Explosive Diversification: Organized Crime Adaptation to Mexico's Crackdown on Fuel Theft*

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Abstract

Oil theft from pipelines funds armed criminal groups around the world. We show that a 2019 crackdown on oil theft in Mexico prompted criminal groups to diversify into gas theft, a more technologically challenging and dangerous activity. This adaptive response to enforcement increased cartel presence by 18% and homicide rates by 19% in municipalities hosting gas pipeline infrastructure. Cartel diversification into gas theft was concentrated in places neighboring oil pipelines and driven most strongly by cartels previously specialized in oil theft. The emergence of large-scale gas theft in Mexico presages threats to gas infrastructure worldwide and reveals how law enforcement crackdowns can provoke criminal diversification into spatially and technologically related activities – spreading violence into previously unaffected areas.

JEL codes: Q34, Q35, Q32, Q48, 017

Keywords: Hydrocarbon Theft, Energy Infrastructure, Organized Crime, Law Enforcement, Mexico

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1 Introduction

Organized criminal groups frequently target extractive industries such as mining and oil, where point-source rents provide opportunities for appropriation (Berman et al., 2017; Parker and Vadheim, 2017; Dube and Vargas, 2013). Oil theft from pipelines is a particularly pressing problem. Worldwide, oil thefts exceeded 200 million barrels and US$11 billion in 2015, funding armed groups in Colombia, Ecuador, Indonesia, Mexico, Nigeria, Russia, and Syria, among other countries (Valencia, 2024, 2022; Rexer and Hvinden, 2023; May, 2017). Until recently, theft of liquified petroleum gas (LPG) and natural gas from pipelines has been much less common. However, gas pipeline infrastructure is expanding rapidly as countries shift from coal to gas for electricity generation and households adopt gas for cooking and heating (Kojima, 2021; International Energy Agency, 2019). In 2024, there were over 1 million km of gas pipelines operating globally and 238,000 km proposed or under construction – 81% of these in low or middle-income countries (Global Energy Monitor, 2025).

Preventing this vast gas pipeline infrastructure from becoming a revenue source for organized crime is an urgent policy challenge, given that criminal groups increase violence (Sobrino, 2020), reduce economic growth (Fenizia and Saggio, 2024), provoke forced migration (Daniele et al., 2023), and corrupt governance and elections (Trudeau, 2022; Lessing, 2018).[1] Governments often resort to heavy-handed enforcement efforts to combat organized crime, but crackdowns can have the unintended effect of increasing violence and provoking diversification toward novel revenue sources (Battiston et al., 2024; López Cruz and Torrens, 2023; Dell, 2015). Understanding patterns of criminal diversification in response to crackdowns is essential to effectively combat organized crime.

This paper examines how organized criminal groups adapt to law enforcement interventions, and the resulting implications for crime, violence, and socioeconomic development. We focus on the first documented instance of large-scale gas pipeline theft, which emerged in Mexico following a government crackdown on oil theft in 2019.[2] This crackdown involved military intervention to shut down high-theft oil pipelines, heightened policing along pipeline corridors, and temporary transport of fuel by truck between December 2018 and April 2019. We assess

[1] Across Latin America, between 77-101 million people – 14% of the population – live under the influence of organized criminal groups (Uribe et al., 2025). This makes organized crime one of the most severe threats to governance and development in the region (Corrales and Freeman, 2024). Mexico is particularly impacted by violence associated with organized criminal groups (i.e., cartels), whose presence in communities reduces profits and salaries and increases poverty and unemployment (Gutiérrez-Romero and Oviedo, 2017).

[2] In Mexico, oil theft involves tapping pipelines to siphon refined oil products (e.g., gasoline and diesel). This activity is dominated by cartels, which exert substantial influence over police and employees of the state-owned oil company, Pemex. In 2018, cartels stole an average of 58 thousand barrels of gasoline per day, amounting to US$3.5 billion in value and 8% of national consumption (Solis, 2018). When prices are high, a cartel can siphon US$90,000 worth of gasoline from a pipeline tap in just 6 minutes (May, 2017).

whether these measures achieved their immediate goal of reducing oil theft and violence in municipalities hosting oil pipelines. We also examine whether the crackdown on oil theft inadvertently prompted cartels to refocus toward less-policed gas pipelines, generating spillovers of violence and cartel presence into municipalities hosting gas pipeline infrastructure.[3]

Methodologically, we combine georeferenced maps of refined oil and gas pipelines with annual municipality-level reports of pipeline thefts, cartel presence, and homicides. We use difference-in-differences and event study specifications to measure changes in these outcomes before and after the 2019 crackdown in municipalities with refined oil or gas pipelines, relative to municipalities without pipelines. Additionally, we explore effects of the crackdown on other crimes and socioeconomic development outcomes, as well as spatial spillovers of violence into neighboring, non-pipeline municipalities.

Results show that the crackdown successfully decreased the number of illegal taps on refined oil pipelines in the short-term, reversing a trend of exponential growth in pipeline thefts since 2010. However, oil thefts began to rise again in 2021 and recovered to 80% of their 2018 peak by 2023. Despite the crackdown's efficacy in temporarily reducing thefts, homicide rates in municipalities with oil pipelines remained unchanged (at levels well above the national average) and the number of active cartels *increased* by an average of 1 during the two years following the crackdown. These results suggest that the crackdown disrupted incumbent cartels in oil pipeline municipalities, creating opportunities for rival groups to enter.

Furthermore, we document a 1,085% increase in gas pipeline thefts (+3.8 taps per municipality-year from a baseline mean of just 0.24 taps per year) following the crackdown. This increase was concentrated in places that neighbor or host an oil pipeline, indicating that cartels displaced by the crackdown shifted spatially toward theft from nearby gas pipelines. We show that this shift is associated with an increase of 4 homicides per 100 thousand residents (+19%) and 0.36 active cartels (+18%) in municipalities hosting gas pipeline infrastructure, suggesting that cartels used violence to secure gas pipeline territories.

Theft of refined gas products is significantly more dangerous and technologically complex than oil theft, requiring coordination with pipeline operators to notify thieves when pipes will be depressurized in order to safely tap them (Nájar, 2019). In line with the skill-intensive nature of gas theft, we find that increased cartel activity in gas pipeline municipalities is driven most strongly by cartels with previous experience in oil theft – though presence of cartels without prior oil theft experience also grows. By increasing the risks associated with oil theft, we

[3]This shift toward gas thefts received contemporaneous media attention (Nájar, 2019) and corresponded with a sharp increase in gas-related accidents, from an annual average of 36 between 2003-2017 to 275 in 2019 and 307 in 2020 – 63% of which involved fires or explosions (CENAPRED, 2021).

conclude that the crackdown made gas theft relatively more attractive, prompting cartels to overcome the fixed costs of accessing new territories, stealing specialized equipment, and co-opting pipeline operators. Based on these findings, we discuss a conceptual framework based on López Cruz and Torrens (2023) and Battiston et al. (2024)'s models of cartel diversification into new illicit sectors following a crackdown on an existing sector. We introduce the criteria of *technological* and *spatial overlap* between existing and new sectors in determining whether incumbent cartels or newcomers will expand in the wake of a crackdown.

Finally, to measure purely spatial spillovers, we exclude pipeline municipalities altogether and estimate effects of the crackdown on homicide rates in municipalities that neighbor places with oil or gas infrastructure, relative to non-neighbors. Findings reveal large spillovers of violence into places neighboring oil pipeline municipalities (+5.8 homicides per 100 thousand residents, a 30% increase), indicating that cartels not only substituted toward gas theft, but also shifted spatially into neighboring areas to evade the crackdown.

Adding a new chapter to previous studies showing how Mexico's crackdown on drug trafficking in the 2000s provoked the rise of oil theft (Battiston et al., 2024; López Cruz and Torrens, 2023; Dell, 2015), these novel findings show how crackdowns on organized crime lead to a continuous cat-and-mouse process of adaptation and diversification – with predictable technological and spatial patterns. Furthermore, our findings underscore how the global build-out of gas pipeline networks will require careful management and monitoring to prevent pipelines from becoming a revenue source for organized criminal groups. We discuss policy implications from Mexico's experience in the Conclusion.

1.1 Related Literature and Contributions

This study contributes to three strands of literature on the economics of crime: (i) the behavior of organized criminal groups, (ii) unintended consequences of enforcement and crackdowns, and (iii) crime focused on extractive industries, particularly pipeline theft.

Literature on organized criminal groups has shown that they infiltrate and loot healthy firms (Mirenda, 2022), prey on profitable farmers (De Haro, 2025), undermine free and fair elections (Trudeau, 2022), and reduce economic growth (Fenizia and Saggio, 2024). Governments face trade-offs in combating these groups, as targeting their revenue sources may lead them to prey on local residents instead (Blattman et al., 2024). We build on this literature by studying criminal groups' adaptation to a major crackdown effort using rich data on cartel presence and crime. Our results reveal that cartel diversification into gas theft aligns with previous patterns of specialization, with cartels behaving as firms that accumulate skills in specific crimes and face both spatial and technological barriers to entry into new criminal activities.

Studies of law enforcement crackdowns have largely concluded that criminal groups are adaptable and resilient, and that disruptions of illicit equilibria increase violence (Magaloni et al., 2020; Herrera and Martinez-Alvarez, 2022; Jones, 2013). For instance, a policy aimed at preventing trade of conflict minerals from the Democratic Republic of the Congo led warlords to shift toward gold mining and looting of civilians (Parker and Vadheim, 2017). In the Brazilian Amazon, the prohibition of mahogany harvesting led to higher violence without reducing the mahogany trade (Chimeli and Soares, 2017). Finally, Dell (2015) finds that crackdowns on drug trafficking in Mexico increased violence as cartels fragmented and took advantage of weakened rivals. We contribute to this literature by showing that Mexico's 2019 crackdown on oil theft triggered violent cartel diversification into a new and explosive activity: gas pipeline theft.

Extractive industries are especially vulnerable to criminal appropriation because they present fixed point targets and generate large rents (Dube and Vargas, 2013; Angrist and Kugler, 2008). Berman et al. (2017) show that increases in world mineral and metal prices significantly increase violence around African mines as groups fight to control resource windfalls. Our findings provide further evidence that fixed extractive infrastructures (i.e., pipelines) are vulnerable to criminal appropriation and associated violence, even far removed from active production areas.

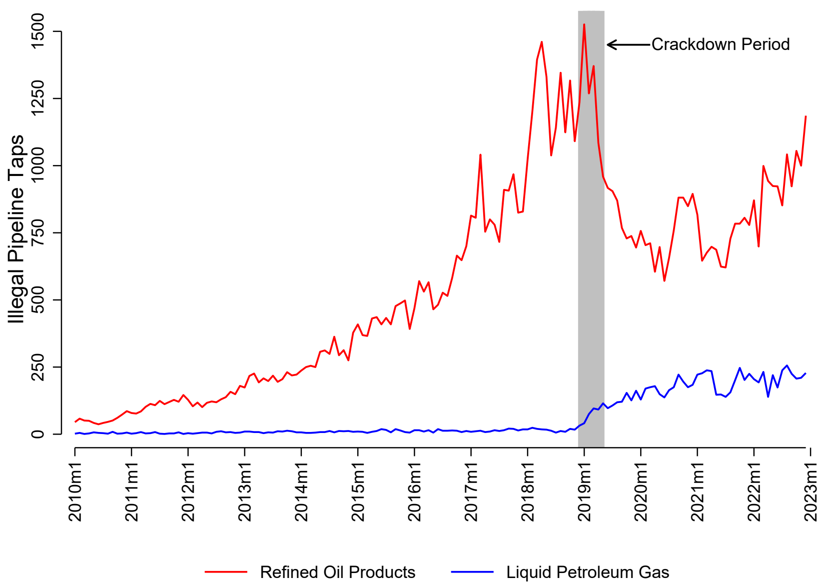
Most specifically, we build on existing studies of pipeline theft, which presents a growing problem in countries including Brazil, Colombia, Ecuador, Indonesia, Mexico, Nigeria, Russia, and Syria (Ventriglia et al., 2023). López Cruz and Torrens (2023) document increased oil thefts and violence near oil pipelines after a government crackdown on drug trafficking in Mexico in 2007, providing evidence that cartels substituted for lost drug revenues with fuel theft. Battiston et al. (2024) leverage the same 2006 drug trafficking crackdown to show that upstart cartels leapfrogged incumbents to engage in pipeline thefts, leading to cartel specialization and segmentation of illegal markets. Rexer (2023) finds that a policy that shifted ownership of Nigerian's oil fields to local firms reduced oil thefts, as local firms were better able to strike bargains with armed groups and leverage government connections to improve law enforcement. We build on previous studies of pipeline theft in Mexico by documenting a new stage in the story of cartel diversification: from oil thefts to gas–which represents a significant increase in technical sophistication and infiltration of state agencies. More broadly, we contribute to the literature on global pipeline theft by quantifying the emergence of gas theft at scale for the first time. The growth of this lucrative and explosive market in Mexico presages threats to other gas-producing regions around the world.

2 Background

2.1 Mexico's War on Drugs and the Rise of Pipeline Theft

In 2006, Mexico's government launched a War on Drugs to combat drug trafficking organizations. The government employed a kingpin strategy, which involved apprehending leaders of these organizations. This tactic destabilized large drug cartels, leading to their fragmentation, increased competition from newly formed organizations (Calderón et al., 2015), and diversification into non-drug-related activities, including extortion of agricultural workers (De Haro, 2025) and theft of refined oil products from pipelines – with accompanying increases in violence (López Cruz and Torrens, 2023; Battiston et al., 2024). Reports of illegal taps on refined oil pipelines increased dramatically following the War on Drugs, peaking at 15,000 reported taps in 2018. Figure 1 shows monthly reports of illegal taps on refined oil and gas products between 2010 and 2022.

Figure 1: Illegal Taps on Refined Oil and Gas Pipelines



Note: Data were obtained from Pemex, Mexico's state-owned petroleum company, through a freedom of information request. Refined oil products are defined as gasoline and diesel.

Criminal organizations have developed effective methods to steal refined oil products (primarily gasoline and diesel) from pipelines operated by Pemex, the state-owned oil company.[4] Cartel members pay or coerce Pemex employees to share information on pipeline locations and provide the necessary equipment and information on how to extract the fuel (Cultura Colectiva, 2019; López Cruz and Torrens, 2023). Collaborating Pemex employees also notify cartels of the

[4]In 2017, a nationwide energy reform allowed private investments in crude oil exploration, as well as gas and gasoline distribution. However, Pemex continues to own and operate nearly all production and transportation infrastructure (e.g., refineries and pipelines).

best time to drill to avoid an explosion, and of the type of fuel (e.g., gasoline or diesel) passing through the pipeline. The stolen fuel is loaded into barrels or trucks and sold in local markets or along local roads. Consumers of stolen fuel products include factories, transportation businesses, taxi drivers, and gas stations. Fuel theft can also substantially subsidize local fuel prices and constitutes a valuable source of income for local residents, complicating efforts to combat this lucrative activity (Torres, 2017; Ralby, 2017). In 2018, Pemex reported losses of approximately US$3.5 billion due to illegal gasoline taps, which amounted to 8% of national gasoline consumption (Solis, 2018). Fuel theft also causes substantial losses in tax revenues, which Mexico's tax authority estimated at US$3.15 billion in 2021 (Tapia Cervantes, 2021).

As illustrated in Figure 1, thefts of liquid petroleum gas (LPG) from gas pipelines were almost unheard of prior to 2019. Corresponding with the crackdown on refined oil theft beginning in December 2018, illegal gas taps quickly increased by over 500%. Approximately 50,000 tons of LPG were stolen monthly in 2022 (Usla, 2022) – accounting for 7.6% of national consumption. LPG presents unique opportunities for criminal organizations because 79% of Mexican households use it for cooking and heating (INEGI, 2022).

Stolen LPG is stored in small cylinders and sold to local consumers informally. Gas pipeline theft is intrinsically more dangerous than oil pipeline theft, since gas is stored under extreme temperatures and pressures and taps cannot be made while the pipeline is in use. Instead, thieves rely on tip-offs on when the pipeline will be available for tapping, or provoke accidents that require pipes to be shut down (Nájar, 2019). The rise in gas pipeline theft is thus closely associated with a dramatic rise in gas-related accidents (mostly fires and explosions), from an average of 36 per year between 2003 and 2017 to 275 in 2019 and 307 in 2020 (Appendix Figure A1). Gas thefts are often undertaken in densely populated urban areas, putting local residents at risk. Mexico's National Center for the Prevention of Disasters reports 208 deaths and 2352 injuries from gas fires and explosions since 2003, with most occurring in recent years (CENAPRED, 2021).

2.1.1 Pipeline Thefts Respond to World Fuel Prices

Using monthly data on fuel prices from CRE, we regress the number of oil or gas pipeline thefts recorded in a municipality-month on (i) national gasoline and diesel prices, (ii) national LPG prices, and (iii) Brent Crude world oil prices, including municipality fixed effects and clustering standard errors at the municipality level. Results, reported in Appendix Table A1, reveal a significant positive association between fuel prices and thefts. A 10% increase in exogenous world oil prices is associated with a 3.6% rise in refined oil pipeline thefts. Thefts are even more responsive to national fuel prices: a 10% increase in Mexican gasoline and diesel prices is associated with a 5% increase in fuel thefts. If efforts to crack down on pipeline theft lead to increased fuel prices, this could paradoxically encourage additional thefts.

2.2 The 2019 Crackdown on Oil Pipeline Theft

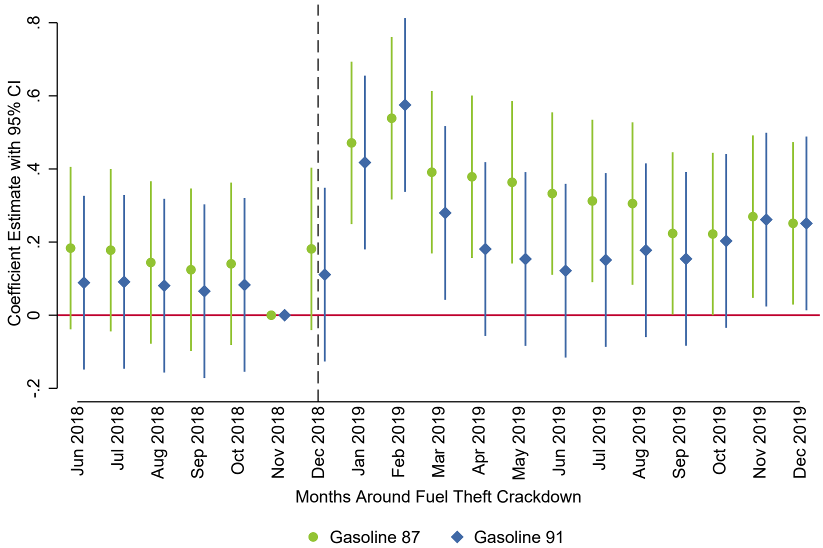
Rising levels of oil pipeline theft and associated violence reached a boiling point in 2018, corresponding with the beginning of Andrés Manuel López Obrador's term as president of Mexico. In late December 2018, López Obrador declared a far-reaching crackdown on pipeline theft (Crisis Group, 2022). The crackdown involved closure of severely affected stretches of oil pipelines and using fuel trucks to transport refined oil products across these stretches under increased military patrols and surveillance. This intervention resulted in widespread disruption of local fuel markets and fuel shortages (Specia, 2019).

In Figure 2, we use state-month level gasoline price data from Mexico's Energy Regulatory Commission to compare gasoline prices in targeted states versus non-targeted states before and after the crackdown. Targeted states are defined as those where the Mexican government shut down pipelines and other fuel infrastructure between late December 2018 and April 2019 to combat fuel theft (Caballero-Morales and Martínez-Flores, 2019; Carranza Garcia and Esposito, 2019). Estimates include month and state fixed effects. Results reveal a significant fuel price spike in states affected by the crackdown (peaking at a price differential of up to 0.6 Mexican pesos per liter), beginning in January 2019 and persisting for at least a year.

The most dramatic fallout from Mexico's crackdown on fuel theft came on January 19th 2019, when a massive explosion resulting from a gasoline pipeline tap killed at least 74 people and injured hundreds more in the town of Tlahuelilpan, Hidalgo. Up to 800 people had converged on the gushing pipeline tap to collect fuel in jerrycans, in part because the crackdown had created local fuel shortages (Semple, 2019). Discussing the incident, residents explained that: "In these towns, we all have a relative or friend who is dedicated to [pipeline theft]... Here, even the mayor protects *huachicol*... Authorities here receive money from *huachicol*. It pays very well and it's an opportunity to enjoy a better life (McDonnell and Linthicum, 2019)."

The high costs and substantial disruptions involved in the 2019 crackdown made it unsustainable in the long-term, leading to a winding down of crackdown efforts in April 2019. Since the crackdown did not resolve underlying security challenges, institutional weaknesses, and local incentives driving pipeline theft, illegal taps on refined oil pipelines began to grow again from 2021 onward (Crisis Group, 2022).

Figure 2: Crackdown Effects on Gasoline Prices in Affected States



Note: Figure reports coefficient estimates from the following specification: $Y_{st} = \delta_s + \gamma_t + \sum_{t \neq 12/18} \beta_t T_{st} + \epsilon_{st}$, where Y_{st} are nominal gasoline 87 and 91 prices in Mexican Pesos per liter, δ_s and γ_t are state and month fixed effects, respectively, and T_{st} is an indicator taking a value of 1 in states where the Mexican government shut down oil pipelines in December 2018 to combat fuel theft. These states are identified as Hidalgo, México, Jalisco, Michoacán de Ocampo, Guanajuato, Querétaro, and Aguascalientes based on reports by Caballero-Morales and Martínez-Flores (2019) and Carranza Garcia and Esposito (2019). Data on fuel prices are from CRE (2023).

3 Conceptual Framework

Previous studies of organized criminal groups have often conceptualized them as profit maximizing firms (López Cruz and Torrens, 2023; Olken and Barron, 2009; Fiorentini and Zamagni, 1999). Along these lines, Battiston et al. (2024) propose a model of cartel diversification in response to the Mexican government's crackdown on drug trafficking in 2006. In this model, profit-maximizing incumbent cartels (those already established as drug traffickers) and newcomer cartels face the choice of investing in the traditional drug trafficking sector or diversifying into a new sector (oil pipeline theft). Investment in the new sector involves a fixed cost of entry, which dissuades diversification until a government crackdown on drug trafficking changes the relative costs and benefits of the two illicit activities. Since the incumbent cartel enjoys greater productivity in drug trafficking due to its first-mover advantage, it is more likely to remain in this sector following the crackdown, while the newcomer is more likely to leapfrog into the new sector (Battiston et al., 2024).

We extend this conceptual framework by considering the *skill content* and *spatial distribution* of alternative illicit sectors. Organized criminal groups accumulate sector-specific human capital and territorial footprints, and diversifying into new activities involves heterogeneous costs of entry depending on technological and spatial similarity between the traditional and new activity.

In the case of drug trafficking and oil pipeline theft analyzed by Battiston et al. (2024), the two illicit activities possess low degrees of technological and spatial overlap, implying that incumbent cartels' accumulated know-how and territorial control of drug trafficking routes is of little use for oil pipeline theft. This gives the advantage in pipeline theft to newcomer cartels. In the more recent case of oil theft and gas theft that we analyze, the two illicit activities involve a high degree of technological and spatial overlap, allowing incumbents to leverage their accumulated skill in pipeline tapping, inside connections with pipeline operators, and territorial control over pipeline territories to diversify. Incumbents thus face lower costs of entry into gas theft than do newcomers – consistent with our empirical finding that post-crackdown diversification into gas pipeline theft was driven most strongly by cartels previously specialized in oil theft.

Why would cartel expansion into new territories increase violence? Previous studies have shown that violence is associated with cartel fragmentation – often provoked by the loss of a leader – and competition between rival groups (Sobrino, 2020; Atuesta and Ponce, 2017). Beyond turf wars and power struggles, arrival of a cartel in a previously cartel-free area may increase violence because cartels lack legal means of securing property rights and arbitrating disputes, forcing them to rely on violence to establish norms and punishments (Badillo-Sarmiento and Trejos-Rosero, 2024).

4 Data

Our sample consists of 2,471 municipalities tracked annually between 2015-2022. In this section, we describe each of our data sources and present descriptive statistics.

4.1 Energy Infrastructure

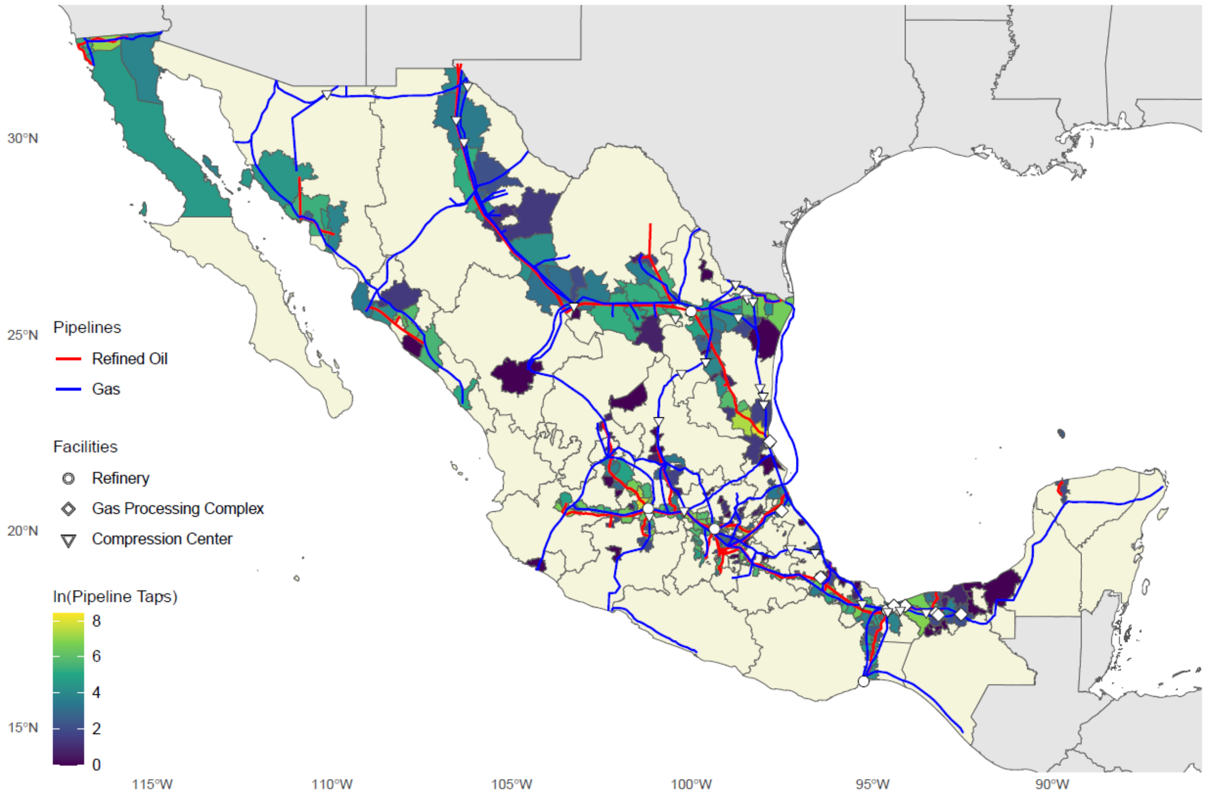
We obtained georeferenced information on Mexico's energy infrastructure from the National Commission of Hydrocarbons (Comisión Nacional de Hidrocarburos) (CNH, 2019). Data include precise locations of oil refineries, gas processing complexes, and gas compression centers, as well as pipelines used in the transportation of crude, refined oil and gas products, as of 2019. Among oil pipelines, we focus on those designated as carrying gasoline and diesel – the products targeted by fuel thieves – and exclude pipelines that exclusively carry other products, such as crude oil, fuel oil (a heavy fuel used by industry), and jet fuel.

Mexico's gas distribution infrastructure includes government-owned pipelines (the "SISTRAGAS" system) as well as privately owned pipelines. In our main specifications, we do not differentiate between the two. We exclude importation pipelines from our analysis, as these are located outside the Mexican territory. Figure 3 maps Mexico's refined oil and gas pipelines, as well as the locations of refineries, gas processing complexes, and gas compression centers.

4.2 Illegal Taps on Oil and Gas Pipelines

Data on reports of illegal gasoline, diesel, and liquid petroleum gas pipeline taps were obtained through a freedom of information request to Pemex. The data include the number of illegal taps reported each month in each Mexican municipality from 2010 to 2022. Taps on refined fuel and gas products are reported separately. In Figure 3, we overlay cumulative oil and gas pipeline taps reported in each municipality between 2010-2022.

Figure 3: Mexico: Refined Oil and Gas Processing and Transportation Infrastructure



Note: Geo-referenced data on pipelines and other energy infrastructure are from the National Commission of Hydrocarbons (CNH, 2019); data on pipeline taps were obtained from Pemex through freedom of information requests. Areas in beige reported no illegal pipeline taps between 2010-2022.

4.3 Crime Reports

We use data on homicides from the National Department of Health Information (Sistema Nacional de Información en Salud – SINAIS). This database includes information on the cause of death, location of death, and type of weapon used in all homicides. It also reports the sex, occupation, marital status, and insurance affiliation of the deceased.[5]

[5]We prefer this database to police report data from the Ministry of Public Security (SSP) because it provides more details on the victim, including insurance affiliation, which we use to identify murders of Pemex employees

Using municipal data on population from the National Institute of Statistics and Geography (INEGI), we calculate homicide rates per 100,000 people for males, females, potentially cartel-related individuals, Pemex employees, and military personnel. Potentially cartel-related homicides are defined as deaths of men aged 15-40 who were killed by firearms (De Haro, 2025). We use this definition because homicides of men within this age group have been shown to closely match the geographic and temporal patterns of reported executions associated with cartel rivalry in Mexico (Calderón et al., 2015). Furthermore, civilian access to firearms in the country is highly restricted, and over 70% of all guns recovered at crime scenes can be traced back to drug cartel organizations (Mineo, 2022).

As a measure of deaths from combat between the military and cartels, we identify homicides of individuals whose insurance affiliation was with SEDENA, Mexico's Defense Ministry. Since military family members can also have this affiliation, we limit this definition to homicides of working-age SEDENA-affiliates (18-60 years old) killed by firearms. Similarly, we identify homicides of Pemex employees as deaths of working-age Pemex-affiliates by firearms. Data on other crimes were obtained from the Ministry of Public Security (SSP). This database includes information on all crimes reported to the police in each municipality. We focus on robberies, kidnappings, threats and extortion, and non-lethal physical violence.

4.4 Cartel Presence

The Mapping Criminal Organizations project (Signoret et al., 2017) provides a municipality-year panel dataset on the presence of criminal organizations in Mexico. The project employs a web-crawling technique to identify news articles related to criminal cartels on Google and Google News. Using the number of times a cartel is mentioned in news articles, the database determines whether a cartel is present in a particular municipality. The database contains information on the presence of 75 different criminal organizations in Mexico at the municipal level from 1990 to 2021.

4.5 Socioeconomic Development Indicators

To measure socioeconomic impacts, we draw data on higher education enrollment rates at the municipality-year level from the National Association of Universities and Higher Education Institutions (Asociación Nacional de Universidades e Instituciones de Educación Superior – ANUIES) for the years 2017-2021. We draw data on formal employment rates at the

and military personnel. It also does not suffer from under-reporting of homicides – as police reports might – since it is based on death certificates rather than police investigations.

municipality-year level from the Telephone Survey of Occupation and Employment (Encuesta Telefónica de Ocupación y Empleo – ETOE) for 2015-2022.

Table 1 reports baseline, pre-crackdown (2015-2018) summary statistics for (i) municipalities with either a gas or refined oil pipeline and (ii) non-pipeline municipalities. Municipalities hosting a pipeline exhibit higher homicide, cartel presence, and crime rates than the rest of the country. Socioeconomic indicators are similar for places with and without pipelines. Pipeline-hosting municipalities have larger populations; we report main results as rates per 100k residents to account for these differences.

5 Empirical Strategy

We implement a pre/post difference-in-differences (DiD) approach to estimate effects of the government's fuel theft crackdown on homicide rates, cartel presence, and other outcomes in municipalities with refined oil or gas pipelines. Specifically, we compare municipalities with (i) refined oil pipelines or (ii) gas pipelines to those without pipelines, before and after the 2019 crackdown.[6] Our main specification is as follows:

$$Y_{it} = \alpha_i + \tau_t + \delta(P_i^G \times Post_{t\geq 2019}) + \gamma(P_i^O \times Post_{t\geq 2019}) + e_{it} \quad (1)$$

where Y_{it} is an outcome of interest in municipality i and year t and P_i^G and P_i^O are binary variables indicating the presence of pipelines carrying gas and refined oil products, respectively. $Post_{t\geq 2019}$ indicates the period before and after the military crackdown on fuel theft in 2019. Finally, we control for time-invariant municipality characteristics and temporal shocks using municipality (α_i) and year-fixed effects (τ_t).

Our primary parameter of interest in this specification is δ, which measures change in the outcome in municipalities with a gas pipeline after the crackdown, relative to municipalities that do not host gas pipelines. If criminal organizations diversified into gas pipeline theft, we expect to observe an increase in homicide rates and cartel presence in municipalities with a gas pipeline ($\hat{\delta} > 0$). A secondary parameter of interest is γ, which measures the direct effect of the crackdown on places with oil pipelines. For outcomes such as homicide rates and cartel presence, negative values of $\hat{\gamma}$ would suggest the crackdown was effective at reducing crime in directly targeted oil-pipeline municipalities. In our preferred specification, we normalize

[6] Ideally, we would be able to identify the location and date of military crackdown operations to achieve a more precise definition of municipalities' treatment status. However, repeated freedom of information requests to Mexico's Federal Police, Ministry of Defense, and Pemex were unsuccessful due to the sensitive national security nature of these data. We thus rely on the presence of oil and gas pipelines and the timing of the crackdown to define treatment.

Table 1: Summary Statistics in Municipalities with Gas or Refined Oil Pipelines

	Gas or refined oil			**Rest of country**		
	Mean	SD	Obs.	Mean	SD	Obs.
Reports of illegal taps						
Gas	0.24	1.87	2,660	0.00	0.12	7,232
Refined petroleum	12.88	46.79	2,660	0.34	5.44	7,232
Homicide rates						
All	23.13	30.07	2,648	18.97	38.01	7,176
Male	20.58	27.79	2,648	16.87	34.60	7,176
Female	2.44	4.69	2,648	2.03	7.73	7,176
Cartel related	9.86	16.89	2,648	7.19	19.00	7,176
Pemex employee	0.06	0.62	2,648	0.01	0.16	7,176
Military	0.05	0.65	2,648	0.02	0.41	7,176
Cartel data						
All cartels	3.22	5.42	2,660	1.18	3.00	7,232
Huachicol specialized	1.83	2.38	2,660	0.71	1.50	7,232
Non-huachicol specialized	1.39	3.43	2,660	0.48	1.75	7,232
Robberies						
All	384.71	404.53	2,648	138.46	235.58	7,176
Home & business	93.35	122.41	2,648	31.75	68.02	7,176
Highway & street	160.71	221.97	2,648	50.07	109.61	7,176
Machinery	1.43	4.98	2,648	0.79	5.20	7,176
Other	114.38	135.82	2,648	47.22	96.01	7,176
Other crimes						
Kidnapings	1.49	4.15	2,648	0.64	3.64	7,176
Threats & extortion	50.98	69.29	2,648	25.75	58.75	7,176
Non-lethal violence	125.52	121.88	2,648	65.93	102.83	7,176
Socioeconomic Indicators						
Population (in thousands)	110.39	232.68	2,648	21.88	45.13	7,176
Formal employment	0.91	1.10	2,648	0.91	2.40	7,176
Higher Education Enrollment	0.03	0.04	670	0.03	0.04	829
Gini (2015)	0.37	0.03	656	0.38	0.04	1,790

Notes: This table presents the summary statistics of the relevant variables used in this study. Homicide, robbery, and crime rates are expressed as the number of cases per 100,000 people. Huachicol specialized cartels refer to the ten criminal organizations identified as having high participation in fuel theft. Non-lethal violence consists of injuries and other crimes that threaten life. Information on higher education enrollment from ANUIES was not available for 2015-2016. Data on gini was obtained from the 2015 census.

homicide and crime rates to number of incidents per 100,000 municipal inhabitants to account for large differences in population size between municipalities.[7] We also estimate event studies

[7] We focus on homicides as our primary outcome of interest since other types of crime are often under-reported. According to Mexico's National Survey of Victimization and Perceptions of Public Security (ENVIPE), over 90% of crimes in the country are not reported by civilians – largely due to intimidation by organized criminal groups – or filed by the police. For completeness, we report crackdown effects on other crimes in Section 6.4.

to assess dynamic effects of the crackdown:

$$Y_{it} = \alpha_i + \tau_t + \sum_{k \neq 2018} \delta_k \, P_i^G \times I(t = k) + \sum_{k \neq 2018} \gamma_k \, P_i^O \times I(t = k) + v_{it} \qquad (2)$$

In this specification, coefficients δ_k and γ_k capture the impact of the military crackdown k years before or after 2019 on outcome Y_{it} in municipalities that host gas and refined oil pipelines, respectively. Pre-crackdown year 2018 is omitted as a baseline reference. Besides revealing dynamic treatment effects across years, event studies also allow evaluation of the identifying parallel pre-trends assumption that underlies DiD strategies.

There are several potential threats to identification in our empirical strategy. First, reverse causality could occur if direct treatment (i.e., directly experiencing the military crackdown due to the presence of oil pipelines) was caused by trends in outcomes of interest during pre-treatment periods. As shown in the results below, this is indeed the case for oil pipeline municipalities: increasing rates of oil pipeline thefts, homicides, and cartel presence led the government to focus its military crackdown on those areas. While oil pipeline municipalities were thus *endogenously* treated and exhibit strong pre-trends, gas pipeline municipalities were *exogenously* treated by spillovers from a crackdown focused elsewhere. In light of this distinction, we interpret results for oil pipeline municipalities as descriptive, and results for gas pipeline municipalities as causal.

A second threat to identification could come from violations of the stable unit treatment value assumption (SUTVA) if spillovers from treated groups contaminate the control group (i.e., non-pipeline municipalities). We quantify spatial spillovers explicitly in Section 6.5. We also estimate a "spillover-free" robustness check in Section 7 that excludes control municipalities sharing a border with places hosting oil or gas pipelines and find similar results.

Finally, our estimates could suffer from omitted variable bias if treated municipalities (those with oil or gas pipelines) and control municipalities differ in ways that systematically affect pre- and post-treatment trends. In our preferred specifications, we include municipality and year fixed effects to reduce these concerns. In Section 7, we estimate a robustness check that limits the sample to treated and control municipalities that exactly match on binned baseline characteristics – including matching weights – ensuring that treated and control groups are comparable on a rich set of baseline observables. We find that results are strongly robust to both these exercises. Results are also robust to controlling for municipality-year Covid-19 rates, reducing concerns over another potential confounder. Finally, we note that nearly all pipelines were constructed prior to 2018, and most gas pipelines were constructed in the 1940s through 1980s –

with their location determined by engineering considerations and cost-minimizing routes. Siting of pipelines was thus orthogonal to socioeconomic and crime characteristics of municipalities decades later.

6 Results

This section presents our empirical results. We first show estimates of the crackdown's *within-municipality* impact on illegal taps reported on gas or refined oil pipelines for municipalities that host pipelines. Next, we show effects of the crackdown on homicide rates, cartel presence, and other crimes in municipalities with gas or refined oil pipelines *relative to non-pipeline municipalities.* We then show spillover effects onto neighboring (non-pipeline) municipalities. Finally, we report crackdown effects on socioeconomic outcomes. As noted in Section 5 above, oil pipeline municipalities were endogenously targeted due to upward-trending levels of theft and violence – leading us to interpret results for these places descriptively. In contrast, gas pipeline municipalities were affected indirectly by spillovers from the crackdown on oil pipeline municipalities, making their treatment plausibly exogenous.

6.1 Refined Oil and Gas Theft

Prior to our main empirical results showing effects of the crackdown on homicide rates, cartel presence, and other crimes, we estimate a modified specification to measure effects on the number of illegal oil and gas thefts reported by Pemex. Since these outcomes are almost always zero in non-pipeline municipalities, we omit non-pipeline municipalities and estimate event studies separately for municipalities hosting (i) refined oil pipelines or (ii) gas pipelines:

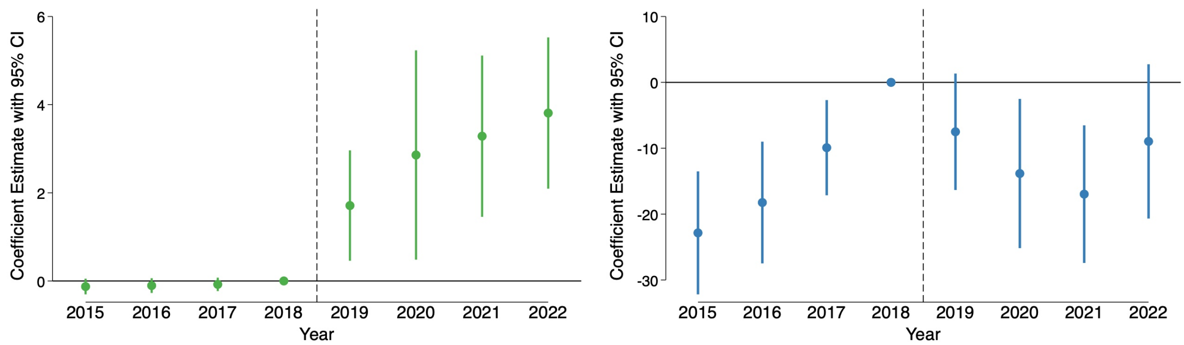
$$Y_{it}^{f} = \alpha_i + \tau_t + \sum_{k \neq 2018} \beta_k^f \, P_i^f \times I(t = k) + w_{it} \tag{3}$$

In this specification, Y_{it}^{f} is the number of illegal taps reported in municipality i and year t for fuel type $f = \{\text{gas}, \text{refined oil}\}$, P_i^f is a binary variable indicating the presence of a pipeline carrying fuel f, and α_i and τ_t are municipality and year fixed effects to control for time-invariant municipality characteristics and time shocks. Standard errors are clustered at the municipality level. This specification measures *within-municipality* changes over time for the subsample of municipalities with pipelines.

Figure 4 reports estimated effects of the fuel theft crackdown on (a) illegal taps on gas pipelines and (b) illegal taps on refined oil pipelines. As shown in Panel (a), there is effectively no trend in gas pipeline thefts prior to the 2019 crackdown, after which gas thefts increase significantly, rising by an average of 1.7 thefts per municipality-year in 2019 and by 3.8 thefts per municipality-year by 2022. As shown in Panel (b), illegal taps on refined oil pipelines were trending sharply upwards in years preceding the military crackdown, which is precisely what triggered the crackdown in the first place. The strong pre-trend in this panel is thus to be expected. The 2019 crackdown was associated with a temporary reversal in this upward trend and significant reduction in oil thefts for several years (relative to their 2018 level), before thefts begin trending back toward previous levels in 2022.

Figure 4: Effects of the Fuel Theft Crackdown on Illegal Pipeline Taps

(a) Gas taps (b) Refined oil taps

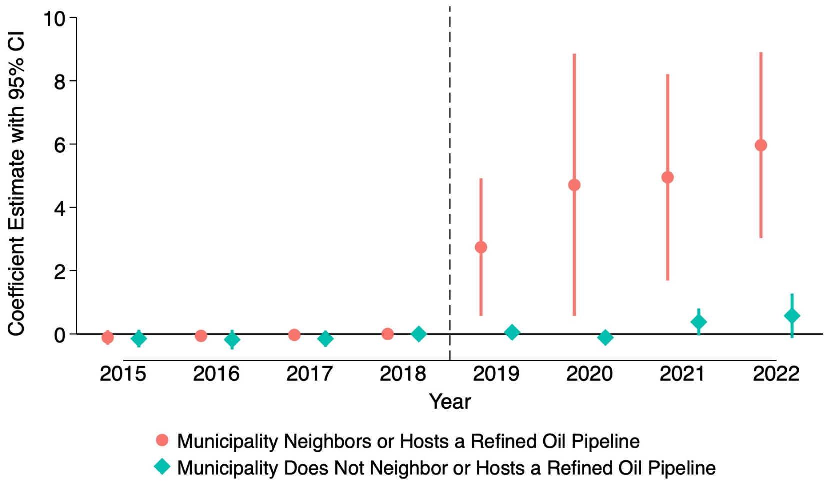


Note: Figure reports coefficient estimates and 95% confidence intervals for (a) number of illegal taps reported on gas pipelines (liquid petroleum gas and natural gas), and (b) number of illegal taps reported on refined oil (gasoline and diesel) pipelines, estimated using Equation 3. This specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

We next decompose gas thefts into those occurring near and far from places with oil pipelines by estimating separate gas theft event studies for (i) municipalities that neighbor or host a refined oil pipeline and (ii) municipalities that do not neighbor or host a refined oil pipeline. Results, reported in Figure 5, indicate that the post-crackdown increase in gas pipeline thefts occurred in municipalities that neighbor or host a refined oil pipeline, confirming the importance of geographic proximity in enabling substitution between these distinct but technologically related criminal activities.[8]

[8] Based on media reporting that gas pipeline theft is easier in places where gas pressure is higher (Nájar, 2019), we compute the distance between municipality centroids and the nearest gas compression center (facilities that maintain gas pressure along pipelines). We then re-estimate event studies of gas pipeline thefts for places near ($\leq$50km) and far ($>$50km) from a compression center. Specifically, we estimate a four-way specification to explore joint effects of neighboring an oil pipeline (where spatial substitution from oil to gas theft is easier) and neighboring a compression center. Results, reported in Appendix Figure A2, indicate that post-crackdown increases in gas taps are driven by proximity to oil pipelines, with no significant difference based on proximity to a compression center. This suggests that any advantage in gas theft resulting from optimal pipeline pressure is not large enough to overcome the fixed costs of entering distant new territories.

Figure 5: Crackdown Effects on Gas Thefts Near/Far from Oil Pipelines



Note: Figure reports coefficient estimates and 95% confidence intervals for the number of illegal gas taps reported in municipalities hosting gas pipelines, decomposed into two groups: (i) municipalities that neighbor or host a refined oil pipeline, and (ii) municipalities that do not neighbor or host a refined oil pipeline. Specification includes municipality and year fixed effects, and standard errors are clustered at the municipality level.

6.2 Homicides

We now move on to our main empirical strategy, which compares pre/post-2019 outcomes in municipalities with gas or oil pipelines relative to non-pipeline municipalities. Table 2 shows results from estimation of Equation 1 on homicide rates for different demographic groups. Column (1) shows the effect of the 2019 crackdown on overall homicides. We find that the crackdown increased the homicide rate in municipalities with a gas pipeline by 4.1 per 100,000 inhabitants, representing a 19% increase over a baseline mean of 21.3. In oil pipeline municipalities, we find a positive but statistically insignificant association with homicides. Due to non-parallel pre-trends for refined oil pipeline municipalities, we avoid drawing conclusions regarding the impact of the crackdown in these endogenously selected places.

Columns (2)-(6) show crackdown effects across different demographic groups: males, females, Pemex employees, potentially cartel-related individuals, and military personnel. Estimates indicate that the post-crackdown rise in homicide rates in gas pipeline municipalities was driven by homicides of males and potentially cartel-related individuals. We estimate an 18.5% increase in homicides among males and a 24.8% increase among potentially cartel-related individuals. These increases may be the result of criminal groups fighting over territorial control of gas pipelines. We find no statistically significant effects of the crackdown on homicide rates among females, Pemex employees, or military members.

Figure 6 reports event study results from estimation of Equation 2 for the overall homicide rate. Panel (a) of this figure confirms pre/post estimates of the crackdown impact on homicides

Table 2: Crackdown Effects on Homicides in Municipalities with Gas and Refined Oil Pipelines

	All (1)	Male (2)	Female (3)	Pemex (4)	Cartel (5)	Military (6)
Gas pipeline × Post 2019	4.054***	3.491**	0.355	-0.007	2.125**	0.036
	(1.540)	(1.423)	(0.231)	(0.011)	(0.886)	(0.059)
Refined oil pipeline × Post 2019	4.222	3.796	0.253	-0.018	1.408	0.054
	(2.658)	(2.437)	(0.308)	(0.024)	(1.575)	(0.107)
Observations	19648	19648	19648	19648	19648	19648
Adj. R-squared	0.356	0.355	0.076	0.175	0.325	0.041
Mean dep. var.	21.31	18.87	2.30	0.02	8.58	0.05

Notes: This table reports coefficient estimates and standard errors from estimation of Equation 1. Dependent variables are measured as number of homicides per 100,000 inhabitants. Homicides of Pemex employees are estimated based on homicides of individuals of working age (18-60 years old) insured through Pemex. Potential cartel-related homicides are classified as males aged 18-40 killed by a firearm. Homicides of military personnel are estimated based on individuals insured through SEDENA, ages 18-60, and killed by a firearm. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

in municipalities with gas pipelines. The crackdown significantly increased homicides by 2.1 per 100,000 residents in the year following the intervention, and by 4.8 additional homicides in 2021. Moreover, we find no significant trends in homicide rates among gas pipeline municipalities prior to 2019, supporting the identifying parallel pre-trends assumption. Event study estimates of homicide rates disaggregated by demographic group are reported in Appendix Figure A3, confirming that the post-crackdown increase in homicide rates in gas pipeline municipalities was driven by homicides of men. Since men are more likely to be involved in organized crime and violence, this provides further evidence that conflict over control of gas pipelines was the underlying driver of the increase in homicides.[9] Panel (b) illustrates dynamic effects of the crackdown on homicides in municipalities with refined oil pipelines. As with oil thefts, there is an upward trend in homicides prior to 2019, which is partly why the crackdown focused on these areas. Though estimates are statistically insignificant, they suggest the crackdown may have halted the upward trend in homicide rates but did not substantially reduce violence in these places.

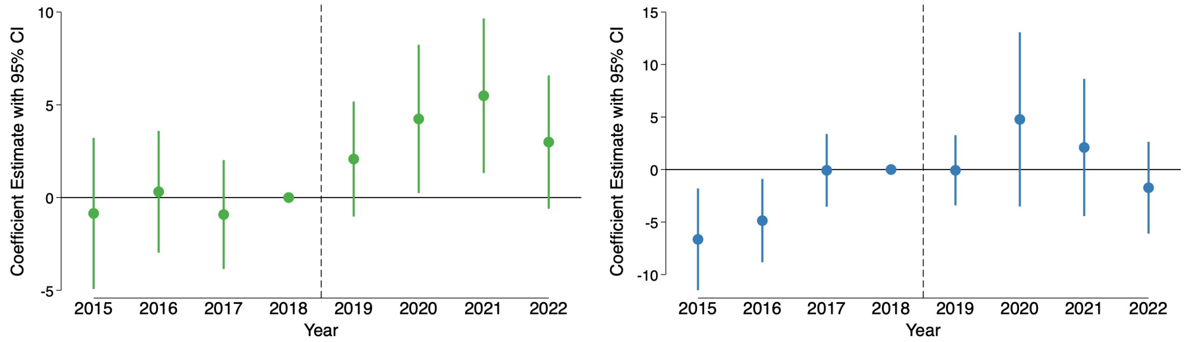
6.3 Cartel Presence

Table 3 shows estimated crackdown effects on cartel presence. Columns (1)-(3) report effects on the number of cartels (intensive margin), while Columns (4)-(6) report effects on a binary

[9] In Appendix Figure A4, we estimate homicide event studies separately for gas pipeline municipalities that neighbor or host an oil pipeline versus those that do not. While estimated effects are not statistically distinguishable between these sub-samples, we find that the increase in homicides is concentrated in places near oil pipelines – precisely where gas thefts increased.

Figure 6: Dynamic Crackdown Effects on Homicide Rates

(a) Gas Pipeline Municipalities (b) Refined Oil Pipeline Municipalities



Note: Figure reports coefficient estimates and 95% confidence intervals for homicide rates per 100,000 residents in (a) municipalities hosting gas pipelines and (b) municipalities hosting refined oil pipelines, relative to non-pipeline municipalities, estimated using Equation 2. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

variable equal to one if at least one cartel is present in a municipality (extensive margin).

Following the military crackdown in 2019, the number of cartels operating in municipalities with a gas pipeline increased, on average, by 17% (corresponding to an increase of 0.36 cartels). Similarly, Panel (a) of Figure 7 confirms that the average number of cartels in gas pipeline municipalities exhibited statistically significant growth after the crackdown. In 2019, there were 0.31 additional cartels in these areas relative to pre-crackdown 2018 levels. By 2021, there were 0.44 additional cartels.[10] As shown in Panel (b), municipalities with refined oil pipelines also experienced increased cartel activity for two years following the crackdown, followed by a reduction in average cartel presence in 2021. Strong upward pre-trends in cartel activity in municipalities with refined oil pipelines was, along with thefts and homicides, an endogenous driver of the 2019 crackdown in these places.

Drawing on media coverage and a research report, we identify nine cartels that are most prominently involved in fuel theft (Etellekt Consultores, 2016; Langner, 2017; Castillo, 2021; González, 2020).[11] Seven of these groups are large, well-established cartels responsible for 95% of all illegal fuel taps in 2016 (Etellekt Consultores, 2016), while the remaining two are smaller, local organizations also specialized in fuel theft (Castillo, 2021; González, 2020). Column (2) of Table 3 reports estimated crackdown effects on the number of these fuel theft-specialized cartels (*huachicol* specialized) operating in gas pipeline municipalities. Results indicate that the

[10] Considering the statistically insignificant but noteworthy upward pre-trend in cartel presence in gas pipeline municipalities in 7a, we assess robustness of the significant post-treatment effect using the method proposed by Rambachan and Roth (2023) and find that the observed pre-trend does not invalidate rejection of the null hypothesis for post-trend violations up to 1.2 times the magnitude of the pre-trend violation ($\bar{M} = 1.2$).

[11] The nine cartels identified as *huachicoleros* are the Cartel Jalisco Nueva Generación (CJNG), Los Zetas, the Gulf Cartel, the Sinaloa Cartel, the Beltrán Leyva Organization, La Familia Michoacana, Los Caballeros Templarios, the Cartel de Santa Rosa de Lima (CSRL), and La Unión León. The last two began as smaller criminal groups and gained power through gasoline theft.

Table 3: Crackdown Effects on Cartel Presence

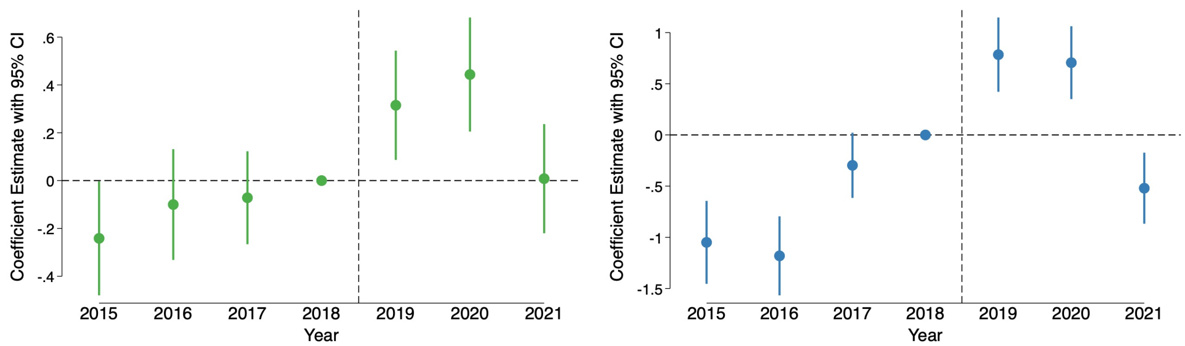
	Number of Cartels			Cartel Presence (1/0)		
	All	Huachicol Specialized	Non-Huachicol Specialized	All	Huachicol Specialized	Non-Huachicol Specialized
	(1)	(2)	(3)	(4)	(5)	(6)
Gas pipeline × Post 2019	0.360***	0.230***	0.130**	0.0339**	0.0420***	0.0355**
	(0.090)	(0.048)	(0.060)	(0.015)	(0.015)	(0.016)
Refined oil pipeline × Post 2019	0.957***	0.282***	0.675***	-0.00678	-0.00735	0.0491**
	(0.154)	(0.071)	(0.118)	(0.018)	(0.018)	(0.021)
Observations	17311	17311	17311	17311	17311	17311
Adj. R-squared	0.884	0.819	0.867	0.642	0.640	0.606
Mean dep. var.	2.024	1.164	0.860	0.408	0.384	0.252

Note: This table reports coefficient estimates and standard errors from estimation of Equation 1. In Column (1) the dependent variable measures total active cartels; in column (2) the dependent variable measures fuel theft-specialized cartels, and in column (3) the dependent variable measures non-fuel theft specialized cartels, where fuel-theft specialized cartels are identified from Etellekt Consultores (2016), Langner (2017), Castillo (2021), and González (2020). Columns (4)-(6) report results for analogous binary categories to assess the extensive margin of cartel presence. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 7: Dynamic Crackdown Effects on Cartel Presence

(a) Gas Pipeline Municipalities

(b) Refined Oil Pipeline Municipalities



Note: Figure reports coefficient estimates and 95% confidence intervals for the number of active cartels in (a) municipalities hosting gas pipelines and (b) municipalities hosting refined oil pipelines, relative to non-pipeline municipalities, estimated using Equation 2. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

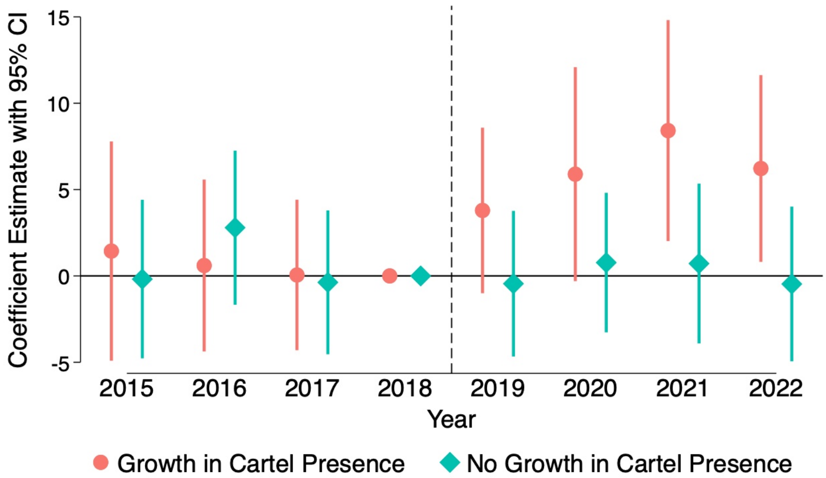
crackdown increased the number of fuel theft-specialized cartels in gas pipeline areas by 19.8%, corresponding to an average of 0.23 more cartels of this type. Column (3) reports corresponding estimates for cartels that are not known to specialize in fuel theft. The effect of the crackdown was notably smaller among non-specialized cartels, suggesting cartels with previously accumulated experience in oil pipeline thefts were more likely to substitute toward gas pipeline theft.[12] In Appendix Figure A5, we report analogous event study estimates. Results indicate that, prior to 2019, trends in the presence of both types of cartels were parallel between (treated) gas pipeline municipalities and (control) non-pipeline municipalities. After the military crackdown,

[12] A Wald test comparing coefficient estimates in columns (2) and (3) yields a chi-squared value of 3.32 and p-value of 0.068, indicating a weakly significant statistical difference between effects for these two groups. Similar patterns hold in columns (5) and (6), which report effects on binary indicators of cartel presence. Individual results for each of the nine fuel theft cartels are reported in Appendix Table A2.

cartel presence in gas pipeline municipalities increased significantly among both specialized and non-specialized cartels, but point estimates are larger among specialized cartels.

Finally, Figure 8 reports effects of the crackdown on homicide rates, decomposed into (i) places where cartel presence increased following the crackdown and (ii) places where cartel presence remained unchanged. Results show that the post-crackdown increase in homicides in gas pipeline municipalities was concentrated in places where new cartels entered – indicating a strong correlation between cartel entry and increased violence.

Figure 8: Gas Pipeline Municipalities: Correspondence between Cartel Activity and Homicides



Note: Figure reports coefficient estimates and 95% confidence intervals for estimation of a modified version of Equation 2 with two treatment indicators, defined as (i) municipalities with gas pipelines where the number of active cartels grew by at least one after the beginning of the crackdown, and (ii) municipalities with gas pipelines that did not experience post-crackdown cartel growth. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

6.4 Other Crimes

Table 4 shows effects of the crackdown on other crime rates: robberies, kidnappings, threats, extortion, and non-lethal crimes (injuries and other crimes that threaten life). In gas pipeline municipalities, robberies and threats and extortion do not change after the crackdown, but reported non-lethal violence increases by an average of 6.1 incidents per 100,000 residents, corresponding to a 6.4% increase following the crackdown. Interestingly, results show a decrease in kidnappings of 0.28 cases per 100,000 residents, corresponding to a 36.5% decline relative to the 2018 mean.[13]

For municipalities hosting refined oil pipelines, robberies and non-lethal violence decreased by 24.1% (49.28 per 100,000 residents) and 14.7% (14.09 per 100,000 residents), respectively.

[13]Self-reported data on other crimes should be interpreted with caution, considering that people may be less inclined to report crimes in places where organized criminal groups are active. Thus, reporting rates could differ between pre and post-crackdown periods, as the rate of cartel presence increased. This reporting issue is not a concern for homicide data, which are collected from death certificates.

Table 4: Crackdown Effects on Other Crimes

	Robberies (1)	Kidnap (2)	Threats & Extortion (3)	Non-lethal Violence (4)
Gas pipeline × Post 2019	0.722	-0.287*	3.281	6.105**
	(8.472)	(0.151)	(2.869)	(3.021)
Refined oil pipeline × Post 2019	-49.28***	-0.345	0.228	-14.09***
	(12.926)	(0.244)	(3.999)	(4.249)
Observations	19648	19648	19648	19648
Adj. R-squared	0.838	0.119	0.526	0.736
Mean dep. var.	204.4	0.786	49.83	95.57

Note: Table reports coefficient estimates and standard errors from estimation of Equation 1. Dependent variables are measured as number of crimes per 100,000 inhabitants. Non-lethal violence consists of injuries and other crimes that threaten life. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

These results may be attributable to increased military and police presence from the crackdown. To verify this, in Table 5, we further decompose robberies by type: those targeting homes and businesses, highways and streets, machinery, and other. In oil pipeline municipalities, the crackdown is associated with a reduction in the incidence of thefts on highways and streets by 27.7%, but had no significant association with robberies focused on homes and businesses. These results suggest the post-crackdown reduction in robberies could have been driven by increased military surveillance on roads. Finally, results show the crackdown increased thefts of machinery by 83% in gas pipeline municipalities – potentially reflecting increased thefts of equipment used for gas pipeline tapping.

Table 5: Crackdown Effects on Robberies (Disaggregated)

	Home & Business (1)	Highway & Street (2)	Machinery (3)	Other (4)
Gas pipeline × Post 2019	-1.429	1.026	1.046***	2.201
	(2.878)	(4.714)	(0.283)	(3.408)
Refined oil pipeline × Post 2019	-6.933	-22.45***	-0.521	-18.22***
	(4.913)	(7.569)	(0.366)	(5.017)
Observations	19648	19648	19648	19648
Adj. R-squared	0.752	0.792	0.146	0.740
Mean dep. var.	48.13	80.80	1.255	65.83

Note: Table reports coefficient estimates and standard errors from estimation of Equation 1. Dependent variables are measured as number of robberies of specific types per 100,000 inhabitants. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.5 Spatial Spillovers to Neighbors

Besides diversifying into gas pipeline theft, cartels affected by the 2019 crackdown may have shifted spatially into neighboring municipalities to avoid military operations around oil pipelines. To test this possibility, we redefine treated municipalities to be those that (i) neighbor a municipality hosting a refined oil pipeline or (ii) neighbor a municipality hosting a gas pipeline. We exclude all municipalities that host pipelines, leaving non-neighbor, non-pipeline municipalities as controls. DiD results on homicides based on this specification are reported in Table 6.

Estimates show no effect of the crackdown on homicide rates in municipalities neighboring municipalities with gas pipelines. This is to be expected, since gas pipeline municipalities did not experience the military crackdown directly, and criminal groups operating in these areas were therefore not displaced. In contrast, we find large spillovers of violence into municipalities neighboring places with refined oil pipelines, with homicides increasing by 5.8 per 100 thousand residents, or 30%, in these places. Increased homicides are driven by homicides of men and potentially cartel-related individuals. This spillover effect suggests our main estimates for refined oil municipalities may underestimate the true impact of the crackdown on homicide rates, making our estimates conservative. Given that some municipalities neighbor both gas and refined oil pipeline municipalities, the presence of spatial spillovers could still bias our overall estimates by contaminating the non-pipeline control group. To verify this, we estimate a robustness check wherein we exclude direct pipeline neighbors from the control group (see Section 7).

Table 6: Crackdown Effects on Homicides in Neighboring, Non-Pipeline Municipalities

	All (1)	Male (2)	Female (3)	Pemex (4)	Cartel (5)	Military (6)
Neighbor with gas pipeline × Post 2019	-1.303	-1.593	0.267	-0.00678	-0.621	0.00803
	(1.773)	(1.647)	(0.323)	(0.007)	(0.886)	(0.027)
Neighbor with refined oil pipeline × Post 2019	5.806**	5.631***	-0.0226	0.00294	2.091*	0.0819
	(2.369)	(2.125)	(0.449)	(0.007)	(1.190)	(0.068)
Observations	14352	14352	14352	14352	14352	14352
Adj. R-squared	0.327	0.331	0.0567	0.100	0.294	0.00214
Mean dep. var.	19.56	17.33	2.141	0.00461	7.570	0.0372

Notes: Table reports coefficient estimates and standard errors measuring spillovers of the 2019 crackdown onto homicide rates in municipalities neighboring municipalities that host refined oil or gas pipelines. The sample is restricted to municipalities with no refined oil or gas pipelines. The specification thus compares outcomes between non-pipeline neighbors (treated) and non-pipeline non-neighbors (controls). Dependent variables are measured as homicides per 100,000 inhabitants. Homicides of Pemex employees are estimated based on homicides of individuals of working age (18-60 years old) insured through Pemex. Potential cartel-related homicides are males aged 18-40, killed by a firearm. Homicides of military personnel are estimated based on individuals insured through SEDENA, ages 18-60, and killed by a firearm. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.6 Socioeconomic Development Outcomes

Finally, we explore effects of the 2019 fuel theft crackdown on socioeconomic indicators: the share of the population with formal employment (a measure of economic activity) and the share of the population enrolled in higher education (a proxy for availability of illicit alternatives to studying). While strong cartel presence may harm economic activity and draw students away from school, pipeline theft also subsidizes local fuel prices and brings income into communities, potentially boosting economic activity. These countervailing effects may partially offset each other, resulting in ambiguous impacts on socioeconomic indicators.[14]

Results, reported in Appendix Figures A6 and A7, indicate the crackdown had no statistically significant effect on formal employment or higher-education enrollment at the 5% level, with the exception of a significant positive coefficient estimate for higher-education enrollment in oil pipeline municipalities in 2021. Based on weakly significant estimates, there is suggestive evidence the crackdown was associated with (i) a downward trend in formal employment in municipalities with oil pipelines – in line with reduced illicit incomes – and (ii) a downward trend in higher-education enrollment in gas pipeline municipalities – in line with increased cartel activity and recruitment of young adults in these areas. The post-crackdown decline in higher education enrollment in gas pipeline municipalities was concentrated in places neighboring oil pipelines – precisely where pipeline thefts increased the most (Appendix Figure A8).

7 Robustness Checks

In this section, we implement a variety of alternative specifications and tests to assess the robustness of our main results. Given spillovers to neighboring municipalities documented in Section 6.5, we first estimate a "spillover free" specification to ensure that spillovers of the crackdown into neighboring municipalities do not bias our main estimates. To do so, we exclude all non-pipeline control municipalities that border places with refined oil or gas pipelines, leaving only non-pipeline, non-neighbor places as controls. Results, presented in Tables A3 and A4, show that our main estimates for homicides and cartel presence are strongly robust to this restriction. Point estimates of crackdown effects on homicides and cartel presence are slightly larger when excluding neighbors, suggesting that spillovers bias our main estimates downwards. The estimated effect of the crackdown on homicide rates in gas pipeline municipalities increases from +19% to +20%, and the estimated effect on cartel presence increases from +18% to +20%

[14] We focus on higher education enrollment (among 18+ year olds), rather than school enrollment among 6-14 year olds – as analyzed in Battiston et al. (2024) – since 18+ year olds are more likely than children to be on the recruitment margin for cartels, especially for a skill-intensive activity such as pipeline theft.

in the spillover-free specification.

Second, we address concerns that municipalities with pipeline infrastructure may have been chosen to host this infrastructure for endogenous reasons and may exhibit systematically different trends. To do so, we implement a Coarsened Exact Matching (CEM) procedure (Iacus et al., 2012) to restrict the sample of treated municipalities and control municipalities to those that match on pre-treatment characteristics, thus ensuring that treated and control municipalities are comparable. We match municipalities exactly on state and quintiles of pre-treatment (2015-2018) homicide rates, number of active cartels, formal employment share, population, and income level. We keep only municipalities that match and include matching weights in the regressions. Results, reported in Appendix Figure A9 and Table A5, are strongly robust to this restriction. The estimated impact on homicide rates in gas pipeline municipalities decreases from +19% to +18%, and the estimated effect on cartel presence decreases from +18% to +14% when restricting treated and control units to the matched subsample.

Third, we re-estimate DiD and event study specifications using log-transformed outcomes, which are less influenced by extreme values. Log-transforming outcomes introduces difficulties in the presence of heteroskedasticity and large proportions of zero-value outcomes, as is our case (Manning and Mullahy, 2001; Silva and Tenreyro, 2006). In DiD models, this can result in level and log-transformed specifications yielding coefficient estimates with different signs (McConnell, 2024). Log-transformed results for homicides and cartel presence, reported in Appendix Tables A6 and A7, are very similar to our preferred estimates.

Next, we address concerns that potentially differential Covid-19 infection rates in pipeline and non-pipeline municipalities from 2020 onward could confound our estimate of crackdown impacts on homicides and cartel presence. To do so, we collect municipality-year panel data on Covid-19 infection rates per 100,000 residents from Mexico's Directorate General of Epidemiology and re-estimate our main specifications controlling for these rates. Results are strongly robust to this additional control (see Appendix Table A8). Event studies controlling for Covid-19 rates are also strongly robust (results available upon request).

To assess whether results could be driven by a single outlier state, we perform a leave-one-out analysis by re-estimating event studies for our main outcomes of interest (pipeline thefts, homicide rates, and cartel presence) repeatedly with one state omitted each time. We do so for each state that was treated by the crackdown, as identified in contemporary news coverage. Estimates, reported in Appendix Figure A10, are highly stable across leave-one-out specifications, suggesting results are not driven by a single outlier state.

Finally, we assess the robustness of event study estimates for pipeline thefts, homicides, and cartel presence to potential violations of the identifying parallel pre-trends assumption using the methodology developed in Rambachan and Roth (2023). Robust confidence sets for different values of a parameter $\bar{M}$ – measuring the degree to which post-treatment trends may deviate from a linear extrapolation of pre-treatment trends – are reported in Appendix Figure A11. Gas pipeline thefts exhibit an $\bar{M}$ breakdown value of 2, indicating that rejection of the null hypothesis for this outcome is robust to post-treatment violations of parallel trends up to 2 times the size of pre-treatment violations. The breakdown value of $\bar{M}$ for cartel presence is 1.2, indicating that the statistically insignificant but notable upward pre-trend for this outcome observed in Figure 7 does not invalidate rejection of the null hypothesis for post-trend violations up to 1.2 times the magnitude of the pre-trend violation. For homicides, the $\bar{M}$ breakdown value is 0.25, indicating that rejection of the null hypothesis is robust to violations of parallel trends that are slightly more than linear.

8 Discussion and Policy Implications

Using rich data on crime and cartel presence combined with detailed maps of Mexico's pipeline infrastructure, we document that the Mexican government's heavy-handed military crackdown on oil pipeline theft in 2019 succeeded in temporarily reducing oil thefts, but did not root out violence or cartel presence in targeted areas. Furthermore, it encouraged criminal organizations – especially those with prior experience in oil theft – to diversify into thefts from nearby gas pipelines. Theft of highly-pressurized gas products is a much more technologically advanced operation than oil theft, requiring deeper infiltration of pipeline operators and frequently resulting in fires and explosions. Cartels' shift into gas theft required them to expand geographically and compete over gas pipeline territories, leading to a significant increase in cartel presence (+18%) in these areas. In turn, competition over pipelines unleashed violence, with homicide rates in gas pipeline municipalities growing by 19% after the crackdown. Cartels may have also responded to the crackdown on oil theft by expanding their reach into neighboring, non-pipeline municipalities, leading to a 30% increase in homicide rates in these places.

These findings have implications for the design of policies focused on combating organized crime and pipeline theft. The military's approach of shutting down pipelines and re-routing fuel shipments through tanker trucks led to spikes in local fuel prices, potentially incentivizing further thefts and eroding local support for enforcement efforts. Moreover, pipeline shutdowns and truck convoys were a temporary solution that did not address root issues such as poor monitoring of pipeline corridors, infiltration of pipeline operators, and lack of local economic opportunities besides fuel theft (Crisis Group, 2022). As a result, oil theft rates bounced back after the crackdown ended. Furthermore, by increasing the risks of oil pipeline theft but leaving gas pipelines unguarded, the crackdown changed the cost-benefit calculus of gas theft, prompting cartels to overcome fixed costs of entry into this more advanced and dangerous activity.

What could Mexico have done differently, and how should other countries go about preventing or combating pipeline theft? Generally, our findings suggest that *if* heavy-handed crackdowns on illicit activities are undertaken, cartel diversification into neighboring areas and technologically related sectors should be anticipated, and these sectors should also receive increased protection. Specifically to pipeline theft: precision policing, technology adoption, and institutional reforms are likely to be more effective and less disruptive than mass pipeline shutdowns. Technologies to deter or rapidly detect pipeline thefts include ground pressure sensors, cameras and drones, and pipeline pressure monitors that can identify taps in real time (Atmos International, 2024; Adegboye et al., 2019). Deployment of these technologies could help catch thieves in the act or quickly shut off illegal taps – reducing the duration of profitable siphoning. Teams specialized in rapid response to tap detections could be drawn from federal personnel and rotated between locations, making infiltration more difficult. Policing efforts can be focused on stretches of pipeline that are closed for maintenance, which is when they are most vulnerable to tapping. Oil and gas theft may also be combated on the retail end by monitoring and auditing gas stations and LPG distributors, which often buy and resell stolen fuel. Ultimately, governments must maintain control over areas hosting energy infrastructure and promote formal economic opportunities for residents such that criminal groups struggle to take hold. This may involve channeling a share of oil and gas revenues toward communities hosting pipeline infrastructure to create shared incentives for protection and maintenance of pipelines.

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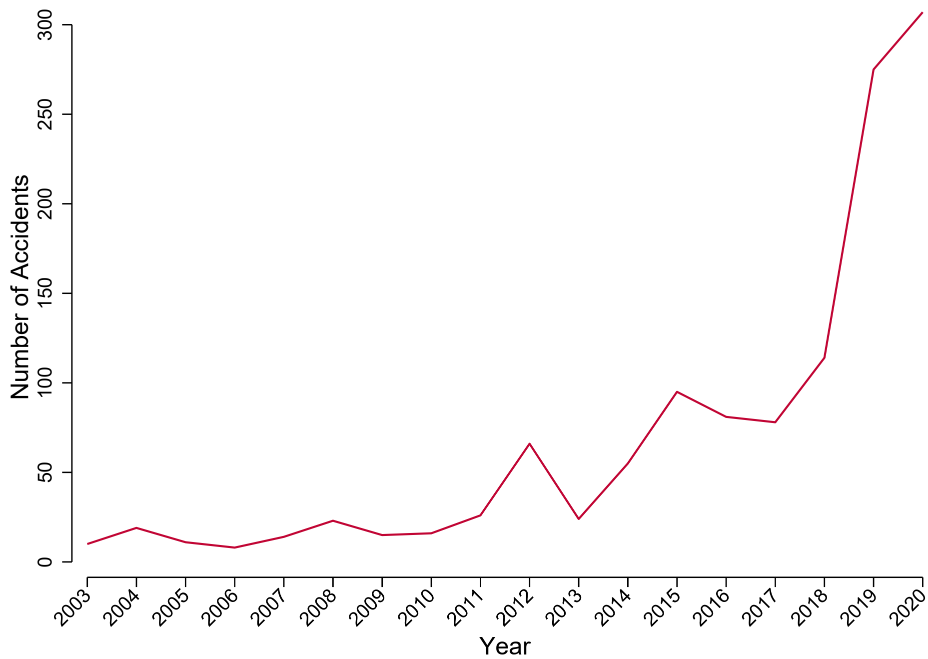
Appendix

Figure A1: Gas-Related Accidents



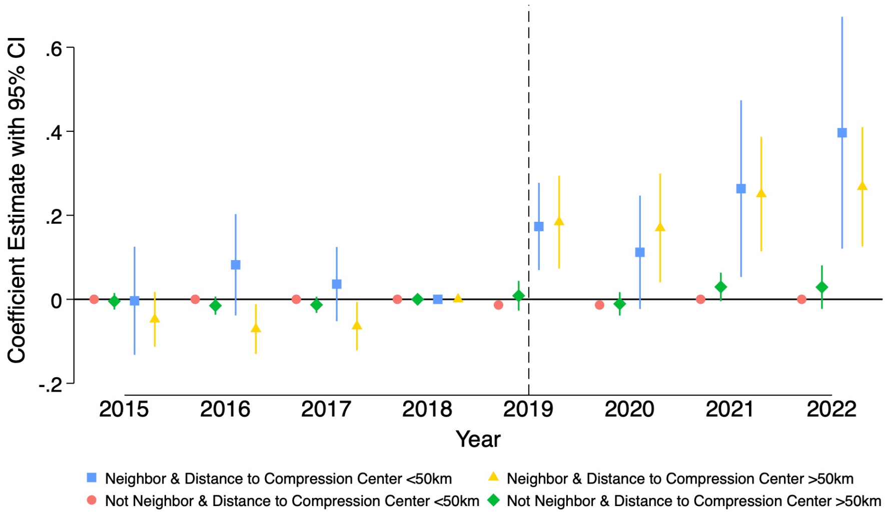
Note: Data are drawn from Mexico's National Center for Disaster Prevention (CENAPRED, 2021). Gas related accidents include fires, explosions, and other accidents.

Table A1: Sensitivity of Gas and Refined Oil Thefts to Fuel Prices

		Dependent Variable	
		Illegal Oil Taps	Illegal Gas Taps
		(1)	(2)
(a) Mexican Gasoline & Diesel Price	*Coef.*	0.520***	0.107***
	St. Err.	(0.072)	(0.025)
(b) Mexican LPG Price	*Coef.*	0.132**	0.022
	St. Err.	(0.058)	(0.027)
(c) Brent World Oil Price	*Coef.*	0.378***	0.069***
	St. Err.	(0.052)	(0.019)

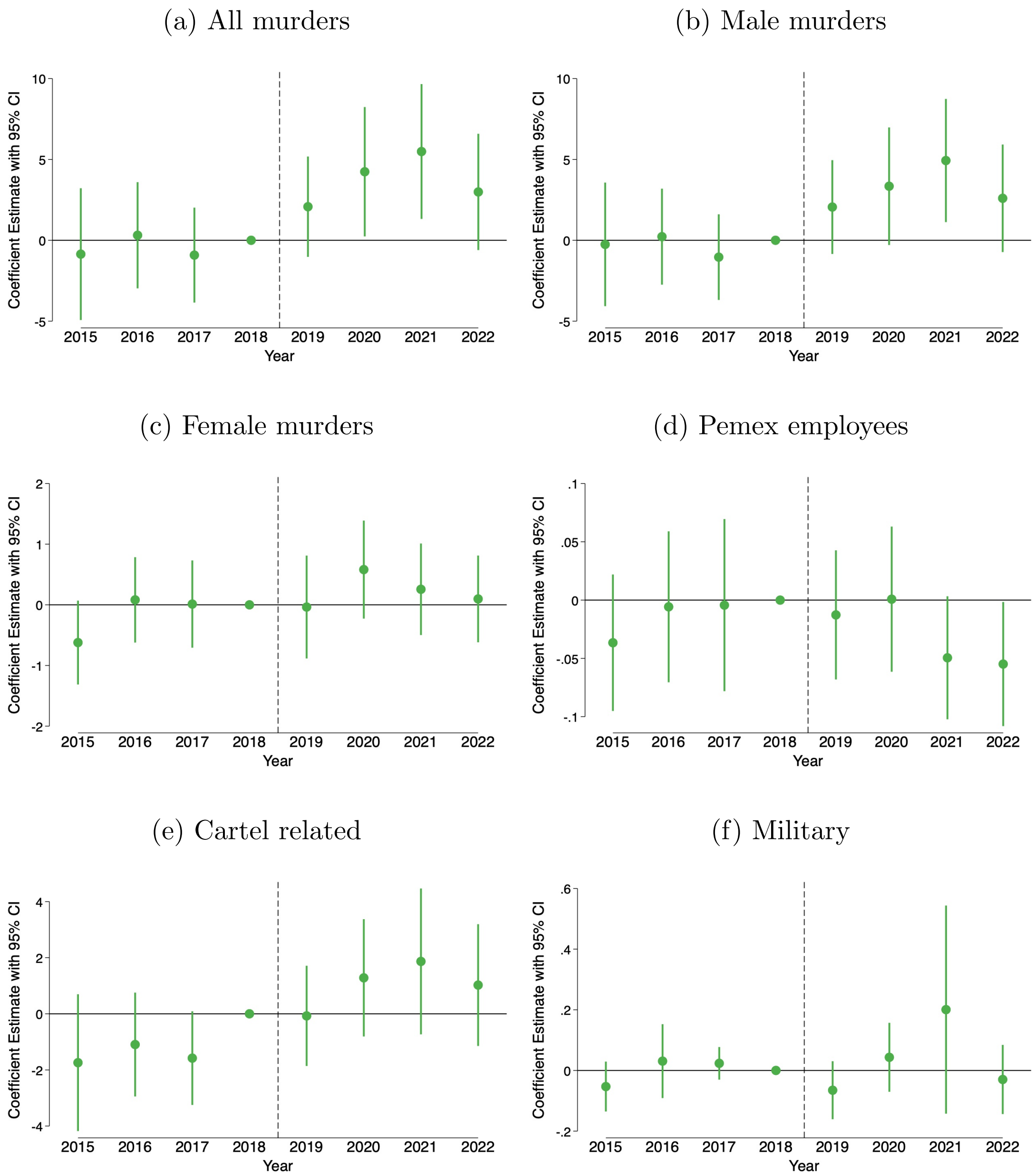
Note: Table presents coefficient estimates and standard errors in parentheses for regressions of the number of illegal taps on the country-level mean retail price of gasoline and diesel (Panel a), the country-level mean liquid petroleum gas (LPG) retail price (Panel b), and Brent Crude world oil price (Panel c), which moves exogenously to local events in Mexico. Column (1) reports results for illegal taps on refined oil pipelines, while Column (2) reports results for illegal taps on gas pipelines, both measured at the municipality-month level. All regressions include municipality fixed effects and standard errors are clustered at the municipality level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A2: Heterogeneity in Gas Pipeline Thefts, by Neighboring/Not-Neighboring an Oil Pipeline and Near/Far from a Gas Compression Center



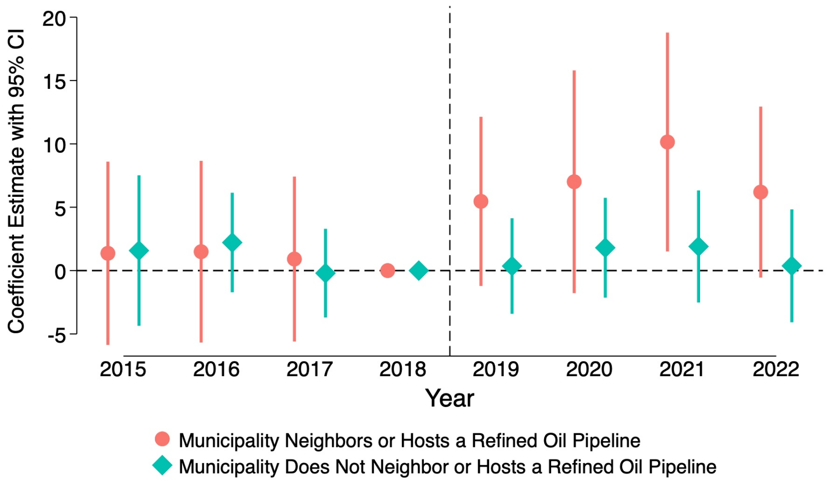
Note: Figure reports coefficient estimates and 95% confidence intervals for an event study specification with municipality and year fixed effects and four treatment interactions: neighbor/non-neighbor × near/far from a gas compression center. Near/far is defined using a 50km radius cutoff. Neighbors are defined as municipalities that are adjacent to or that themselves contain an oil pipeline. Standard errors are clustered at the municipality-level.

Figure A3: Crackdown Effects on Homicides in Municipalities with Gas Pipelines (Disaggregated)



Note: Figure reports coefficient estimates and 95% confidence intervals for homicide rates per 100,000 residents among (a) all residents, (b) males, (c) females, (d) Pemex employees, (e) likely cartel-related murders, and (f) military personnel, estimated using Equation 2. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

Figure A4: Crackdown Effect on Homicides Near/Far from Oil Pipelines



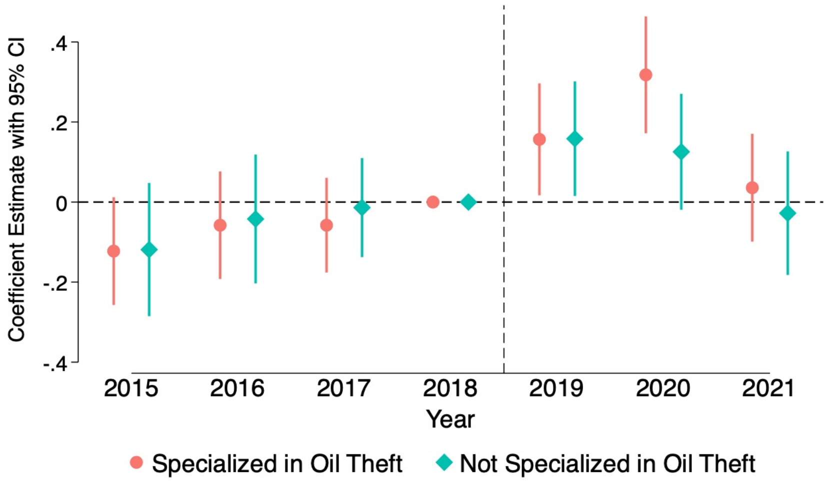
Note: Figure reports coefficient estimates and 95% confidence intervals for homicide rates reported in municipalities hosting gas pipelines, decomposed into two groups: (i) municipalities that neighbor or host a refined oil pipeline as well as a gas pipeline, and (ii) municipalities that do not neighbor or host a refined oil pipeline. Specification includes municipality and year fixed effects, and standard errors are clustered at the municipality level.

Table A2: Crackdown Effects on Cartel Presence in Municipalities with Refined Oil and Gas Pipelines (Disaggregated by Cartel)

	CJNG (1)	Zetas (2)	Golfo (3)	Sinaloa (4)	BLO (5)	Fam. Mich. (6)	Templarios (7)	Juarez (8)	CSRL (9)	Union Leon (10)
Gas pipeline × Post 2019	0.0609***	0.0164	0.0341***	0.0495***	0.00940	0.00957	0.00431	0.0148*	0.0302**	0.000972
	(0.016)	(0.013)	(0.013)	(0.013)	(0.009)	(0.010)	(0.009)	(0.008)	(0.012)	(0.003)
Refined Oil pipeline × Post 2019	-0.00888	0.000793	0.0546***	0.00126	0.0500***	0.0206	0.0260	0.00420	0.116***	0.0167***
	(0.019)	(0.018)	(0.020)	(0.018)	(0.015)	(0.018)	(0.017)	(0.014)	(0.020)	(0.006)
Observations	17311	17311	17311	17311	17311	17311	17311	17311	17311	17311
Adj. R-squared	0.624	0.550	0.540	0.566	0.596	0.571	0.556	0.536	0.470	0.439
Mean dep. var.	0.273	0.178	0.124	0.172	0.101	0.108	0.0941	0.0532	0.0577	0.00335

Note: This table reports coefficient estimates and standard errors from estimation of Equation 1. The dependent variables are dichotomous variables equal to one if the respective cartel is present in a municipality in a year. CJNG stands for Cartel Jalisco Nueva Generación, BLO for Bentrál Leyva Organization, Fam. Mich. for La Familia Michoacana, and CSRL for Cartel Santa Rosa de Lima. Clustered standard errors at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A5: Crackdown Effects on Cartel Presence in Gas Pipeline Municipalities, by Cartel Type

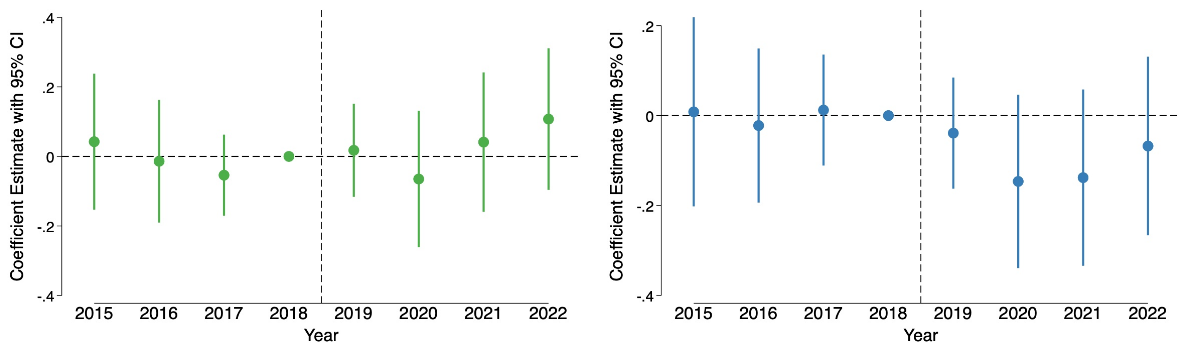


Note: Figure presents coefficient estimates and 95% confidence intervals from estimation of Equation 2, with outcomes disaggregated into the number of active cartels specialized in oil theft and other cartels. Treatment is defined as being a municipality with a GAS pipeline. Standard errors are clustered at the municipality-level. Fuel-theft-specialized cartels are identified from media and reports (Etellekt Consultores, 2016; Langner, 2017; Castillo, 2021; González, 2020).

Figure A6: Crackdown Effects on the Share of Population with Formal Employment

(a) Gas Pipeline Municipalities

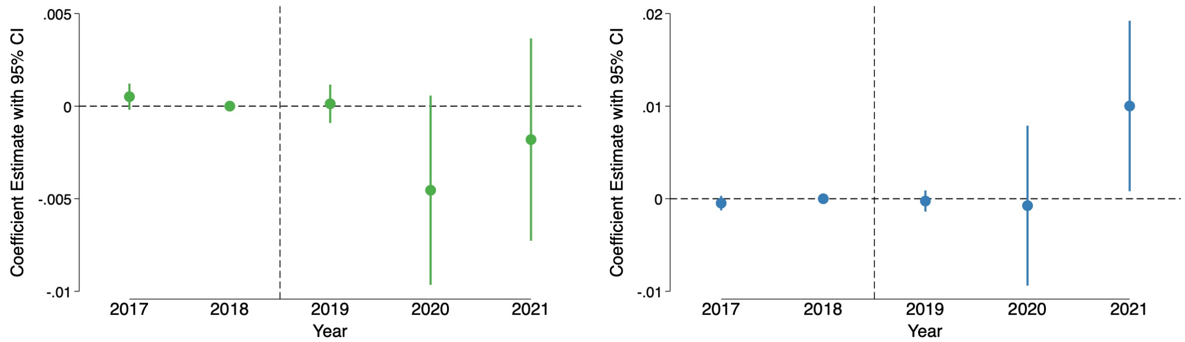
(b) Oil Pipeline Municipalities



Note: Figure reports coefficient estimates and 95% confidence intervals for the share of the population (out of 1) holding formal employment in (a) municipalities hosting gas pipelines and (b) municipalities hosting refined oil pipelines, relative to non-pipeline municipalities, estimated using Equation 2. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

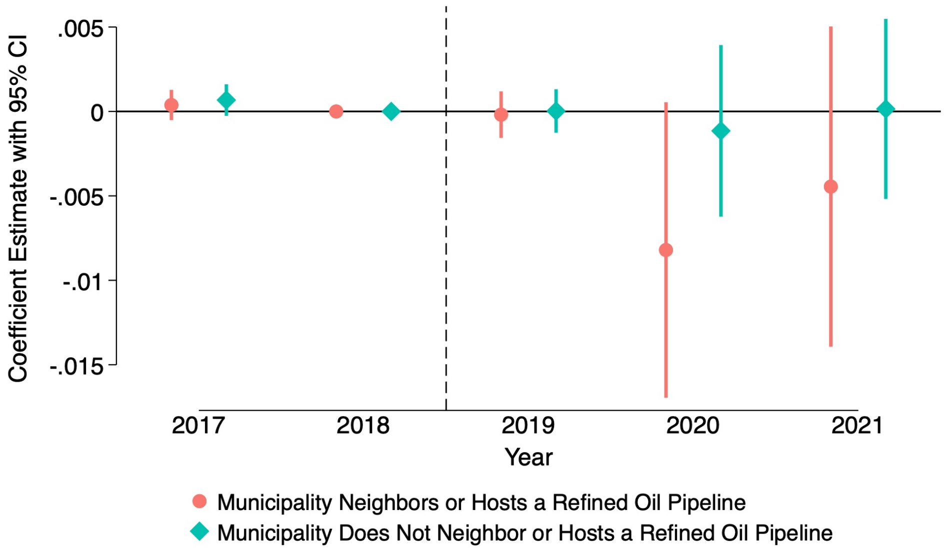
Figure A7: Crackdown Effects on the Share of Population Enrolled in Higher Education

(a) Gas Pipeline Municipalities (b) Oil Pipeline Municipalities



Note: Figure reports coefficient estimates and 95% confidence intervals for the share of the population (out of 1) enrolled in higher education in (a) municipalities hosting gas pipelines and (b) municipalities hosting refined oil pipelines, relative to non-pipeline municipalities, estimated using Equation 2. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

Figure A8: Crackdown Effects on Enrollment in Higher Education in Gas Pipelines Municipalities, Decomposed by Neighboring/Not-Neighboring an Oil Pipeline



Note: Figure reports coefficient estimates and 95% confidence intervals for the share of the population (out of 1) enrolled in higher education in municipalities hosting gas pipelines, relative to non-pipeline municipalities, estimated using Equation 2. Treatment is decomposed into places that neighbor or host a refined oil pipeline and places that do not. Specification includes municipality and year fixed effects. Standard errors are clustered at the municipality level.

Table A3: No-Neighbors Analysis: Crackdown Effects on Homicides

	All (1)	Male (2)	Female (3)	Pemex (4)	Cartel (5)	Military (6)
Gas pipeline × Post 2019	4.329***	3.756***	0.341	-0.007	2.192**	0.045
	(1.555)	(1.439)	(0.234)	(0.011)	(0.895)	(0.059)
Refined oil pipeline × Post 2019	4.359	3.928	0.246	-0.018	1.442	0.058
	(2.663)	(2.442)	(0.309)	(0.025)	(1.578)	(0.107)
Observations	18088	18088	18088	18088	18088	18088
Adj. R-squared	0.365	0.360	0.077	0.177	0.321	0.050
Mean dep. var.	21.29	18.88	2.27	0.02	8.59	0.05

Note: This table reports coefficient estimates and standard errors from Equation 1. This specification drops all non-pipeline municipalities that are adjacent to a municipality with a refined oil or gas pipeline to avoid bias introduced by potential spillovers into these control units. Dependent variables are measured as number of homicides per 100,000 inhabitants. Homicides of Pemex employees are estimated based on homicides of individuals of working age (18-60 years old) insured through Pemex. Potential cartel-related homicides are classified as males aged 18-40 killed by a firearm. Homicides of military personnel are estimated based on individuals insured through SEDENA, ages 18-60, and killed by a firearm. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4: No-Neighbors Analysis: Crackdown Effects on Cartel Presence

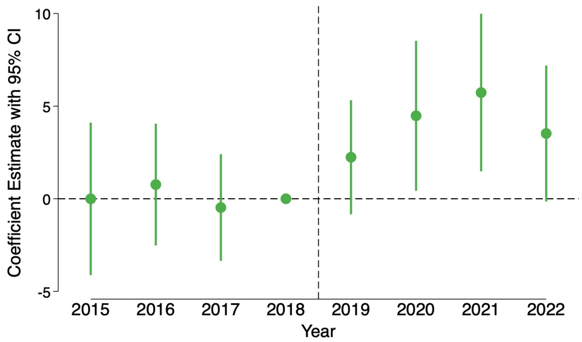
	Number of Cartels			Cartel Presence (1/0)		
	All (1)	Huachicol Specialized (2)	Non-Huachicol Specialized (3)	All (4)	Huachicol Specialized (5)	Non-Huachicol Specialized (6)
Gas pipeline × Post 2019	0.405***	0.258***	0.147**	0.0412***	0.0497***	0.0425***
	(0.091)	(0.048)	(0.060)	(0.015)	(0.015)	(0.016)
Refined oil pipeline × Post 2019	0.988***	0.300***	0.687***	-0.00287	-0.00327	0.0531**
	(0.155)	(0.071)	(0.119)	(0.018)	(0.018)	(0.021)
Observations	15827	15827	15827	15827	15827	15827
Adj. R-squared	0.888	0.825	0.872	0.646	0.644	0.618
Mean dep. var.	2.057	1.166	0.890	0.405	0.380	0.252

Note: This table reports coefficient estimates and standard errors from Equation 1. This specification drops all non-pipeline municipalities that are adjacent to a municipality with a refined oil or gas pipeline to avoid bias introduced by potential spillovers into these control units. In Column (1) the dependent variable measures total active cartels; in column (2) the dependent variable measures fuel theft-specialized cartels, and in column (3) the dependent variable measures non-fuel theft specialized cartels, where fuel-theft specialized cartels are identified from Etellekt Consultores (2016), Langner (2017), Castillo (2021), and González (2020). Columns (4)-(6) report results for analogous binary categories to assess the extensive margin of cartel presence. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

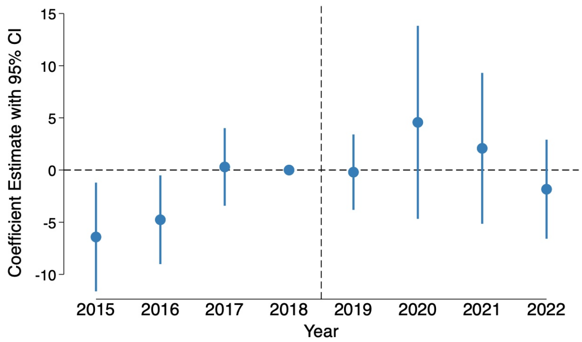
Figure A9: Event Studies with Matched Sub-sample

A. Homicides

(a) Gas Pipeline Municipalities

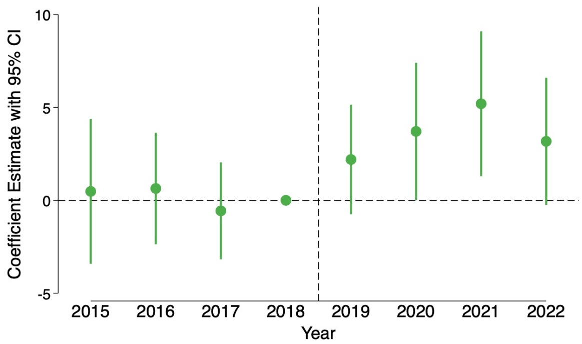


(b) Oil Pipeline Municipalities

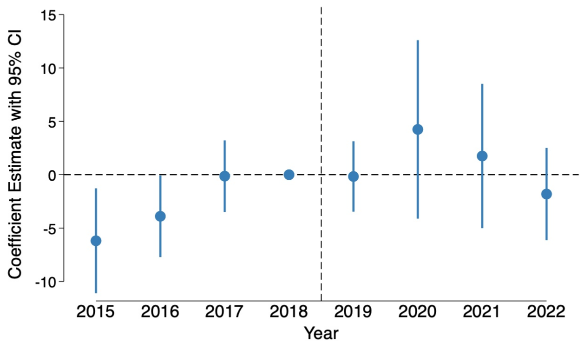


B. Male Homicides

(c) Gas Pipeline Municipalities

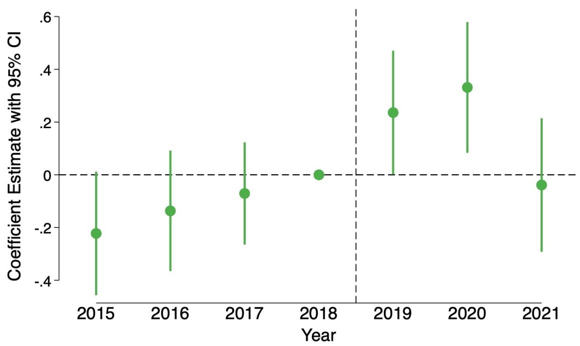


(d) Oil Pipeline Municipalities

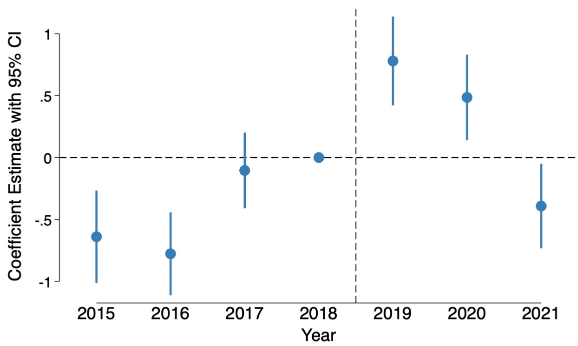


C. Number of Cartels

(e) Gas Pipeline Municipalities



(f) Oil Pipeline Municipalities



Note: Event studies are estimated analogously to Equation 2, including year and municipality fixed effects and clustering standard errors at the municipality level. Panel A show results on all homicides, Panel B presents results for homicides of males, and Panel C show results on the number of cartels. Outcomes in Panels A and B are defined as total homicides per 100,000 residents. Outcomes in Panel C are defined as the number of active cartels in a municipality. Sample is restricted to treated municipalities (i.e., municipalities that contain a refined oil or gas pipeline) and control municipalities that exactly match on state and quintiles of pre-treatment (2015-2018) homicide rates per 100,000 residents, number of active cartels, formal employment share of the population, income level, and population. Matching weights from the Coarsened Exact Matching (CEM) procedure are included in event study regressions.

Table A5: Results on Matched-subsample

	Homicides			Number of Cartels		
	All	Male	Cartel	All	Huachicol Specialized	Non-Huachicol Specialized
	(1)	(2)	(3)	(4)	(5)	(6)
Gas pipeline × Post 2019	3.911**	3.424**	2.049**	0.285***	0.207***	0.078
	(1.600)	(1.479)	(0.919)	(0.092)	(0.052)	(0.055)
Refined oil pipeline × Post 2019	3.936	3.612	1.249	0.672***	0.273***	0.399***
	(2.925)	(2.689)	(1.742)	(0.142)	(0.076)	(0.095)
Observations	19000	19000	19000	16737	16737	16737
Adj. R-squared	0.380	0.377	0.338	0.861	0.818	0.823
Mean dep. var.	21.49	19.04	8.78	2.06	1.23	0.83

Notes: This table reports the results from a match sub-sample. Sample is restricted to treated municipalities (i.e., municipalities that contain a refined oil or gas pipeline) and control municipalities that exactly match on state and quintiles of pre-treatment (2015-2018) homicide rates per 100,000 residents, number of active cartels, formal employment share of the population, income level, and population. Matching weights from the Coarsened Exact Matching (CEM) procedure are included in event study regressions. Columns (1-3) show results on the homicide rates per per 100,000 inhabitants. Potential cartel-related homicides are males aged 18-40, killed by a firearm. Columns (4-6) report the results on the total number of active cartels. Dependent variable measures in Columns (5) and (6) measure presence on fuel-specialized cartels and non-fuel theft specialized cartels, prespectively, where fuel-theft specialized cartels are identified from Etellekt Consultores (2016), Langner (2017), Castillo (2021), and González (2020). Municipality and year-fixed effects are included in all specifications. Clustered standard errors at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Log-Transformed Estimates: Crackdown Effects on Homicides

	All	Male	Female	Pemex	Cartel	Military
	(1)	(2)	(3)	(4)	(5)	(6)
Gas pipeline × Post 2019	0.099**	0.079*	0.060*	-0.002	0.125***	-0.002
	(0.047)	(0.048)	(0.033)	(0.004)	(0.047)	(0.008)
Refined oil pipeline × Post 2019	0.021	0.015	0.027	-0.002	-0.044	0.007
	(0.057)	(0.058)	(0.043)	(0.007)	(0.063)	(0.012)
Observations	19648	19648	19648	19648	19648	19648
Adj. R-squared	0.507	0.506	0.285	0.252	0.478	0.054
Mean dep. var.	1.96	1.84	0.54	0.01	1.11	0.01

Note: This table reports coefficient estimates and standard errors from Equation 1. All outcomes are normalized to homicide rates per 100,000 residents and then log-transformed. Homicides of Pemex employees are estimated based on homicides of individuals of working age (18-60 years old) insured through Pemex. Potential cartel-related homicides are classified as males aged 18-40 killed by a firearm. Homicides of military personnel are estimated based on individuals insured through SEDENA, ages 18-60, and killed by a firearm. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Log-Transformed Estimates: Crackdown Effects on Cartel Presence

	Log(Number of Cartels)		
	All	Huachicol Specialized	Non-Huachicol Specialized
	(1)	(2)	(3)
Gas pipeline × Post 2019	0.0876***	0.0802***	0.0462***
	(0.020)	(0.017)	(0.017)
Refined oil pipeline × Post 2019	0.0978***	0.0506**	0.128***
	(0.027)	(0.024)	(0.025)
Observations	17311	17311	17311
Adj. R-squared	0.821	0.781	0.793
Mean dep. var.	0.613	0.486	0.312

Note: This table reports coefficient estimates and standard errors from Equation 1. All dependent variables are log-transformed. In Column (1) the dependent variable measures total active cartels; in column (2) the dependent variable measures fuel theft-specialized cartels, and in column (3) the dependent variable measures non-fuel theft specialized cartels, where fuel-theft specialized cartels are identified from Etellekt Consultores (2016), Langner (2017), Castillo (2021), and González (2020). Columns (4)-(6) report results for analogous binary categories to assess the extensive margin of cartel presence. Municipality and year-fixed effects are included in all specifications. Standard errors clustered at the municipality-level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Results Controlling for COVID

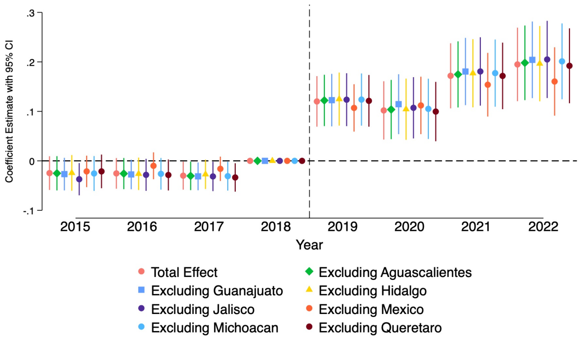
	Homicides			Number of Cartels		
	All	Male	Cartel	All	Huachicol Specialized	Non-Huachicol Specialized
	(1)	(2)	(3)	(4)	(5)	(6)
Gas pipeline × Post 2019	3.989***	3.441**	2.082**	0.363***	0.232***	0.131**
	(1.537)	(1.420)	(0.883)	(0.090)	(0.048)	(0.060)
Refined oil pipeline × Post 2019	3.829	3.496	1.150	0.958***	0.286***	0.672***
	(2.737)	(2.511)	(1.622)	(0.155)	(0.072)	(0.118)
Observations	19648	19648	19648	17199	17199	17199
Adj. R-squared	0.356	0.355	0.325	0.884	0.819	0.867
Mean dep. var.	21.31	18.87	8.58	2.03	1.17	0.86

Notes: This table reports the results controlling for the reported number of covid cases per capita at the municipality-year level. Columns (1-3) show results on the homicide rates per per 100,000 inhabitants. Potential cartel-related homicides are males aged 18-40, killed by a firearm. Columns (4-6) report the results on the total number of active cartels. Dependent variable measures in Columns (5) and (6) measure presence on fuel-specialized cartels and non-fuel theft specialized cartels, respectively, where fuel-theft specialized cartels are identified from Etellekt Consultores (2016), Langner (2017), Castillo (2021), and González (2020). Municipality and year-fixed effects are included in all specifications. Clustered standard errors at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

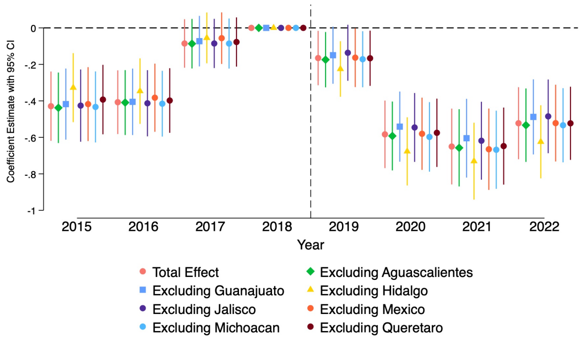
Figure A10: Leave-One-Out Analysis: Event Studies Excluding Targeted States

A. Pipeline Thefts

(a) Gas Pipelines

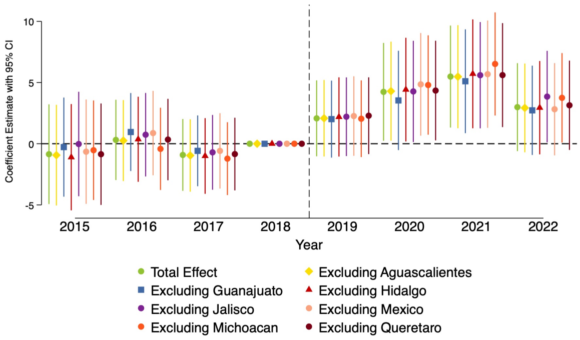


(b) Oil Pipelines

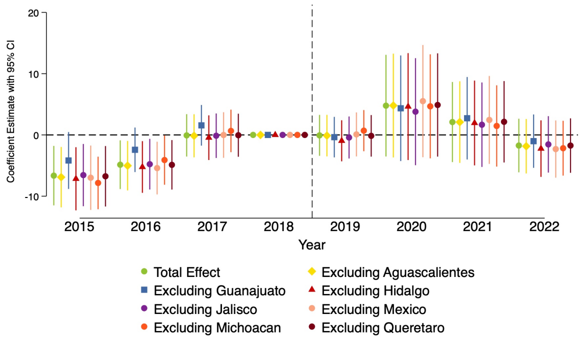


B. Homicides

(c) Gas Pipeline Municipalities

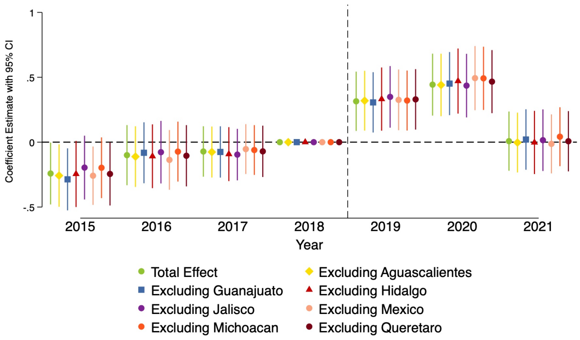


(d) Oil Pipeline Municipalities

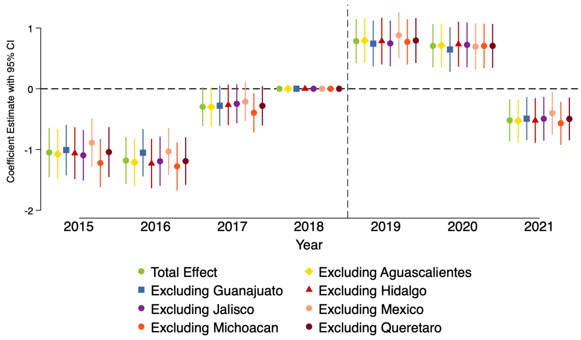


C. Number of Cartels

(e) Gas Pipeline Municipalities



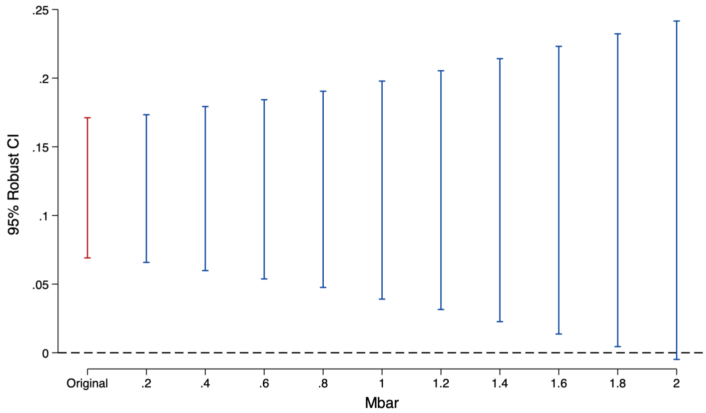
(f) Oil Pipeline Municipalities



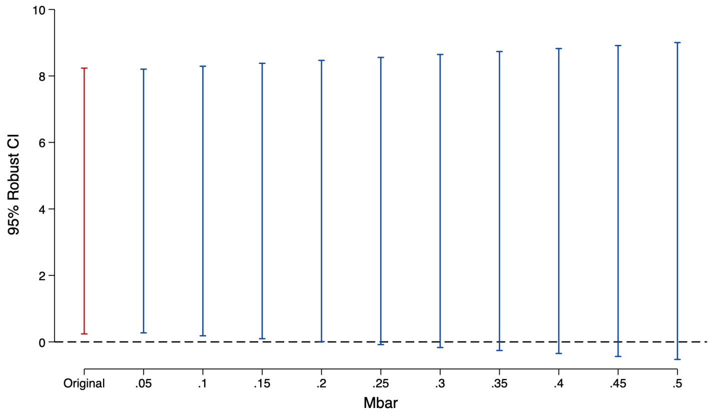
Note: Event studies are estimated analogously to Equation 2, including year and municipality fixed effects and clustering standard errors at the municipality level. However, these specifications are estimated repeatedly, leaving out one crackdown-affected state each time to assess stability of results to potential outlier states.

Figure A11: Rambachan and Roth (2023) Breakeven Analysis for Key Outcomes in Gas Pipeline Municipalities

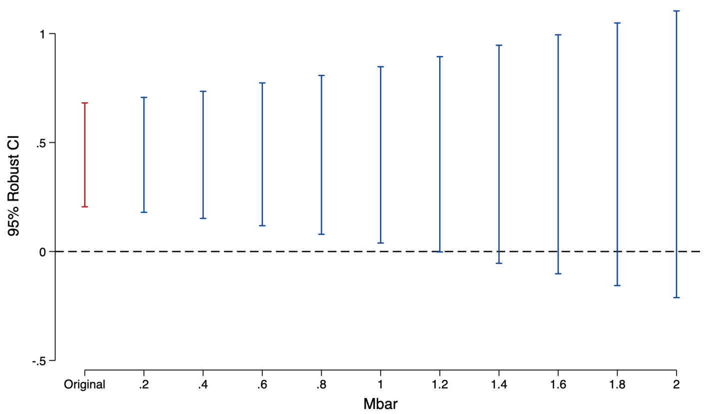
(a) Gas Taps



(b) All Homicides



(c) Number of Cartels



Note: Panels report robust confidence sets for different values of $\bar{M}$, based on the *honestdid* package from Rambachan and Roth (2023), for main results (a) gas taps, (b) homicide rates, and (c) cartel presence. "Breakeven" $\bar{M}$ values indicate the magnitude of the deviation of a linear extrapolation of post-trends from pre-trend violations under which the null hypothesis can still be rejected.