Act Section 1502
  - Was enacted in 2010 to mitigate longstanding conflict in Eastern DRC
  - DRC's small-scale mining sector––integral to many corporate supply chains––has financed armed groups
  - Section 1502 aims to curtail these flows by requiring disclosure of due-diligence efforts
- Local mine certifications translate D-F mandate into local actions
  - Can disrupt equilibria of local armed group authority
  - But without injecting functional institutions, certifications cannot resolve the ongoing armed conflict
- We examine how conflict-free gold mine certifications, motivated by the Dodd-Frank Act, influence conflict dynamics in the DRC

Our Results in Three Figures

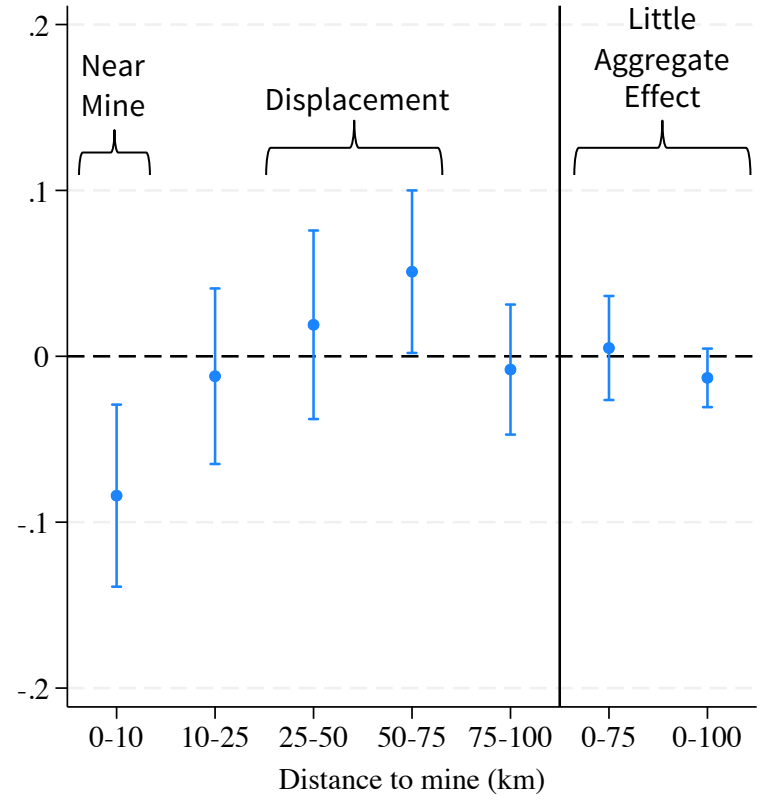
Change in Conflict (within 10km)



Change Only For AG-Initiated Conflict



Geographical Displacement of Conflict



Setting:
Artisanal Mining in the Eastern DRC

Source of financing for some armed factions and subject to certification (e.g., Dodd-Frank and EU)

Artisanal Mining and Armed Conflict

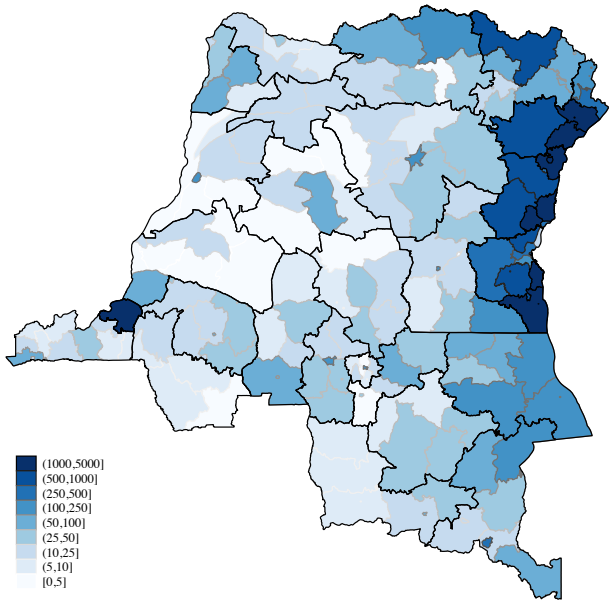
- Artisanal and small-scale mining is a large sector of the DRC economy
  - Employs more than 2 million people
  - 20% of DRC GDP
  - Each mine typically employs 100-200
- Ideal financing source for militant factions
  - Some finance activity through violently looting mining communities
  - Others establish systems of governance that monopolize violence and provide “essential functions of a state” (Sánchez de la Sierra, 2020)
- After metal is smelted, no way to identify source
  - First step is very important
  - Artisanal mining certifications operationalize regulation to the mining community level

Artisanal Mining Certifications

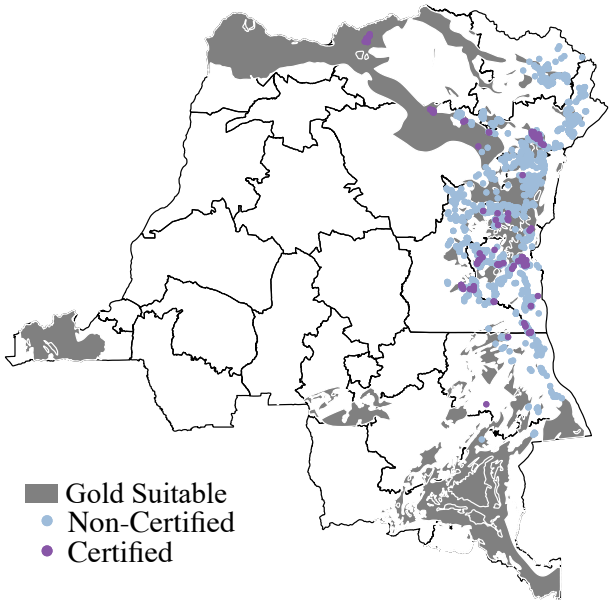
- ICGLR mine certification scheme initiated in 2011 after Dodd-Frank
  - Implementation in the DRC focuses on mines in high-conflict provinces
  - Only for 3TG minerals (covered by Dodd-Frank)
- We analyze the period around the initial certification visit
  - Selected by the DRC government
  - Inspector physically visits mine site and checks for armed presence
  - Follow-up visits occur at least annually

Figure 1. Conflicts and Small-Scale Mines

Panel A: Conflicts by Territory



Panel B: Gold Suitability and Mines



General Framework

- Mines can sell minerals in two ways
  - Officially to smelters (higher amount) and unofficially to smugglers (lower amount)
- Armed groups tax local population
  - Stationary bandits have interest in continued success of mines and communities
  - In return for tax, stationary armed groups “protect” communities against themselves and others
- Certification scheme increases the audit “risk” of the mine from ~2% to 100%
  - All certified mines (regardless of status) are visited at least annually in the future
  - Mines cannot sell officially (i.e., lose certification) if conflict is detected
- After audit, it becomes relatively more beneficial for armed groups to conceal financing by protecting certified mine
  - Thus, armed groups increase the amount spent on protection
- Tension: two different effects can occur in equilibrium
  - Substitution effect: armed group optimally redistributes protection to certified mines from uncertified mines due to limited resources and increased audit risk
  - Income effect: armed group receive more tax revenue from certified mines and expand protection to all mines

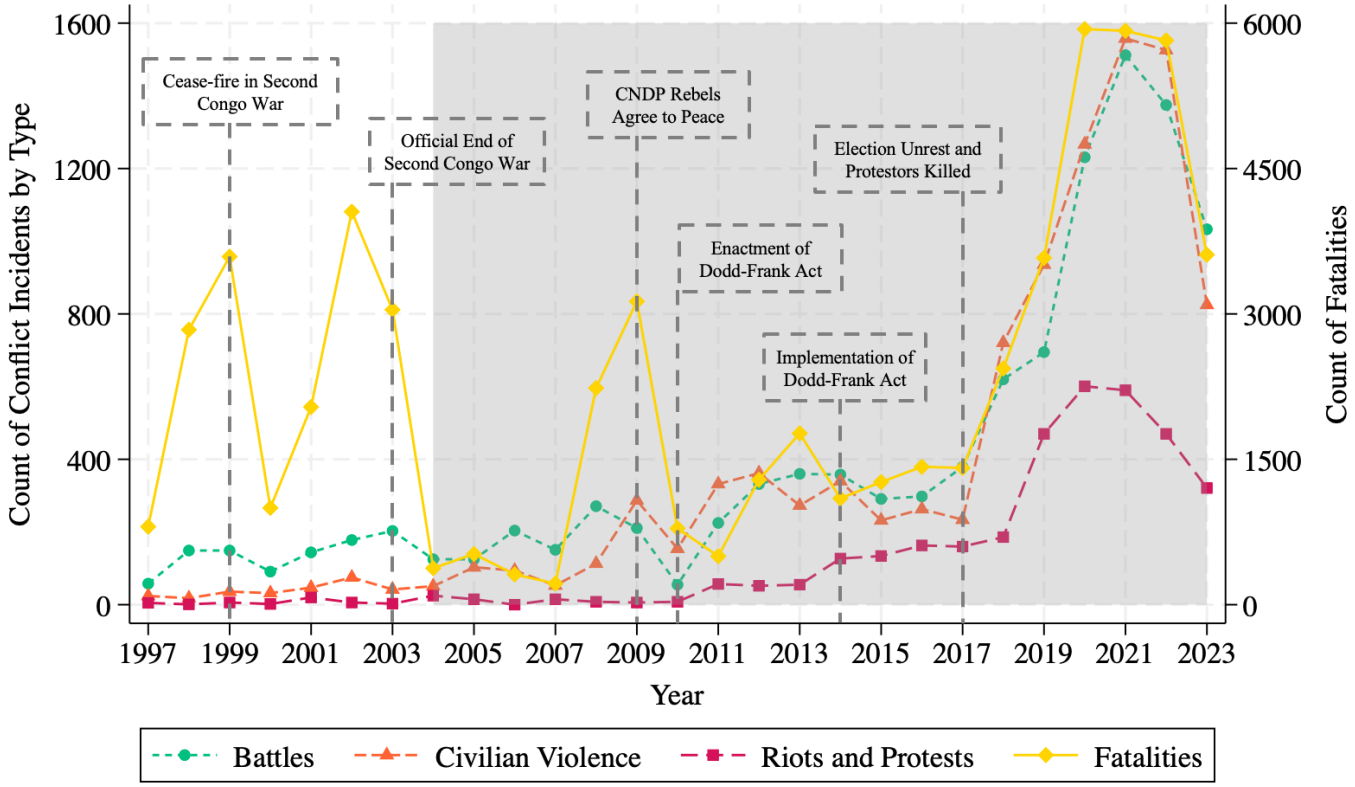
Method:
Measuring Conflict

Both our conflict measure and the certification program are local to mines

Dependent Variable: Nearby Conflicts

- Spatial analysis of conflicts within radii of artisanal mines
- Conflict dataset captures conflict instances recorded by media/NGOs
  - Includes details on type and fatalities
  - We use only eastern province data
  - Fatalities more comprehensive
- Conflicts geolocated to the nearest village, so relatively precise

Figure 2: Conflict Incidents and Fatalities



Assignment of Treatment

- Provincial governments select mines for certification
  - Main concern is selection on security
  - Additional economic variables could also play a role
- We have not been able to confirm selection criteria with the DRC Ministry of Mines
  - No statistical association between certification choice and pre-cert conflict or local economic characteristics with territory-year FE
  - Certifications occur in groups over time but are not clumped in one province or area – may affect economic magnitudes

Table 1. Certification Selection

Dep. Var.: 𝟙(*Certified*)	All Years	
	No FE	FE
	(10)	(11)
asinh(*Conflict 10km*)$_{t-1}$	-0.003	0.001
	(0.002)	(0.002)
asinh(*Avg Lum 1km*)$_{t-1}$	0.000	-0.001
	(0.003)	(0.003)
EVI 1km$_{t-1}$	-0.156***	-0.035
	(0.054)	(0.027)
asinh(*Dist to Road*)	-0.001	0.000
	(0.003)	(0.001)
asinh(*Dist to Maj Road*)	-0.006**	-0.002
	(0.003)	(0.002)
asinh(*Dist to Pop*)	0.005**	0.002
	(0.002)	(0.001)
asinh(*Dist to Cert*)$_t$	-0.037***	-0.056***
	(0.005)	(0.008)
𝟙(*Protected Area*)	0.005	-0.004*
	(0.017)	(0.002)
Constant	0.285***	
	(0.043)	
Territory x Year FE	No	Yes
R-squared	0.126	0.242
Observations (Mine)	25,784	25,748

Security (pre-period)

Economic growth

Agriculture alternative

Accessibility

Legality

Results:
Certification and Conflict Intensity Near Mines

Conflict decreases in the area proximal to certified mines

Certifications and Conflict

$$\mathbb{1}(All\ Conflicts_{m,t}) = \beta_1\ CFC_m \times Year\ Relative\ to\ Cert_{m,t} + \alpha_m + \delta_{r,t} + \varepsilon_{m,t}$$

- Dependent variable: 𝟙(All Conflicts)
- CFC: Treatment indicator for certified mines
- Conley (1999) standard errors (100km) to account for geographical and spatial correlation
- Fixed effects: mine, territory x year
- Interpretation:
  - Gradual decrease in conflict after certifications
  - Effect only for gold mines, not 3T mines
  - Average treatment effect significant

Figure 3 Panel A: Conflict Incidence

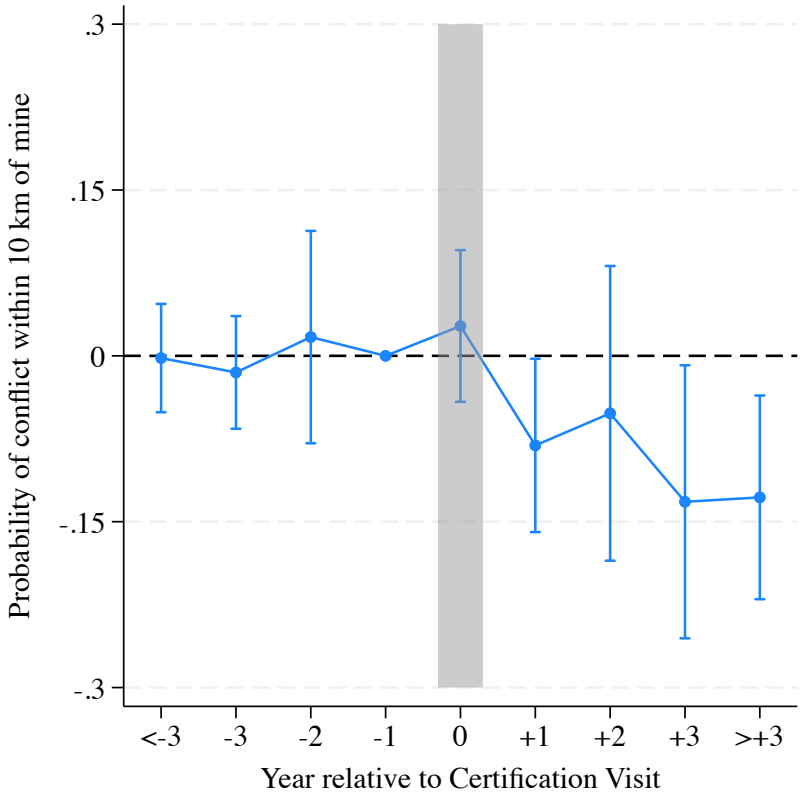
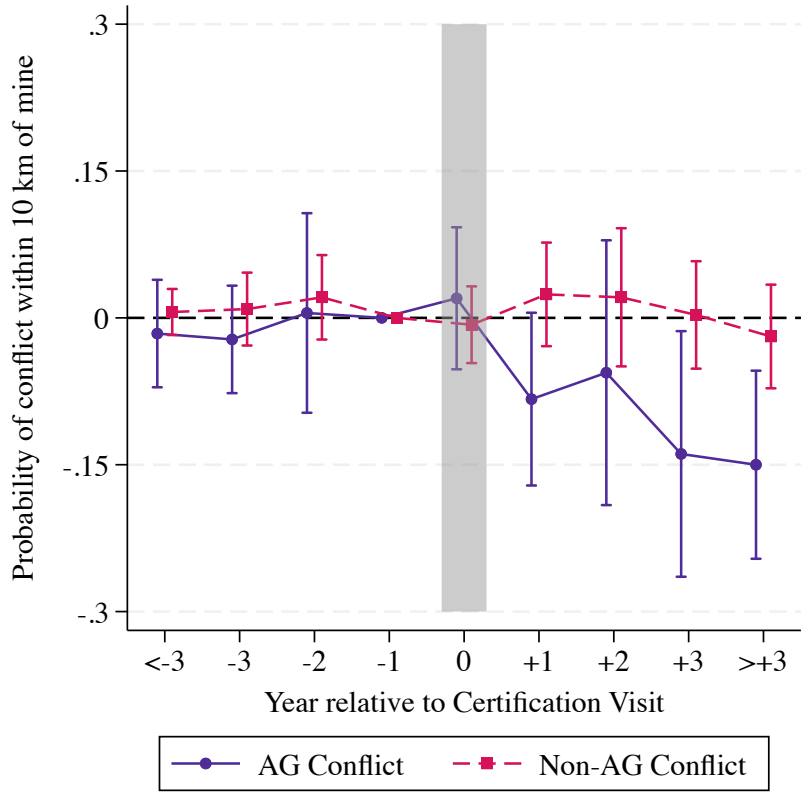


Figure 3 Panel D: Conflict Incidence by Type



Fatalities and Sensitivity Tests

$$\text{asinh}(Fatalities_{m,t})/\mathbb{1}(All\ Conflicts_{m,t}) = \beta_1\ CFC_m \times Year\ Relative\ to\ Cert_{m,t} + \alpha_m + \delta_{r,t} + \varepsilon_{m,t}$$

- Dependent variable: asinh(*Fatalities*)/𝟙(All Conflicts)
- CFC: Treatment indicator for certified mines
- Conley (1999) standard errors (100km) to account for geographical and spatial correlation
- Fixed effects: mine, territory x year
- Interpretation:
  - Same as conflict probability results
  - Magnitude: 0.4 deaths per certified mine-year
  - Magnitude for battles: 0.2 deaths per certified mine-year

Figure 3 Panel B: Fatality Count

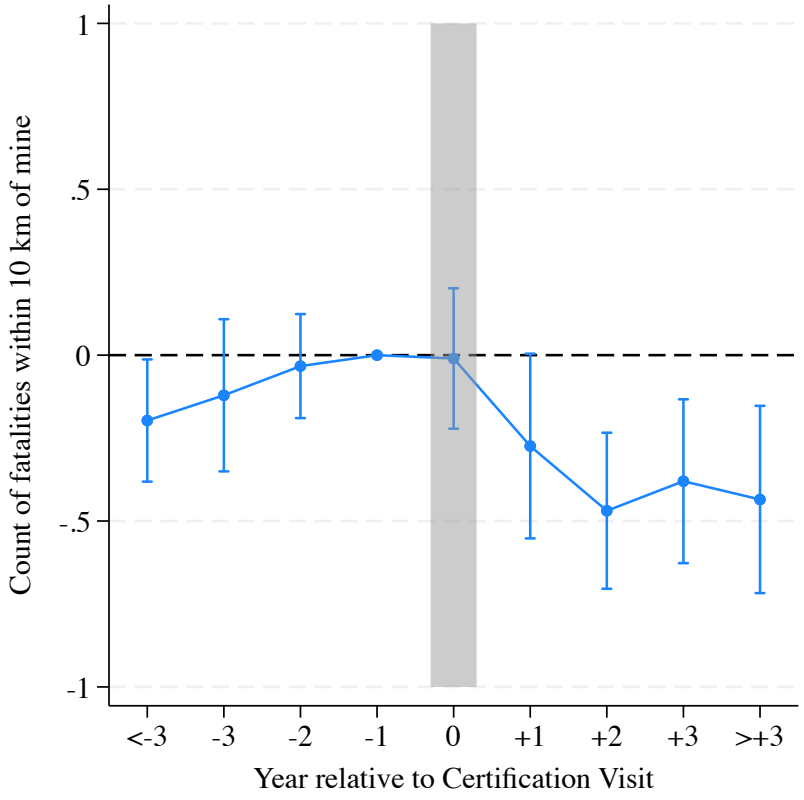
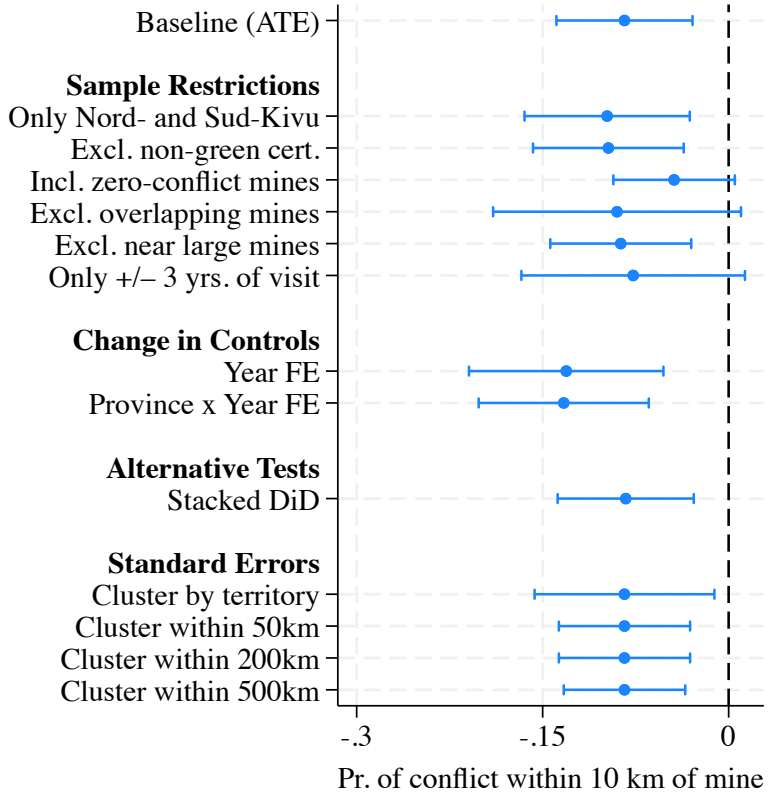


Figure 3 Panel C: ATE and Sensitivity Tests



Results:
Displacement of Conflict

Conflict moves further away from certified mines but does not decrease in the aggregate

Displacement of Conflict

$$\mathbb{1}(All\ Conflicts_{m,t}) = \beta_1\ CFC_m \times Year\ Relative\ to\ Cert_{m,t} + \alpha_m + \delta_{r,t} + \varepsilon_{m,t}$$

- Dependent variable: $\mathbb{1}$(All Conflicts)
- CFC: Treatment indicator for certified mines
- Conley (1999) standard errors (100km) to account for geographical and spatial correlation
- Fixed effects: mine, territory x year
- Interpretation:
  - Negative average effect between 0–10km for gold
  - Positive average effect between 25–75km for gold
  - No effect for 3T
  - Stronger displacement to mining areas

Figure 4 Panel A: Conflict Incidence

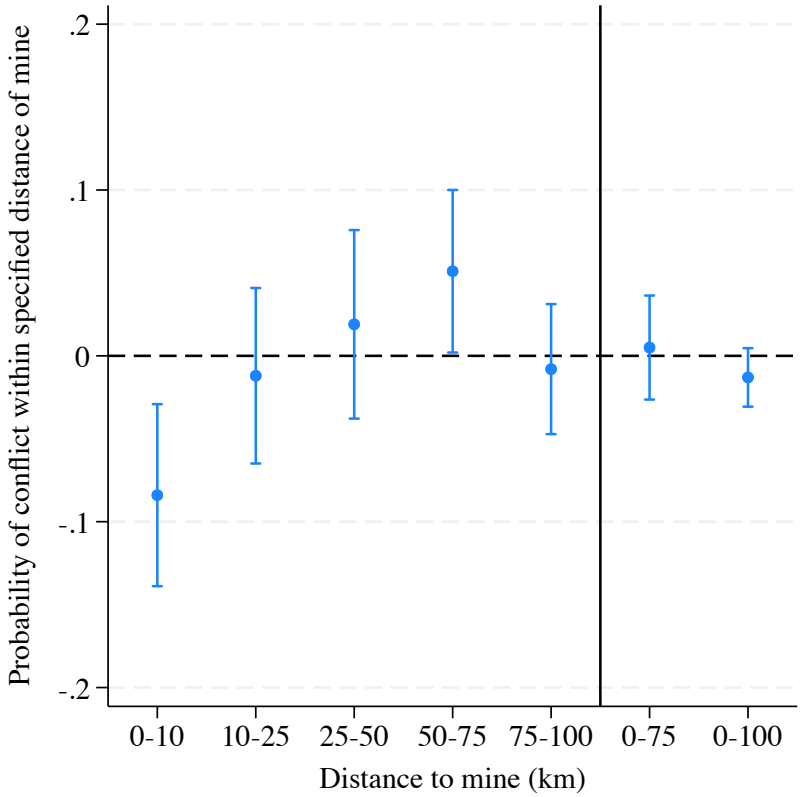
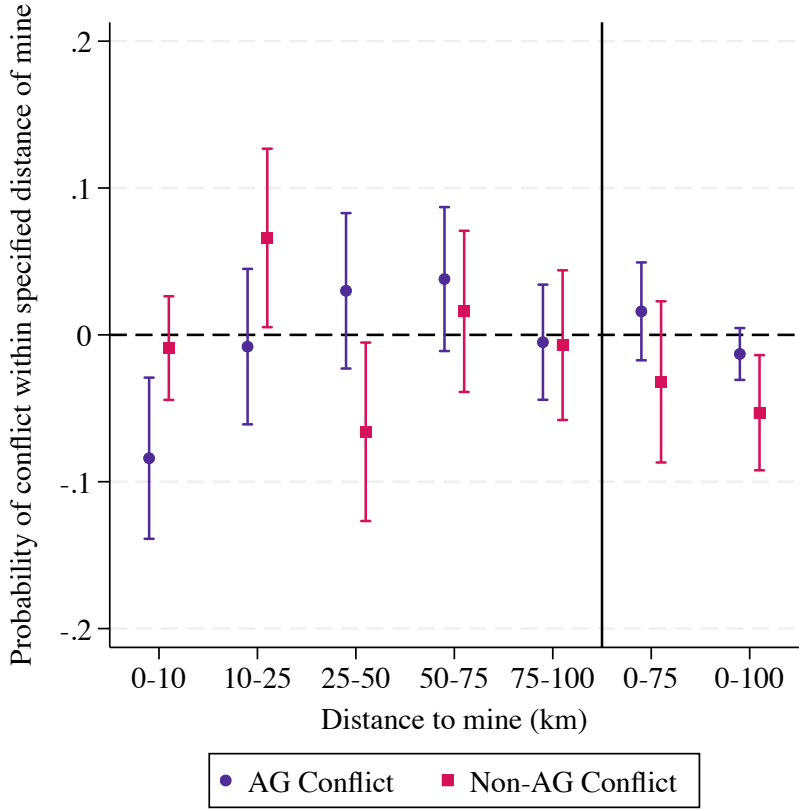


Figure 4 Panel D: Conflict Incidence by Type



Aggregate Territory Effect

$$\text{asinh}(\textit{All Conflicts}_{r,t}) = \beta_1 \, \text{asinh}(\textit{Count})/\textit{Fraction}_{r,t} + \alpha_r + \delta_{p,t} + \varepsilon_{m,t}$$

- Dependent variable: asinh(All Conflicts)
- Ind. variable: Count or fraction of certified mines in region
- Standard errors: clustered at territory level
- Fixed effects: territory, province x year

- Interpretation:
  - Effect of certifications (count or fraction) on aggregate (territory-level) conflict not negative in any category

Table 3. Certifications and Territory-Level Conflict Intensity

	asinh(*All Conflict*)		asinh(*AG Conflict*)		asinh(*All Fatalities*)	
	(1)	(2)	(3)	(4)	(5)	(6)
asinh(*Gold Cert Count*)	0.053**	0.016	0.063***	0.024	0.048	-0.000
	(0.021)	(0.022)	(0.023)	(0.022)	(0.030)	(0.023)
Territory FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
Province x Year FE	No	Yes	No	Yes	No	Yes
Adj. R-squared	0.696	0.740	0.684	0.734	0.550	0.637
Observations (Territory-Year)	1,700	1,700	1,700	1,700	1,700	1,700

Results:
Intent-to-Treat Around Dodd-Frank Enactment

No statistically or economically significant effect

Intent-to-Treat at Enactment of Dodd-Frank

$$\mathbb{1}(All\ Conflicts_{m,t}) = \beta_1\ GoldSuitable_m \times Post2011_{m,t} + \alpha_m + \delta_{r,t} + \varepsilon_{m,t}$$

- Dependent variable: $\mathbb{1}$(All Conflicts)
- Gold: Villages with gold mines or suitable for gold
- Standard errors: clustered at territory level
- Fixed effects: mine, territory x year
- Interpretation:
  - Intent-to-treat effect not statistically or economically significant

Figure 5 Panel A: Conflict Incidence

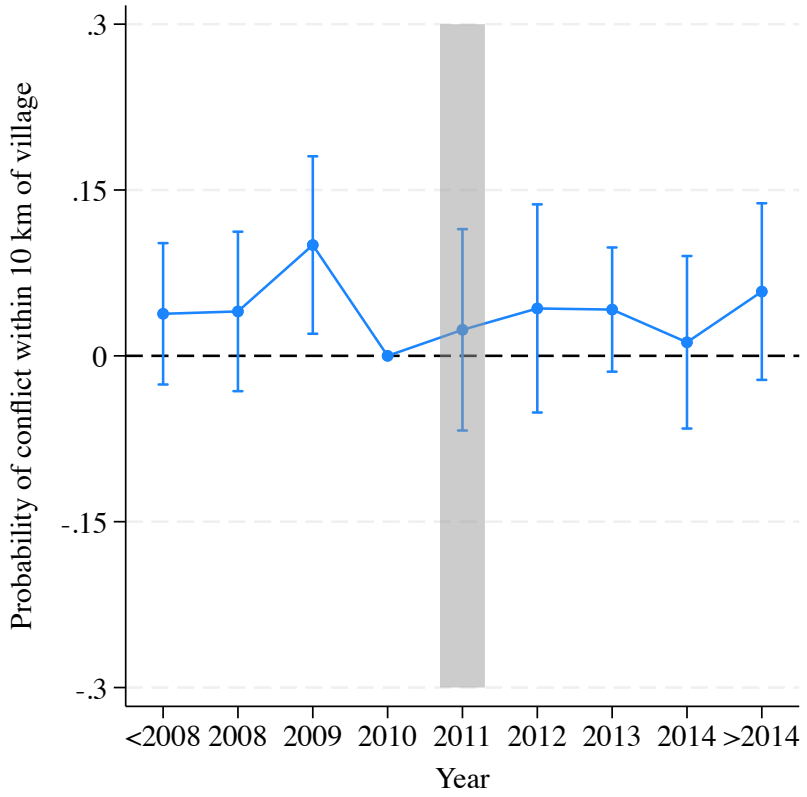
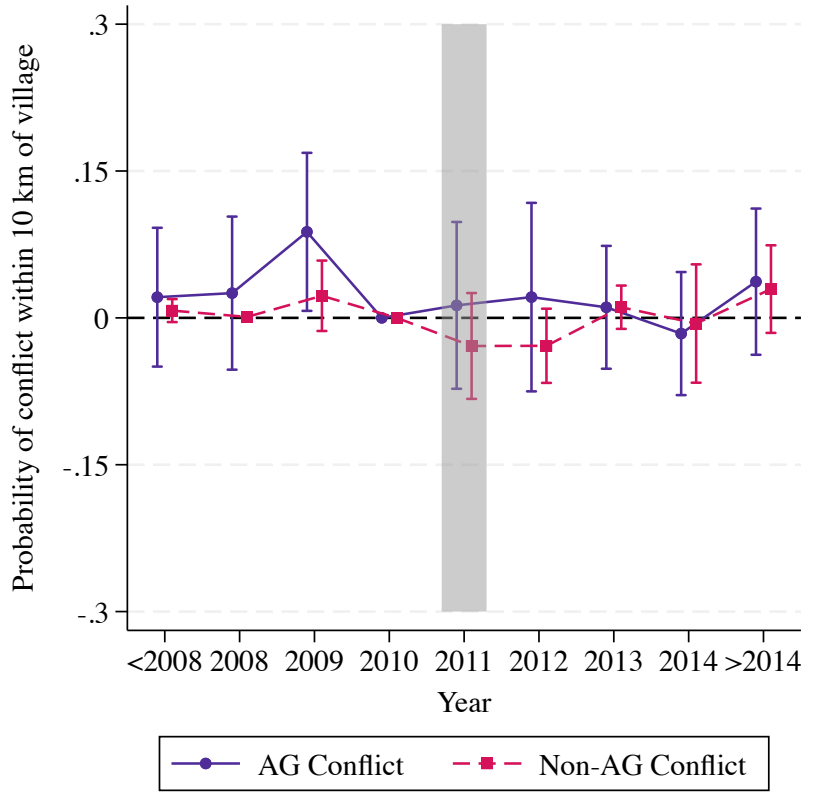


Figure 5 Panel D: Conflict Incidence by Type



Main Takeaways

- Key evidence:
  - No significant deterrence effects of the program initiation (i.e., Dodd-Frank enactment)
  - Initial certification visits are associated with a local reduction in future conflict probability
  - Conflicts shift to a greater distance from certified mines without changing aggregate conflict intensity
- Consistent with certifications:
  - Increasing the demand for local monopolies on violence
  - Strengthen stationary bandits that trade in protection from themselves and competing factions
  - No “traditional” certification effect
- For policy evaluation purposes, a displacement of conflicts away from mining areas is different from a broader reduction in conflicts—distinct political and economic implications
- Illustrates the unintended consequences of supply-chain certification systems in resolving complex geopolitical challenges, such as the humanitarian crisis in the DRC