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RESEARCH ARTICLE

Strategic Resources for Drug Trafficking Organizations and the Geography of Violence: Evidence from Mexico

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Abstract
This article helps understand why locations close to strategic infrastructure to transport illegal drugs (seaports, airports, highways, and US ports of entry along the Mexico-US border) or to increase income (pipelines) experience different levels of violence due to DTOs operations. Our theory breaks down the impact of the geographical distance to these facilities on violence into two effects. The first effect is produced by the level of (violent) competition among DTOs, measured by the number of DTOs employing violence. We report that greater proximity to the U.S. ports of entry along the Mexico-US border, ports, and airports furthers the number of competitors, and such increase boosts violence. The second effect shapes the intensity of competition among DTOs. Reductions in the costs of excluding competing DTOs from using the facility could trigger greater confrontation among DTOs. We confirm the importance of this second effect in relation to ports and the U.S. ports of entry along the Mexico-US border.

Keywords: Criminal violence; pipelines; airports; highways; ports; US ports of entry; drug trafficking organizations; Mexico

Introduction

Criminal violence is rampant in Latin America making it the most violent region in the world (Erickson 2018; Pérez-Ricart et al. 2021). However, in cases like Mexico, criminal violence remains highly concentrated in specific territories (Atuesta, Siordia, and Lajous 2018). Why does violence occur more often in some places instead of others? In this article, we study how the location of strategic infrastructures—such as highways, pipelines, ports of entry to the United States, ports, and airports—shapes the violence associated with DTOs' efforts to control these infrastructures. In doing so, this article contributes to current explanations of the subnational variation of criminal violence by explaining why some locations close to these strategic infrastructures experience different levels of violence. Building upon the idea that proximity to strategic infrastructures shapes the dynamics of violence (Lujala 2009) and upon key characteristics of these infrastructures, this article explains variations in the levels of violence registered in localities close to these infrastructures.

Previous studies have noted that DTOs are increasingly diversifying their strategies to respond to increasing competition in countries like Mexico (Felbab-Brown 2019; Calderón et al. 2020; Magaloni et al. 2020; Herrera and Martínez-Álvarez 2022). For instance, DTOS seek to engage in other crimes such as abductions, kidnapping, and human trafficking (García-Ponce and Lajous 2014; Nellemann et al. 2016; Bergman 2018; Franco-Vivanco, Martínez-Álvarez, and Martínez 2023). DTOs also try to gain access to key infrastructures to increase their economic benefits and achieve tactical advantages. Key infrastructures that could provide DTOs with such advantages can include oil pipelines to obtain cash (Franco-Vivanco, Martínez-Álvarez, and Martínez 2023; López Cruz and Torrens 2023), points of entrance to drug markets (the border with the United States),[1] and airports, highways, and seaports to reduce transportation costs of illegal assets. Monopolistic control of this infrastructure facilitates the transportation of illegal drugs, assures additional sources of income, and prevents other DTOs from doing so, which could weaken rivals. Acquiring and holding such control could significantly increase DTOs' profits and diminish those of rivals. However, achieving monopolistic control might be difficult as other DTOs might fight back.

Theoretically, we argue that relevant characteristics of each infrastructure produce two main effects in the dynamics of competition and violence. The first effect comes from the level of (violent) competition among DTOs, defined by the number of DTOs fighting for the monopolistic control of an infrastructure. We pose that DTOs make the decision to compete for control in a location by considering the potential benefits of these infrastructures. Resources with high monopolistic benefits such as entrance points to drug markets, ports, and airports incentivize DTOs to compete for this control, and consequently, the number of DTOs fighting for the infrastructure rises. The scope of competition (measured by the number of DTOs employing violence) for the control of these infrastructures is key to explain variations in violence in localities close to these types of infrastructures: where the number of DTOs competing for the control grows, violence increases. Then, competition among DTOs plays a relevant role to understand the uneven distribution of violence and the high concentrations of violence throughout Mexican territory.

The second effect is caused by certain characteristics of the infrastructures which may make competition among existing DTOs more violent. These features affect the costs of excluding existing rivals related to monitoring the infrastructure, bribing officials to use it, or both.[2] We contend that some resources such as highways, pipelines, and airports pose more challenges to exclude rivals as they are larger in nature, which increases the costs of monitoring and bribing. Therefore, DTOs may be more willing to peacefully share the use of such infrastructures with other DTOs and will thus fight less frequently for control.

We empirically test this argument with geocoded data of drug-related homicides in Mexican localities from 2006 to 2011. We calculated the distance of localities to different strategic infrastructure, including the border with the United States as a proxy for entrance to drug markets, and to oil pipelines, airports, ports, and highways. Using a mediation model with structural equations we unpack the effect of such distances on drug-related homicides based on: 1) an indirect effect (evaluating the first theoretical effect mentioned above) through changes in the configuration of competition (measured by the number of DTOs active in the locality); and 2) a direct effect (evaluating the second theoretical effect mentioned above) related to the effect of the characteristics of the infrastructures. Following the first effect, our results suggest that greater proximity to the border with the United States and ports increases the number of competitors, and such an increase boosts criminal violence. In contrast, we find that closeness to highways and pipelines is not associated with more competition, and therefore, we do not find increases in the rates of criminal violence. Regarding the second effect, violence does not increase in relation to pipelines, airports, and highways (with very high costs to exclude DTOs from using them) in contrast to the greater confrontation seen around ports and the border with the United States.

[1]We acknowledge that we employ the term "infrastructure" to simplify the naming of these sites and facilities despite the lack of walls built in parts of the border with the United States.

[2]Non-excludability is a key characteristic of public goods that involves unrestrictive access to the use of the good. In the economic literature, a good or service is considered excludable if consumers who have not paid for it are prevented from having access to it (Brito and Oakland 1980). In this article, the term "excludability" is used in reference to the costs DTOs incur to exclude other DTOs from using the infrastructure.

Previous studies have highlighted how proximity to trafficking routes can shape the levels of criminal violence (Calderón et al. 2015; Dell 2015). We complement these studies by providing a comprehensive framework to understand how the nature of different infrastructures shapes the competition dynamics between DTOs and, in turn, the violence they produce. By focusing on different types of infrastructures for transportation of people, diverse products, and oil, we also contribute to the understanding of how these types of infrastructures create different incentives for the rise of violence from those created by the legal exploitation of natural resources (Lujala 2009; Rettberg and Ortiz-Riomalo 2016). We highlight that vigorous competition among criminal organizations keenly explains variations in violence close to the infrastructures.

Finally, our study complements those subnational explanations related to local politics (Dell 2015; Durán-Martínez 2018; Snyder and Durán-Martínez 2009; Trejo and Ley 2018), to law enforcement violence (Ríos 2012; Calderón et al. 2015; Phillips 2015; Atuesta and Ponce 2017), and to the spatial diffusion of violence (Osorio 2015).

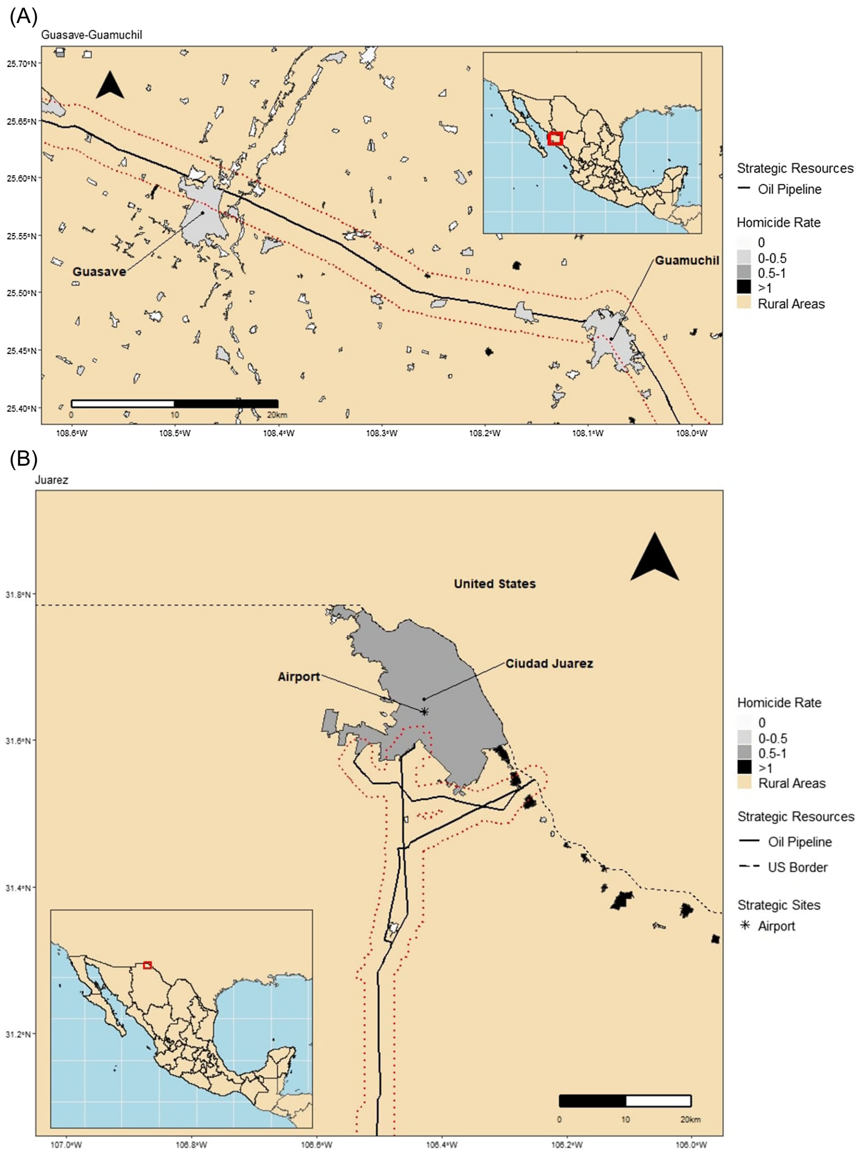
Mexico and the Local Dynamics of Violence

DTOs have operated in Mexico since at least the 1970s. The existence of a dominant-party autocracy in all levels of government—federal, state, and municipal—kept drug-related violence at low levels (Grillo 2012). Then, the governmental transition towards democratization at the state and municipal levels created political conditions for the rise of DTO violence (Trejo and Ley 2018). When the government intensified the strategy of military confrontation against DTOs in 2006, however, violence exploded to unprecedented levels. Our study focuses on the period 2006–2011, during which homicide rates increased from 5 to 25 per 100,000 inhabitants (Shirk and Wallman 2015). Military interventions contributed to split DTOs (Atuesta and Ponce 2017; Felbab-Brown 2019; Magaloni et al 2020; Calderón et al. 2020; Herrera and Martínez-Álvarez 2022). In response, DTOs increasingly diversified their activities to increase income and compensate for losses (Williams 2012; Campbell and Hansen 2014: Shirk and Wallman 2015). These activities included extraction of oil and gas from pipelines, kidnapping, extortion, human trafficking, and bank robbery (Astorga and Shirk 2010; Locks 2015; Magaloni et al. 2020).

Criminal violence has remained geographically concentrated, with DTOs aiming to defend the control of their *plazas*—their areas of influence—or capture other DTOs' plazas or strategic locations (Grillo 2012, 169; Ponce 2016, 2019; Ponce et al. 2022). For instance, 3% of the most violent localities concentrated 85% of all drug-related homicides during 2006–2011 (Atuesta, Siordia, and Lajous 2018). One explanation for such a dynamic is that these areas are closer to strategic resources whose control is particularly valuable to DTOs. However, this is not always the case. Map 1 shows different localities in Sinaloa and Chihuahua state; both have been traditionally the most violent states in Mexico. The map highlights these localities' homicides rates and their proximity to oil pipelines and the US border as both are infrastructures large in nature. Map 1 suggests that not every strategic resource is associated with similar levels of violence. In panel A, localities in Sinaloa, close to the oil pipeline of *Petróleos Mexicanos* (PEMEX hereafter) and contained in a red buffer of 2 km, experienced relatively low levels of violence, even when oil trafficking can provide profits to DTOs. Panel B similarly shows how even though the two localities in the southern area of Ciudad Juárez which are very close to an oil pipeline do not experience violence, buy those close to the US border experienced a relatively high homicide rate, including Ciudad Juárez itself.[3]

Map 2 also shows different localities in Sinaloa, but now mainly focusing on the proximity to airports and ports. The map displays how violence figures were relatively low in localities surrounding the airport of Los Mochis, whereas the town of Topolobampo, a seaport experienced

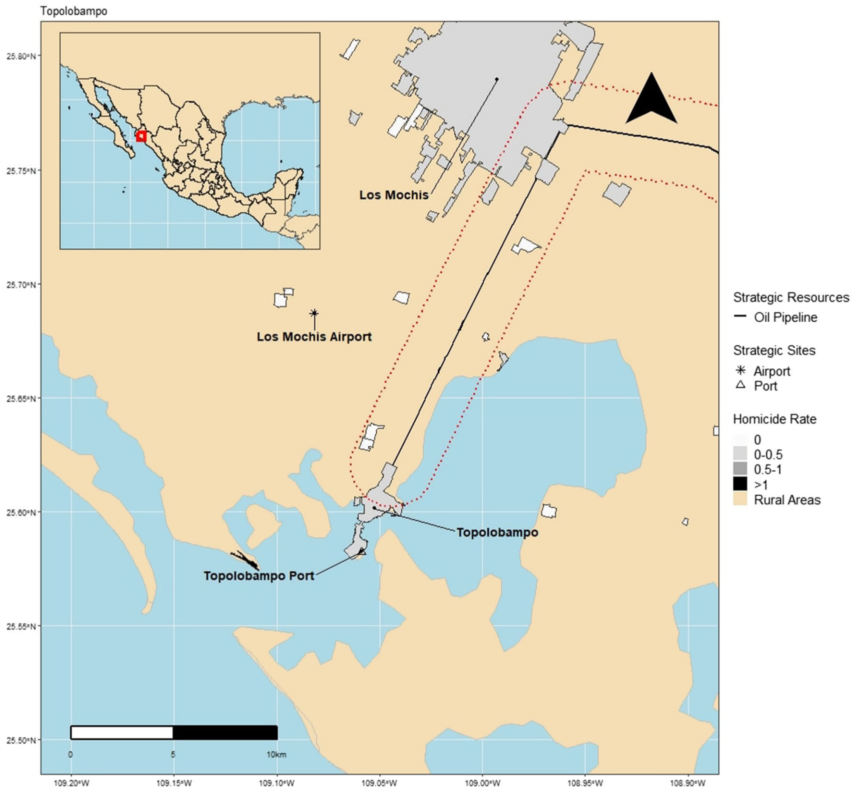
[3]The localities included in our analysis comprise units smaller than municipalities, but for large cities like Ciudad Juárez, they are considered as localities themselves.



Map 1. Violence in localities of Sinaloa (Panel A) and Chihuahua (Panel B) states.

a higher homicide rate. Why do localities close to a port experience higher levels of violence than those close to airports, if both facilitate the transportation of drugs? Why do localities close to oil pipelines experience relatively lower levels of violence than those close to the US border when both are relatively large? Why are areas close to the US border more violent than those further away? In what follows we provide a theory that accounts for these variations.

Mexico represents an ideal testing ground for our arguments for several reasons. First, Mexico has experienced an unprecedented increase of criminal violence since 2006 with high levels of inter-DTO competition (Atuesta and Ponce 2017; Trejo and Ley 2018). Second, Mexico has a vast network of resources and strategic infrastructures that allows us to analyze, with considerable variability, how it shapes the dynamics of violence across communities. There are 140,000 km of highways, 56 airports, and 139 ports (INEGI 2019); furthermore, the US-Mexico border is 3,237 km long, with 24 border crossings (Department of Homeland Security 2017; US Customs and Border



Map 2. Violence in localities of Sinaloa (close to ports and airports).

Protection 2019).[4] Third, Mexico is the tenth largest producer of oil in the world (Seelke et al. 2015), with 13,750 km of oil and gas pipelines across the country (INEGI 2019).

Our Hypotheses

We argue that the geographical concentration of criminal violence in surrounding areas of the studied infrastructures is explained by DTOs' ambition for monopolistic control of them that can lead to logistic, tactical, and economic advantages (Dell 2015; Fuerte Celis et al. 2019). Previous studies have highlighted the importance of airports and ports for the shipping of large amounts of drugs (Atkinson et al. 2017). Similarly, DTOs may consider highways important for the distribution of drugs to nearby cities or specific domestic markets. Furthermore, free passage of drugs to key drug markets like passage through the border with the United States offers a considerable advantage to any DTO, especially if such an arrangement excludes other DTOs from doing so (Fuerte Celis et al. 2019). Finally, (illegal) extraction of oil or gas from pipelines provides additional financial resources that can help DTOs increase their income (Berbotto and Chainey 2021; Jones and Sullivan 2019). As DTOs mainly seek economic gains (Phillips 2015), these potential logistical, tactical, and economic advantages may incite DTOs to fight one another for monopolistic control.

Such infrastructures, however, do not produce similar levels of violence in surrounding territories. To explain these variations, we break down the impact of these infrastructures on

[4]Although PEMEX data suggest there are more than 52,000 km of pipelines (CARTOCRITICA 2017), available information details only 13,750 km (INEGI 2019).

violence into two effects. The first is the effect on violent competition, measured by the number of DTOs that *enter* the area to compete through violent means for monopolistic control. As violence is always costly, if DTOs decide to employ it, the benefits must outweigh its costs.[5] We expect that, as the benefits of monopolistic control over the infrastructure grow, the number of DTOs deciding to compete (by employing violence) for the control of the infrastructure will increase. And, as current research shows, increases in the number of DTOs leads to an increase in violence (Atuesta and Ponce 2017). In sum, the first effect considers the composition of violent competition for the control of the infrastructure.

The second effect is determined by certain characteristics of the analyzed infrastructures that may make DTOs competition more violent, regardless of the number of additional rivals. We argue that the costs of excluding other *existing* DTOs (for those that decided to compete for control of the infrastructure) from using the infrastructures also explain the level of violence among DTOs. The greater the cost, the less inclined a DTO may be in fighting to ensure monopolistic control. We posit that the costs to exclude DTOs from using the infrastructure beyond the costs of fighting are of two principal types: 1) monitoring costs of learning the location of rival DTOs when using the infrastructure; and 2) costs of bribing and monitoring state officials for excluding other rival DTOs from using the infrastructure. As these costs increase, DTOs might avoid trying to exclude other DTOs from using the infrastructures. For instance, as the size of an infrastructure grows, monitoring costs increase because rivals can maintain their anonymity more effectively and it becomes more costly to deploy more resources to track other DTOs. Bribing officials also becomes more costly as enforcing compliance of corrupt agreements gets harder. Following this reasoning, DTO violence may be negatively correlated with monitoring and bribing costs. The rest of this section presents the hypotheses based on these two effects.

Key Segments of the Border with the United States

For DTOs, key segments of the border with the United States have been critical to ensure that drugs are able to enter the US market—the largest drug market in the world. If a DTO can achieve monopolistic control of drug shipments to the United States through a key segment of the border, the benefits will be significant. Even though the US border is long, there are only a few segments close to ports of entry which allow DTOs to transfer drugs through customs or clandestine tunnels, built close to highway networks on the US side. If DTOs achieve monopolistic control of these key infrastructures, rivals (likely operating in nearby areas) would not gain access to the important US market. While the construction of tunnels would represent a fixed cost for DTOs, the establishment of corruption networks is a variable one. Multiple clandestine tunnels discovered across the border with the US suggest these costs are acceptable if they help establish an efficient, effective, and stable way of transferring substantial amounts of drugs to the United States. As a result of these high returns, we expect that a relatively high number of DTOs might be interested in achieving control of key border segments. Communities close to key segments, therefore, might witness a greater number of DTOs competing to dominate entry points into the United States.

Regarding the second effect, DTOs could offer illegal payments to US customs officials not only for letting them transfer drugs, but also for guaranteeing exclusive rights to do so. If DTOs can find officials willing to accept illegal payments, shifts in the balance of DTO power may follow (Bailey and Taylor 2009; Macías-Medellín and Ponce 2022). However, payments could become costly as US officials might request higher amounts if their risks of being caught, potential penalties, and opportunity costs increase. Furthermore, the inherent instability of these

[5]These benefits include the expected rents and income derived from the control of the infrastructure. It also discounts the costs required to achieve such control. The state and the military might increase these costs if their presence is both strong and disruptive for DTO activities.

arrangements could also increase costs as the officials may be transferred to other locations—or renege on their promises to benefit only one DTO.

It is because of these potentially high costs and uncertainty that DTOs have also constructed clandestine tunnels to transfer drugs across the Mexico-US border (Carstensen 2013).[6] DTOs can exclude rivals from using "their" tunnels, as such tunnels usually have just one or a very limited number of entrances, keeping monitoring costs relatively low. At the same time, another DTO operating nearby may attempt to take control of the tunnel instead of building a new one. These attempts could trigger violence. Considering these arguments, we state the following hypotheses:

Hypothesis 1A. (First Effect): There is greater incidence of violence due to increased competition (the number of DTOs fighting) in localities close to segments of the Mexico-US border near a port of entry to the United States.

Hypothesis 1B. (Second Effect): Levels of violence among DTOs are relatively higher in localities closer to segments of the Mexico-US border near a port of entry to the United States (beyond that caused by competition among DTOs).

Airports and Ports

Airports and ports are routinely used by DTOs to transport drugs to domestic and international markets. The financial benefits may be significant if drugs are shipped in large containers through ports or by many carriers through airports. We also note that the likelihood of shipping larger amounts of drugs might be higher through ports than via airports since the use of big containers might increase the likelihood of transporting larger amounts per shipment. Previous studies have reported these activities as means of transportation of illegal drugs in different settings (Zaitch 2002; Caulkins, Burnett, and Leslie 2009; Kostakos and Antonopoulos 2010). Regarding the first effect, we expect that DTOs might be strongly inclined to compete for monopolistic control of these benefits through violent means. Such competition might trigger violence in communities close to these infrastructures.

The collaboration of bribed officials or key bureaucrats working in these infrastructures might also be necessary to ensure success in the transportation of drugs. DTOs could go even further and request officials to grant them exclusive rights to ship drugs from these infrastructures. We also consider that monitoring costs of rival DTO personnel might be greater in airports than in ports since numerous passengers could transport drugs on many different flights.[7] In particular, flight departures are likely to be more frequent than those of vessels from ports. Information to corroborate compliance from bribed officials might become expensive enough to eliminate DTOs' incentives from attempting to exclude other DTOs from using airports. By contrast, the administration of access to vessels in ports tends to be more centralized and restricted to fewer people. Thus, we propose the following hypotheses:

Hypothesis 2A. (First Effect): There is greater incidence of violence due to increased competition (the number of DTOs fighting) in localities closer to ports and airports. This effect on violence is likely to be stronger closer to ports than to airports.

[6]Although their location is unknown, these tunnels are very likely located close to the ports of entry to the United States as DTOs need roads to transport their drugs from the border. We acknowledge that our analysis is limited due to the unavailability of this information.

[7]However, we acknowledge that this difference might tend to disappear as the size of the airport becomes smaller. We leave the study of airports of different sizes for future research.

Hypothesis 2B. (Second Effect): Levels of violence among DTOs are relatively higher in localities closer to ports and airports (beyond that caused by competition among DTOs). This effect on violence is likely to be stronger closer to ports than to airports.

Highways

Highways can also provide DTOs with access to domestic markets. However, the risks of transporting drugs through highways might be relatively high as the Mexican military frequently inspects cars and trucks. Fighting or bribing the whole military to ensure total control of highways could become prohibitively costly. If total control of a highway is not achieved, risks and costs of transporting drugs by road may increase. These factors—together with the time required to transport and the significant opportunity costs given the effectiveness of alternative means of transporting through flights and maritime vessels—might diminish the benefits of controlling localities close to highways. Then these lessened net benefits of monopolistic control would reduce the number of DTOs interested in competing for it through violent means in such areas.

Moreover, the costs of excluding other DTOs from highway access could be prohibitive. To achieve this, a DTO would have to stop most vehicles and verify they are not carrying drugs or bribe the military to do this. Even if a DTO holds information about rivals' actions or intentions, it is unlikely to be effective enough to prevent other DTOs from using the highway. As a result, the costs of excluding other DTOs from employing highways are significantly high. We thus state the following hypotheses:

Hypothesis 3A. (First Effect): There is not significant DTO competition (the number of DTOs fighting) and thus incidence of violence in localities closer to highways is not higher.

Hypothesis 3B. (Second Effect): Levels of violence are not higher in localities closer to highways (beyond that caused by competition among DTOs).

Pipelines

The benefits of holding monopolistic control of areas close to pipelines are expected to be very high, as achieving total control of a pipeline might provide the DTO with significant resources to increase profits and strengthen its capabilities (Le Billon 2001; Lujala 2009; Korman 2019). However, the costs of deploying armed DTO members along the pipeline to fight the military and possibly other DTOs to ensure its total control might be prohibitive. Pipelines tend to be significantly long which can make monopolistic control very costly.[8] Since the benefits reduce, we do not expect to observe several DTOs employing violence for achieving monopolistic control.

Regarding the second effect, since the costs to a DTO of excluding rivals already exploiting segments of pipelines would be prohibitive, due to the vast areas covered by pipelines, DTO members would need to spend considerable time patrolling many kilometers of a pipeline. Incentives to exclude DTOs from accessing pipelines are weak. Thus, the violence among DTOs should be relatively low in localities close to pipelines. We expect that:

Hypothesis 4A. (First Effect): There is no significant DTO competition (the number of DTOs fighting) and thus incidence of violence in localities closer to pipelines is not higher.

[8]Even for stealing oil from small portions of pipelines, Berbotto and Chainey (2021) state that DTOs target pipelines in remote locations accessible by vehicle, and have to bribe security officials to reduce the risk of arrest.

Hypothesis 4B. (Second Effect): Levels of violence are not higher in localities closer to pipelines (beyond that caused by competition among DTOs).

Empirical Analysis

To test our hypotheses, we built a novel database with information at the locality-year level from 2006 to 2011. Localities are spatial units below the municipal level that are employed by the National Institute of Statistics, Geography, and Information (INEGI)—the Mexican statistics office—to collect census data. Specifically, a locality is defined as any place that is occupied by one or more households that may or may not be inhabited (INEGI 2010). Since we rely on a geocoded database of criminal violence, we need spatial polygons to assign events to a spatial unit. As such, we only use those localities for which INEGI had defined polygons. INEGI draws spatial polygons only for localities that have at least one well-defined block. The rest are registered as points and are mostly rural localities—i.e., with less than 2,500 inhabitants, according to INEGI. Unfortunately, we cannot include them in the sample as there are not pre-defined spatial polygons to link them with the events of violence.[9] This might be a potential drawback because we might be truncating events to only urban areas, whereas some violence might occur in overlooked rural areas—we acknowledge this limitation. However, 90% (45,428 out of 49,981) of the localities included in the sample are rural. In addition, we are including 90% (32,704 out of 36,378) of violent events from the geocoded database (Atuesta, Siordia, and Lajous 2018).

By employing localities as the level of analysis we can more accurately capture local dynamics of violence, in contrast to studies using more aggregated units, like the municipal level. Moreover, we ensure there is at least one inhabitant in the localities we employ. Without any inhabitants, transportation facilities, or extraction sites, localities are likely to be irrelevant to explain violence in the empirical analysis.[10] If there is a bias produced by omitting such areas, we do not anticipate it to be significant as the level of violence in these localities is marginal.

To measure our dependent variable, we rely on the geocoded version of the CIDE-PPD database (Atuesta, Siordia, and Lajous 2018) and matched each point to the spatial polygons of localities. We measure the dependent variable in two ways. First, the variable *Total Violence* counts the number of homicides by locality and year regardless of the type of event and the victim. Second, the variable *Inter-DTO Violence* counts deaths registered only from inter-cartel violence (number of homicides excluding security officials killed in such events).[11] Even though our focus is on violent interactions between DTOs, these groups might also expand violence when fighting other actors such as officials or civilians, which are included in the measure of *Total Violence*.

Key independent variables are measured as the distance of each locality to key segments of the US border, airports, highways, non-military seaports, and pipelines. Except for the distance to the US border, the rest of our measures indicate the distance of each locality to the *closest* object of interest throughout Mexican territory (natural resource or transportation facility). For the case of the US border, we employ 100 km segments of the border for each port of entry (50 kms on each side). This helps us consider areas where DTOs are more likely to both develop illegal networks with customs officials and build tunnels to connect the transportation of drugs to highways and storage facilities on the US side.[12] We calculate Great Circle distances to account for the fact that

[9]An alternative is to build Voronoi polygons for these localities, but we prefer to avoid the creation of arbitrary polygons since the polygons INEGI uses were built based on highly detailed information from census records of personnel on the ground.

[10]Since only 10% of homicides (5,470 out of 50,158) are not registered in our dataset, the precision gained in our measures by using this unit of analysis outweighs the costs of dropping observations for these missing localities.

[11]These are homicides that exclusively occurred as result of confrontations among DTOs or within a DTO.

[12]All distances were calculated with the *sf* package in R.

the earth is an oblate spheroid (see Keele and Titiunik 2015). All distances are coded in kilometers and logged to account for differences in scale.[13]

The location and installation of the studied infrastructures are plausibly exogenous to other factors such as governmental security policies—which are a major driver of drug violence (Lessing 2017; Durán-Martínez 2018). Most infrastructures were built during the administration of the Institutional Revolutionary Party (Partido Revolucionario Institucional, PRI) and their construction depended on economic drivers rather than on factors linked to security. Likewise, the US-Mexico border was drawn in the nineteenth century. Considering these facts, it becomes reasonable to assume that these infrastructures are exogenous to changes in violence levels. This enhances confidence on the right causal path between resources and the levels of violence: from infrastructures to violence.[14]

We control for covariates that the literature on criminal violence identifies, related to both the number of competing DTOs and criminal violence. Some scholars suggest that military strategies increase violence and fragmentation of DTOs—that the capturing or removal of key DTO personnel can in turn incite internal fights for DTO leadership (breaking up single DTOs into multiple factions) or may incite violent challenges from more powerful DTOs upon those weakened by the state (Williams 2012; Phillips 2015; Atuesta and Ponce 2017). As such, we control for the effect of state enforcement policies with the number of killed DTO members in confrontations with security agencies during the previous year.

We also employ binary variables to account for the presence of each DTO in each locality. Durán-Martínez (2018) points out that drug violence increases when DTOs organize their security agencies with external recruits. Since DTOs use different recruitment strategies, we account for this factor and other intrinsic characteristics of DTOs through these dichotomous variables. We consider the major Mexican DTOs identified by Coscia and Ríos (2012).[15] Furthermore, previous scholarly work suggests that the partisan identity of local governments can shape the levels of violence both because some parties use more crackdowns and because opposition parties are unprotected by the federal government (Dell 2015; Trejo and Ley 2016). We thus include the partisan identity of the municipality and the state governments.

Moreover, we control for socio-economic variables at the locality level. We include the natural logarithm of the *population* as in more populated places the incidence of violence might be higher. We also incorporate a measure of *social development* as this factor could explain citizens' involvement in DTOs. This measure captures the number of deficiencies in key development areas such as health, public services, and spaces between dwellings (CONEVAL 2010). Moreover, we incorporate the percentage of people over 15 years old without basic education to account for *schooling*, which might explain easier recruitment by DTOs (Osorio 2015). Finally, we estimate all the models with fixed effects by year to account for unobserved heterogeneity of each year that might drive change in violence and number of DTOs.[16]

To test our hypotheses, we employ mediation analysis through a structural equations model. This allows us to break down the effect of geographical distances on violence into two effects: 1) the direct effect of such distances on the number of homicides; and 2) the indirect effect (or mediated effect) of spatial distances on violence occurring because of changes in the number of

[13]For descriptive statistics and descriptions of the variables and their sources, consult Appendix 1 in the Online Appendix. This also offers detailed explanations of the criteria we use to calculate the distances to each of the infrastructures.

[14]To control for the potential overlap between infrastructures, in all our models we include the distances to all infrastructures.

[15]The major DTOs included in Coscia and Ríos (2012) database are Zetas, Beltrán-Leyva faction, Tijuana Cartel, Juárez Cartel, Sinaloa Cartel, Gulf Cartel, and the Michoacan Family.

[16]We acknowledge that we do not aim to explain variations over time in violence levels through our key independent variables measuring distances. These fixed effects by year are intended precisely to account for these variations. Other control variables that change over time also help explain these variations.

DTOs engaging in violence[17] (Preacher, Zyphur, and Zhang 2010). While the indirect effect evaluates our "A" Hypotheses, the direct effect assesses the validity of our "B" Hypotheses. Following this description, we employ the following equations:

$$violence_{lt} = \alpha + \theta_k distance_l + \gamma Number\ of\ DTOs_{tl} + X'\delta_k + \phi_t + \varepsilon_l \quad (1)$$

$$Number\ of\ DTOs_{lt} = \alpha + \theta_k distance + Z'\xi_k + \ \phi_t + \varepsilon_l \quad (2)$$

In Equation (1) we estimate the *direct effect* of being closer to any of the infrastructures considered strategic for DTOs on levels of violence in locality l at time t. In Equation (2) we estimate the *indirect effect* of the distance of localities to the infrastructures on the number of DTOs of the criminal market inside each locality l at time t. ϕ_t is the year fixed effect. Z' and X' are $k\ x\ n$ control matrices for each equation. We estimate both equations using a negative binomial model as the dependent variables are counts with variances higher than the mean, rendering a Poisson model inappropriate.

Note that we include different control matrices given that both processes—violence and the number of DTOs—depend on different factors. Matrix Z'includes a one-year lagged term of the number of groups to account for serial correlation and all controls except for which major DTO had presence in each municipality. Matrix X', by contrast, includes a one-year lagged term for the levels of violence and the variable indicating which group had presence in each municipality.

Criminal violence has temporal dynamics that are important to consider. Our current strategy is based on estimating the models with all locality-year units pooled. We account for such temporal dynamics of the dependent variable using year fixed effects as we built our dataset with a panel structure. Moreover, in the Online Appendix we include models using a cross-section design summing up the total number of deaths per locality from 2006 to 2011. This model helps show our estimation is robust to both data structures and to the fact that our key independent variables do not vary over time.

We also acknowledge that DTOs might be able to anticipate some of the costs involved in excluding rival DTOs from using the infrastructures. However, we pose that such expectations are imperfect due to several informational problems. First, DTOs are uncertain about the duration of the conflict against rival DTOs. Second, DTOs might not have complete information on the number of DTOs already competing for control of the infrastructures. Third, it is also hard to anticipate how many other DTOs might enter the area to compete for control of the infrastructure. We clarify that the absence of perfect information does not preclude DTOs from estimating some costs and making decisions on whether to compete. If DTOs enter to compete, our "A" Hypotheses (first effect) account for it. While controlling for the number of DTOs competing (measured by the indirect effect), the second effect, employed to elaborate our "B" Hypotheses, focuses on the costs of excluding competitors given certain level of competition. Finally, we do not employ estimates of the benefits or costs of excluding other DTOs from using the infrastructures to support our causal argument. We acknowledge this is a limitation of our research design. Although our results may convincingly point in the direction of a causal link, further research could attempt to provide estimations of the components of DTOs' finances.

Results

Table 1 reports the results of our estimations. As our independent variables are distances, a negative sign indicates that localities *further away* from a given resource have less incidence of violence than those closer; but this also implies the contrary, i.e., localities *closer* to a given infrastructure have more violence than those further away. Panel A shows the estimations of

[17]The number of DTOs is measured as the number of different criminal groups that participated in at least one violent event by locality and year.

Table 1. Mediation Negative Binomial Estimates

	(1) Total Violence	(2) Inter DTO Violence
Violence		
Distance to Closest Border Segment (100 km, logged)	−0.411***	−0.332***
	(0.024)	(0.024)
Distance to Closest Pipeline (logged)	0.243***	0.230***
	(0.014)	(0.015)
Distance to Closest Port (logged)	−0.108***	−0.125***
	(0.022)	(0.022)
Distance to Closest Airport (logged)	0.192***	0.179***
	(0.024)	(0.024)
Distance to Closest Highway (logged)	0.066***	0.061***
	(0.014)	(0.015)
Number of DTOs	1.738***	1.728***
	(0.070)	(0.067)
Total Violence (t-1)	0.020**	
	(0.008)	
Inter DTO Killings (t-1)		0.004
		(0.008)
PAN Mayor	0.145*	0.061
	(0.072)	(0.074)
PRI Mayor	0.193**	0.158*
	(0.069)	(0.070)
PRD Mayor	0.371***	0.339***
	(0.074)	(0.076)
PRI Governor	−0.454***	−0.470***
	(0.051)	(0.053)
PAN Governor	−0.699***	−0.727***
	(0.067)	(0.070)
Zetas	0.316***	0.226***
	(0.044)	(0.046)
Beltran Leyva	0.571***	0.537***
	(0.054)	(0.055)
Sinaloa	0.650***	0.702***
	(0.053)	(0.054)
Familia	0.105#	0.131*
	(0.055)	(0.056)
Golfo	−0.141**	−0.176***
	(0.051)	(0.053)

(*Continued*)

Table 1. (*Continued*)

	(1) Total Violence	(2) Inter DTO Violence
Juárez	0.829***	0.936***
	(0.073)	(0.073)
Tijuana	−0.215*	−0.080
	(0.086)	(0.086)
Social Development	−0.733***	−0.677***
	(0.030)	(0.031)
Population (logged)	0.940***	0.930***
	(0.015)	(0.015)
Schooling	−0.005*	−0.004*
	(0.002)	(0.002)
Constant	−6.784***	−7.293***
	(0.288)	(0.295)
Number of DTOs		
Distance to Closest Border Segment (100 km, logged)	−0.349***	−0.349***
	(0.035)	(0.035)
Distance to Closest Pipeline (logged)	0.189***	0.189***
	(0.025)	(0.025)
Distance to Closest Port (logged)	−0.105**	−0.105**
	(0.034)	(0.034)
Distance to Closest Airport (logged)	−0.063#	−0.063#
	(0.038)	(0.038)
Distance to Closest Highway (logged)	0.026	0.026
	(0.031)	(0.031)
Number of DTOs (t-1)	0.583***	0.583***
	(0.070)	(0.070)
Killed DTO Members (logged, t-1)	0.424***	0.424***
	(0.122)	(0.122)
PAN Mayor	0.563***	0.563***
	(0.130)	(0.130)
PRI Mayor	0.471***	0.471***
	(0.131)	(0.131)
PRD Mayor	0.651***	0.651***
	(0.132)	(0.132)
PRI Governor	−0.225*	−0.225*
	(0.095)	(0.095)
PAN Governor	−0.952***	−0.952***
	(0.123)	(0.123)

(*Continued*)

Table 1. (*Continued*)

	(1) Total Violence	(2) Inter DTO Violence
Social Development	−0.999***	−0.999***
	(0.067)	(0.067)
Population (logged)	0.807***	0.807***
	(0.025)	(0.025)
Schooling	0.002	0.002
	(0.004)	(0.004)
Constant	−7.526***	−7.526***
	(0.491)	(0.491)
Observations	235997	235997
Log Likelihood	−25329.709	−23340.728
Time Fixed Effects	Yes	Yes

Note: Standard errors in parentheses; #p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Equation (1) where we assess the effect of the location on violence. Panel B shows the estimations that explain the number of DTOs as shown in Equation (2). Columns 1 and 2 show that localities closer to strategic US border segments, to ports, and to airports register more DTOs than localities further away from these infrastructures.

To analyze the effects of each infrastructure on violence, in Tables 2 and 3 we report the exponentiated coefficients (IRR) of the estimation of the direct and the indirect effects calculated from the structural model. It is noteworthy that IRR values below 1 reflect a negative impact, which means that violence decreases as distance to the infrastructure increases (or violence increases as distance to the infrastructure decreases). In contrast, IRR values above 1 reflect a positive impact; that means that violence increases as distance to the infrastructure increases. Table 3 shows the same calculations as in Table 2 but using the number of inter-DTO homicides as the dependent variable, and the results are similar. In Table 2 we employ the first model specification (from Table 1) to calculate the impacts of the distance to infrastructures on the total number of homicides. Results indicate that that an increase of one percentage point in the proximity to the US border, drug-related homicides increase by 46% (IRR = 0.546) due to the increased number of DTOs, supporting Hypothesis 1A, whereas homicides increase by 33% (IRR = 0.662) regardless of more groups, supporting Hypothesis 1B.

Column 3 in Table 2 indicates that an increase of one percentage point in the proximity of localities to ports, implies an increase of 17% (IRR = 0.833) in the number of total homicides due to a higher number of DTOs employing violence, but of only an increase of 10% (IRR = 0.898) as a direct effect, which supports Hypothesis 2B. By contrast, although an increase of one percentage point in the proximity of localities to airports is associated with 10% (IRR = 0.896) more deaths as an indirect effect, the same change in the distance sees a reduction in the number of homicides by 21% as a direct effect, rejecting Hypothesis 2B (IRR = 1.212), but only for airports.

Highways show a different picture. When localities are closer to highways, they experience less violence than those further away, although the impact is only 7% on average (IRR = 1.068) as a direct effect, which supports Hypothesis 3B. In addition, the indirect effect is non-significant, which also shows support for Hypothesis 3A.

Table 2. Direct, Indirect, and Total Effects on Violence

	(1)	(2)	(3)	(4)	(5)
	Distance to Closest Pipeline	Distance to US Border	Distance to Closest Port	Distance to Closest Airport	Distance to Closest Highway
Indirect	1.390***	0.546***	0.833**	0.896#	1.047
	(0.063)	(0.036)	(0.050)	(0.059)	(0.057)
Direct	1.275***	0.663***	0.898***	1.212***	1.068***
	(0.018)	(0.016)	(0.019)	(0.029)	(0.015)
Total	1.773***	0.362***	0.748***	1.086	1.118*
	(0.084)	(0.025)	(0.048)	(0.076)	(0.062)
Observations	235997	235997	235997	235997	235997

Note: Exponentiated coefficients; standard errors in parentheses
#p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 3. Direct, Indirect, and Total Effects on Violence

	(1)	(2)	(3)	(4)	(5)
	Distance to Closest Pipeline	Distance to US Border	Distance to Closest Port	Distance to Closest Airport	Distance to Closest Highway
Indirect	1.387***	0.547***	0.833**	0.897#	1.047
	(0.062)	(0.035)	(0.050)	(0.059)	(0.056)
Direct	1.259***	0.718***	0.882***	1.196***	1.063***
	(0.019)	(0.017)	(0.019)	(0.029)	(0.016)
Total	1.747***	0.393***	0.735***	1.072	1.113#
	(0.083)	(0.027)	(0.047)	(0.075)	(0.062)
Observations	235997	235997	235997	235997	235997

Note: Exponentiated coefficients; standard errors in parentheses
#p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Finally, for an increase of one percentage point in the proximity to a pipeline, localities have, on average, 40% (IRR = 1.390) fewer drug-related homicides due to the reduced number of groups, supporting the validity of Hypothesis 4A, but only 28% (IRR = 1.275) fewer homicides regardless of the number of groups, supporting arguments in Hypothesis 4B.

In sum, Tables 2 and 3 confirm that closeness to ports and the US border positively correlates with increased violence, occurring through the effect on the number of DTOs competing violently and through mechanisms suggested in our "B" hypotheses (indirect and direct effects). The effect of closeness to airports is mixed. Only the indirect effect (through the effect on additional number of DTOs competing violently) seems to be positively correlated with greater violence. However, this effect is not strong enough to produce significantly greater violence when we observe the total effect indicator. These results suggest that some DTOs seem likely to achieve monopolistic control of airports. Nevertheless, since the costs of monitoring/excluding other DTOs are high, DTOs ultimately tend to share (relatively) peacefully with other DTOs their access to airports. Finally, violence is not higher in localities close to highways and pipelines. This suggests DTOs are not

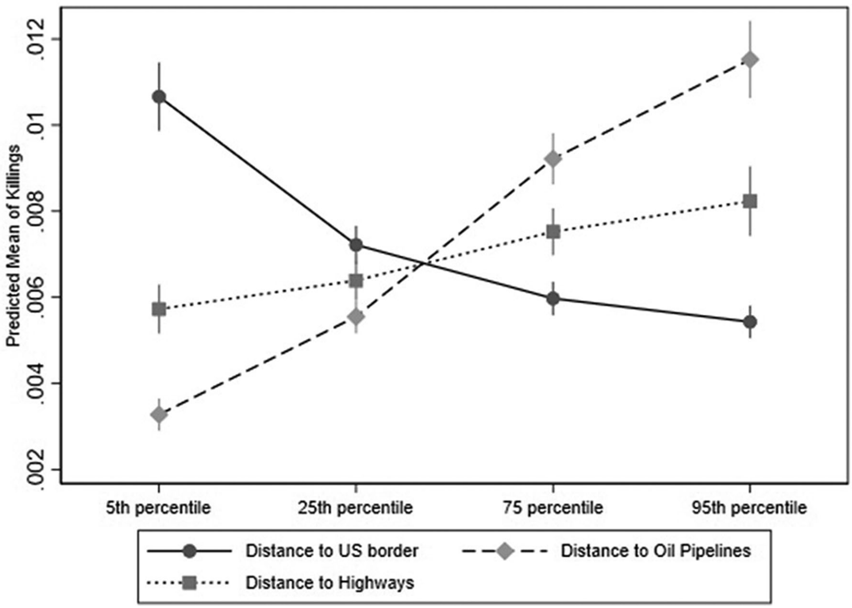


Figure 1. Predicted Mean of Killings.

interested in competing violently for the monopolistic control of these infrastructures or excluding other DTOs from using it.[18]

To show the substantive magnitude of our estimations, Figures 1 and 2 show the expected means of killings as the distances to different infrastructures vary, based on the first model shown in Table 1. The graphs report how the expected mean of killings change between localities being in the fifth percentile in distance to a particular infrastructure and localities in the ninety-fifth percentile of the distribution, with the rest of the covariates held at their means. Some infrastructures are more comparable to each other given their size; therefore, we first compare in Figure 1 the expected values of violence related to the largest infrastructures: highways, pipelines, and the US border. As displayed, localities closer to the US border have significantly higher levels of violence, whereas localities closer to highways and pipelines have less violence than those further away. For instance, when the average locality is close to an oil pipeline (1 km away) it would experience a third of the killings of a similar locality far from it (215 km away), whereas a locality close to the US border (1 km away) will have two times more killings than one far away (215 km away). Interestingly, localities close to a highway (1 km away) have almost 75% more killings than those close to a pipeline. This suggests that the differences between the US border and the other two infrastructures likely respond to greater competition and the relatively low costs of excluding rivals.[19]

The two other infrastructures, ports and airports, are smaller in nature. We thus show in Figure 2 the expected mean of killings as distances to these sites vary. In this case, the direct effect

[18]We acknowledge that *huachicoleo* (gasoline siphoning) became a more frequent practice *after* the period we analyze, more precisely during the Peña Nieto administration. This more frequent practice could have produced effects on violence such as those found by López Cruz and Torrens (2023) (for instance, attracting more DTOs). We also acknowledge that the use of the locality as the unit of analysis might underestimate the effect of the distances to highways given that a small locality may only be related to a smaller sector of the highway.

[19]We acknowledge that even though the nature of highways and pipelines increase the costs to keep monopolies and exclude rivals reducing the incentives to use violence, localities closer to key segments of highways and pipelines might be relatively more valuable as they allow transportation of goods to important markets or facilitate the extraction of oil in less guarded locations.

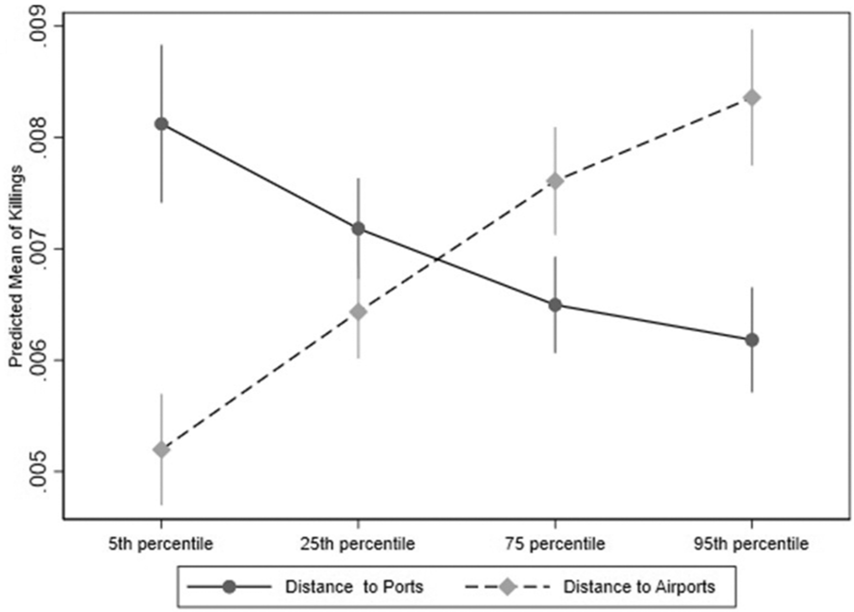


Figure 2. Predicted Mean of Killings by Distance to Resources.

seems to explain more convincingly differences in the expected means of killings between these two types of infrastructures.[20] For example, when the average locality is located 1 km away from a port (in the fifth percentile), it would experience 24% more killings than a similar locality located 320 km away. In contrast, an average locality close to an airport (1 km away) would have an average of killings almost 38% smaller than one further away (320 km away).[21]

Robustness Checks

We conduct a series of robustness checks to validate our results. First, we estimate our models without control variables to show our results are not driven by controls.[22] Second, we estimate the models with additional control variables that may shape the dynamics of violence. We employ the marginalization degree index of each locality as a proxy of development (CONAPO 2010). The marginalization degree index was built to measure income levels rather than focusing on the lack of access to basic resources. Higher levels of this variable imply that localities are more marginalized in economic terms. To account for further political factors, we include a binary variable to indicate whether the leftist party of the Democratic Revolution (Partido Revolucionario Democrático, PRD hereafter) controlled state governments. This variable allows us to account for additional political factors that are associated with partisanship and the control of criminal

[20]We emphasize that differences in violence between these two types of infrastructures are probabilistic and might depend to some extent on the sizes of these installations. The same (probabilistic) logic applies to the other infrastructures, as different features such as monitoring and bribing costs might vary across them.

[21]These patterns might be driven by population: communities close to pipelines and airports can be less populated than those closer to highways and ports. We divided the estimation of expected values by population and the results remain the same. Figures 3.1 and 3.2 in the Online Appendix show these results.

[22]Tables 2.1.1, 2.1.2, and 2.1.3 in the Online Appendix display these results. The results of these estimations tend to be similar to those displayed in Tables 1, 2, and 3, except for one exception. The effects of the closeness to airports seem heterogeneous: without including controls, the results suggest that airports increase the levels of violence through both the number of DTOs and the arguments supporting Hypothesis 2B. However, this different result might be the product of omitted variables.

violence (Dell 2015; Trejo and Ley 2016, 2018). We also include a dummy variable to indicate whether there was partisan change in the most recent municipal election. Such changes can drive policies of crackdowns and destabilize protection rackets for DTOs and thus increase violence (Dell 2015; Trejo and Ley 2018). We also control for male employment using the percentage of employed males in each locality (INEGI 2010). Higher unemployment might increase recruitment opportunities by DTOs and thus increase violence (Osorio 2015; Durán-Martínez 2018). We also change the measure of state repression. Instead of using the number of DTO members killed in confrontations, we employ the number of DTO members detained in confrontations, as this might constitute a more accurate measure of the state's abilities to confront DTOs. Finally, we include the percentage of the area of each locality covered by land suitable for opium and marijuana cultivation (Bahaug and Lujala 2005; Lujala 2009). Areas more suitable for drug cultivation can increase the levels of violence as they could be more valuable for DTOs.[23]

Third, as localities are embedded into larger units including municipalities and states, we estimate the interclass correlation coefficient (ICC) for each level—municipal or state—to figure out if there were multilevel impacts that could bias our results. We find weak evidence of multilevel correlations, either from municipalities or states, with localities' levels of violence rendering multilevel models unnecessary. In other words, the variability of violence at the locality level is not explained by the state or municipal variation.[24]

Fourth, to account for unobserved factors that might drive violence and number of DTOs employing violence, we estimate all the models with fixed effects by state.[25] Fifth, we run models excluding the ten localities with more homicides on average during the period.[26] Sixth, we run models employing robust standard errors that cluster residuals at the locality level.[27]

Seventh, we consider that the relevance of the segments of the US-Mexico border might vary. Therefore, in addition to employing 100 kms segments of the border for each port of entry (see Table 1), we use three alternative measures of the border to then calculate the distance of each locality to them: 1) segments of 50 kms; 2) the whole border (Department of Homeland Security 2017); and 3) only the ports of entry (US Customs and Border Protection 2019)—i.e., the centroids of each port of entry.[28] Eighth, as our key explanatory variables do not vary over time, we also estimate our main models using a cross-section design summing up the number of homicides by locality over the entire period.[29] Even when employing all these alternative measures, the models confirm the robustness of our main findings reported in Tables 2 and 3.

Ninth, we consider possible interactive relationships between some infrastructures and other factors that might drive our results, which other studies suggest might be relevant activators of the effect of some of our variables. López Cruz and Torrens (2023) show that municipalities close to the oil pipelines network but also near oil refineries in Mexico experience lower levels of violence. To account for the presence of refineries, we include in our models an interaction term between the distance to pipelines and the localities belonging to a municipality with a refinery. Our main findings remain the same. Osorio (2015) also shows how, at the municipal level, when both the density of roads and law enforcement increases, the levels of violence among DTOs decreases. To control for this nuance, we estimate our models including an interaction term between localities

[23]Tables 2.2.1, 2.2.2, and 2.2.3 in the Online Appendix display these results.

[24]Table 2.3.1 displays these results. Despite these ICC results, we estimate multilevel models with localities nested in states. The key findings remain similar to those displayed in Tables 2 and 3. Tables 2.3.2, 2.3.3, and 2.3.4 show these results.

[25]Tables 2.4.1, 2.4.2, and 2.4.3 in the Online Appendix display these results. We acknowledge that support for Hypothesis 2A for the case of airports is relatively weak compared to other models.

[26]Tables 2.5.1., 2.5.2, and 2.5.3 in the Online Appendix show these results.

[27]Tables 2.6.1., 2.6.2, and 2.6.3 in the Online Appendix show these results.

[28]Tables 2.7.1., 2.7.2, 2.7.3, and 2.7.4 in the Online Appendix present these results.

[29]Tables 2.8.1., 2.8.2, and 2.8.3 in the Online Appendix show these results.

with high levels of law enforcement and the distance of localities to highways. Once again, our main results do not change.[30]

Tenth, it is possible that the proximity of localities to these infrastructures is a proxy for urbanization and concentration of wealth. Although our models include socio-economic variables and population rates, we also estimated additional models with a binary variable indicating whether the locality was urban or rural following INEGI (2010) criteria and our results remain equal.[31]

Conclusions

This article provides several lessons. First, the location of the US border segments and ports, and to a point those of airports, helps explain the concentration of criminal violence throughout Mexican territory, although each resource influences violence differently. These differences are related to the mechanism linking each infrastructure with the different levels of violence. We find that each infrastructure attracts a different number of competitors for its control, and such different levels of competition produce different levels of criminal violence. In addition, our results also suggest that the costs of excluding existing competitors from using the infrastructure also affect levels of violence. As these expected (or experienced) costs rise, the incentives to exclude competitors weaken and violence decreases. In sum, infrastructures that attract greater number of competitors (ports, airports, and key segments of the US border) and involve lower monitoring and exclusion costs increase violence in nearby localities. It is relevant to stress that the effect on the number of competitors employing violence is key to explaining variations in violence in locations close to these infrastructures.

Second, policymakers in charge of reducing violence should consider these findings. For instance, they might also want to consider how the presence of these infrastructures alters competition among DTOs, which boosts violence. It also helps our understanding of the logistics and optimizing strategies DTOs follow to maximize benefits. Strategies that reduce the economic benefits that these infrastructures provide to DTOs might in turn reduce violence in nearby areas. Investment in intelligence might help identify effective interventions to reduce these benefits or increase the costs for DTOs. Further research shall consider studying the effects of different types of policy intervention in localities close to these infrastructures.

Finally, we show that criminal violence is a complex phenomenon with multiple causal mechanisms. If governments seriously aspire to free their societies from these organizations, they will need to consider the importance of these infrastructures to the strength of DTOs. In fact, the use of these infrastructures might delay or diminish the potential gains that legalization or new regulations might create for reducing violence.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/lap.2024.11

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[30]"High levels of law enforcement" is a binary variable indicating whether the municipality experienced three standard deviations of the amount of DTOs killed by the government. We estimate models including law enforcement in the first equation as in our main models. Tables 2.9B.1, 2.9B.2, and 2.9B.3 in the Online Appendix show these results. We include another set of models including it in both equations and the results remain the same. Tables 2.9B.4, 2.9B.5, and 2.9B.6 in the Online Appendix show these results. However, in contrast with Osorio (2015), we find that localities in the category of high levels of law enforcement and close to highways are hosts to more DTOs, and therefore, higher levels of violence (in contrast with those communities farther away). This finding also complements previous analyses: when looking at the proximity to roads instead of the internal density of roads, violence tends to increase because of increased competition.

[31]Tables 2.10.A.1, 2.10.A.2, 2.10.A.3, 2.10.B.1, 2.10.B.2, and 2.10.B.3 in the Online Appendix display these results. INEGI classifies as urban, localities that have either more than 2,500 inhabitants or that are the major population centers of each municipality. We also included a binary indicator for localities that had exclusively more than 2,500 inhabitants.

References

Astorga, Luis, and David Shirk. 2010. Drug Trafficking Organizations and Counter-Drug Strategies in the U.S.-Mexican Context, Working paper 10-01, Center for U.S.-Mexican Studies.

Atkinson, Michael, Moshe Kress, and Roberto Szetchman. 2017. Maritime Transportation of Illegal Drugs from South America. *International Journal of Drug Policy* **39**: 43–51.

Atuesta, Laura H., and Aldo F. Ponce. 2017. Meet the Narco: Increased Competition among Criminal Organisations and the Explosion of Violence in Mexico. *Global Crime* **18**, 4: 375–402.

Atuesta, Laura H., Oscar S. Siordia, and Alejandro Madrazo Lajous. 2018. The "War on Drugs" in Mexico: (Official) Database of Events between December 2006 and November 2011. *Journal of Conflict Resolution* **117**: 1–25.

Bailey, John, and Matthew Taylor. 2009. Evade, corrupt, or confront? Organized crime and the state in Brazil and Mexico. *Journal of Politics in Latin America* **1**, 2: 3–29.

Berbotto, Arantza Alonso, and Spencer Chainey. 2021. Theft of Oil from Pipelines: An Examination of its Crime Commission in Mexico Using Crime Script Analysis. *Global Crime* **22**, 4: 265–87.

Bergman, Marcelo. 2018. Criminal Diversification and Corruption in the Drug Business. In *Illegal Drugs, Drug Trafficking and Violence in Latin America*, ed. Marcelo Bergman. pp. 63–72. New York: Springer.

Brito, Dagobert, and William Oakland. 1980. On the Monopolistic Provision of Excludable Public Goods. *The American Economic Review* **70**, 4: 691–704.

Buhaug, Halvard, and Päivi Lujala. 2005. Accounting for Scale: Measuring Geography in Quantitative Studies of Civil War. *Political Geography* **24**, 4: 399–418. https://doi.org/10.1016/j.polgeo.2005.01.006.

Calderón, Gabriela, Gustavo Robles, Alberto Díaz-Cayeros, and Beatriz Magaloni. 2015. The Beheading of Criminal Organizations and the Dynamics of Violence in Mexico's Drug War. *Journal of Conflict Resolution* **59**, 8: 1455–85.

Calderón, Laura, Kimberly Heinle, Rita Kuckertz, Octavio Rodríguez Ferreira, and David Shirk. 2020. *Organized Crime and Violence in Mexico: 2020 Special Report*. San Diego: University of San Diego.

Campbell, Howard, and Tobin Hansen. 2014. Is Narco-Violence in Mexico Terrorism? *Bulletin of Latin American Research* **33**, 2: 158–73.

CONAPO. 2010. Índice de marginación por localidad 1990-2010. Accessed January 2019. http://www.conapo.gob.mx/.

Carstensen, Briguette. 2013. Cartel-Extremist Relations: Increasing Concerns at the U.S.-Mexico Border. *American Intelligence Journal* **31**, 1: 49–53.

Caulkins, Jonathan, Honora Burnett, and Edward Leslie. 2009. How Illegal Drugs Enter an Island Country Insights from Interviews with Incarcerated Smugglers. *Global Crime* **10**, 1–2: 66–93.

CARTOCRITICA. 2017. ¿Por Dónde Circulan Los Hidrocarburos En México?

CONEVAL. 2010. ¿Que Es El Índice de Rezago Social? https://www.coneval.org.mx/Medicion/IRS/Paginas/Que-es-el-indice-de-rezago-social.aspx

Coscia, Michele, and Viridiana Rios. 2012. Knowing Where and How Criminal Organizations Operate Using Web Content. In *Proceedings of the 21st ACM International Conference on Information and Knowledge Management*. New York: ACM. 1412–21. https://doi.org/10.1145/2396761.2398446.

Dell, Melissa. 2015. Trafficking Networks and the Mexican Drug War. *The American Economic Review* **105**, 6: 1738–79.

Department of Homeland Security. 2017. DHS Data. https://www.dhs.gov/data. Accessed February 2019.

Durán-Martínez, Angélica. 2018. *The Politics of Drug Violence. Criminals, Cops, and Politicians in Colombia and Mexico*. Oxford: Oxford University Press.

Erickson, Amanda, 2018. *Latin America is the World's Most Violent Region. A New Report Investigates Why*. Canadian Global Affairs Institute. Canada. https://policycommons.net/artifacts/2327391/latin-america-is-the-worlds-most-violent-region/3087958/

Felbab-Brown, Vanda. 2019. *Mexico's Out-of-Control Criminal Market*. Washington, DC: Brookings Institution.

Fuerte Celis, María del Pilar, Enrique Pérez Lujan, and Rodrigo Cordova Ponce. 2019. Organized Crime, Violence, and Territorial Dispute in Mexico (2007–2011). *Trends in Organized Crime* **22**: 188–209.

Franco-Vivanco, Edgar, **César. B. Martínez-Álvarez, and Iván. F. Martínez**. 2023. Oil Theft and Violence in Mexico. *Journal of Politics in Latin America*. Online First.

García-Ponce, Omar, and Andrés Lajous 2014. "How Does a Drug Cartel Become a Lime Cartel?" Washington Post. Published on May 20, 2014 (Tuesday).

Grillo, Ioan. 2012. *El narco. En el corazón de la insurgencia criminal mexicana*. Mexico: Tendencias Editores.

Herrera, Joel Salvador, and César Martínez-Álvarez. 2022. Diversifying Violence: Mining, Export-Agriculture, and Criminal Governance in Mexico. *World Development* **151**: 1–14.

INEGI. 2010. *Manual de Cartografía Geoestadística*. Mexico.

INEGI. 2019. *Diccionario de datos topográficos. Escala 1:250 000*. Versión 2. Mexico.

Jones, Nathan, and John Sullivan. 2019. Huachicoleros: Criminal Cartels, Fuel Theft, and Violence in Mexico. *Journal of Strategic Security* **12**, 4: 1–24.

Keele, Luke J., and Rocío Titiunik. 2015. Geographic Boundaries as Regression Discontinuities. *Political Analysis* **23**, 1: 127–55. https://doi.org/10.1093/pan/mpu014.

Korman, James. 2019. Drug Cartels, Oil Rents, and Homicide—the Case of Mexico. SSRN: https://ssrn.com/abstract=3490397

Kostakos, Panos, and Georgios A. Antonopoulos. 2010. The "Good," the "Bad" and the "Charlie": The Business of Cocaine Smuggling in Greece. *Global Crime* **11**, 1: 34–57.

Le Billon, Philippe. 2001. The Political Ecology of War: Natural Resources and Armed Conflicts. *Political Geography* **20**, 5: 561–84.

Lessing, Benjamin. 2017. *Making Peace in Drug Wars: Crackdowns and Cartels in Latin America*. New York: Cambridge University Press.

Locks, Benjamin. 2015. Extortion in Mexico: Why Mexico's Pain Won't End with the War on Drugs. *Yale Journal of International Affairs* **10**, 67: 67–83.

López Cruz, Iván, and Gustavo Torrens. 2023. Hidden Drivers of Violence Diffusion: Evidence from Illegal Oil Siphoning in Mexico. *Journal of Economic Behavior & Organization* **206**, C: 26–70.

Lujala, Paivi. 2009. Deadly Combat over Natural Resources: Gems, Petroleum, Drugs, and the Severity of Armed Civil Conflict. *The Journal of Conflict Resolution* **53**, 1: 50–71.

Macias-Medellín, Martín, and Aldo F. Ponce. 2022. Los narcos y los corruptos: las organizaciones criminales y sus efectos sobre la percepción de la corrupción en México. In *Huellas de la Guerra: Los Costos Sociales de la Violencia Criminal en México*, ed. Aldo Ponce. Mexico: Editorial CIDE. pp. 131–170.

Magaloni, Beatriz, Gustavo Robles, Aila Matanock, Vidal Romero, and Alberto Díaz Cayeros. 2020. Living in Fear: The Dynamics of Extortion in Mexico's Drug War. *Comparative Political Studies* **53**, 7: 1124–1174.

Nellemann, Christian, Rune Henriksen, Arnold Kreilhuber, Davyth Stewart, Maria Kotsovou, Patricia Raxter, Elizabeth Mrema, and Sam Barrat. 2016. *The Rise of Environmental Crime: A Growing Threat to Natural Resources, Peace, Development, and Security*. New York: United Nations Environment Programme.

Osorio, Javier. 2015. The Contagion of Drug Violence: Spatiotemporal Dynamics of the Mexican War on Drugs. *Journal of Conflict Resolution* **59**, 8: 1403–32.

Pérez-Ricart, Carlos, Jerónimo Castillo, Alex Curry, and Mónica Serrano. 2021. Guns in Latin America: Key Challenges from the Most Violent Region on Earth. In Gun Trafficking and Violence, ed. David Pérez Esparza, Carlos Pérez-Ricart, and Eugenio Weigend Vargas. pp. 93–122. Cham: Palgrave Macmillan.

Phillips, Brian J. 2015. How Does Leadership Decapitation Affect Violence? The Case of Drug Trafficking Organizations in Mexico. *Journal of Politics* **77**, 2: 324–36.

Ponce, Aldo F. 2016. Cárteles de droga, violencia y competitividad electoral a nivel local: evidencia del caso mexicano. *Latin American Research Review* **51**, 4: 62–85.

Ponce, Aldo F. 2019. Violence and Electoral Competition: Criminal Organizations and Municipal Candidates in Mexico. *Trends in Organized Crime* **22**, 2: 231–54.

Ponce, Aldo F., Rodrigo Velázquez López Velarde, and Jaime Sáinz Santamaría. 2022. Do Local Elections Increase Violence? Electoral Cycles and Organized Crime in Mexico. *Trends in Organized Crime* **25**: 37–57.

Preacher, Kristopher J., Michael J. Zyphur, and Zhen Zhang. 2010. A General Multilevel SEM Framework for Assessing Multilevel Mediation. *Psychological Methods* **15**, 3: 209–33.

Rettberg, Angelika, and Juan Felipe Ortiz-Riomalo. 2016. Golden Opportunity, or a New Twist on the Resource-Conflict Relationship: Links between the Drug Trade and Illegal Gold Mining in Colombia. *World Development* **84**: 82–96.

Ríos, Viridiana. 2012. How Government Structure Encourages Criminal Violence. The Causes of Mexico's Drug War. PhD Dissertation, Harvard University, Cambridge, MA. http://www.gov.harvard.edu/files/Rios_PhD Dissertation.pdf.

Seelke, Clare, Michael Ratner, M. Ángeles Villarreal, and Phillip Brown. 2015. Mexico's Oil and Gas Sector: Background, Reform Efforts, and Implications for the United States. Congressional Research Service. CRS Report, 1–22.

Shirk, David, and Joel Wallman. 2015. Understanding Mexico's Drug Violence. *Journal of Conflict Resolution* **59**, 8: 1348–76.

Snyder, Richard, and Angélica Durán-Martínez. 2009. Does Illegality Breed Violence? Drug Trafficking and State-sponsored Protection Rackets. *Crime, Law, and Social Change* **52**: 253–73.

Trejo, Guillermo, and Sandra Ley. 2016. Federalism, Drugs, and Violence. Why Intergovernmental Partisan Conflict Stimulated Inter-Cartel Violence in Mexico. *Política y Gobierno* **23**, 1: 9–52.

Trejo, Guillermo, and Sandra Ley. 2018. Why Did Drug Cartels Go to War in Mexico? Subnational Party Alternation, the Breakdown of Criminal Protection, and the Onset of Large Scale Violence. *Comparative Political Studies* **51**, 7: 900–37.

U.S. Customs and Border Protection. 2019. Locate a Port of Entry. https://www.cbp.gov/about/contact/ports. Accessed February 2019.

Williams, Phil. 2012. The Terrorism Debate Over Mexican Drug Trafficking Violence. *Terrorism and Political Violence* **24**, 2: 259–78.

Zaitch, Damián. 2002. From Cali to Rotterdam: Perceptions of Colombian Cocaine Traffickers on the Dutch Port. *Crime, Law and Social Change* **38**: 239–66.

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