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Diversifying violence: Mining, export-agriculture, and criminal governance in Mexico

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ABSTRACT

A growing body of evidence suggests that criminal organizations across the Global South actively exploit natural resources in the communities where they operate with important sociopolitical consequences. In this article, we investigate the case of Mexico where the incursion of criminal groups into the mining and export-agricultural sectors impacts violence at the local level. We propose two mechanisms that explain why criminal groups diversify. First, the war-profit motive suggests that competition and state repression prompt criminal organizations to look for non-traditional sources of incomes and to build up their violence-making capacities. Second, the governance motive suggests that extracting rents from key industries represents a strategy for these organizations to establish territorial control in local communities. Using homicide data from 2007 to 2011, we demonstrate that access to primary sector revenues is associated with higher levels of violence among Mexican municipalities. Using qualitative evidence from Michoacán, we show how the introduction of criminal governance systems to rural areas was a key factor in explaining why criminal groups diversified toward mining and export-agriculture.

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1. Introduction

In 2014, a high-ranking official in Mexico's federal government recognized that drug trafficking was no longer the main source of income for some criminal organizations in the country (Castillo, 2014). This official specifically referenced Los Caballeros Templarios (The Knights Templar), a criminal group based in the southwestern state of Michoacán that had diversified its profit-making activities from producing methamphetamines to illegal mining, logging, and protection rackets. This interview occurred a year after a revolt erupted in the state, in which local agricultural elites organized vigilante groups to fight back against violence and extortion they had experienced from the Knights Templar (García-Ponce & Lajous, 2014).

How does access to revenues from natural resources affect levels of criminal violence? A growing body of evidence suggests that criminal organizations across the Global South have turned towards different economic sectors to diversify their revenue-generating portfolios (Bergman, 2018; Nellemann et al., 2016; 2020). In the case of Mexico, some scholars cite prolonged conflicts, the fragmentation of criminal organizations, and falling prof-

its from drug markets as the key drivers of this phenomenon (Calderón et al., 2020; Felbab-Brown, 2019; Guerrero Gutiérrez, 2011; Magaloni et al., 2020). Yet, there is insufficient theorization on the mechanisms that connect criminal diversification, particularly towards natural resources, to violence.

Furthermore, quantitative evidence on this relationship has been limited for two reasons. First, existing research on the resource-violence connection tends to focus on civil war contexts. In contrast, settings dominated by criminal violence have received far less attention. Second, explanations of criminal violence in Mexico emphasize violent competition among criminal organizations and the effects of state repression against criminal groups as the main drivers of violence in the country (e.g., Durán-Martínez, 2018; Flores-Macías, 2018). Hence, both strands of research have overlooked the intersection between organized crime, natural resources, and violence.

We address these gaps in the literature by drawing on two bodies of work. First, the resource-conflict literature has shown a strong association between the presence of natural resources and the onset, duration, and intensity of civil wars and other types of conflict (Collier & Hoeffler, 2004; Fearon, 2005; Ross, 2004). At the subnational level, scholars have studied how criminal and other armed non-state actors compete for the extraction and profits from minerals and oil resources (Dube & Vargas, 2013; Rettberg et al., 2018; Stoop et al., 2019). Second, according to an emerging

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literature on criminal governance, criminal organizations across Latin America actively exert territorial control in the communities and regions where they operate. This includes, for example, capturing local governments, establishing legitimacy among the locals, and taxing a variety of economic activities (Arias, 2017; Magaloni et al., 2020; Trejo & Ley, 2020). Hence, the main research question of this article is, how does access to revenues from natural resources affect levels of violence in settings dominated by criminal organizations?

Mexico represents an ideal case to study the relationship between criminal diversification, natural resource extraction, and violence for two main reasons. First, the country is a major exporter of primary commodities ranging from copper and silver to various food crops. Moreover, Mexico has become increasingly dependent on exports since the implementation of trade reforms between the 1980s and 1990s (Moreno-Brid & Ros, 2009). Second, since the mid-1990s, criminal groups in the country have undergone a process of paramilitarization resulting from inter-group divisions and clashes with the state's armed forces (Trejo & Ley, 2020). The escalation of state repression against criminal networks since late 2006 only intensified these processes. As a result, the incentives for criminal organizations to diversify away from drug trafficking have only become stronger.

In this article, we advance two arguments. First, we posit that access to revenues from valuable commodities, such as metals and agricultural goods for exports, are associated with higher levels of criminal violence. These resources and production chains tend to be concentrated among a small set of producers, which makes them susceptible to capture or taxation by criminal organizations. Second, we suggest two mechanisms that explain this relationship: the *war-profit motive* and the *governance motive*. According to the former, competition among criminal organizations has led some of these groups to expand their profit-making activities into new economic sectors, including natural resources. Regarding the latter, capturing rents and production chains from key industries represents a strategy for criminal organizations to establish territorial control in local communities, which in turn allows them to secure a steady stream of rents from their subjects.

We employ a mixed-methods approach to test the empirical validity of these claims. From a quantitative perspective, we analyze the relationship between revenues from mining and agricultural commodities and violence for a panel of 2,450 Mexican municipalities from 2007 to 2011. Our results suggest that access to revenues from natural resources is associated with differences in violence rates among municipalities, but not changes within municipalities. This correlation is positive and strong, even after controlling for socioeconomic and strategic covariates, spatial dynamics, and municipal and year fixed effects. This association is also higher for our measures of mining revenues than for agricultural revenues. From a qualitative standpoint, we explore the relationship between criminal diversification, violence, and criminal governance in Michoacán, a state with both a sizable endowment of these commodities and an important criminal presence.

The article proceeds as follows. In the next section, we discuss the existing literature on the drivers of criminal violence in Mexico, followed by our conceptual framework for understanding the relationship between natural resources and criminal activities. In the fourth section we present our data and methods. In the fifth section we show our analysis of a panel of 2,450 Mexican municipalities from 2007 to 2011. In the sixth section, we complement our quantitative evidence with a case study centered on Michoacán. The final section summarizes our arguments and findings and suggests areas for further research.

2. Drug trafficking and violence in Mexico

Over the last twenty-five years, levels of criminal violence and insecurity have increased considerably across Latin America (Bergman, 2018). In Mexico, one of the key drivers of this trend is the illicit drug trade. Although drug trafficking dates to the early twentieth century, it was historically characterized by relatively low levels of violence (Astorga, 2005). However, after the mid-1990s, and in particular after President Felipe Calderón declared a war on drugs and organized crime in late 2006, violence proliferated and became highly visible in regions of strategic importance for the drug industry (Durán-Martínez, 2018; Trejo & Ley, 2020).

Social scientists have advanced three interrelated explanations for the expansion of criminal violence in Mexico. The first one centers on landmark political changes in the country. Between the 1950s and the 1980s, political actors with ties to the Institutional Revolutionary Party (PRI), which ruled from 1929 to 2000, played a key role in informally patronizing and regulating the drug trade (Astorga, 2005). They provided political protection in exchange for revenues with the expectation that violence would be kept to a minimum (Knight, 2012; Serrano, 2012).

However, these politico-criminal networks eroded as electoral competition increased after the 1980s. Hence, drug trafficking organizations became vulnerable to crackdowns by the state's security forces and to attacks by rivals (Trejo & Ley, 2020). As a result, criminal groups built up their violence-making capabilities to secure and expand their territories. To this end, many accounts of violence in Mexico focus on the consequences of democratization, electoral competition, and state fragmentation (Astorga, 2005; Blume, 2017; Durán-Martínez, 2018; Rios, 2015; Snyder & Durán-Martínez, 2009).

Other explanations of violence focus on the market dynamics of Mexico's drug trade. Drug trafficking organizations often employ violence to compete for and secure territories with a comparative advantage in smuggling routes, drug production, and local drug markets (Calderón et al., 2015; Castillo & Kronick, 2020). Moreover, these groups engage in the exploitation of an informal class of workers willing to participate in various aspects of the drug trade, including violence-making activities (Herrera, 2019). Competition engenders not only inter-cartel violence, but attacks on local and subnational authorities as well (Blume, 2017; Trejo & Ley, 2020).

Finally, several studies have emphasized the role that the state's militarized crackdowns on criminal organizations have on increasing levels of violence, especially after the onset of Calderón's War on Drugs (Flores-Macías, 2018). In particular, the decapitation of drug trafficking organizations is strongly associated with higher homicide rates. The removal of a criminal leader usually leads to internal power struggles and instability within criminal networks. Thus, violence increases as organizations fragment into smaller, competing groups, or as rivals exploit the opportunity to attack (Atuesta & Ponce, 2017; Calderón et al., 2015; Castillo & Kronick, 2020; Dell, 2015; Osorio, 2015; Phillips, 2015; Rios, 2013).

The interplay between the profit-making motives of criminal organizations and state efforts to curtail these activities is at the center of the explanations of criminal violence in Mexico. However, there are gaps in this literature that raise important questions. In particular, why do the power, influence, and complexity of criminal organizations continue to grow despite a prolonged period of state repression? As some scholars have noted, the political economy of criminal violence is much more intricate and complex than only the drug trade (Noria Research, 2020). There is substantial evidence that criminal syndicates have diversified their operations into other sectors while increasing their political influence in the communities where they operate (Trejo & Ley, 2020). These criminal groups have generated new dynamics of violence outside of

the illegal markets for drugs, from the extraction of rents from natural resources to the exploitation of local communities (ibid.). The following section develops a conceptual framework for understanding these dynamics.

3. Criminal diversification and violence

In this section, we develop a conceptual framework to understand why criminal organizations target the natural resources sector and why this may affect levels of violence. We define criminal diversification as the expansion of criminal syndicates to sectors other than illicit drug markets. In general, diversification entails the extraction of rents from businesses and producers through fees and taxes—what organized crime scholars call protection rackets (Campana & Varese, 2018; Gambetta, 1993). There are historical examples of mafias diversifying into licit businesses as a way to launder money (Cedillo, 2011), but also to escape state repression and turf wars (Varese, 2020). But criminal groups less frequently engage in the supply chain of natural resources, from their production or extraction to their final distribution in markets (Zabylina and van Uhm, 2020).

A longstanding strand of research has studied the role of access to natural resources revenues in conflict settings. Initial cross-national studies argued that primary commodity exports, such as petroleum and precious metals, are associated with the onset, duration, and intensity of civil wars (Collier & Hoeffler, 2004; Fearon, 2005; Ross, 2015). Regardless of their political motivations, armed groups tend to target extractive industries to fund and enhance their warring capabilities. Furthermore, a recent meta-analysis showed that the relationship between the value of natural resources and armed conflict varies by the type of commodity (Blair et al., 2021). Whereas mining resources are statistically associated with higher levels of conflict, agricultural goods tend to have either the opposite or null effects on violence.

Other studies at the subnational level have complemented this line of resource-conflict research. For example, Dube and Vargas (2013) study the effects of changes in the price of different natural resources on violence in Colombia. The authors find that falling coffee prices were associated with higher rates of violence as the opportunity costs of joining armed groups decreased for agricultural workers. Likewise, higher oil revenues had a positive effect on violence—as municipal governments with access to these rents became richer, they became targeted by competing armed groups. More recently, illegal gold mining has increased violence in some parts of Colombia as criminal organizations historically involved in drug trafficking have capitalized on the gold rush (Rettberg & Ortiz-Riomalo, 2016). As these authors suggest, criminal groups have developed “resource portfolios”, which entail the ability to extract revenues from different types of commodities (ibid.).

In this study, we argue that criminal organizations have diversified their revenue-generating portfolios towards the natural resources sector through two mechanisms: the *war-profit motive* and the *governance motive*. Regarding the former, since the 1990s, inter-cartel conflicts and clashes with the state have increased levels of violence in Mexico (Trejo & Ley, 2020). The War on Drugs only intensified competition, which incentivizes drug trafficking organizations to expand their revenue-generating activities to new economic sectors (Magaloni et al., 2020). This also entails a risk-reduction and investment strategy by criminal groups whose traditional revenue sources are under threat (Correa-Cabrera, 2017; Jones, 2016). Hence, similarly to armed groups in conflict settings, criminal organizations require secure sources of income to build up their violence-making capabilities as they face intense competition and state crackdowns. We argue that natural resources represent an attractive option to do so.

Regarding the second mechanism, criminal governance systems have emerged in communities across Latin America. Criminal governance refers to the ways criminal groups actively seek to control and administer the territories where they operate, by organizing different aspects of local economies, politics, and society (Arias, 2017; Lessing, 2020). In Mexico, criminal groups often attempt to and succeed in capturing municipal governments, police forces, and other state institutions—making them *de facto* powerholders in some parts of the country (Trejo & Ley, 2020). In this context, access to natural resources are both a source of revenue for criminal groups and a key strategy for establishing their hegemony at the local level. In communities dependent on these commodities, their capture bolsters the ability of criminal organizations to control other economic sectors as well as the local population.

These interrelated mechanisms explain why criminal organizations have expanded their revenue-generating activities to different economic sectors. The need to build up their revenue sources and to strengthen their territorial control motivates Mexican criminal organizations to tax or seize the production chains of key industries. Although criminal diversification is not exclusive to primary commodities such as mining and agricultural goods, we focus on these sectors for several reasons.

First, urban centers are overrepresented in research on criminal governance (Arias, 2017; Lessing, 2020). As a result, many studies mostly shed light on criminal diversification into areas such as extorting formal and informal businesses, kidnapping, human trafficking, prostitution, and copyright piracy (Blattman et al., 2021; Jones, 2016; Moncada, 2016). But recent research demonstrates that criminal groups play an important role in the formation of local political orders and economic development in rural settings (del Valdivia, 2021; Dest, 2021; Peñaranda Currie et al., 2021). And if the dynamics of criminal governance vary between rural and urban areas (Blume, 2017), so should some of the markets targeted by criminal groups. In the Mexican countryside, natural resources represent a viable diversification alternative given their abundance, economic importance, and ease of access.

Mexico is a major exporter of metals such as gold, silver, and copper, as well as export-oriented agricultural commodities like avocados and other high-value crops. As a result, they are usually the most profitable sectors in rural areas where many criminal organizations operate. These resources also tend to be concentrated among a small set of producers. In the case of mineral commodities, deposits are often located in relatively isolated areas where the state's presence is weak and that of armed non-state actors is strong (Rettberg & Ortiz-Riomalo, 2016). All of these factors combined make the production chains of primary commodities relatively easy to tax or capture for criminal groups. In other words, they are highly “lootable” (Dal Bó & Dal Bó, 2011; Ross, 2004).

Successfully diversifying into these economic sectors is essential to the self-reproduction of criminal organizations, not only as profit-oriented groups, but also as actors with violence-making capabilities. Therefore, we hypothesize that access to natural resources is associated with higher levels of violence.

4. Data and methods

4.1. Dependent variables

To test the validity of our arguments, we first analyze the relationship between criminal violence and access to rents from mining and agricultural commodities at the municipality-year level in Mexico from 2007 to 2011. We choose this period for two reasons. First, the Calderón administration launched a militarized offensive against criminal networks and drug trafficking in December 2006,

which rapidly changed the incentives of criminal organizations to engage in economic diversification. Second, as we explain below, some of the key correlates of violence at the municipal level are only available for this period.

Our main dependent variable is *criminal violence*, which we operationalize as the homicide rate for males ages 15–39 per 100,000 inhabitants. In the absence of reliable data from public security agencies, this is the most accurate approximation of criminal violence in Mexico given that young men are the demographic group most vulnerable to criminal activities and violence (Calderón et al., 2015). We obtained this data from mortality statistics published by Mexico's National Institute of Statistics and Geography (2020). We use a linear interpolation of census data to calculate homicide rates (INEGI, 2005, 2010, 2015). We log our outcome variable to account for the skewed distribution of the variable.

As a robustness check, we re-estimate our models using *criminal executions* as an alternative measure of violence. Criminal executions refer to homicides allegedly related to organized crime. These data were obtained from the Drug Policy Program at the Center for Teaching and Research in Economics (CIDE-PPD; Atuesta et al., 2019). Researchers at CIDE-PPD anonymously received official data on drug-related violence between December 2006 and November 2011, which they compiled, cleaned, and published for public use. We turned these data into a logged execution rate per 100,000. Although the CIDE-PPD data register lower homicide rates than the INEGI data, they are highly correlated and produce similar results (see Appendix A and B).

4.2. Key predictors

Estimating the relationship between criminal violence and natural resources presents a few empirical challenges. Regions with natural resources, either mining reserves or highly-productive agriculture, tend to be different from places without them. Crucially, these differences may be correlated with the outcome variable, introducing bias. For example, in the case of mining, these municipalities are smaller, more isolated, and more mountainous than the rest of the country. These characteristics are conducive to weak state presence, which makes them relevant confounders in the relationship between resources and violence.

Although we do not claim to fully address these endogeneity issues, our empirical strategy employs different indicators of natural resources with plausible exogenous variation in the production and price of these commodities. First, we follow Dube and Vargas (2013) and employ producer status for municipalities with mineral and export-oriented agricultural production before the onset of the contemporary War on Drugs. We assume that being a producer of metals and export-oriented crops in the years before the militarization of the state's anti-crime strategy is a good approximation of current producer status given that the natural resources endowments rarely change over time. In addition, violence dynamics during our period of analysis should not affect producer status in the immediate past. This approach allows us to investigate the differences in levels of violence between municipalities that have access to revenues from primary commodities and those without.

Specifically, we employ a binary variable that takes the value of 1 when a municipality was a *mining producer* (gold, copper, or silver) in 2003 and 0 otherwise. We employ another binary variable that indicates whether a municipality was an *export-agricultural producer* in 2003 and 0 otherwise. We specifically include the following export-oriented crops for this indicator: avocado, lime, papaya, mango, banana, grapes, cucumber, cantaloupe, melon, and watermelon (González, 2020). The year 2003 corresponds to the earliest available municipal data for agricultural commodities. Although earlier data exist for mining, we use 2003 for both vari-

ables to harmonize the analysis and avoid introducing additional sources of bias.

Second, we estimate the revenues generated by the mining and export-agricultural sectors at the municipality-year level. Unlike the binary indicators discussed above, revenue data are in panel format covering the 2007 to 2011 period. *Mining revenues per capita* is calculated by multiplying the yearly production output of gold, silver, and copper (in metric tons) by their respective international prices, which is then divided by the municipal population. We use the same approach to calculate *export-agricultural revenues per capita* using production and international price data for the aforementioned crops. We calculate the natural logarithm of both variables to adjust for skewness. Data on mining production come from the INEGI (2020), while price data were retrieved from the International Monetary Fund (IMF, 2020). Agricultural production data are drawn from the Agriculture, Food, and Fisheries Information Systems (2020) branch of Mexico's Ministry of Agricultural and Rural Development. Price data for agricultural commodities come from the United Nations Food and Agriculture Organization (2020).

This second set of independent variables leverage Mexico's position in international markets to allay some endogeneity concerns. The country is an important exporter of primary commodities, but its international position is not dominant enough to influence international prices. Therefore, calculating revenues from international prices represents a quasi-exogenous source of variation in the value of natural resources—although the quantity may be endogenous to violence, the global prices of these commodities are not. The key assumption of this strategy is that the domestic dynamics of violence in Mexico do not influence the international supply or demand of these commodities. Taken together, these two sets of variables allow us to analyze how changes in the values of natural resources rents affect levels of violence across and within municipalities.

4.3. Controls

In addition to the main independent variables, our models also include several controls that are relevant correlates of criminal violence in Mexico. First, our statistical analysis includes two measures of illicit drug production: *drug cultivation* and *drug labs*. The former is the logged total number of hectares of cannabis and opium seized by the Mexican military in a municipality-year. The latter is a binary variable that takes the value of 1 when the military confiscates clandestine laboratories used to produce synthetic drugs, such as methamphetamines and heroin, and 0 otherwise. We code a municipality as 1 from the first year of confiscation onwards. We obtained data through an existing freedom of information request to the Secretariat of National Defense.¹

We also control for state enforcement using a state-level binary variable to measure the *decapitation* of drug trafficking organizations. The data comes from Phillips (2015) who counts the number of killings and arrests of criminal bosses and drug lords. Since the impacts of such leadership removals often cut across state lines, this variable identifies all municipalities possibly affected by a decapitation. Specifically, all municipality-years in states where that organization has a verified presence are coded as 1 and 0 otherwise.

To account for *criminal presence*, we construct a categorical variable using the CIDE-PPD data described above. We first counted the number of criminal groups that participated in criminal executions. We then recoded the count variable into a

¹ The data can be retrieved by searching for folio 0000700058216 on Mexico's National Transparency Platform (<https://www.plataformadetransparencia.org.mx/>).

categorical variable where 0 = no presence, 1 = one group, and 2 = two or more criminal groups present in a municipality-year. This approach helps us capture two interrelated processes in a single indicator. First, categories 1 and 2 signal the *violent* presence of criminal groups given that the variable is created with violent events data.² Second, category 2 is a proxy for competition since criminal groups are highly territorial and multiple groups existing within the same municipality are likely to clash with one another.

To account for violence spillovers, we employ a spatial-temporal lag of the outcome variable (Franzese & Hays, 2008; Phillips, 2015). We calculate *neighborhood violence* by taking the average homicide rates in all neighboring municipalities for any given municipality-year. We then lag this variable one year to mitigate simultaneity bias. The spatial-temporal lag has the added benefit of approximating previous levels of violence without the use of lagged dependent variables that often generate severe bias in multilevel models.

We also account for *subnational political coordination* between municipal and state governments. This variable takes the value of 1 if the political party of the municipal executive is the same as that of the state governor, and 0 otherwise. We used data on political incumbents from the Center of Research for Development (2017) and the National Institute for Federalism and Municipal Development (2017) to construct this metric. Finally, our models include two sociodemographic variables. First, we include in our models the average years of schooling at the municipal level. Second, to account for changing family and social structures, we control for the percent of female-headed households. These variables were obtained and interpolated from census data (INEGI 2005, 2010, 2015).

4.4. Estimation strategy

In terms of our methods, we employ a linear regression model to estimate the relationship between natural resources and the homicide rates at the municipal level. We first present the models employing the binary indicators of mining and export-agriculture producer status to explore the differences between municipalities with and without access to natural resources rents. Following recent studies on criminal violence, we use state and year fixed effects to account for unobservable factors at the state-level (Atuesta & Ponce, 2017; Rios, 2013). We also estimate these models using municipal-level random effects given the time invariant nature of the main independent variables.

We then show the results using the continuous measure of natural resources revenues, which allows us to analyze how changes in the value of these commodities affect levels of violence. These models include state and municipality fixed effects to control for unobserved and time-invariant characteristics at both levels. We employ them separately in two sets of models. Whereas the models with state-fixed effects allow us to compare the rates of criminal violence in municipalities with different levels of natural resources revenues, the specifications with municipality-fixed effects indicate whether changes in these levels of primary commodities rents are associated with within-municipality variation in the prevalence of homicide rates. We add year fixed effects to control for temporal shocks common to all municipalities in the country. Finally, to account for autocorrelation among the units, we cluster the standard errors by municipality.

Figs. 1–4 show the geographic distribution of our key variables of interest. First, Figs. 1 and 2 display the changes in levels of criminal violence before and after the onset of the War on Drugs. Fig. 1

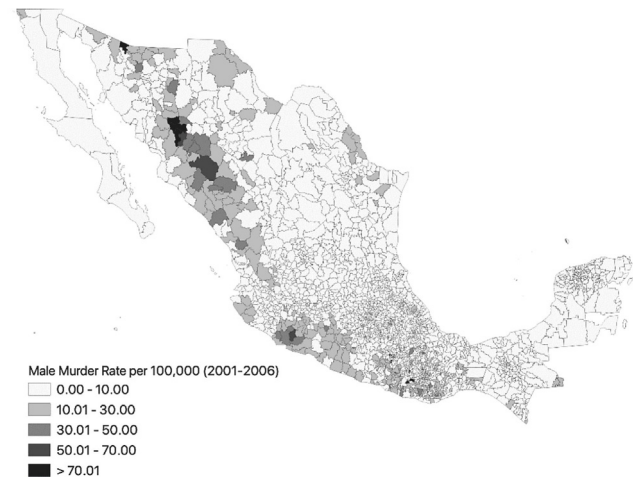


Fig. 1. Municipal distribution of homicide rates among young men per 100,000 People, 2001–2006. Source: authors' own elaboration with data from (INEGI, 2020).

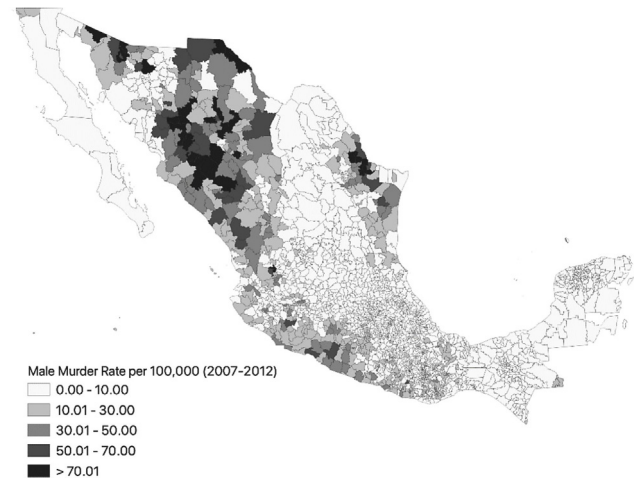


Fig. 2. Municipal distribution of homicide rates among young men per 100,000 people, 2007–2012. Source: authors' own elaboration with data from (INEGI, 2020).

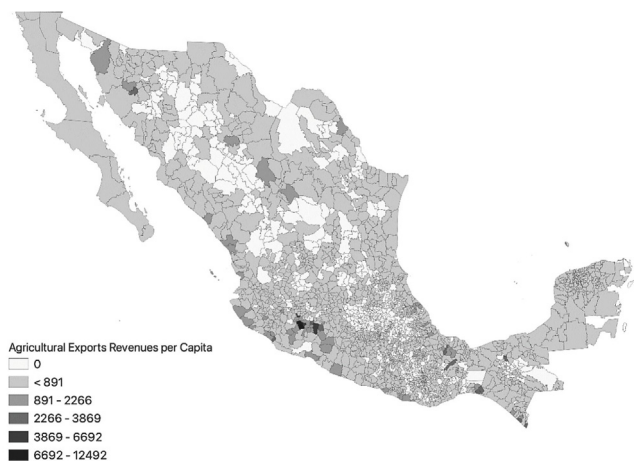


Fig. 3. Municipal distribution of export-oriented agricultural revenues per capita, 2003–2017. Source: authors' own elaboration with data from (INEGI, 2020).

² This variable is limited by the fact that it only captures the violent presence of criminal groups. Some groups may operate in Mexican municipalities but refrain from using violence.

shows the average homicide rates during the presidency of Vicente Fox (2001–2006) and Fig. 2 during the presidency of Felipe Calderón (2007–2012). Second, Fig. 3 shows the spatial distribution

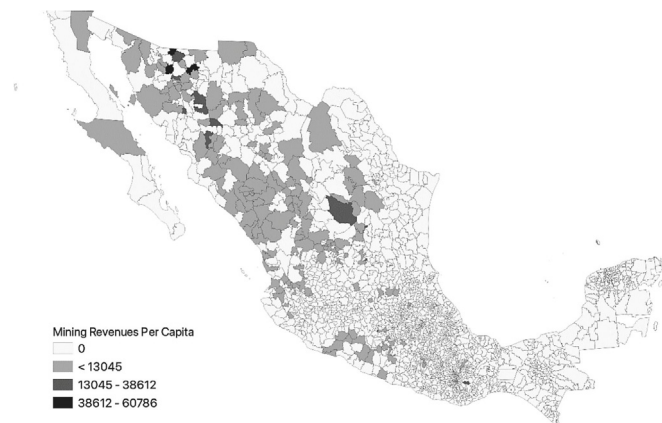


Fig. 4. Municipal distribution of mining revenues per capita, 2001–2017. Source: authors' own elaboration with data from (INEGI, 2020).

of mining revenues in the country. Finally, Fig. 4 presents a map of the municipalities of Mexico according to their export-oriented agricultural revenues per capita.

5. Empirical findings

To recapitulate, the main hypothesis of this article is that access to revenues from natural resources, in particular mining and export-agriculture, is associated with higher levels of criminal violence. Table 1 shows the results for the first component of the quantitative analysis: the relationship between producer status and violence. As mentioned before, these models allow us to compare how violence differs in municipalities with and without access to rents from natural resources. Model 1 uses state and year fixed effects. Model 2 uses the same estimation technique but with one-year lags on all time-variant predictors. Models 3 and 4 replicate these procedures with municipality random effects and year fixed effects.

Across the four models, the coefficients for mining and export-oriented agricultural producer status are positive and statistically significant. The coefficients for the mining binary variable range from 0.275 to 0.586 additional logged homicides per 100,000 inhabitants. This means that mineral producers have a homicide rate 31 to 80% higher than non-producing municipalities. The coefficients for the export-agricultural producers range from 0.185 to 0.236 additional logged homicides. In other words, agricultural producers have a homicide rate approximately 20–26% greater than non-producers. These results are robust to the inclusion of covariates, fixed effects, and the spatial lags of homicide rates.

Hence, the first take-away from our empirical analysis is that municipalities that produce mining and export-oriented agricultural commodities tend to be more violent than non-producing municipalities. In Fig. 5 and Fig. 6 we provide additional graphical evidence of this claim. Fig. 5 shows the changes in the average homicide rate in mining municipalities compared to the rest of the country. Fig. 6 shows the homicide trend in municipalities that produced export-oriented agricultural commodities versus all other municipalities. In both cases, municipalities with access to natural resources tend to be more violent than those without them.

There are two key differences between the two groups. First, the gap in homicide rates between producers and non-producers is much clearer among mining municipalities than for agricultural municipalities. Second, whereas mining municipalities were more violent than non-mining municipalities throughout the period of analysis, non-agricultural municipalities briefly experienced higher homicide rates than agricultural ones in 2010. But violence

in agricultural municipalities dramatically surpassed that of their counterparts in 2011.

Table 2 presents the findings using our second set of independent variables (revenues of mining and export-oriented agricultural commodities). Model 1 employs state and year fixed effects. Model 2 use the same estimation technique but with one-year lags on the time-variant predictors. Models 3 and 4 replicate these procedures with municipality- and year-fixed effects. It is important to emphasize that each set of models (1 and 2 versus 3 and 4) shows a different aspect of the relationship between natural resources rents and violence in Mexico. Whereas the models with state and year fixed effects allow us to compare this association across municipalities, the models with municipality and year fixed effects show how changes in resource rents affect within-municipality variation.

Overall, the findings of Table 2 show that revenues from mining and export-oriented agricultural commodities are associated with higher homicide rates in municipalities with access to these resources. Moving along the range of mining revenues per capita is associated with 0.052 to 0.058 additional logged homicide rates per 100,000 inhabitants. Since both the independent and dependent variables are logged, this translates to an approximately 0.5% increase in the homicide rate for every 10% increase in mining revenues. For export-oriented agriculture, a coefficient of 0.041–0.048 suggests that for every 10% increase in revenues per capita, the homicide rate increases by about 0.4%. These results are robust to the inclusion of state and year fixed effects, covariates, and spatial lags. The models including municipality- and year-fixed effects show, however, that access to revenues from natural resources is not associated with within-municipality variation in homicide rates. In both cases, the coefficients are not distinguishable from zero.

Among other independent variables presented in both tables, drug cultivation, the proportion of female-headed households, and criminal presence are stand out as consistent and strong predictors of violence. Most interestingly, municipalities with the violent presence of criminal groups can have homicide rates up to 130% higher than those without. Municipalities with multiple criminal groups, however, experience homicide rates up to 285% higher than those with no criminal groups. This finding points to the territorial and competitive nature of organized crime in contemporary Mexico.

In summary, the findings from the first component of our empirical strategy suggest that access to natural resources wealth is associated with higher levels of criminal violence in Mexico from 2007 to 2011. First, the models employing the binary variables for mining and export-oriented agricultural producer status show that both types of municipalities are systematically different from the rest of the country in terms of their average levels of violence. Second, we also found strong evidence suggesting that revenues from natural resources partially explain differences in rates of criminal homicides across but not within municipalities.

6. Case study: natural resources and criminal violence in Michoacán

The statistical analysis provides general support for our argument. However, it does not explain how criminal diversification into natural resources produces violence. We suggest that there are two main mechanisms that link mining and agricultural endowments with criminal outcomes: the *war-profit motive* and the *governance motive*. The first one refers to violence that results from the competition among criminal organizations for the control of these rents. The intensification of state repression dislocated the traditional sources of income for these groups, which incentivized

Table 1
Fixed and random effects models for criminal violence and production status.

	Model 1	Model 2	Model 3	Model 4
Mining producer	0.275** (0.097)	0.290** (0.109)	0.525*** (0.107)	0.586*** (0.126)
Export-agriculture producer	0.209*** (0.031)	0.236*** (0.033)	0.185*** (0.030)	0.212*** (0.033)
Drug cultivation	0.151*** (0.015)	0.167*** (0.016)	0.190*** (0.014)	0.212*** (0.013)
Drug labs	0.092 (0.070)	0.069 (0.073)	0.200** (0.065)	0.164* (0.065)
Education	0.043*** (0.012)	0.065*** (0.013)	0.084*** (0.010)	0.115*** (0.011)
Female-headed households	0.934** (0.322)	1.155*** (0.341)	0.794** (0.289)	0.853** (0.316)
Subnational coordination	0.027 (0.025)	0.009 (0.027)	0.019 (0.024)	-0.001 (0.026)
Decapitations	0.024 (0.032)	0.199*** (0.033)	0.208*** (0.027)	0.366*** (0.030)
Criminal presence				
One group	0.833*** (0.060)	0.534*** (0.058)	0.831*** (0.050)	0.432*** (0.055)
Two or more groups	1.187*** (0.064)	0.762*** (0.065)	1.277*** (0.063)	0.718*** (0.067)
Neighborhood violence	0.008*** (0.002)	0.007*** (0.001)	0.009*** (0.002)	0.008*** (0.002)
Constant	-0.259 (0.179)	-0.421** (0.156)	-0.210* (0.084)	-0.311*** (0.092)
State FE	Y	Y	N	N
Year FE	Y	Y	Y	Y
Municipal RE	N	N	Y	Y
1-yr lags	N	Y	N	Y
Observations	12,141	12,141	12,141	12,141
R-squared	0.311	0.320	0.255	0.248

Robust standard errors in parentheses; *** p < .001, ** p < .01, * p < .05, + p < .1.

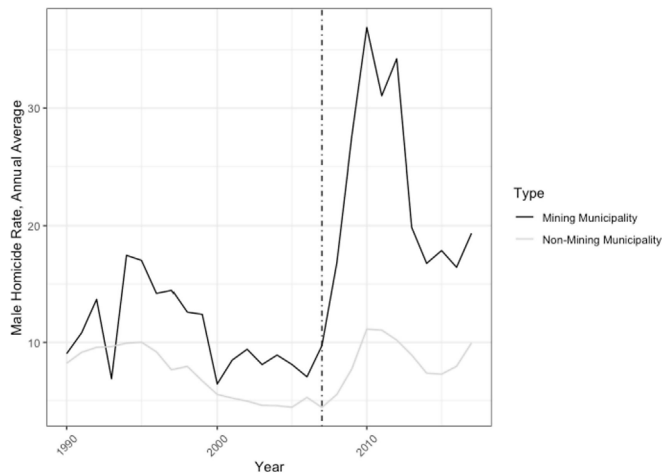


Fig. 5. Criminal violence and mineral producer status, 1990–2012. Source: authors' own elaboration with data from (INEGI, 2020).

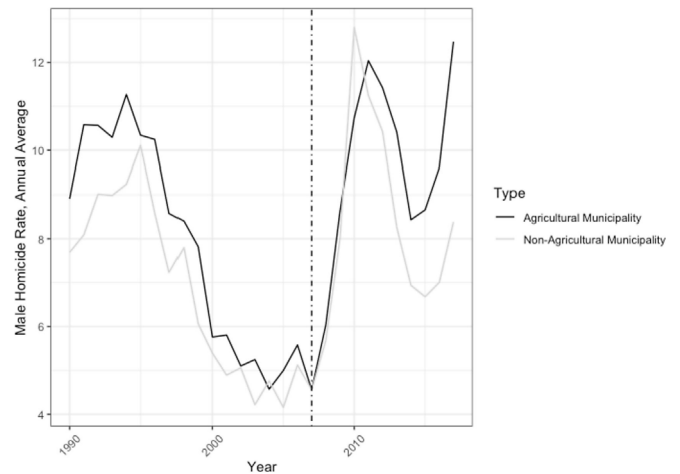


Fig. 6. Criminal violence and export-agriculture producer status, 1990–2012. Source: authors' own elaboration with data from (INEGI, 2020).

them to target other economic sectors. The second one claims that criminal organizations tend to target key industries as part of a strategy to establish territorial control over the areas where they operate, which in turn allows them to secure a steady stream of rents from local communities.

In this section we analyze how the endowment of natural resources affects violence. We examine the case of Michoacán, a state that encompasses multiple dynamics of criminal violence. Michoacán is a historical producer of illicit crops since the 1950s and synthetic drugs since the 1990s (Maldonado, 2012). It is also a major shipping corridor for a variety of goods, licit and otherwise, that move through the Port of Lázaro Cárdenas. Since the early

2000s, high-intensity violence has afflicted several parts of Michoacán. In late 2006, President Calderón mobilized the military and federal police to violence hotspots through Joint Operation Michoacán—the first federal intervention of the contemporary War on Drugs. Relatedly, multiple experiments in criminal governance have emerged in Michoacán during this period, which exposed local communities to new dynamics of exploitation by criminal groups. Finally, Michoacán is a geographically and economically diverse state with a variety of natural resource endowments that make it an important exporter of primary commodities.

We center our analysis on two regions within Michoacán: Tierra Caliente and Sierra-Costa (see Fig. 7). Both have historically high

Table 2
Two-way fixed effects models for criminal violence and revenues.

	Model 1	Model 2	Model 3	Model 4
Mining revenues	0.052*** (0.014)	0.058*** (0.014)	0.041 (0.030)	0.037 (0.029)
Export-agriculture revenues	0.041*** (0.007)	0.048*** (0.007)	-0.036 (0.024)	-0.006 (0.020)
Drug cultivation	0.148*** (0.015)	0.163*** (0.015)	-0.009 (0.020)	0.041* (0.018)
Drug labs	0.091 (0.069)	0.067 (0.073)	-0.008 (0.089)	-0.024 (0.093)
Education	0.048*** (0.012)	0.071*** (0.013)	-0.607** (0.231)	-0.685** (0.209)
Female-headed households	1.006** (0.322)	1.232*** (0.340)	-1.068 (1.423)	-2.253 (1.494)
Subnational coordination	0.026 (0.025)	0.008 (0.027)	0.018 (0.029)	-0.024 (0.031)
Decapitations	0.026 (0.032)	0.201*** (0.033)	0.017 (0.032)	0.191*** (0.032)
Criminal presence				
One group	0.838*** (0.0594)	0.539*** (0.058)	0.577*** (0.061)	0.101* (0.051)
Two or more groups	1.211*** (0.0640)	0.790*** (0.066)	0.885*** (0.068)	0.245*** (0.062)
Neighborhood violence	0.00771*** (0.00150)	0.007*** (0.001)	0.003* (0.002)	0.003+ (0.001)
Constant	-0.254 (0.181)	-0.419** (0.162)	4.807** (1.493)	5.615*** (1.335)
State FE	Y	Y	N	N
Year FE	Y	Y	Y	Y
Municipal FE	N	N	Y	Y
1-yr lags	N	Y	N	Y
Observations	12,141	12,141	12,141	12,141
R-squared	0.311	0.321	0.062	0.031

Robust standard errors in parentheses; *** p < .001, ** p < .01, * p < .05, + p < .1.

levels of violence, drug trafficking, and primary sector dependency (Guerra Manzo, 2018; Maldonado, 2010). They have also been at the center of criminal disputes and military interventions since the early 2000s (Maldonado, 2012; Zepeda Gil, 2017). And whereas agribusiness dominates the political economy of Tierra Caliente, mining is the prominent industry in the Sierra-Costa. In this section, we show how both types of natural resources intersect with criminal governance in these regions and in turn generate new dynamics of violence.

6.1. Criminal governance in southern Michoacán

The emergence of criminal governance in Michoacán can be traced to the early 2000s when a conflict broke out between the homegrown Valencia Cartel (aka Milenio Cartel) and the Gulf Cartel. Whereas the former had deep roots in the Tierra Caliente region, the latter was based in the northern state of Tamaulipas. A period of high intensity violence unfolded as the Gulf Cartel sent their private militia, known as Los Zetas, to Michoacán. Los Zetas were composed of deserters from an elite special forces unit in the Mexican Army, which enabled them to use counterinsurgency tactics to expel the Valencia organization from the state (Maldonado, 2012).

Los Zetas' control over Michoacán was short-lived, however, as a new organization known as La Familia Michoacana (The Michoacán Family) formed to combat the "invasion" (Guerrero Gutiérrez, 2014). Between 2005 and 2006, La Familia expanded their territorial presence while gaining the favor of local communities threatened by Los Zetas. Joint Operation Michoacán consolidated the presence of La Familia as military and federal police forces dealt devastating blows to Los Zetas (ibid.).

By the time Los Zetas were expelled from the state, La Familia had made considerable progress in establishing a criminal gover-

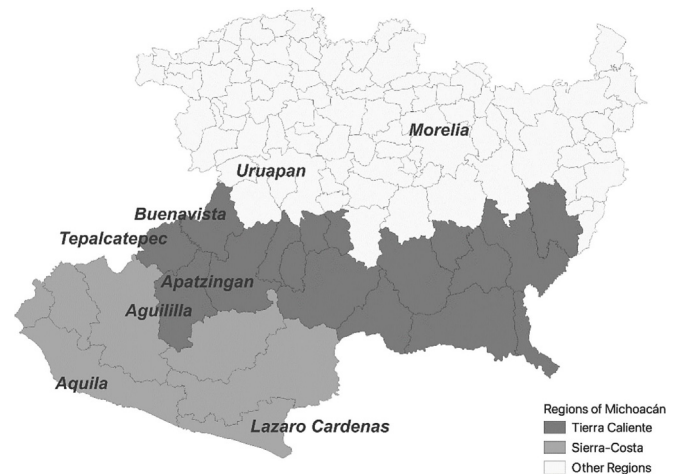


Fig. 7. Regions of Michoacán and key municipalities. Source: authors' own elaboration.

nance system. They consolidated their presence in two-thirds of Michoacán's municipalities by capturing local governments and police forces, as well as by providing public security and social services to local communities (Lemus, 2015). Michoacán's municipalities were especially vulnerable to criminal capture as evidenced by the high number of attacks by criminal organizations against political actors in the state. Between 2007 and 2012, Michoacán accounted for 28.5% of all high-profile criminal attacks in Mexico—a total of 69 attacks.³ More than half of these attacks occurred in Tierra Caliente and the Sierra-Costa.

³ Calculated with data from Trejo and Ley (2021).

Criminal governance under La Familia evolved as infighting within the organization gave rise to the Knights Templar faction in 2011. As the direct successors to La Familia, the Templars expanded the reach and scope of criminal governance in southern Michoacán. Although Los Zetas had begun the practice of extorting and dispossessing local communities for profit (Guerra, 2017), the Templars established an extensive taxation regime that encompassed virtually all economic activities (Hernández Navarro, 2014; Lemus, 2015). The Templar organization collapsed, however, after an armed uprising by local elites gained popular support across southern Michoacán. Instead of ending criminal governance, this short-lived movement ultimately fragmented and reorganized Michoacán's criminal landscape (Herrera, Forthcoming).

6.2. Export-agriculture and violence in Tierra Caliente

The brief history of criminal governance in Michoacán serves as a background to understand how criminal diversification into natural resources produces violence in the state. We begin by discussing the relationship between export-agriculture and violence in Tierra Caliente.⁴ Tierra Caliente is a lowland region surrounded by the highland communities of the Meseta Purépecha to the north and the Sierra-Costa to the south. Fig. 8 shows the geographic location of mining concessions, as well as the spatial variation in agricultural revenues across the state.

Tierra Caliente's high temperatures and fertile lands make it ideal for year-round agriculture. During the mid-twentieth century, the Mexican state jumpstarted this potential through a development project known as the Tepalcatepec Commission (1947–1960). Investments in hydroelectric dams, irrigation systems, and public infrastructure—along with an international cotton boom—made Tierra Caliente an agricultural powerhouse (Barkin & King, 1970). By the turn of the century, Tierra Caliente had experienced the boom and bust of cotton and melon, as well as market reforms that consolidated the export sector while decimating small producers (Stanford, 1993). Export-oriented lime production currently dominates the region's agricultural sector.

Unlike the drug trade, the agricultural sector is not subject to violent competition among criminal organizations. Nonetheless, the prominence of export-agriculture within the region's political economy made it susceptible to extortion by criminal organizations. As mentioned above, Los Zetas were the first organization in Michoacán to diversify their profit-making activities by targeting local businesses and civilians (Guerra, 2017). This practice continued and evolved into a broader taxation regime under La Familia and the Knights Templar. For example, lime growers in Tierra Caliente were taxed 1,000 pesos per hectare of farmland while packing plants paid a peso for every kilo of produce sold (Hernández Navarro, 2014).

Cuotas (fees) paid to criminal groups were not inconsequential in a region that produced 469,000 metric tons of lime in 2012 alone, in addition to 250,000 tons of other export-oriented fruits such as mango, melon, and papaya.⁵ Taxing agribusiness was important for these groups to fund their violence-making capacities. For example, in 2010, La Familia organized an assembly where they invited approximately 300 avocado producers from the city of Uruapan (Cano, 2010). The purpose of the assembly was to solicit “voluntary” contributions for the war effort against Los Zetas.

Criminal diversification into the agricultural sector was not limited to taxation. The Knights Templar eventually began to distort

⁴ Tierra Caliente encompasses the municipalities of Apatzingán, Aguililla, Buenavista, Carácuaro, Churumuco, Gabriel Zamora, La Huacana, Huetamo, Múgica, Nocupétaro, Nuevo Urecho, Parácuaro, San Lucas, Tepalcatepec, Tiquicheo, Turicato, and Tuzantla.

⁵ Calculated using data from (2020).

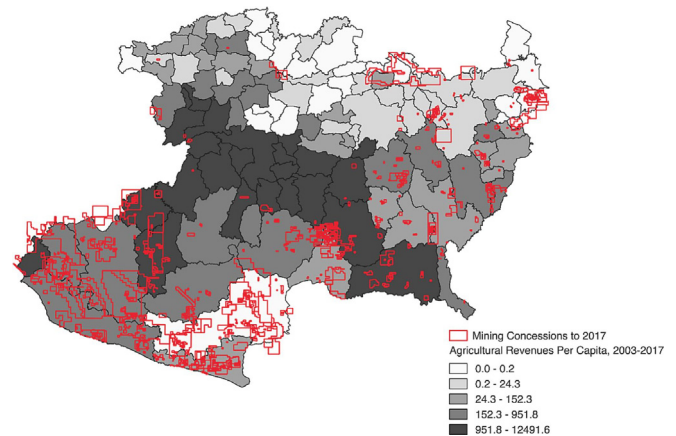


Fig. 8. Geographic distribution of natural resources in Michoacán. Source: authors' own elaboration with data from (INEGI, 2020) and (SIAP, 2020).

prices by periodically altering production. This included limiting the number of days lemon cutters could work, as well as limiting the intake of produce by packing plants (Maerker, 2014). As García-Ponce and Lajous (2014) point out, lime production in Tierra Caliente increased considerably during the 2000s, which led to a decrease in prices between 2011 and 2012. Given that lime production for the export market is a key industry in the region, and in turn a valuable source of rents for criminal groups, the Knights Templar proceeded to exert direct control over production to regain profits (ibid.).

The capture of major production chains, as well as violent repression against local populations, resulted in a revolt against the Templars. In February 2013, the towns of La Ruana, Tepalcatepec, and Buenavista formed vigilante groups known as *autodefensas* (self-defense groups). Over the course of a year, the vigilantes swept through southern Michoacán “liberating” communities and effectively dismantling the Templar organization (Guerra Manzo, 2015). This uprising, however, did not end criminal governance in the region, let alone the extortion of primary industries. The *autodefensas* were organized by local elites, including affluent ranchers, agricultural producers, and traffickers with deep-seeded interests in the region. An uneasy alliance with the state, and the defeat of the Templars, ultimately empowered the criminal elements within the movement (Herrera, Forthcoming). As a result, many ex-*autodefensas* now make up the multitude of new criminal groups that subject communities and producers to violence and taxation as they compete for control over Tierra Caliente (ibid.).

6.3. Mining and violence in the Sierra-Costa

The Sierra-Costa region encompasses 13,000 square kilometers of mountainous terrain and rocky coastlines that stretch over 200 km.⁶ With the exception of Lázaro Cárdenas, one of Mexico's most important ports, the Sierra-Costa is sparsely populated by mesizo communities in the highlands and indigenous (Nahua) communities along the coast (Cochet, 1991). In contrast to Tierra Caliente, the Sierra-Costa benefited little from modernization projects during the twentieth century and it remains relatively isolated. Much of the region is unsuitable for agribusiness; therefore, most communities depend on other primary activities such as mining, logging, cattle ranching, and drug trafficking (ibid.). The Sierra-Costa is especially rich in iron deposits. Between 2006 and 2012, the municipalities of Aquila and Lázaro Cárdenas alone extracted over 20 million metric

⁶ The Sierra-Costa region includes the municipalities of Aquila, Arteaga, Coahuayana, Coalcoman, Chinicuilá, Lázaro Cárdenas, and Tumbiscatio.

tons of iron ore, which is equivalent to nearly 25% of all national production.⁷

Much like the export-oriented agricultural industry in Tierra Caliente, the wealth generated by the mining industry has attracted criminal organizations seeking to diversify their revenue-generating activities. By 2014, a reported 50% of all mining activities in Michoacán were controlled by criminal organizations—in particular, by the Knights Templar (Calderón, 2014). As federal authorities have commented, iron ore is the main source of income for the Templars. From the point of extraction to the point of exportation, they make about 15 dollars for every ton of iron that is shipped from the port of Lázaro Cárdenas (Castillo, 2014).

Mining profits are siphoned by the Templars and other criminal groups at different points along the commodity chain: extraction, transportation, processing, storage, and shipment. Most commonly, mining companies are taxed for every ton of extracted minerals—two to five dollars according to different sources (Becerra-Acosta, 2014; Cano, 2014; Lemus, 2018; Nájjar, 2014). Some criminal organizations also directly engage in mineral exploitation by forcing permit holders to share their mining rights or by illegally mining in isolated and unexploited areas (Nájjar, 2014).

The intersection between mining and organized crime has generated complex dynamics of violence and dispossession in southern Michoacán (Carbajal Glass, 2019). In the coastal municipality of Aquila, where several indigenous Nahua communities hold legal rights to mineral-rich lands, mining companies have been known to employ violence to secure their operations (Lemus, 2015). These companies, often subsidiaries of transnational firms, repress local dissent against their activities by recruiting and training local civilians for private militias known as *guardias blancas* (white guards).

In some cases, these firms have allied themselves with criminal groups to achieve their goals (Cendejas et al., 2015; Hernández Navarro, 2017). For example, the Templars were employed by mining companies to persecute community leaders and activists in Santa María de Ostula and San Miguel Arcángel—two indigenous communities that have actively mobilized against the over-exploitation of their lands and unpaid royalties (Lemus, 2018). This corporate-criminal nexus in the mining industry has led to the assassination and disappearance of multiple activists—facilitating the illegal dispossession of previously unexploited lands. In 2009, and again in 2013, community police and vigilante groups formed in response to violence and criminal repression across the Sierra-Costa (Álvarez Rodríguez, 2020; Gledhill, 2014).

We reemphasize, however, that resistance does not mean an end to extortion. Some vigilante groups engaged in the same taxation tactics as criminal organizations. In Aguililla, a *terracalienteño* town that sits at the base of the Sierra Madre del Sur, mining companies were taxed 4 dollars per ton of iron ore extracted (Becerra-Acosta, 2014). With a daily output of 5,000 tons, the Templars extracted 20,000 dollars per day from mining in Aguililla. When the *autodefensas* took control of the town, they required mining companies to help their armed struggle with a tax of 2 dollars per ton—half of the illegal taxes paid to the Templars, but illegal taxation, nonetheless.

As both case studies show, criminal diversification into natural resources has generated complex dynamics of violence in southern Michoacán. Two main patterns emerge from this analysis. First, criminal organizations target the natural resources sector not only to secure financial resources, but also to consolidate their clout over the regions where they operate. Given the importance of these commodities in the local political economy, controlling the pro-

duction chains of key industries strengthens the regional influence of criminal groups.

Second, the mechanisms that connect natural resources rents with violence vary by commodity; for example, whereas local producers are more relevant in the lime industry, internationally-financed companies are paramount in the mining sector. These different forms of ownership have important implications for the dynamics of violence at the local level. In the Sierra-Costa, the nexus between organized crime and mining firms facilitated the domination of local communities by the Knights Templar, as well as the expansion of extractive activities by transnational capital in the region. In Tierra Caliente, the implementation of a widespread taxation regime generated a fierce backlash from civil society—even if civil society contained its own criminal elements. The relationship between extraction and violence, however, is not unique to Michoacán. It forms part of larger pattern of (para)militarization in resource-rich areas across Mexico and Latin America to the benefit of implicated economic and political actors (Paley, 2014).

7. Concluding remarks

Over the last two decades, levels of criminal violence have increased dramatically in different parts of Mexico. This sociopolitical crisis has been the subject of a growing number of empirical studies and political debates. Social scientists have shown that the causes of this phenomenon are complex and multifaceted. On the one hand, the explosion of violence stems from a historical rupture with Mexico's authoritarian past (Astorga, 2005). On the other hand, militarized state interventions have exacerbated the violent dynamics of the illicit drug trade (Durán-Martínez, 2018; Flores-Macías, 2018).

One key aspect of contemporary violence and organized crime in Mexico remains relatively understudied and under-theorized: the diversification of criminal groups beyond traditional illicit activities. Across the Global South, scholars and journalists have observed how criminal organizations are diversifying their profit-making portfolios into different natural resources (Nellemann et al., 2016; 2020). There is an abundance of evidence to suggest that these processes are occurring in Mexico (Calderón et al., 2020; Felbab-Brown, 2019). Moreover, businesses, individuals and families, and entire local communities are increasingly subject to exploitation by criminal organizations (Magaloni et al., 2020; Trejo & Ley, 2020).

More in general, studies of criminal governance tend to focus on urban settings (Arias, 2017; Lessing, 2020), while the dynamics of criminal organizations in rural areas have received far less attention. Recently, scholars have shown that criminal organizations are key for the formation of local political orders and economic development in rural settings (Blume, 2021; Dest, 2021; Peñaranda Currie et al., 2021). Criminal rule in such cases is facilitated by the control over natural resources including fertile agricultural lands, illegal mining, natural protected areas, and illegal logging (Colectivo Darién, 2021; Devine et al., 2021; Gonzalez-Duarte, 2021; Rettberg & Ortiz-Riomalo, 2016). In the process these groups have exacerbated local violence, particularly against marginalized groups (del Valdivia, 2021).

To fill this gap, we draw from the resource-conflict and criminal governance literatures to investigate why criminal groups diversify toward natural resources, and how these processes generate violence in Mexico. We argue that revenues from export agriculture and mining are associated with higher levels of violence through two mechanisms. First, as criminal organizations compete with one another for territories, they are incentivized to diversify their revenues to build up their violence-making capacities. State

⁷ Calculated using data from (2020).

repression further incentivizes criminal groups to diversify their revenues, in particular if these are at risk and/or if they must combat the state. We call this the war-profit motive. Second, accessing natural resources also represents a key aspect of establishing hegemony at the local level. In communities dependent on natural resources, capturing rents from different parts of their production chains bolsters the ability of criminal organizations to control other economic sectors as well as the local population. We call this the governance motive.

To test our arguments, we employed a mixed-methods approach to studying criminal diversification and violence. We provide quantitative evidence that access to natural resources is associated with violence in Mexican municipalities. More specifically, we find that access to revenues from mining and export-agricultural commodities is associated with higher homicide rates. This relationship is stronger for mining commodities than for agricultural commodities. However, we do not find evidence that levels of revenues affect within-municipality variation in violence. The insights from our case study on Michoacán strengthens our confidence in this null finding. We did not find any journalistic or anecdotal evidence that changes in the value of mining or agricultural commodities affect levels of violence in producing municipalities. Although the international commodity super boom increased prices between 2003 and 2009, there is no evidence to suggest that this price shock had any impact on violence.

Instead, this finding is consistent with our criminal governance hypothesis: criminal organizations seek to enhance their control over municipalities with access to revenues from natural resources; therefore, what differentiates natural resource-rich versus non-rich municipalities is the presence of these commodities, but not levels of production or revenues. Criminal organizations could be non-responsive to the prices of mining and agricultural commodities for a variety of reasons, including their size and structure. Given that many of them are relatively small and loose networks of criminals, they could have less capacity, or a lack of interest, to respond to changes in the global prices of commodities accordingly.

To highlight the mechanisms behind our statistical findings, we examined the dynamics of criminal violence in the Tierra Caliente and Sierra-Costa regions of Michoacán. We find that the introduction of criminal governance systems to these rural zones was a key factor in why and how criminal groups choose to diversify their profit-making portfolios toward mining and export-agriculture. We also find that that criminal diversification generates new patterns of violence. In the Sierra-Costa, the presence of criminal

groups in the mining industry facilitated the exploitation and dis-possession of local communities by mining corporations. In Tierra Caliente, the widespread exploitation of local communities, which began with the extortion of local traffickers and agricultural elites, generated a fierce backlash from civil society in the form of armed vigilante groups.

Finally, as we mentioned before, the relationship between criminal organizations, violence, and natural resources goes beyond the mining and export-oriented agricultural sectors. We identify two key areas for further research. First, according to journalistic accounts, criminal networks have also targeted the logging industry in northern and western Mexico (Arredondo Vera, 2017; González Covarrubias, 2019), as well as the country's energy infrastructure—in particular, the national network of gasoline pipelines (Stargardter, 2018). Hence, additional empirical work is necessary to investigate the extent to which criminal organizations are engaging in these sectors and what are the consequences for levels of violence in affected regions. Second, future research should provide more empirical evidence about the mechanisms behind this relationship, in particular the extent to which criminal organizations engage in inter-group competition and criminal governance efforts to seize natural resources rents.

CRedit authorship contribution statement

Joel Salvador Herrera: Methodology, Investigation, Formal analysis, Validation, Data curation, Writing – original draft, Writing – review & editing. **Cesar B. Martinez-Alvarez:** Conceptualization, Methodology, Investigation, Formal analysis, Visualization, Data curation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Appendix A

Fixed and random effects models for criminal executions and production status.

	Model 1	Model 2	Model 3	Model 4
Mining producer	0.323*** (0.097)	0.319** (0.114)	0.543*** (0.118)	0.588*** (0.146)
Export-agriculture producer	0.183*** (0.024)	0.218*** (0.029)	0.202*** (0.025)	0.223*** (0.031)
Drug cultivation	0.112*** (0.014)	0.131*** (0.017)	0.172*** (0.013)	0.219*** (0.015)
Drug labs	0.320*** (0.070)	0.345*** (0.089)	0.438*** (0.066)	0.411*** (0.085)

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Appendix (continued)

	Model 1	Model 2	Model 3	Model 4
Education	0.047*** (0.008)	0.091*** (0.010)	0.062*** (0.007)	0.117*** (0.009)
Female-headed households	0.609** (0.204)	0.925*** (0.252)	0.438* (0.199)	0.803** (0.255)
Subnational coordination	0.011 (0.021)	-0.029 (0.025)	-0.017 (0.020)	-0.087*** (0.026)
Decapitations	-0.010 (0.026)	0.224*** (0.037)	0.220*** (0.023)	0.482*** (0.034)
Criminal presence				
One group	1.417*** (0.059)	0.574*** (0.072)	1.409*** (0.058)	0.403*** (0.074)
Two or more groups	1.685*** (0.071)	0.845*** (0.082)	1.873*** (0.068)	0.836*** (0.082)
Neighborhood violence	0.006*** (0.001)	0.004** (0.001)	0.007*** (0.002)	0.006*** (0.002)
Constant	-0.364** (0.118)	-0.609*** (0.149)	-0.433*** (0.062)	-0.653*** (0.079)
State FE	Y	Y	N	N
Year FE	Y	Y	Y	Y
Municipal RE	N	N	Y	Y
1-yr lags	N	Y	N	Y
Observations	12,141	9,715	12,141	9,715
R-squared	0.468	0.416	0.400	0.319

Robust standard errors in parentheses; *** p < .001, ** p < .01, * p < .05, + p < .1

Appendix B

Two-way fixed effects models for criminal executions and revenues.

	Model 1	Model 2	Model 3	Model 4
Mining revenues	0.050*** (0.012)	0.049*** (0.014)	0.007 (0.031)	0.014 (0.043)
Export-agriculture revenues	0.048*** (0.006)	0.054*** (0.007)	0.001 (0.022)	0.030 (0.028)
Drug cultivation	0.109*** (0.014)	0.127*** (0.017)	0.007 (0.018)	0.020 (0.021)
Drug labs	0.311*** (0.069)	0.339*** (0.089)	0.246** (0.093)	0.073 (0.126)
Education	0.052*** (0.008)	0.097*** (0.009)	-0.607*** (0.179)	-0.714* (0.303)
Female-headed households	0.628** (0.199)	0.962*** (0.247)	-2.870* (1.194)	-4.488** (1.637)
Subnational coordination	0.007 (0.021)	-0.030 (0.025)	0.021 (0.025)	-0.047 (0.032)
Decapitations	-0.008 (0.027)	0.228*** (0.037)	-0.017 (0.026)	0.218*** (0.036)
Criminal presence				
One group	1.420*** (0.058)	0.578*** (0.071)	1.160*** (0.057)	-0.103 (0.070)
Two or more groups	1.710*** (0.071)	0.867*** (0.083)	1.541*** (0.067)	0.132+ (0.071)
Neighborhood violence	0.005*** (0.001)	0.004** (0.001)	0.002 (0.001)	0.001 (0.001)
Constant	-0.392** (0.130)	-0.629*** (0.159)	4.684*** (1.154)	5.887** (1.952)

Appendix (continued)

	Model 1	Model 2	Model 3	Model 4
State FE	Y	Y	N	N
Year FE	Y	Y	Y	Y
Municipal FE	N	N	Y	Y
1-yr lags	N	Y	N	Y
Observations	12,141	9,715	12,141	9,715
R-squared	0.470	0.418	0.176	0.042

Robust standard errors in parentheses; *** p < .001, ** p < .01, * p < .05, + p < .1

References

Arias, E. D. (2017). *Criminal enterprises and governance in Latin America and the Caribbean*. Cambridge University Press.

Arredondo Vera, Í. (2017). *Narcotola*. Narcotola: El Universal. <https://www.eluniversal.com.mx/periodismo-de-investigacion/narcotola-en-chihuahua-desplaza-raramuris>.

Atorga, L. (2005). El siglo de las drogas. *Plaza & Janes*.

Atuesta, L. H., & Ponce, A. F. (2017). Meet the Narco: Increased competition among criminal organisations and the explosion of violence in Mexico. *Global Crime*, 18(4), 375–402.

Atuesta, L. H., Siordia, O. S., & Lajous, A. M. (2019). The “War on Drugs” in Mexico: (Official) database of events between December 2006 and November 2011. *Journal of Conflict Resolution*, 63(7), 1765–1789.

Álvarez Rodríguez, I. M. (2020). El crimen organizado como peligro. Movilizaciones armadas en el suroeste de Michoacán. In S. Maldonado (Ed.), *Hacia la justicia cuando escasean las garantías. Sociedad civil en contextos de violencia* (pp. 211–236). El Colegio de Michoacán.

Barkin, D., & King, T. (1970). *Regional economic development: The river basin approach in Mexico*. Cambridge University Press.

Becerra-Acosta, J. P. (2014, February 26). En Aguililla, mineros pagan extorsión... contra la extorsión. *Milenio*. <https://www.milenio.com/policia/en-aguililla-mineros-pagan-extorsion-contra-la-extorsion>.

Bergman, M. (2018). *Illegal drugs, drug trafficking and violence in Latin America*. Springer International Publishing.

Blair, G., Christensen, D., & Rudkin, A. (2021). Do commodity price shocks cause armed conflict? A meta-analysis of natural experiments. *American Political Science Review*, doi.org/10.1017/S0003055420000957.

Blattman, C., Lessing, B., Tobon, S., & Duncan, G. (2021). Gang rule: Understanding and countering criminal governance. *SocArXiv*. <https://doi.org/10.31235/osf.io/5nyqs>.

Blume, L. R. (2017). The old rules no longer apply: Explaining Narco-assassinations of Mexican Politicians. *Journal of Politics in Latin America*, 9(1), 59–90.

Blume, L. R. (2021). Narco Robin Hoods: Community support for illicit economies and violence in rural Central America. *World Development*, 143. <https://doi.org/10.1016/j.worlddev.2021.105464>.

Calderón, G., Robles, G., Díaz-Cayeros, A., & Magaloni, B. (2015). The beheading of criminal organizations and the dynamics of violence in Mexico. *Journal of Conflict Resolution*, 59(8), 1455–1485.

Calderón, L. Y., Heinle, K., Kuckertz, R. E., Rodríguez Ferreira, O., & Shirk, D. A. (2020). *Organized crime and violence in Mexico: 2020 special report*. University of San Diego.

Calderón, V. (2014, January 11). El ‘narco’ se expande a la minería. *El País*. https://elpais.com/internacional/2014/01/11/actualidad/1389466753_576842.html.

Campana, P., & Varese, F. (2018). Organized crime in the United Kingdom: Illegal governance of markets and communities. *The British Journal of Criminology*, 58(6), 1381–1400.

Cano, A. (2014, February 2). Autodefensas: varias minas de Michoacán son o fueron explotadas por los templarios. *La Jornada*. <https://www.jornada.com.mx/2014/02/02/politica/008n1pol>.

Cano, A. (2010, December 18). La Familia, cártel al que le gustan las asambleas. *La Jornada*. <https://www.jornada.com.mx/2010/12/18/politica/007r1pol>.

Carbajal Glass, F. (2020). Where the metal meets the flesh: Organized crime, violence, and the illicit iron ore economy in Mexico’s Michoacán State. In Y. Zabyelina & D. van Uhm (Eds.), *Illegal mining: Organized crime, corruption, and ecocide in a resource-scarce world* (pp. 147–183). Springer.

Castillo, E. (2014, March 17). Mexico drug cartel makes more dealing iron ore. Associated Press. <https://apnews.com/article/612bfdcc22704ef585876859c4190274>.

Castillo, J. C., & Kronick, D. (2020). The logic of violence in drug war. *American Political Science Review*, 114(3), 874–887.

Cedillo, J. A. (2011). La cosa nostra en México (1938–1950): Los negocios de Lucky Luciano y la mujer que corrompió al gobierno mexicano. *Grijalbo*.

Cendejas, J. M., Arroyo, O., & Sánchez, A. (2015). Comunalidad y buen vivir como estrategias indígenas frente a la violencia en Michoacán: Los casos de Cherán y San Miguel de Aquila. *Revista Pueblos y Fronteras Digital*, 10(19), 257–284.

CIDAC. (2017). *Resultados electorales, 1985–2012*. Centro de Investigación para el Desarrollo.

Cochet, H. (1991). *Alambradas en la sierra. Un sistema agrario en México: La Sierra de Coalcomán*. El Colegio de Michoacán.

Darién, C. (2021). Trafficking as settler colonialism in eastern Panama: Linking the Americas via illicit commerce, clientelism, and land cover change. *World Development*, 145. <https://doi.org/10.1016/j.worlddev.2021.105490>.

Collier, P., & Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford Economic Papers*, 56(4), 563–595.

Correa-Cabrera, G. (2017). *Los Zetas Inc.: Criminal corporations, energy, and civil war in Mexico*. University of Texas Press.

Dal Bó, E. D., & Dal Bó, P. D. (2011). Workers, warriors, and criminals: Social conflict in general equilibrium. *Journal of the European Economic Association*, 9(4), 646–677.

Dell, M. (2015). Trafficking networks and the Mexican drug war. *The American Economic Review*, 105(6), 1738–1779.

Dest, A. (2021). The coca enclosure: Autonomy against accumulation in Colombia. *World Development*, 137. <https://doi.org/10.1016/j.worlddev.2020.105166>.

Devine, J. A., Wrathall, D., Aguilar-González, B., Benessaiah, K., Tellman, B., Ghaffari, Z., & Pongstingel, D. (2021). Narco-degradation: Cocaine trafficking’s environmental impacts in Central America’s protected areas. *World Development*, 144. <https://doi.org/10.1016/j.worlddev.2021.105474>.

Dube, O., & Vargas, J. F. (2013). Commodity price shocks and civil conflict: Evidence from Colombia. *The Review of Economic Studies*, 80(4), 1384–1421.

Durán-Martínez, A. (2018). *The politics of drug violence: Criminals, cops and politicians in Colombia and Mexico*. Oxford University Press.

FAOSTAT. (2020). *FAOSTAT Data*. Food and Agriculture Organization of the United Nations.

Fearon, J. D. (2005). Primary commodity exports and civil war. *Journal of Conflict Resolution*, 49(4), 483–507.

Felbab-Brown, V. (2019). *Mexico’s out-of-control criminal market*. Brookings Institution.

Flores-Macías, G. (2018). The consequences of militarizing anti-drug efforts for state capacity in Latin America: Evidence from Mexico. *Comparative Politics*, 51(1), 1–20.

Franzese, R. J., & Hays, J. C. (2008). Interdependence in comparative politics. *Substance, Theory, Empirics, Substance. Comparative Political Studies*, 41(4–5), 742–780.

Gambetta, D. (1993). *The Sicilian Mafia: The business of private protection*. Harvard University Press.

García-Ponce, O., & Lajous, A. (2014). *How does a drug cartel become a lime cartel?* Washington Post.

Gledhill, J. (2014). Indigenous autonomy, delinquent states, and the limits of resistance. *History and Anthropology*, 25(4), 507–529.

Gonzalez-Duarte, C. (2021). Butterflies, organized crime, and “sad trees”: A critique of the Monarch Butterfly Biosphere Reserve Program in a context of rural violence. *World Development*, 142. <https://doi.org/10.1016/j.worlddev.2021.105420>.

González Covarrubias, J. (2019). *La rebelión ecológica del pueblo de Cherán, Michoacán*. Animal Político. <https://www.animalpolitico.com/2019/12/rebelion-ecologica-cheran-michoacan/>.

González, H. (2020). What socioenvironmental impacts did 35 years of export agriculture have in Mexico? (1980–2014): A transnational agri-food field analysis. *Journal of Agrarian Change*, 20(1), 163–187.

Guerra, E. (2017). Vida cotidiana, organizaciones criminales y la construcción de un orden social ilegal. Un estudio de caso en Tierra Caliente, Michoacán. *Cuadernos de Trabajo del Monitor del Programa de Política de Drogas*, No. 16. Centro de Investigación y Docencia Económica.

Guerra Manzo, E. (2015). Las autodefensas de Michoacán. *Política y cultura*, 44, 7–31.

Guerra Manzo, E. (2018). Rostros del habitus violento en Michoacán: Los distritos de Coalcomán y Apatzingán, c. 1930–1980. *Estudios de Historia Moderna y Contemporánea de México*, 56, 3–34.

- Guerrero Gutiérrez, E. (2011). *Security, drugs, and violence in Mexico: A survey*. 7th North American Forum.
- Guerrero Gutiérrez, E. (2014). *La dictadura criminal*. Nexos: La dictadura criminal. <https://www.nexos.com.mx/?p=20026>.
- Hernández Navarro, L. (2014). *Hermanos en armas. Policías comunitarias y autodefensas*. Para Leer en Libertad, A.C..
- Hernández Navarro, L. (2017). Minería, narco y comunidades indígenas. *La Jornada* <https://www.jornada.com.mx/2017/05/09/opinion/017a2pol>.
- Herrera, J. S. (2019). Cultivating violence: Trade liberalization, illicit labor, and the Mexican drug trade. *Latin American Politics and Society*, 61(03), 129–153.
- Herrera, J. S. (Forthcoming). The limits of resistance to criminal governance: Cyclical violence and the aftermath of the autodefensa movement in Michoacán, Mexico. *Global Crime*.
- IMF (2020). *Primary commodity price system*. International Monetary Fund.
- INAFED, (2017.) *Sistema nacional de información municipal*. Instituto Nacional para el Federalismo y el Desarrollo.
- INEGI. (2005). *Encuesta Intercensal 2005*. Instituto Nacional de Estadística y Geografía.
- INEGI. (2010). *Censo de Población y Vivienda 2010*. Instituto Nacional de Estadística y Geografía.
- INEGI. (2015). *Encuesta Intercensal 2015*. Instituto Nacional de Estadística y Geografía.
- INEGI. (2020). *Registros administrativos: Estadísticas*. Instituto Nacional de Estadística y Geografía.
- Jones, N. P. (2016). *Mexico's illicit drug networks and the state reaction*. Georgetown University Press.
- Knight, A. (2012). Narco-violence and the state in modern Mexico. In W. G. Pansters (Ed.), *Violence, coercion, and state-making in twentieth-century Mexico: The other half of the Centaur* (pp. 115–134). Stanford University Press.
- Lemus, J. J. (2015). Tierra sin Dios: Crónica del desgobierno y la guerra en Michoacán. *Grijalbo*.
- Lemus, J. J. (2018). México a cielo abierto: De cómo el boom minero resquebrajó al país. *Grijalbo*.
- Lessing, B. (2020). Conceptualizing criminal governance. *Perspectives on Politics*. <https://doi.org/10.1017/S1537592720001243>.
- Maerker, D. (2014, April 1). Auxilio, ¿dónde está el Estado? Nexos. <https://www.nexos.com.mx/?p=20052>.
- Magaloni, B., Robles, G., Matanock, A. M., Diaz-Cayeros, A., & Romero, V. (2020). Living in fear: The dynamics of extortion in Mexico's drug war. *Comparative Political Studies*, 53(7), 1124–1174.
- Maldonado, S. (2010). *Los márgenes del Estado mexicano. Territorios ilegales, desarrollo y violencia en Michoacán*. El Colegio de Michoacán.
- Maldonado, S. (2012). Drogas, violencia y militarización en el México rural: El caso de Michoacán. *Revista Mexicana de Sociología*, 74(1), 5–39.
- Moncada, E. (2016). *Cities, business, and the politics of urban violence in Latin America*. Stanford University Press.
- Moreno-Brid, J. C., & Ros, J. (2009). *Development and growth in the Mexican economy: A historical perspective*. Oxford University Press.
- Nájar, A. (2014). Minería, el nuevo negocio de los carteles mexicanos. *BBC Mundo* https://www.bbc.com/mundo/noticias/2014/03/140318_mexico_mineria_nuevo_negocio_carteles_narcotrafico_templarios_zetas_an.
- Nellemann, C., Henriksen, R., Kreilhuber, A., Stewart, D., Kotsovou, M., Raxter, P., Mrema, E., & Barrat, S. (2016). *The rise of environmental crime: A growing threat to natural resources, peace, development and security*. United Nations Environment Programme.
- Noria Research (2020). *Violence takes place series: Land, markets and power in rural Mexico*. Noria Research. <https://noria-research.com/mxac/violence-takes-place/>.
- Osorio, J. (2015). The contagion of drug violence spatiotemporal dynamics of the Mexican war on drugs. *Journal of Conflict Resolution*, 59(8), 1403–1432.
- Paley, D. (2014). *Drug war capitalism*. AK Press.
- Peñaranda Currie, I., Otero-Bahamon, S., & Uribe, S. (2021). What is the state made of? Coca, roads, and the materiality of state formation in the frontier. *World Development*, 141. <https://doi.org/10.1016/j.worlddev.2021.105395>.
- Phillips, B. J. (2015). How does leadership decapitation affect violence? The case of drug trafficking organizations in Mexico. *The Journal of Politics*, 77(2), 324–336.
- Rettberg, A., Leiteritz, R. J., Nasi, C., & Prieto, J. D. (Eds.). (2018). *¿Diferentes recursos, conflictos distintos? La economía política regional del conflicto armado y la criminalidad en Colombia*. Universidad de los Andes.
- Rettberg, A., & Ortiz-Riomalo, J. F. (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(August), 82–96.
- Rios, V. (2013). Why did Mexico become so violent? A self-reinforcing violent equilibrium caused by competition and enforcement. *Trends in Organized Crime*, 16(2), 138–155.
- Rios, V. (2015). How government coordination controlled organized crime the case of Mexico's cocaine markets. *Journal of Conflict Resolution*, 59(8), 1433–1454.
- Ross, M. L. (2004). What do we know about natural resources and civil war? *Journal of Peace Research*, 41(3), 337–356.
- Ross, M. L. (2015). What have we learned about the resource curse? *Annual Review of Political Science*, 18, 239–259.
- Serrano, M. (2012). States of violence: State-crime relations in Mexico. In W. G. Pansters (Ed.), *Violence, coercion, and state-making in twentieth-century Mexico: The other half of the centaur* (pp. 135–158). Stanford University Press.
- SIAP. (2020). *Estadística de Producción Agrícola*. Servicio de Información Agroalimentaria y Pesquera.
- Snyder, R., & Durán-Martínez, A. (2009). Does illegality breed violence? Drug trafficking and state-sponsored protection rackets. *Crime, Law and Social Change*, 52(3), 253–273.
- Stanford, L. (1993). El Tratado de Libre Comercio y el impacto de los cambios en la política agraria: El caso de la Tierra Caliente michoacana. *Relaciones*, 14(54), 71–101.
- Stargardter, G. (2018). *The Refinery Racket: Mexico's drug cartels, now hooked on fuel, cripple nation's refineries*. Reuters. <http://www.reuters.com/investigates/special-report/mexico-violence-oil/>.
- Stoop, N., Verpoorten, M., & van der Windt, P. (2019). Artisanal or industrial conflict minerals? Evidence from Eastern Congo. *World Development*, 122, 660–674.
- Trejo, G., & Ley, S. (2020). *Votes, drugs, and violence: The political logic of criminal wars in Mexico*. Cambridge University Press.
- Trejo, G., & Ley, S. (2021). High-profile criminal violence: Why drug cartels murder government officials and party candidates in Mexico. *British Journal of Political Science*, 51(1), 203–229.
- Valdivia, F. del R., & Okowí, J. (2021). Drug trafficking in the Tarahumara region, northern Mexico: An analysis of racism and dispossession. *World Development*, 142. <https://doi.org/10.1016/j.worlddev.2021.105426>.
- Varese, F. (2020). How mafias migrate: Transplantation, functional diversification, and separation. *Crime and Justice*, 49, 289–337.
- Zabyelina, Y., & van Uhm, D. (Eds.). (2020). *Illegal mining: Organized crime, corruption, and ecocide in a resource-scarce world*. Springer International Publishing.
- Zepeda Gil, R. (2017). Violencia en Tierra Caliente: Desigualdad, desarrollo y escolaridad en la guerra contra el narcotráfico. *Estudios Sociológicos*, 36(106), 125–160.