

ONLINE APPENDIX

Landing on Water: Air Interdiction, Drug-Trafficking Displacement, and Violence in the Brazilian Amazon

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A Appendix - Anecdotal Evidence

A.1 Decentralized Drug Trafficking in the Amazon

We present some anecdotal evidence on the decentralization of drug-related crime within the Amazon during the 2000's and early 2010's. Overall, our period of analysis was not marked by the presence of large criminal organizations, but rather by small groups or even individuals haphazardly involved in drug trafficking.

Criminals in the region were not typically affiliated with a single organized group. For example, the Federal Police's "Operation Ilhas" in 2011 arrested 32 individuals involved in cocaine trafficking in Amazon rivers who collaborated without a clear hierarchical structure. Instead, they formed a sort of "criminal consortium," pooling resources to transport drugs from multiple traffickers simultaneously and thereby reducing transportation costs ([Procuradoria da República no Amazonas, 2011](#)). This type of consortium was subject to recurrent fractures, leading to violence among members.

There were also pirate gangs operating along important river routes. In 2011, authorities apprehended 11 individuals implicated in piracy in the Solimões River ([Melo, 2011](#)). In one episode, pirates intercepted a speedboat carrying 300 kg of cocaine going from Peru to Manaus ([Polícia Federal, 2016](#)). The pirates shot five individuals transporting the illicit substance, three of which were arrested in the hospital after receiving medical care.¹⁹

Furthermore, there are many accounts of drug-related crime affecting communities. Some reports reveal drug traffickers trying to enlist locals to transport cocaine along the Amazon rivers ([Couto and Oliveira, 2017](#)). According to these reports, a boatman could earn between \$1,000 and \$1,600 working with drug trafficking. Other, more trivial, involvements of local populations with the drug business were also common. In Tabatinga, a city situated in the border of Brazil,

¹⁹For more details, please refer to pages 379-385 of [Polícia Federal \(2016\)](#) report.

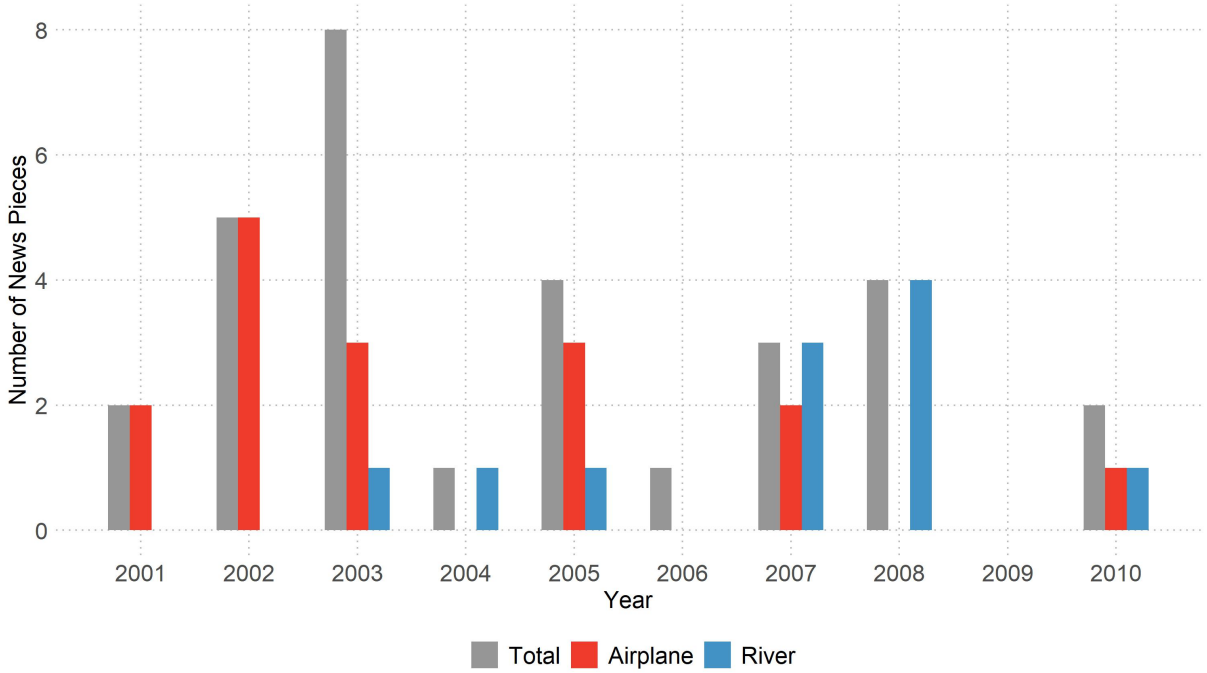
Peru, and Colombia, for example, motorcycle taxi riders were involved in distributing coca paste, according to a news piece by [Abbud \(2011\)](#).

In all the examples listed above, we find that foreign nationals are also involved in drug trafficking, but to a lesser extent than Brazilians. For instance, the vast majority of those indicted in the Police operations “Ilhas” and “La Muralla” are Brazilians. In fact, at the time of the air interdiction, there were very few foreigners living in the West Amazon region. According to the 2000 Brazilian Census, foreigners represented no more than 0.3% of the resident population in the West Amazon states. Hence, local communities should be the most affected by the shift of cocaine trafficking from aerial to river routes.

A.2 Air versus River Transportation

We provide anecdotal evidence about air versus river transportation based on media coverage. Figure A.9 shows the number of news pieces on drug trafficking in the Amazon from major newspapers in Brazil ([O Globo, 2023](#); [O Estado de São Paulo, 2023](#)). Observations are categorized according to the mode of transportation that was mentioned in each piece. Although only suggestive, this shows a shift from air (red bars) to river (blue bars) drug trafficking around 2004, when the interdiction was implemented.

Figure A.9: News Pieces on Drug Trafficking in the Amazon



Notes: Figure shows the number of news pieces related to drug trafficking in the Amazon region collected from two major newspapers in Brazil: “O Estado de São Paulo” and “O Globo”. To gather this data, we searched the digital archives of these newspapers for pieces containing the following keywords (in Portuguese): “Amazon”, “Cocaine”, and “Trafficking.” We categorized the mode of transportation based on what was mentioned in each news piece. Gray bars represent all pieces containing those keywords. Red bars represent news pieces that mentioned air drug trafficking. Blue bars represent pieces that mentioned river drug trafficking.

B Appendix - Propensity Score Matching

In this section, we repeat our main specification, except that we re-weigh observations according to an IPW procedure (Hirano et al., 2003; Busso et al., 2014; Cunningham, 2021).

First, we specify a Probit model to estimate the probability $\hat{p}$ that each municipality is in cocaine-trafficking river routes (treated group). In this estimation, we add the same explanatory variables included in vector X_i from Equation 2.

We run the Probit model detailed in Equation B.1, such that $\Phi(\cdot)$ is a standard cumulative Normal distribution and α is a vector of coefficients estimated by maximum likelihood.

$$(B.1) \quad Prob(Treated_i = 1 | X_i) = \Phi(X_i \alpha)$$

The estimated coefficients are presented in Table B.1.

Table B.1: Probit Regression of Treatment Status on Pre-Intervention Cross-Sectional Municipal Characteristics for Municipalities with less than 100,000 people

(log) Population	1.04*** (0.31)
(log) Income p.c.	−0.75 (1.19)
Avg. School Years	−2.30*** (0.51)
(%) Low Income	2.15 (2.90)
(%) Urban Pop.	0.27 (1.56)
(%) Aged 20-39	12.46 (11.94)
(%) Forest Cover	2.90*** (1.04)
(%) Jobs Agriculture	−5.36** (2.08)
(%) Jobs Mining	−26.88 (23.33)
(%) Jobs Pub. Sector.	16.46*** (6.34)
Constant	−2.71 (9.86)
Pseudo-R2	0.76
AIC	88.69
Observations	269

Notes: Only AC, AM, RO, RR, and MT. Population threshold from Census 2000. *p<.1; **p<.05; ***p<.01

Then, we run our main model in Equation 2 using the estimated propensity scores $\hat{p}$ to re-weight the regression (Hirano et al., 2003; Busso et al., 2014; Cunningham, 2021). We attribute weights $1/\hat{p}$ for treated units and $1/(1 - \hat{p})$ for control units. Additionally, because very low or very high values of $\hat{p}$ can excessively over-weight some observations, we only keep observations with $0.05 \leq \hat{p} \leq 0.95$.

By re-weighting and restricting our sample using IPW, we get more balanced treated and control groups on average. Table B.2 presents descriptive statistics for each observable characteristic included in X_i . The *Unmatched* columns describe our main sample, whereas the *Matched* columns present the re-weighted and restricted sample produced by the IPW procedure.

Table B.2: Propensity-Score Matching Balance Test for Municipalities with less than 100,000 people

	Unmatched			Matched		
	Treated (1)	Control (2)	Difference (3)	Treated (4)	Control (5)	Difference (6)
Avg. School Years	3.152	4.510	-1.358 (0.102)	3.900	3.827	0.073 (0.144)
(log) Income p.c.	5.759	6.142	-0.383 (0.045)	5.929	5.901	0.028 (0.056)
(log) Population	9.709	9.260	0.449 (0.112)	9.578	9.745	-0.167 (0.166)
(%) Jobs Agriculture	0.461	0.441	0.021 (0.022)	0.505	0.479	0.027 (0.039)
(%) Jobs Mining	0.002	0.010	-0.008 (0.004)	0.003	0.002	0.000 (0.002)
(%) Jobs Pub. Sector.	0.080	0.058	0.022 (0.005)	0.071	0.076	-0.005 (0.011)
(%) Forest Cover	0.902	0.481	0.420 (0.038)	0.812	0.807	0.005 (0.052)
(%) Low Income	0.714	0.414	0.300 (0.021)	0.603	0.600	0.003 (0.032)
(%) Aged 20-39	0.271	0.322	-0.051 (0.004)	0.292	0.286	0.005 (0.007)
(%) Urban Pop.	0.455	0.553	-0.099 (0.029)	0.453	0.473	-0.020 (0.046)
Observations	67	202	-	27	36	-

Notes: Columns (1) and (2) show the means of each variable conditional on treatment status. Columns (4) and (5) show the re-weighted means such that treated and control municipalities receive weights $1/p$ and $1/(1-p)$ respectively. Column (3) shows the estimated coefficient of an OLS regression of each variable on treatment. Column (6) repeats the regression in Column (3), but re-weighting according to (4) and (5).

The IPW, however, comes at the cost of dropping many observations from the sample. Moreover, there is weak evidence of common support in the matched sample. Figure B.1 presents the distribution of estimated propensity scores ($\hat{p}$) for treated and control units after we eliminate extreme values.

Keeping in mind the aforementioned potential caveats, Table B.3 presents the new results, which can be directly compared with Table 2. Point-wise estimates are typically slightly larger, but qualitative implications are the same as in our benchmark specification.

Figure B.1: Density of Propensity Score Estimates according to Treatment Status for Municipalities with less than 100,000 people

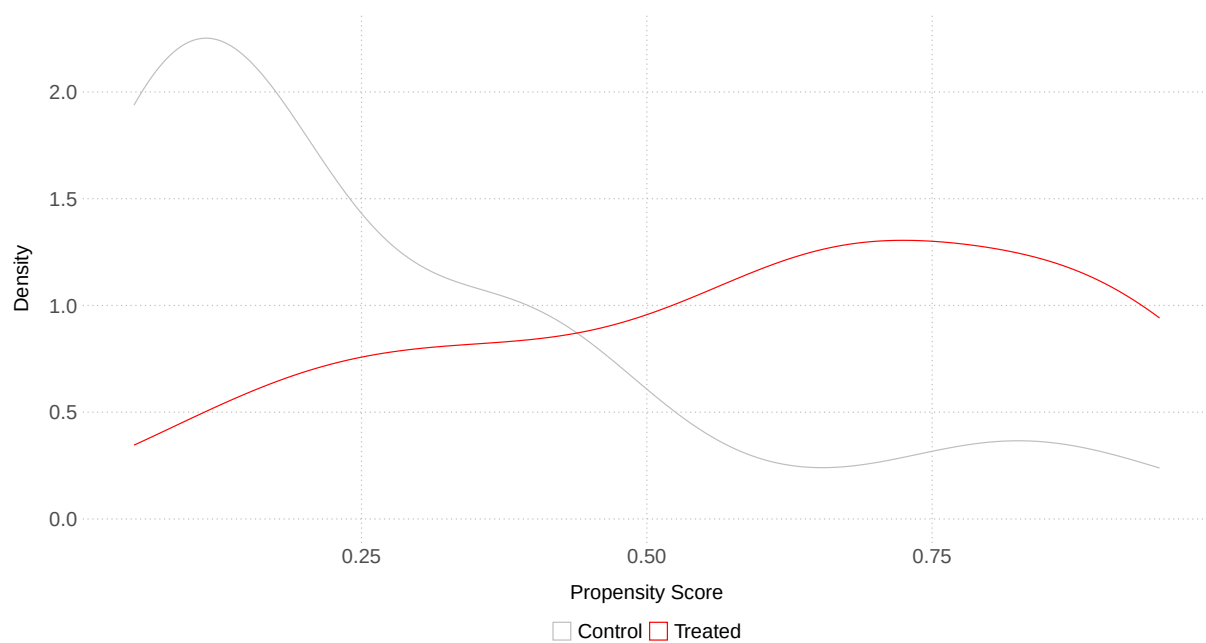


Table B.3: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate			
	(1)	(2)	(3)	(4)
Exposure	-5.0 (3.8)	-3.4 (3.0)	-7.3** (3.1)	-7.8** (3.5)
Exposure $\times I(\text{Year} \geq 2005)$	0.83* (0.47)	0.71* (0.39)	0.92** (0.41)	0.93** (0.38)
Munic FE (63)	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes		
State-Year FE (125)			Yes	Yes
Covariates*Year		Yes		Yes
IPW	Yes	Yes	Yes	Yes
Observations	1,569	1,569	1,569	1,569
R ²	0.48	0.62	0.59	0.70
Within R ²	0.005	0.26	0.008	0.28

Notes: All estimates include municipality and year fixed effects, as well as Inverse Probability Weights. Column (2) adds interaction between covariates in 2000 and year fixed effects; Column (3) adds state-year fixed effects; Column (4) adds both state-year fixed effects and interaction between covariates in 2000 and year fixed effects; Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

C Appendix - Additional Results

C.1 Difference-in-Differences

Table C.1 presents the results for the pure Difference-in-Differences specification, using 2005 as the first year of treatment. Instead of a continuous exposure to cocaine production, as before, this model simply compares treated and control units, before and after the policy change. Variable *Coca River* indicates whether a municipality is treated, i.e., whether it is located on a cocaine-trafficking river route, regardless of how much cocaine is potentially being transported through it.

Table C.1: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Coca River $\times I(\text{Year} \geq 2005)$	11.7*** (1.7)	10.1*** (2.9)	5.2*** (1.5)	6.3** (2.4)	6.4*** (2.3)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.46	0.50	0.50	0.54	0.42
Within R ²	0.03	0.10	0.002	0.07	0.06

Notes: Estimates in Columns (1) to (4) include municipality and year fixed effects, and are weighted by population. Column (2) adds interaction between covariates in 2000 and year fixed effects; Column (3) adds state-year fixed effects; Column (4) adds both state-year fixed effects and interaction between covariates in 2000 and year fixed effects; Column (5) repeats column (4) except we do not include population weights; Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

C.2 Main Table Excluding Infanticides

Table C.2 simply repeats the specifications from Table 2, but with a redefined dependent variable that includes only homicides against people older than one year of age. The population in the denominator is the same as before.

Table C.2: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate for Age > 1				
	(1)	(2)	(3)	(4)	(5)
Exposure	6.6*** (1.8)	3.8* (2.1)	0.11 (1.7)	0.90 (1.9)	-1.0 (1.7)
Exposure $\times I(\text{Year} \geq 2005)$	1.3*** (0.21)	1.2*** (0.35)	0.69*** (0.23)	0.76** (0.37)	0.72** (0.35)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.46	0.49	0.49	0.52	0.40
Within R ²	0.04	0.10	0.002	0.07	0.06

Notes: Estimates in Columns (1) to (4) include municipality and year fixed effects, and are weighted by population. Column (2) adds interaction between covariates in 2000 and year fixed effects; Column (3) adds state-year fixed effects; Column (4) adds both state-year fixed effects and interaction between covariates in 2000 and year fixed effects; Column (5) repeats column (4) except we do not include population weights; Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

C.3 Homicides in Place of Residence

Homicides in our main analysis are registered according to the municipality where they happened. In Table C.3, we use homicides registered according to the victim's municipality of residence.

Table C.3: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate - Place of Residence				
	(1)	(2)	(3)	(4)	(5)
Exposure	6.9*** (1.7)	4.7** (1.9)	0.84 (1.5)	1.7 (1.7)	-0.10 (1.6)
Exposure $\times I(\text{Year} \geq 2005)$	1.2*** (0.19)	1.1*** (0.35)	0.60*** (0.23)	0.69* (0.35)	0.61* (0.34)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.45	0.48	0.48	0.51	0.38
Within R ²	0.04	0.09	0.002	0.05	0.05

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

C.4 Homicides of Foreign Nationals

Table C.4 reports estimates using the homicide rate of foreign nationals per 100,000 residents as the dependent variable. The effects are much smaller than those found for total homicides and, in our preferred specification (Column 4), are only statistically significant at the 10% level. This suggests that the local population, rather than foreign criminal actors from producing countries, is the most affected by the shift in cocaine routes following the air interdiction.

Table C.4: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate of Foreign Nationals				
	(1)	(2)	(3)	(4)	(5)
Exposure	0.20 (0.15)	-0.01 (0.10)	-0.002 (0.12)	-0.08 (0.10)	-0.09 (0.12)
Exposure $\times I(\text{Year} \geq 2005)$	0.02*** (0.009)	0.03* (0.02)	0.03*** (0.01)	0.02* (0.01)	0.04* (0.02)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.15	0.20	0.18	0.23	0.19
Within R ²	0.003	0.07	0.0006	0.06	0.07

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. Homicide rate of foreign nationals is expressed per 100,000 inhabitants. *p<.1; **p<.05; ***p<.01.

C.5 Spatial Correlation

We provide two alternative methods to model spatial correlation. [Driscoll and Kraay \(1998\)](#) propose a method robust to general cross-sectional and serial correlation, whereas [Conley \(1999\)](#) explicitly models spatial correlation based on maximum geographical distances between units. We also test clusters of municipalities according to river basins, which we explain below.

Our results are robust to any of these alternative methods. Table C.5 provides our main estimate in the *baseline* column along with alternative specifications for standard error estimation in subsequent columns.

In *Driscoll-Kraay* (DK), we use two time lags to model cross-sectional correlation. In *Conley*, we provide three different distance thresholds to identify spatially correlated units: 100 km, 250 km, and 500 km. In all cases, our estimates are robust.

In *River Basins*, we cluster municipalities according to rivers and their tributaries. This should capture geographical correlation that operates through the river network. To do this, we use data on Ottobasins, which are organized in levels. A Level 1 Ottobasin is the most comprehensive one and corresponds to the Amazon River Basin and all its tributaries. As levels increase, basins become smaller. We use levels 3 and 4, which constitute 51 and 132 clusters

respectively. To categorize municipalities across river basins, we consider the Ottobasin that covers the largest area in each municipality.

Table C.5: Spatial Correlation: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Baseline (1)	DK (2)	Homicide Rate			River Basins	
			(3)	Conley (4)	(5)	(6)	(7)
Exposure $\times I(\text{Year} \geq 2005)$	0.76** (0.37)	0.76*** (0.20)	0.76** (0.36)	0.76*** (0.27)	0.76*** (0.28)	0.76** (0.38)	0.76** (0.30)
Standard-Errors	Munic FE	L=2	100km	200km	300km	Level 4	Level 3
Observations	6,697	6,697	6,697	6,697	6,697	6,697	6,697
R ²	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Within R ²	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Notes: All specifications include individual fixed effects, state-year fixed effects, pre-treatment covariates interacted with year fixed effects, and population weights $p < .1$; ** $p < .05$; *** $p < .01$. All errors are clustered at the municipality level. Western Amazon municipalities with less than 100,000 people. In River Basins, levels 3 and 4 correspond to Ottobasin definition in which the largest basin is level 1. Level 3 basins delimit 51 clusters whereas Level 4 basins delimit 132 clusters.

C.6 Geographical Heterogeneities and Spillover

C.6.1 Heterogeneity across Routes

In this section, we estimate the effects for each cocaine trafficking route. We omit the pre-period coefficients for conciseness and clarity.

Table C.6 shows that the effect is primarily driven by routes including either Colombia or Peru. Many of them run through the central portion of West Amazon, closer to the main river in the Amazon basin. The pattern in Table C.6 reflects the fact that Peru and Colombia account for most of the world's cocaine production. Moreover, in Peru, production is concentrated in the Aguaytía and Alto Huallaga regions, both located near the Ucayali and Marañón rivers, which flow into the Solimões. In Colombia, the main producing areas—Meta-Guaviare and Putumayo-Caqueta—are also connected to the Solimões via river routes (UNODC, 2004).

Table C.6: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020 - Heterogeneity by route

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure Peru $\times I(\text{Year} \geq 2005)$	1.9*** (0.48)	2.7*** (0.59)	1.3*** (0.44)	1.9*** (0.58)	1.8*** (0.58)
Exposure Colombia $\times I(\text{Year} \geq 2005)$	0.87** (0.44)	1.1* (0.59)	0.43 (0.41)	0.75 (0.56)	0.68 (0.58)
Exposure Bolivia $\times I(\text{Year} \geq 2005)$	-0.25 (0.18)	-0.33 (0.58)	-0.63 (0.42)	-0.69* (0.40)	-0.91* (0.46)
Exposure Colombia-Peru $\times I(\text{Year} \geq 2005)$	1.1*** (0.28)	1.4*** (0.44)	0.57* (0.30)	0.95** (0.42)	0.96** (0.39)
Exposure Peru-Bolivia $\times I(\text{Year} \geq 2005)$	0.94*** (0.28)	1.5*** (0.42)	0.50 (0.33)	0.93** (0.43)	0.84* (0.50)
Exposure Colombia-Peru-Bolivia $\times I(\text{Year} \geq 2005)$	1.4*** (0.27)	1.4*** (0.40)	0.99*** (0.28)	0.90** (0.44)	0.95*** (0.36)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.46	0.50	0.49	0.52	0.40
Within R ²	0.04	0.11	0.007	0.07	0.06

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

C.6.2 Distance to Border

We evaluate how the estimated coefficients vary according to the distance between each municipality and the Brazilian international border with the Andean countries. We compute distances along river paths and then split municipalities in quartiles of distance-to-border.

Table C.7 presents the results, interacting quartiles of distance-to-border with the usual coefficients. The indicator *nearBorder* represents municipalities in the first quartile of distance to border and *midBorder* indicates municipalities in the second and third quartiles. Municipalities in the last quartile are the omitted category.

In our preferred specification (Column 4), we find small and imprecise differences across distance-to-border quartiles.

Table C.7: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020 - Heterogeneity: distance from the Andean Border

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure $\times I(\text{Year} \geq 2005)$	1.2*** (0.27)	1.1*** (0.34)	0.92*** (0.29)	0.87** (0.40)	0.79** (0.36)
Exposure $\times I(\text{Year} \geq 2005) \times \text{nearBorder}$	-0.02 (0.38)	0.34 (0.44)	-0.34 (0.41)	-0.07 (0.44)	0.10 (0.47)
Exposure $\times I(\text{Year} \geq 2005) \times \text{midBorder}$	0.12 (0.31)	0.41 (0.37)	-0.21 (0.29)	0.09 (0.34)	0.03 (0.31)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.46	0.50	0.49	0.52	0.40
Within R ²	0.04	0.10	0.005	0.07	0.06

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

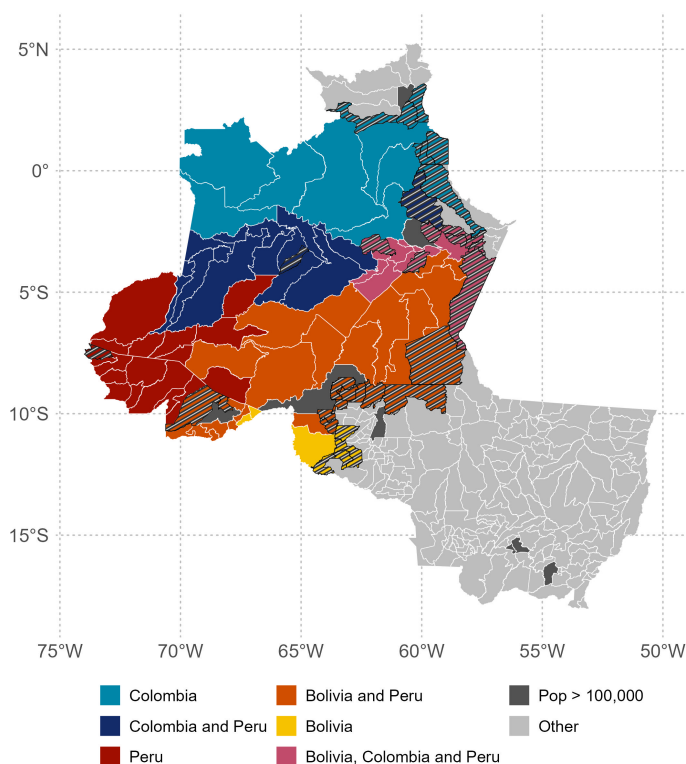
C.6.3 Geographic Spillover

We examine whether control municipalities adjacent to treated ones experienced an increase in the correlation between violence and cocaine production among their treated neighbors. We identified control municipalities that bordered at least one treated municipality and assigned them the exposure level of their neighbors. If a municipality had multiple treated neighbors, we used the maximum exposure value.

Figure C.1 below highlights the treated, spillover, and control municipalities. Spillover municipalities (hashed) share the same color as their neighbor with the highest exposure.

After defining the exposure of municipalities to cocaine trafficking, we conducted a regression similar to our baseline, but this time including Exposure Spillover as a separate variable. The results, presented in Table C.8 below, suggest that neighboring municipalities also experienced an increase in violence following the Force Down/Shoot Down policy, although the effect was of a smaller magnitude. Moreover, our main estimates remain stable even after accounting for spillovers.

Figure C.1: Municipalities Categorized According to River Routes Crossing their Territory and their Neighbors



Notes: Spillover municipalities share the same color as their neighbor with the highest exposure. These are marked with a striped pattern in the map.

Table C.8: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020 - Spillover Effects to Neighbouring Municipalities

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure $\times I(\text{Year} \geq 2005)$	1.2*** (0.21)	1.4*** (0.34)	0.74*** (0.23)	0.99*** (0.36)	0.92** (0.38)
$I(\text{Year} \geq 2005) \times \text{Exposure Spillover}$	0.13 (0.25)	0.50* (0.26)	0.12 (0.22)	0.53** (0.24)	0.35 (0.29)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,697	6,697	6,697	6,697	6,697
R ²	0.46	0.49	0.49	0.52	0.40
Within R ²	0.04	0.10	0.002	0.07	0.06

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1, **p<.05; ***p<.01.

C.7 Shorter Period of Treatment

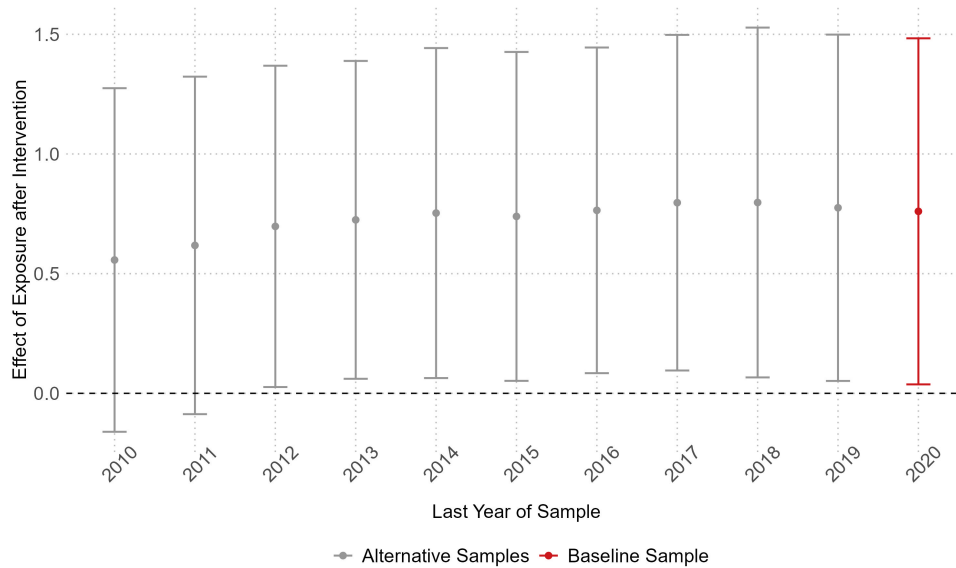
In Table C.9, the sample period ends in 2015 instead of 2020. Figure C.2 repeats this exercise, but instead changes the last year of the sample. Our main sample is in red.

Table C.9: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2015

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure	1.7 (1.3)	3.6** (1.5)	-1.3 (1.5)	0.31 (1.6)	-1.1 (1.5)
Exposure $\times I(\text{Year} \geq 2005)$	1.2*** (0.20)	1.2*** (0.34)	0.66*** (0.21)	0.74** (0.35)	0.75** (0.35)
Munic FE (269)	Yes	Yes	Yes	Yes	Yes
Year FE (20)	Yes	Yes			
State-Year FE (100)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	5,352	5,352	5,352	5,352	5,352
R ²	0.51	0.54	0.52	0.55	0.42
Within R ²	0.02	0.08	0.002	0.06	0.05

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

Figure C.2: Alternative Samples with Shorter Post-Treatment Periods



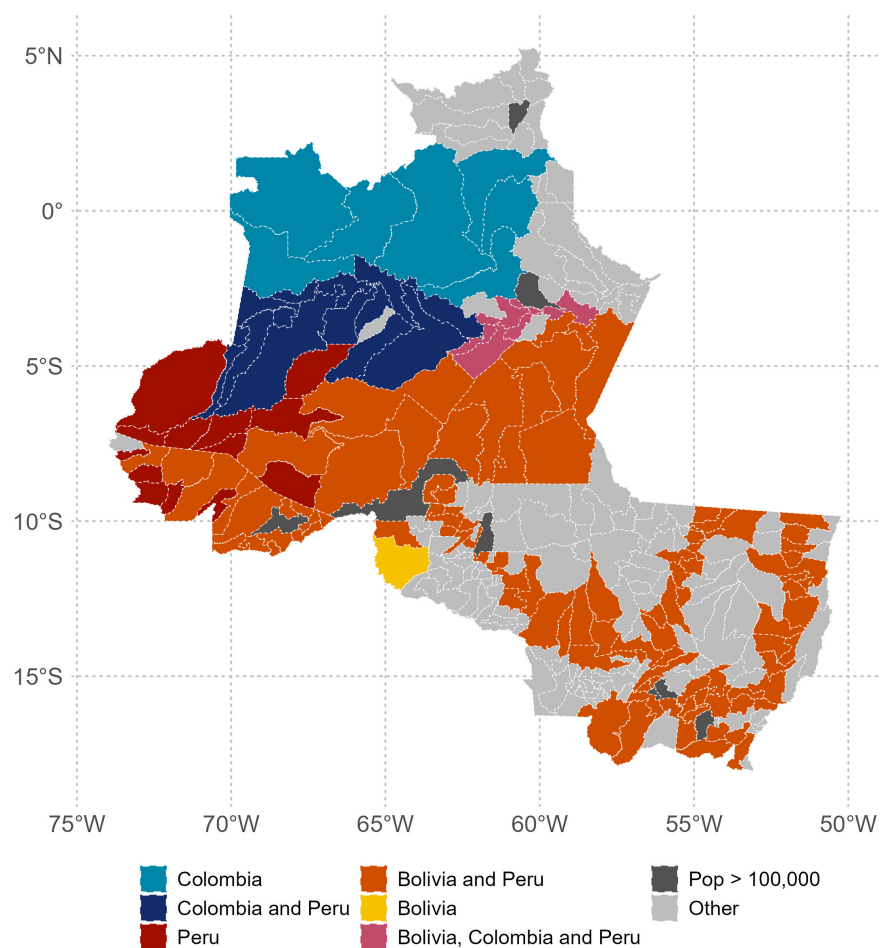
Notes: All specifications include individual fixed effects, state-year fixed effects, pre-treatment covariates interacted with year fixed effects, and population weights (Column 1 of Table 4). Each estimate is based on a sample starting in 1996 and ending in different years shown in the X-axis. All estimates are presented with a 95% confidence interval.

C.8 Municipalities Categorized According to River and Road Routes

Figure C.3 categorizes municipalities according to both river and road routes. We use the work of [Couto and Oliveira \(2017\)](#) to identify cocaine-trafficking road routes. In the database, we can observe municipalities that are exposed to river routes, road routes or both.

As before, the classification of routes is based on their countries of origin (Bolivia, Colombia or Peru). We then use this information to calculate the exposure to cocaine production.

Figure C.3: Municipalities Categorized According to River and Road Routes Crossing their Territory



Notes: Data on roads from [Ministério dos Transportes \(2021\)](#) and [DNIT \(2022\)](#).

D Appendix - Excluding Municipalities with High Infanticide Rates

This appendix presents the main results of the paper for a different sample, which excludes municipalities with abnormally high infanticide rates. These outliers are Caracaraí (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

D.1 Main Table

Table D.1: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure	7.5*** (1.8)	5.3*** (2.0)	1.3 (1.5)	2.5 (1.7)	-0.13 (1.7)
Exposure $\times I(\text{Year} \geq 2005)$	1.3*** (0.21)	1.3*** (0.37)	0.75*** (0.24)	0.84** (0.39)	0.89** (0.36)
Munic FE (265)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,597	6,597	6,597	6,597	6,597
R ²	0.47	0.50	0.49	0.53	0.40
Within R ²	0.04	0.11	0.003	0.07	0.06

Notes: Western Amazon municipalities with less than 100,000 people. All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01. Excludes the following municipalities with high infanticide rates: Caracaraí (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

D.2 Decomposition

Table D.2: Decomposition of Homicides, Exposure to Cocaine Trafficking in River Routes, and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Homicide Rate			Men 20+			Other Homicides		
	Total 20+ (1)	Men 20+ (2)	Women 20+ (3)	Home (4)	Out of Home (5)	Firearm or Stab Wound (6)	Land-related (7)	Police (8)	Undet. (9)
Exposure $\times I(\text{Year} \geq 2005)$	0.71** (0.33)	0.61* (0.33)	0.10** (0.04)	0.10 (0.07)	0.51* (0.28)	0.53* (0.28)	-0.007** (0.003)	0.01* (0.007)	0.06 (0.11)
Observations	6,597	6,597	6,597	6,597	6,597	6,597	6,332	6,597	6,597
R ²	0.51	0.51	0.17	0.25	0.48	0.49	0.22	0.10	0.29
Within R ²	0.06	0.07	0.04	0.04	0.06	0.07	0.06	0.03	0.05

Notes: All specifications include individual fixed effects, state-year fixed effects, pre-treatment covariates interacted with year fixed effects, and population weights. *p<.1; **p<.05; ***p<.01. All errors are clustered at the municipality level. Western Amazon municipalities with less than 100,000 people. Land-related is an indicator variable equal to one when there are deaths in the countryside due to land conflicts according to the Comissão Pastoral da Terra. Police and Undet. are homicide rates committed by the police or by an undetermined actor. Excludes the following municipalities with high infanticide rates: Caracarái (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

D.3 Mechanism

Table D.3: Deaths from Overdose, Exposure to Cocaine Trafficking in River Routes, and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Overdose Death Rate				
	(1)	(2)	(3)	(4)	(5)
Exposure $\times I(\text{Year} \geq 2005)$	0.02** (0.01)	0.05*** (0.02)	0.05*** (0.01)	0.06*** (0.02)	0.06*** (0.02)
Munic FE (265)	Yes	Yes	Yes	Yes	Yes
Year FE (25)	Yes	Yes			
State-Year FE (125)			Yes	Yes	Yes
Population Weights	Yes	Yes	Yes	Yes	
Covariates*Year		Yes		Yes	Yes
Observations	6,597	6,597	6,597	6,597	6,597
R ²	0.09	0.15	0.11	0.16	0.11
Within R ²	0.007	0.06	0.002	0.06	0.04

Notes: Deaths by overdose are classified by ICD-10 codes: X42 and X44, Y12 and Y14, F14 and F19. Estimates in Columns (1) to (4) include municipality and year fixed effects, and are weighted by population. Column (2) adds interaction between covariates in 2000 and year fixed effects; Column (3) adds state-year fixed effects; Column (4) adds both state-year fixed effects and interaction between covariates in 2000 and year fixed effects; Column (5) repeats column (4) except we do not include population weights; Western Amazon municipalities with less than 100,000 people. Excludes the following municipalities with high infanticide rates: Caracaraí (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM). All errors are clustered at the municipality level. *p<.1; **p<.05; ***p<.01.

D.4 Placebo

Table D.4: Placebo: Other Death Rates and Cocaine Exposure in Waterway Trafficking Routes after the Force-Down/Shoot-Down Policy, from 1996 to 2020

	Infect Parasite	Neoplasm	Circulatory	Respiratory	Digestive	Suicide
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Exposure $\times I(\text{Year} \geq 2005)$	0.31 (0.19)	0.09 (0.38)	0.55 (0.54)	0.17 (0.20)	0.13 (0.19)	0.27* (0.15)
Observations	6,597	6,597	6,597	6,597	6,597	6,597
R ²	0.67	0.57	0.72	0.61	0.60	0.33
Within R ²	0.36	0.10	0.07	0.09	0.09	0.06

Notes: All specifications include individual fixed effects, state-year fixed effects, pre-treatment covariates interacted with year fixed effects, and population weights. *p<.1; **p<.05; ***p<.01. All errors are clustered at the municipality level. Western Amazon municipalities with less than 100,000 people. Excludes the following municipalities with high infanticide rates: Caracarái (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

Table D.5: Placebo: GDP per Capita and GDP Composition, Cocaine Exposure in Waterway Trafficking Routes, and the Force-Down/Shoot-Down Policy, from 1996 to 2020

	Traffic Accident	(log) GDP per Capita	Share Agric.	Share Manuf.	Share Service	Share Public	Share Taxes
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Exposure $\times I(\text{Year} \geq 2005)$	0.08 (0.40)	0.002 (0.009)	-0.004 (0.003)	0.002 (0.001)	0.001 (0.002)	-0.002 (0.003)	0.002** (0.001)
Observations	4,770	4,770	4,770	4,770	4,770	4,770	4,770
R ²	0.43	0.96	0.88	0.78	0.93	0.94	0.84
Within R ²	0.08	0.08	0.11	0.07	0.09	0.06	0.06

Notes: All specifications include individual fixed effects, state-year fixed effects, and pre-treatment covariates interacted with year fixed effects. GDP estimates does not include include population weights, because GDP varies more smoothly than homicides. Traffic deaths are considered a proxy for economic activity and urbanization. *p<.1; **p<.05; ***p<.01. All errors are clustered at the municipality level. Western Amazon municipalities with less than 100,000 people. Excludes the following municipalities with high infanticide rates: Caracarái (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

D.5 Robustness

Table D.6: Spatial Correlation: Exposure to Cocaine Trafficking in River Routes and Force-Down/Shoot-Down Policy, from 1996 to 2020

Model:	Baseline (1)	DK (2)	Homicide Rate			River Basins	
			(3)	Conley (4)	(5)	(6)	(7)
Exposure $\times I(\text{Year} \geq 2005)$	0.84** (0.39)	0.84*** (0.21)	0.84** (0.39)	0.84*** (0.32)	0.84* (0.48)	0.84** (0.40)	0.84** (0.32)
Standard-Errors	Munic FE	L=2	100km	200km	300km	Level 4	Level 3
Observations	6,597	6,597	6,597	6,597	6,597	6,597	6,597
R ²	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Within R ²	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Notes: All specifications include individual fixed effects, state-year fixed effects, pre-treatment covariates interacted with year fixed effects, and population weights. *p<.1; **p<.05; ***p<.01. All errors are clustered at the municipality level. Western Amazon municipalities with less than 100,000 people. In River Basins, levels 3 and 4 correspond to Ottobasin definition in which the largest basin is level 1. Level 3 basins delimit 51 clusters whereas Level 4 basins delimit 132 clusters. Excludes the following municipalities with high infanticide rates: Caracaraí (RR), Alto Alegre (RR), Santa Isabel do Rio Negro (AM), and Barcelos (AM).

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