Blood Avocados?
Trade Liberalization and Cartel Violence in Mexico

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Abstract. How do expanding markets shape organized crime and violence in the developing world? We consider two competing theories predicting the effect of market shocks on violence – the rapacity hypothesis which holds that violence will increase, and the opportunity cost hypothesis which holds that violence will decrease. We test this logic in the Mexican avocado industry with a difference-in-differences design leveraging plausibly exogenous changes in municipal export certification, and find that trade liberalization throughout the 2010s led to significant and substantial decreases in cartel-related homicides. We argue that this finding is consistent with three main explanations – labor shifting from illicit to licit markets, community-coordinated armed resistance to cartels, and cartels intentionally limiting violence. This article contributes to the literature on the domestic consequences of trade liberalization by examining its impact on the local economy, violence, and state building in areas of low state capacity.

How do expanding markets shape organized crime and violence in the developing world? Globalization creates new economic opportunities that criminal groups can exploit, driving them to expand or even diversify operations. This is why, for example, the Mafia occupied a central role in the protection industry within expanding legitimate markets in Sicily such as those for lemons (Dimico et al., 2017) and sulphur (Buonanno et al., 2015), or why drug cartels diversify by engaging in large-scale illegal oil taps (Battiston et al., 2022) or iron ore theft (Stevenson, 2013) as the Mexican War on Drugs disrupted illicit markets. As globalization incites organized criminal groups to broaden operations in existing markets or pursue opportunities in new markets, we question the impact of such external shocks on levels of violence in the developing world.

Recent research has shown the various ways in which external shocks have fueled criminal violence in areas of low state capacity. In Colombia for example, studies have shown that the increase in the demand for cocaine leads to more homicides in areas that serve these specific markets, such as those municipalities located on trafficking networks (Millán-Quijano, 2020) or those regions more suitable for cultivating coca (Angrist and Kugler, 2008; Mejia and Restrepo, 2015). But Mejia and Restrepo (2015) simultaneously reveal a contrasting finding – while external shocks in illicit markets lead to an increase in criminal violence, booms in certain licit markets seem to reduce criminal violence. This finding remains consistent with other studies that similarly explore the nexus of expanding licit markets and violence, such as how booms in the coffee (Dube and Vargas, 2013) and flower (Hernandez, 2014) industries have reduced violence in rural areas of Colombia. Generally, these studies tell us that there is, on average, a decrease of violence in these areas of agricultural productivity, though the effect is more acute in areas where institutions are more resilient.

Put simply, the existing research on globalization and organized crime provides us with variable predictions on levels of violence. We draw on insights from this scholarship to inform and advance two competing theories – first, the rapacity hypothesis predicting that market expansion increases criminal violence (Dube and Vargas, 2013; Kronick, 2020; Mag-

aloni et al., 2020; Millán-Quijano, 2020); second, the opportunity cost argument predicting that market expansion decreases criminal violence (Becker, 1968; Dal Bó and Dal Bó, 2011; Mejia and Restrepo, 2015; Dube and Vargas, 2013). On one hand, the rapacity hypothesis holds that competition over resources dominates when institutions are weak. This allows criminal actors to intervene in the market, ultimately using violence to compete over lucrative commodities and territories or to enforce contracts and overcome commitment problems. On the other hand, the opportunity cost hypothesis predicts a decrease of violence when there are positive shocks to labor-intensive commodities. Such shocks lead to greater employment opportunities and wage increases, thereby reducing the returns to appropriation.

In this article, we mediate these competing explanations in an area not yet empirically explored – the avocado industry in Mexico. We take the case of avocados in Mexico to be a most-likely case for revealing how markets shape organized crime in the developing world. Immobile production, slow responsiveness of supply,[1] low technological barriers to entry, small firm sizes, labor intensity,[2] and perishability make the avocado industry vulnerable to predation by organized crime. Low state capacity in Mexico – characterized by its reliance on clientelism, its incomplete private property rights protections, its failure of making credible commitments to private investors, and its difficulties in raising revenue from the population (Cárdenas, 2010) – make this phenomenon even more acute. Media reports and scholarship alike have us handwringing over the seemingly disproportionate increase of violence in avocado-cultivating areas over those regions that do not export avocados; alter-

[1]Starting from a seed, it takes about 10-15 years before an avocado tree will begin to bear fruit (or 3-5 years for a nursery-grown tree). This means that producers are largely bound to their pre-existing supply in the short to medium term, and therefore are limited in their ability to adjust to sudden changes in the market.

[2]Per acre, almost 60% of operating costs come from labor, with other costs including those associated with fertilizers, insecticides, and machinery. Harvesting and packing are the most labor-intensive phase of avocado production, with most workers putting in at least 12-hour days (Arana Coronado, 2010).

natively, some studies assuage us by telling us that such booms may actually reduce violence in producing areas despite the heightened presence of organized crime. Thus, this article fits within existing literature by exploring the effects of trade liberalization on organized crime, specifically the impact of an expanding avocado market on cartel-related homicides in Mexico.

To test the diverging hypotheses with the case of Mexico, we use a difference-in-differences (DID) design to leverage as-if random changes that have granted certain municipalities the ability to export avocados. Specifically, we exploit changes in municipal export certification, driven both by pest-free certification from Mexican authorities as well as changes in U.S. import policy. Using data on cartel-related violence, we find that both the pest-free declarations from Mexican authorities as well as the U.S. import policy have significant and large negative effects on cartel-related violence. We posit two mechanisms that could explain this finding in the case of Mexico. First, vigilante groups have emerged to protect the avocado industry and communities from cartel violence. Second, cartels can exploit previous victims by identifying points of extortion ex ante, thereby reducing the need for violence. Although we cannot rule out alternative mechanisms, qualitative evidence supports these findings.

This article's primary contributions are therefore both empirical and theoretical. Empirically, we take advantage of a natural experiment in Mexico to interrogate how markets shape organized crime and violence in the developing world. Because demand and supply, prices, and ultimately revenue and profits may be endogenous to cartel-related violence, we exploit a DID design to estimate the causal effect of an expanding avocado market on cartel-related violence. We demonstrate that municipalities formerly unable to export avocados internationally experienced significantly lower cartel-related homicide rates and missing persons rates after earning the ability to export compared to municipalities that were unaffected by trade liberalizing policy. In doing so, we also pinpoint strong proxies for cartel violence, which are especially valuable given data scarcity in studies of organized

crime.

This novel empirical strategy thus mediates and sheds light on competing explanations for how licit markets shape organized crime and violence in the developing world, our other contribution. Though we are unable to fully rule out alternative mechanisms that may explain this finding, our quantitative results, qualitative observations, and existing scholarship suggest three main stories – of labor substitution, community organization and armed resistance, and efforts by cartels to limit violence.

The Effect of Market Shocks on Organized Crime

Weakly institutionalized environments serve as a power vacuum for organized criminal groups to emerge. Common accounts of organized crime liken such groups to firms that integrate within legitimate markets in areas of newfound growth where formal state institutions are weak (Gambetta, 1996). Because of the increase in opportunities for rent appropriation through extortion, mafia-type organizations become the legitimate suppliers of order and protection in these areas of low state capacity where trust among actors is low and thus interactions must be mediated by third-party enforcers (Gambetta, 1996; Dimico et al., 2017; Bandiera, 2003; Reuter, 2009).

Though it is clear that organized criminal organizations emerge in these weakly institutionalized contexts, literature on the effect of external market shocks on violence in these environments provides two diverging predictions. Indeed, as criminal organizations enter licit industries, the onset of liberalizing policies may stimulate competition and contestation through attempts to control markets and territory. But the effect of these policies on violence can be either positive or negative. We therefore contemplate these two potential hypotheses of how external shocks change the incentive of violent agents – first, the rapacity hypothesis holds that exogenous shocks increase violence; and second, the opportunity cost argument holds that exogenous shocks decrease violence.

Economic models of conflict predict that market shocks resulting in an increase in the amount or value of a commodity lead to more violence (Ross, 2004; Fearon and Laitin, 2003). Thus, in what can be called the rapacity hypothesis (Dube and Vargas, 2013; Blair et al., 2021), exogenous shocks increase the amount and value of a "prize" to be won, thereby inducing market actors to fight in an attempt to control these resources. For example, as Brazil implemented large-scale trade liberalization from 1990 to 1995, regions exposed to larger tariff cuts experienced an increase in crime due to lower levels of public goods provision coupled with higher levels of inequality (Dix-Carneiro et al., 2018). More broadly, we see this trend with the general increase and value of commodities absent actual liberalizing policies. The increase in the demand and value of cocaine in Western markets in the 1990s and 2000s led to an increase in homicides in Colombian municipalities either strategically located on trafficking networks that serve these markets (Millán-Quijano, 2020) or with a high suitability index for coca cultivation (Mejia and Restrepo, 2015).

The mechanisms underlying the rapacity hypothesis can be reduced to competition and contestation. Criminal actors compete in local oligopolies for the control of strategic territories (Millán-Quijano, 2020; Magaloni et al., 2020; Kronick, 2020). For example, as markets become more lucrative, Kronick (2020) evaluates how booms impact levels of violence within profitable territories. As the 1990s experienced a surge of cocaine transiting Central America, narco-traffickers flooded smuggling corridors. Venezuelan municipalities along the notorious Pan-American Highway – a major drug pipeline for Colombian producers and U.S. consumers – experienced higher rates of violent deaths compared to municipalities not directly on the trafficking route. In a bid to dominate territory and revenue, cartels use violence to establish control over smuggling routes, revenue-producing clientele, and assets from rivals (Lessing, 2015).

Criminal actors additionally may use violence to enforce contracts (Gambetta, 1996) and overcome agent commitment problems (Greif, 1993; Lessing, 2015). Consider how, in the absence of contract law, California prison gangs access a range of instruments to implement

order – primarily, the use of threats and violence – to punish narcs, prevent skimming, and enforce obedience (Skarbek, 2011). Cartels may also target civilians who act as spoilers to their growing enterprise, such as those individuals who stand in the way of territorial expansion or who vocalize opposition to the cartel. Finally, cartels may target state agents themselves who seek to neutralize the reach of organized crime.

Yet in many of these cases, the increase of violence is in the context of a boom in illicit markets. Mejia and Restrepo (2015) theorize that booms in licit markets will conversely lead to a decrease of violence for at least three reasons. First, production may be reallocated to more highly institutionalized areas, reducing rapacity over turf. Second, the state has more incentive to neutralize the effects of criminal actors because it can tax the legal commodity. Third, market participants would be able to use the state to some extent, even if weak, to enforce contracts and protect property. The authors find support for these claims by showing how cocaine booms increase violence because of its illegality, though on the contrary licit booms such as those in minerals or agriculture actually reduce violence.

These findings reinforce what some scholars label the opportunity cost hypothesis (Becker, 1968). Dal Bó and Dal Bó (2011) prominently predict that, while positive shocks to capital-intensive industries increase armed violence, positive shocks to labor-intensive industries diminish it. Higher prices in labor-intensive commodities generate more opportunities for employment, thereby raising the opportunity cost of violence and appropriation. This is why, for example, the negative shock on coffee prices in Colombia led to an increase of violence, for lower employment opportunities increased labor supplied to appropriation (Dube and Vargas, 2013). On the other hand, higher prices in capital-intensive commodities lower the opportunity cost of violence and appropriation. Indeed, the returns to appropriation increased with the rise in the price of oil in Colombia, making oil theft more lucrative (Dube and Vargas, 2013).

To be sure, this hypothesis remains consistent both with other instances of exogenous shocks to the agricultural sector as well as different forms of appropriation. Dube et al.

(2016) show how weather conditions in U.S. maize-growing regions influence the price of maize in Mexico; and that lower maize prices in Mexico led to an increase in the cultivation of marijuana and opium poppies. Furthermore, other studies that yield similar findings emphasize both the nature of the commodity as well as the institutional environment in which production and trade take place. Mejia and Restrepo (2015), for example, similarly find that commodity booms in labor-intensive commodities such as coca, sugar cane, and palm oil reduce conflict, but only when institutions are sufficiently weak.

The Mexican Avocado Industry and Organized Crime

To test these conjectures, we look to the avocado industry in Mexico. Mexican avocado production is primarily situated in the Trans-Mexican Volcanic Belt, where environmental conditions for growth are ideal. Production is most robust in the Pacific state of Michoacán, accounting for 80 percent of total production in Mexico and almost half of the global avocado supply at 43 percent (Foreign Agricultural Service, 2018).

This industry has not always flourished, however. The avocado industry in Mexico and elsewhere in Latin America has long been burdened by a variety of diseases and pests specific to the avocado plant and its close relatives. As a result, various restrictions on avocado exports from this region have been implemented to limit the spread of avocado diseases and pests to other regions. Restrictions on the international trade of Mexican avocados, specifically, have their origins in a U.S. import ban imposed in 1914.[3] Despite continuous efforts by American firms and Mexican avocado producers to relax the ban, it lasted in its original form until 1993, when the Animal and Plant Health Inspection Service (APHIS) began allowing the importation of Mexican avocados to Alaska (Bellamore, 2002).

[3]This ban primarily sought to control the five avocado-specific pests that are prevalent in Mexico but generally not found in the United States: stem weevils *(Copturus aguacatae)*; seed weevils *(Conotrachelus aguacatae, Conotrachelus perseae,* and *Heilipus lauri)*; and seed moths *(Stenoma catenifer).*

U.S. import restrictions began to relax even further following the creation of NAFTA in 1994. This agreement had large effects on avocado regulations from both parties. For the U.S., the agreement increased pressure on APHIS to develop less blunt and inflexible regulations for agricultural imports, leading to the development of more refined procedures for quality control and continued relaxations of the outright ban. Chapter 7 of NAFTA, which established clear guidelines and expectations for the refinement of phytosanitary standards, induced Mexico to develop its own phytosanitary regulations for avocados and their exportation. These regulations and the associated procedures were developed and subsequently enacted by Mexico's Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA; now SADER) in 2005.

These regulations and guidelines involve requirements for inspection, cleaning, and quarantine capabilities at collection centers and packing houses, criteria for shipment rejection and disposal, documentation and storage procedures required for transportation, and regular and codified pest and compliance inspections at various points along the supply chain (SAGARPA, 2005). In accordance with SAGARPA's 2005 regulation, municipalities that do not comply with these procedures and demonstrate a lack of pests and disease are not allowed to export avocados outside of the country. Once an avocado-growing municipality demonstrates a consistently sufficient handle on pests and disease, however, SAGARPA officially declares them free of avocado pests. This declaration then effectively certifies the municipality to export avocados internationally.

While SAGARPA has been gradually expanding the municipalities allowed to export internationally since 2005, until 2016 only 24 pest-free municipalities[4] in Mexico were authorized to export avocados to the continental United States,[5], Hawaii, and Puerto Rico. This has had a large effect on the Mexican avocado industry, since the U.S. is the largest

[4]Acuitzio, Tancitaro, Uruapan, Tingüindin, Salvador Escalante, Nuevo Parangaricutiro, Periban de Ramos, Ario, Los Reyes, Apatzingan, Taretan, Tacambaro, Tingambato, Madero, Cotija de la Paz, Erongaricuaro, Tocumbo, Tuxpan, Irimbo, Hidalgo, Turicato, Ziracuaretiro, Paracuaro, and Tangamandapio.

[5]Per the Code of Federal Regulations (7 CFR 319.56-2), the continental United States includes the 48

importer of Mexican avocados, accounting for roughly 80% of Mexican avocado exports in 2020 (Statista, 2022). Further, all of the municipalities that were allowed to export to the U.S. were in Michoacán.

Thus, since the lifting of the non-tariff barriers in 1997 and with the imposition of phytosanitary regulations, avocado production in Mexico has been concentrated in Michoacán. The main domestic actors in the international supply chain include growers, or *productores* (producers), and the *empacadores* (packing houses) (Moncada, 2021, 125).[6] The *productores* plant and harvest crops. By the early-2000s, Michoacán had around 11,700 producers, each having approximately five to ten hectares of orchard and yielding 10.5 tons of fruit per hectare (Arana Coronado, 2010). However, almost 75 percent of these orchards were not in compliance with the phytosanitary regulations, and ultimately approximately 2,290 producers (28 percent of the share of total producers) were certified to export to U.S. markets. From the *productores*, packers transport the avocados from orchards to packing houses, which sort and clean the fruits and store them in climate-controlled facilities. In the early-2000s, Mexico had 382 packing houses, though only 60 exported produce internationally, and of these only 26 exported avocados to the United States (Arana Coronado, 2010). Packers organize themselves into different collectives, primarily based on destination markets. Specifically, the Avocado Producers and Export Packers Association (APEAM) encompassed the 26 packers servicing U.S. markets, as well as the 2,290 producers. The *empacadores* work with international brokers and traders to transport the produce internationally – the majority of avocados from Michoacán are transported to the United States by land via trucks going through border crossings in Texas.

In February of 2015, however, a USDA policy proposal altered the landscape of

contiguous states, the District of Columbia, and Alaska.

[6]Other actors include: nurseries, which provide plants to the producers; vendors, who sell fertilizer and equipment to producers; the *jornaleros* (laborers) who harvest avocados in the field or work in the packing houses; and drivers, who transport the produce (Moncada, 2021, 125).

avocado production and export in Mexico. APHIS announced a new policy that allowed for broadening the areas that could export to the United States from Michoacán only to all other Mexican states, provided they meet strict guidelines to reduce the risk of transmitting quarantine pests. Such guidelines included "requirements for orchard certification, traceback labeling, pre-harvest orchard surveys, orchard sanitation, post-harvest safeguards, fruit cutting and inspection at the packinghouse, port-of-arrival inspection, and clearance activities" (Animal and Plant Health Inspection Service, USDA, 2016). Notably, in this announcement, officials stated that trade would initially extend only to the remaining municipalities in Michoacán as well as Jalisco, the northern neighbor of Michoacán.

The USDA fully enacted this policy by June 2016. With the potential to open up other production sites that abide by phytosanitary regulations, other municipalities within and outside Michoacán have had the opportunity to become competitive in the international market by increasing production. At the end of 2015, Michoacán dominated the market, while Jalisco trailed behind in a far second place at 6 percent of total avocado production in Mexico (Foreign Agricultural Service, 2018).

As the avocado industry in the Trans Mexican Volcanic Belt has evolved, so too has organized crime. As with avocado production, Michoacán's long narco tradition is partially a function of geography, with "territories of difficult access without the presence of public authority, the agricultural vocation of its economy, the availability of land for illicit crops, and its offer of ports to transport goods on a large scale, [making] it a region suitable for the drug business" (Guerrero Gutiérrez, 2014). From the 1980s to the 1990s, the Milenio Cartel of the Valencia family transformed their initial cocaine business into a drug empire involved in the production and trafficking of cocaine, marijuana, opium poppy, and methamphetamines (Ornelas, 2018, 766).

The Milenio Cartel maintained a relatively uncontested control of these markets until the early 2000s, when the Zetas rose to prominence and displaced them. The Zetas relied on extreme forms of violence and "introduced predatory techniques mainly in the tertiary

and agricultural sectors; the avocado producers, their favorite target" (Ornelas, 2018, 765). However, in-fighting among Zetas leadership led to the emergence of La Familia Michoacana in 2006, which rapidly became successful in undercutting the Zetas (Guerrero Gutiérrez, 2014). In areas of state weakness, La Familia Michoacana provided protection to the producers and exporters in the agricultural markets that were prey to the Zetas (Moncada, 2021, 61). Initially La Familia Michoacana offered these services for free, though eventually demanded criminal taxes in exchange for protection from other predatory actors.

Then another shock to the market occurred in 2006 when Felipe Calderòn won the presidential election. Calderòn claimed that the primary threats to Mexico were organized crime and the drug trade (Moncada, 2021, 124). The first large-scale counter-narcotics operation was Operation Michoacán on 11 December 2006, where the federal government deployed more than 7,000 police and military forces to neutralize drug cartels in the Pacific region (Finnegan, 2010). Calderòn touted that the Mexican Drug War would create a blanket crackdown on all cartels, though violence only intensified and became more lethal and brazen as large syndicates fragmented and dozens smaller groups emerged (Signoret et al., 2021).

As the Mexican Drug War destabilized the drug market, cartels have sought to corner licit markets. Schelling (1971) outlines four primary traits that attract organized crime to agricultural markets in particular: "1) businesses in traditional sectors of the economy with a high degree of territorial specificity; 2) a relative small size of firms; 3) a relatively low technological level; and 4) a region where the public sector is relatively large and legal institutions are weak" (Ornelas, 2018, 762). Avocados specifically are a unique commodity because they are highly perishable – the fruit has such a high metabolic rate that their shelf-life is only about three to four weeks (Arana Coronado, 2010). This ultimately means that the industry is exceptionally vulnerable to extortion because the fruit cannot be stored in order to avoid weak points on the commodity chain that are susceptible to more episodic violence.

Indeed, organized criminal groups have turned to local extortion, making the avo-

cado sector more predatory. This dynamic is in part driven by the fragmentation of drug trafficking organizations following the Mexican Drug War, fueling criminal competition and compelling groups to seek control of markets other than drugs. Specifically, the death of the leader of La Familia Michoacana led to an internal power struggle, from which the Knights Templar emerged (Moncada, 2021, 125). The Knights Templar extorted actors at almost all points in the commodity chain by violently forcing information from avocado collectives in order to more efficiently identify and collect taxes from orchards, packing houses, and transport checkpoints. They charged nurseries for each plant sold; they charged producers MXN 1-3 for every plant they bought, and they initially charged them up to MXN 1,000 (and later MXN 2,000) annually per hectare they owned; and they charged packers a tax per carton leaving the packing house. Eventually, the Knights Templar integrated with avocado market beyond just imposing criminal taxes:

> Likewise the DTO [drug-trafficking organization] interfered in harvesting and sales processes by forcing producers to sign over their lands to members of the cartel group, who then threatened other producers to delay or completely abandon harvesting so as to both generate upward pressure on prices and secure optimal windfalls for the harvests on the lands that they now owned. (Moncada, 2021, 126-127)

Clarín (2019) reported the accounts of three anonymous farmers claiming that failure to obey cartel demands put them at risk for confrontation by *sicarios* who enforce compliance through beatings, torture, or killings. These farmers additionally corroborated the monthly quotas they pay to the crime syndicates, based on the number of hectares planted. Specifically, some farmers have claimed that cartels have hijacked avocado shipments of up to 48 tons (or four truckloads) daily, oftentimes kidnapping the drivers and family members (Trilling, 2019).

Since the mid-2010s, two cartels have vied for control within Michoacán – Los Viagras and Jalisco New Generation. Los Viagras evolved from a self-defense force in the Tierra

Caliente region of Michoacán in 2014 to the larger crime syndicate it is today. And Jalisco New Generation, founded in 2009 and primarily based in the state of Jalisco, has swiftly climbed the ranks of cartels in Michoacán and is now one of the most notorious and violent criminal organizations in Mexico and beyond (Jorgic and Hosenball, 2020). As these groups have expanded, violence between them has flared. In August of 2019, members of Jalisco New Generation shot nine members of Los Viagras in an amusement arcade in Uruapan (Linthicum, 2019). Authorities found the nine members of Los Viagras hanging from an overpass, and ten more bodies dismembered and dumped by the side of the road. On the overpass, Jalisco New Generation hung a banner reading: "Lovely people, carry on with your routines. Be a patriot, kill a Viagra."

Violence has extended even beyond cartels as they attempt to interfere in the avocado market. In February 2022, an unidentified criminal group threatened a U.S. inspector when he rejected a consignment of cartel avocados (Creswell, 2022). This led to a week-long import ban in the United States leading up to the Super Bowl, an event famous for excessive levels of guacamole consumption. While this unprecedented event demonstrates that cartels are becoming more audacious, it also demonstrates the firm resistance of agricultural officials to attempts at exerting undue influence on the export process.

Empirical Strategy: Difference-in-Differences

Differences across municipalities may confound the relationship between avocado production and cartel-related violence. A drawback to directly using avocado production as the independent variable is that agricultural yields may be endogenous to the outcome of interest. For example, producers may grow more avocados in municipalities where there is already a strong presence of organized crime – perhaps these municipalities are on a major drug trafficking route and fruit provides the licit means by which to conceal and transport illicit goods to the United States. A regression analysis would be inadequate of controlling for

unobservable municipality-level confounders, for it would struggle to capture the true relationship between avocado production and cartel-related violence. Indeed, a regression could show a correlation between these two variables that is not necessarily due to market shocks – to be sure, a correlation could be a result of the strategic location of municipalities in which fruit is grown and exported.

Instead, the effect of avocado production on cartel-related violence in a particular municipality should depend on the extent to which the given area is directly impacted by trade policies. We therefore employ a DID design to identify the causal effect of market shocks on cartel-related violence. This design allows us to measure changes in cartel-related violence over time for each municipality, eliminating all time-invariant differences across municipalities that may influence the propensity for organized crime to operate within these different areas.

Treatment

To test the effect of avocado market expansion on cartel violence, we leverage as-if random changes in export ability within the Mexican avocado industry. Specifically, our DID design takes advantage of changes in municipal export certification granted by SAGARPA between 2011 and 2019, as well as a major change in U.S. import policy in June of 2016, each according to the prevalence of pests.[7]

The first changes in export ability we leverage are domestic in source. We compare the change in cartel-related homicides across municipalities following municipality-specific pest-free declarations by Mexico's Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food made between 2011 and 2019. Declarations for newly passed municipalities are made monthly in the Official Journal of the Federation and effectively expose

[7]Similar studies that employ a difference-in-differences design when examining the impact of economic or political shocks on organized crime include Dube et al. (2016), Dix-Carneiro et al. (2018), Brown et al. (2022), and Kronick (2020).

avocado producers in those municipalities to the world market by allowing them to export avocados internationally.

We also account for an important change in U.S. import policy between 2011 and 2019. Namely, we account for a major change in June of 2016, which expanded trade from 24 municipalities in Michoacán to any municipality that meets strict guidelines to reduce the risk of transmitting quarantine pests. Given that the U.S. accounts for roughly 80% of Mexican avocado exports (Statista, 2022), these changes in export ability represent exposure to a much larger market than those granted by domestic certification alone. U.S. treatment also provides us with a further robustness check for certification procedures, since U.S. officials run their own inspections both in Mexico and at the border, with APHIS conducting inspections in Mexico and Customs and Border Protection conducting inspections upon entry to the U.S. In their policy announcement in 2016, U.S. officials stated they expected initially only Michoacán and Jalisco to be compliant with their inspection criteria. For this reason, we consider only Michoacán and Jalisco as treated by the relaxing of U.S. import restrictions during the period of our study. Further, because municipalities require certification from the Mexican government to export at all, Mexican certification and U.S. certification combined are necessary in order to export to the U.S. We therefore combine U.S. trade expansion and Mexican domestic certification to create our measure of access to the U.S. market.

While the varied timing of municipal-level certification from SAGARPA makes it difficult to visualize the impact of the Mexican certification process on trade, the sudden and broad change in U.S. import policy in June of 2016 provides a useful large-scale discontinuity for evaluating this impact visually. Figure 1, therefore, demonstrates the extent to which the USDA Hass Avocado Import Program impacted Mexican avocado exports. This lends credence to the immediate and significant economic impact of trade liberalization for the Mexican avocado industry.

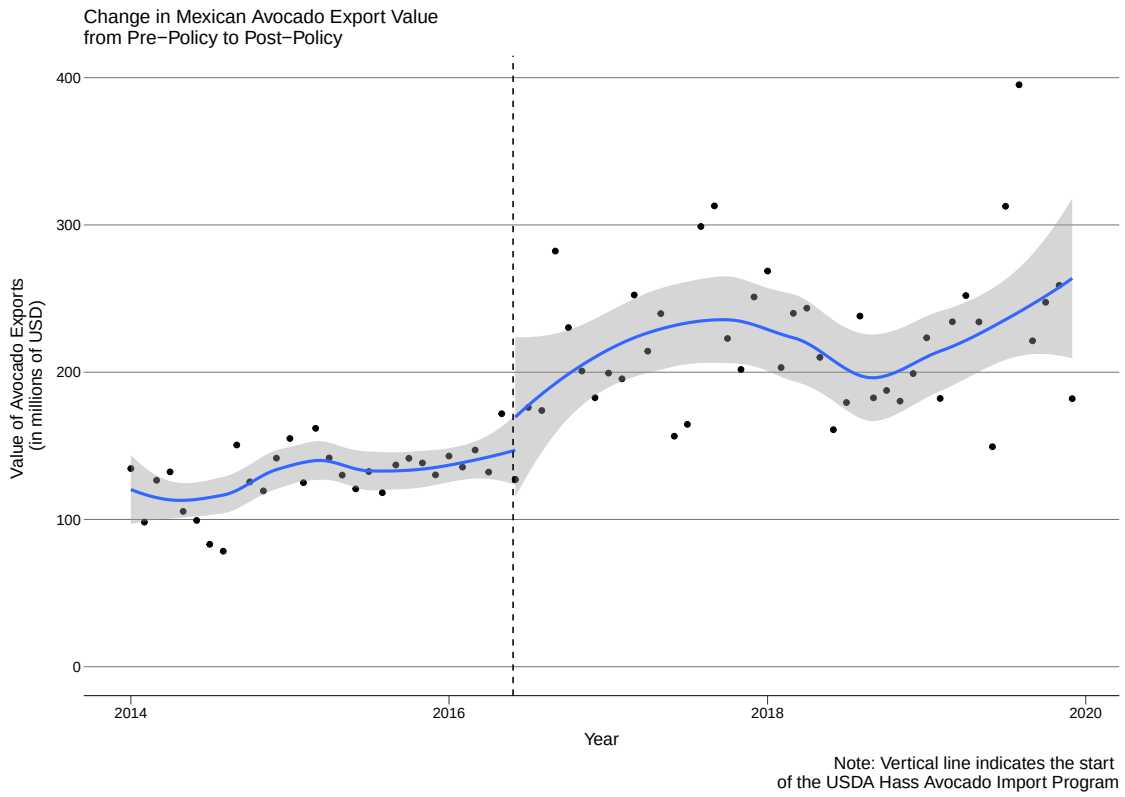

Figure 1

Data

Our outcome of interest is cartel violence, which we operationalize using three separate proxy measures of cartel-related homicides. The first, what Mexico's Secretariat of Public Security calls *homicidios dolosos*, or "intentional homicides," we demonstrate is highly correlated with cartel-related homicides. From this we develop a second proxy, which we manually impute based on the estimated relationship between cartel-related homicides and intentional homicides. For our third proxy, we use data on missing persons. We rely on these proxies because data on cartel-related homicides is unavailable during the period of our study. We are able to determine them, however, given the availability of earlier data on cartel-related homicides.

This earlier data on cartel-related homicides was collected between December of

2006 to September of 2011 and published by the Mexican Attorney General at the level of the municipal-year. Formally titled "Deaths Presumably Related to Criminal Rivalry," this project was intended to capture drug trafficking organization (DTO)-related homicides. Throughout this period, a council composed of the Mexican armed forces, the federal police, the ministry of the interior, and the general public prosecutor's office determined for each case whether it was DTO-related (Secretaría de Gobernación, 2011).

While this data is not available for the period of our study, other government-provided measures of homicides are strongly correlated with DTO-related homicides. Specifically, we leverage homicide and missing persons data provided by Mexico's Executive Secretariat of the National Public Security System (SESNSP).[8] Before 2011, this data is only publicly available for state-years. In order to match these datasets, therefore, we aggregate the Attorney General's DTO-related homicides data up to the state-year. We also only use the data from 2007-2010, the period for which there are complete years of cartel-related homicide data. After testing a few different sub-measures of homicides, including homicides with a firearm, intentional homicides with a firearm, and intentional homicides, we ultimately find intentional homicides to be the best predictor of DTO-related homicides. Table 1 and Figure 2 demonstrate this relationship.

Beginning in 2011, data from the state on homicides is available at the municipal level and on a monthly basis. It is this municipal-month data, therefore, that we use for our main analysis. While later data is available, we end our analysis in 2019 to avoid complications created by the COVID-19 pandemic. Finally, some municipalities do not enter the data set until 2014. We therefore create two balanced panels, one from 2011 to 2019, and the other from 2014 to 2019, and combine them for our main model.

For missing persons, we also leverage data provided by SESNSP. This individual-level data includes information on the date and location of disappearances, which we use to develop a municipal-month measure of missing persons.[9]

[8]Data available at: https://www.gob.mx/sesnsp/.

[9]For each of these outcome variables, we use the total number for each municipality-month without

	ln(cartel homicides)
(Intercept)	−1.67
	(0.80)
ln(intentional homicides)	1.08*
	(0.15)
R^2	0.85
Adj. R^2	0.85
Num. obs.	128
F statistic	54.70
N Clusters	32

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 1: The relationship between cartel homicides and intentional homicides in Mexico, 2007-2010.

Starting with the full set of municipalities in Mexico, we subset our data in two ways before arriving at our final sample. First, we use data from Mexico's Agrifood and Fisheries Information Service (SIAP) on avocado production to determine which municipalities produce avocados. Using hectares of avocado orchards sown, we remove municipalities which have no data on avocado production or which did not plant avocados between 2011 and 2019. Second, we subset our data by geography to produce comparable treatment and control groups, so that our control group may serve as a relevant counterfactual for certified municipalities. Using municipality centroids, we subset our data to only municipalities within 63 miles[10] (the median in our data) of a municipality in the opposite group (treatment/control). We do this separately for each of the two time cohorts, 2011-2019 and 2014-2019.

From the enactment of SAGARPA's 2005 regulation through 2019, 64 municipalities where declared free of avocado pests and cleared for international export. Of these 64, 12 municipalities in the state of Michoacán had been free of avocado pests and exporting avocados prior to the 2005 regulation. During the period from 2011-2019 which this paper

dividing by population. The results are largely similar when adjusting for population, however, as shown by table A1 in the appendix.

[10]These results are robust to alternative cutoffs.

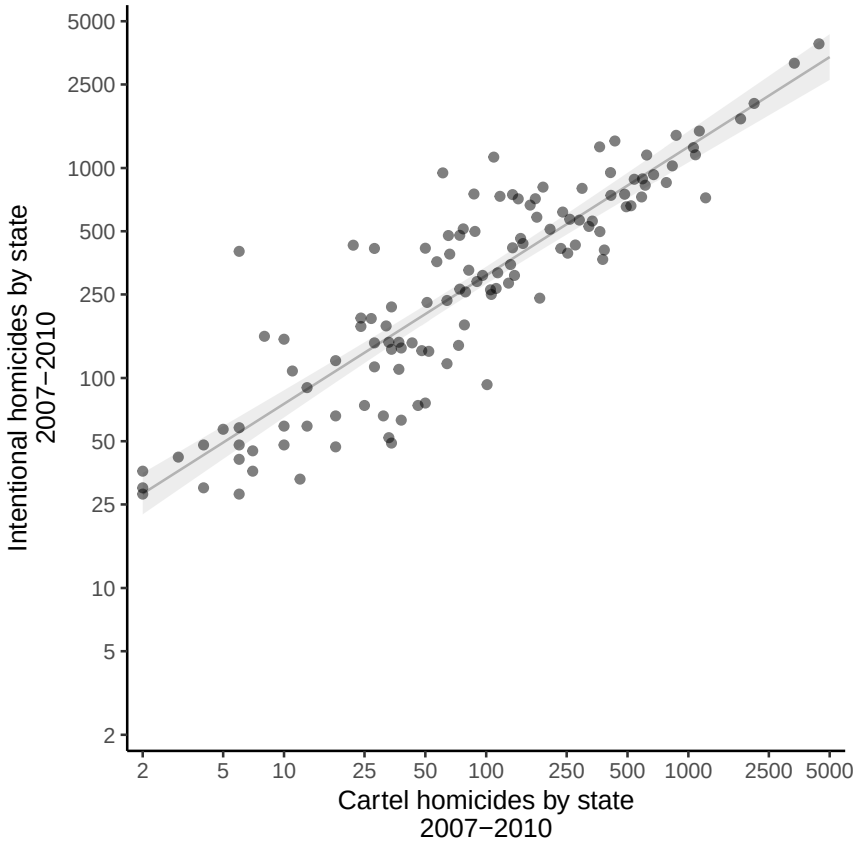

Figure 2

examines, 47 municipalities were declared free of avocado pests. Missing data[11] combined with the above process of subsetting by production and geography leaves 39 municipalities that become certified between 2011 and 2019 in our final dataset; 25 municipalities that were certified before 2011, which are coded as always treated in our data; and 171 municipalities that had yet to become certified as of 2019, which serve as our control group. Figure 3 shows all of these municipalities geographically. For municipalities with data from 2011 to 2019, there are 108 observations each. For municipalities with data from 2014 to 2019, there are 72 observations each. The final dataset has 23,220 observations.

[11]We expect missing data to be uncorrelated with the treatment. SIAP claims that missing data is a result of technological errors from the data-generating processes. In these cases, SIAP logs no data.

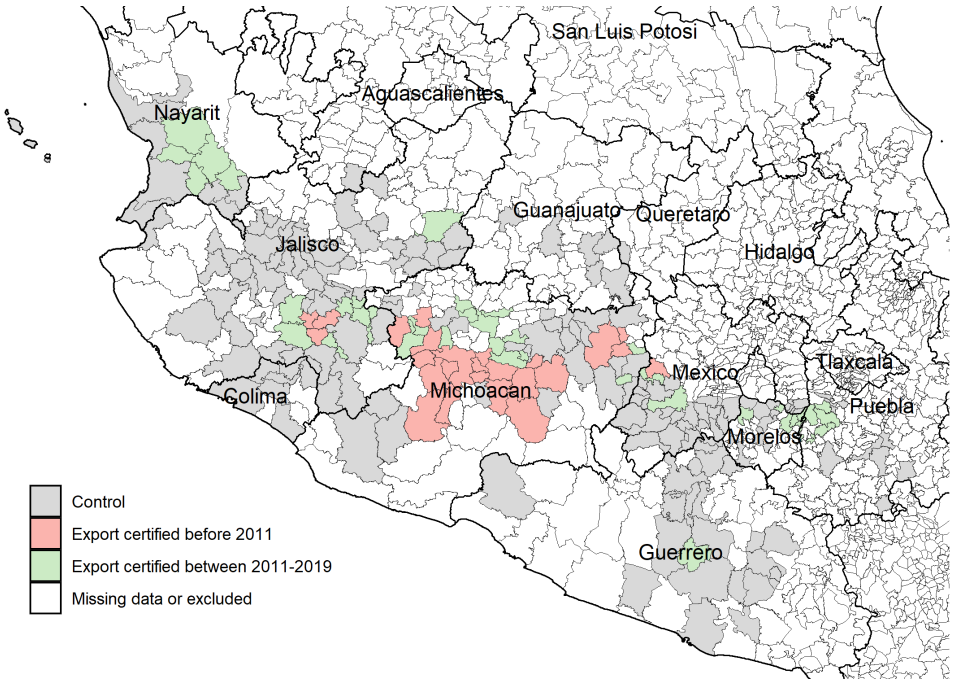

Figure 3

Model

We construct our models as follows:

$$Y_{it} = \beta_1 M_{it} + \beta_2 US_{it} + \delta_i + \alpha_t + \tau_i t_i + \epsilon_{it} \tag{1}$$

where Y_{it} represents the outcome variable for municipality i in time period t; M_{it} is a binary variable representing pest-free status, as declared by the Mexican government; US_{it} is a binary indicator of U.S. trade status; δ_i is a vector of municipality fixed effects, α_t is a vector of time fixed effects, τ_i is a vector of municipality-specific time trends, and ϵ_{it} is the error term.

Results

Table 2 presents regression results for each of our three outcome variables. Before the inclusion of separate time trends by municipality, we find that both pest-free declaration by the Mexican government and a subsequent ability to export avocados, as well as exposure to the U.S. market, have significant and substantively large effects on each measure of cartel violence. In these models, Mexican certification and exposure to the U.S. market lead to 38% and 45% reductions relative to the mean, respectively, in cartel-related homicides when using intentional homicides as a proxy. Similarly, Mexican certification and exposure to the U.S. market lead to 40% and 47% reductions, respectively, compared to the mean value of our imputed proxy for cartel homicides. Finally, the effect of Mexican certification and U.S. market exposure equates to a 38% and near 100% reduction in missing persons relative to the mean.

After the inclusion of separate municipal time trends, however, only exposure to the U.S. market is significant. This is not particularly surprising given that the U.S. is by and large the biggest importer of Mexican avocados. Since the U.S. accounts for nearly 80% of Mexican avocado exports (Statista, 2022), domestic certification alone - exposure to the international market without the ability to trade with the U.S. - exposes producers to just 20% of the international market for Mexican avocados. In these most conservative models, the effect remains similar and substantively large. For intentional homicides, U.S. market exposure leads to the equivalent of a 32% reduction relative to the average. The effect on our manually imputed proxy is a similar 34% reduction relative to the mean, while the effect on missing persons is equivalent to a 36% reduction, though insignificant.

	Int. hom.	Int. hom.	Car. hom.	Car. hom.	Mis. per.	Mis. per.
Mexican cert.	-0.44^{*}	-0.05	-0.11^{*}	-0.01	0.09	-0.11
	(0.18)	(0.18)	(0.04)	(0.04)	(0.14)	(0.14)
U.S. trade	-0.53^{***}	-0.38^{**}	-0.13^{***}	-0.09^{**}	-0.25^{**}	-0.09
	(0.15)	(0.14)	(0.04)	(0.03)	(0.09)	(0.06)
Mun. time trends	N	Y	N	Y	N	Y
R^2	0.79	0.84	0.79	0.84	0.34	0.43
Adj. R^2	0.78	0.84	0.78	0.83	0.32	0.42
Num. obs.	23220	23220	23220	23220	14312	14312
N Clusters	235	235	235	235	187	187

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 2: Difference-in-differences models with time and municipality fixed effects. Int. hom. is intentional homicides; Car. hom. is our imputed measure of cartel homicides; and Mis. per. stands for missing persons. Standard errors are clustered by municipality.

Discussion

Thus far, we have laid out two competing theories for how exogenous shocks through trade liberalization could affect cartel-related violence – the rapacity hypothesis predicting an increase in violence, and the opportunity cost hypothesis predicting a decrease in violence. To investigate these predictions, we test the effect of expanding access to international markets for avocados on cartel violence using a DID design. We find that avocado market expansion has a significant and substantively large negative effect on cartel homicides and missing persons in municipalities allowed to export avocados following pest-free declaration by the Mexican government and access to trade with the United States. These decreases most clearly support the opportunity cost hypothesis that, by generating more opportunities for employment, higher prices in labor-intensive commodities raise the opportunity cost of violence and appropriation. In examining qualitative evidence, however, we also observe two likely alternative mechanisms that could be driving this effect. Given our DID design, it is difficult to rule out further mechanisms, though empirical evidence lends credence to the explanations we articulate here.

First, we observe a pattern of emerging security apparatuses among producers as a

deterrent to cartel influence. To reduce the likelihood of violence from cartels engaged in extortion in the transport, export, packing, of avocados, communities can and have pooled resources for the provision of armed resistance to contest the reach of illicit actors. "Where predatory actors severely disrupt daily activities, target community members with high levels of violence, and apply rules arbitrarily, we expect local communities to have incentives to rise up" (Osorio et al., 2021, 1568), we should expect these community members develop a shared preference for resistance and counter criminal actors. To be sure, victimization has often compelled communities to engage in an ongoing effort to neutralize the effects of violence with their criminal perpetrators through armed self-defense groups (Moncada, 2020). This creates the possibility that the results are consistent with increased competition over resources, but that greater militarization has been a successful deterrent, rather than a catalyst for violence.

In the case of the avocado market in Mexico, economic agents may divert resources to what Ornelas (2018) describes as appropriative or destructive activities – "defensive measures designed to protect their resources" (764). These groups in particular emerge to purge communities of organized crime and to eliminate extortion of local businesses (Osorio et al., 2021). Specifically, we see many examples of cartel violence forcing select towns and collectives to set up informal security bodies to protect farmers. Avocado growers in Tancítaro, Michoacán's largest avocado-producing town, founded the Tancítaro Public Security Force (CUSEPT), a militarized force operating exclusively as an "avocado army" (Fisher and Taub, 2018). Inspired by the notorious leaders of the *autodefensa* vigilante movement that emerged in response to the Knights Templar such as El Americano, Papa Smurf, and Doctor Mireles, this volunteer militia protects local communities against cartels. In Nuevo San Juan Parangaricutiro, *autodefensas* emerged and organized to form *Moviemiento de Vigilancia* to contest the power of El Gastòn, the local *Jefe de la Plaza* and affiliate of Los Viagras (Wolff, 2020). El Gastòn previously vowed to end the extortion of avocado producers in the area, though reneged on his promise and eventually began again to charge local avocado growers a

protection fee for each acre under cultivation. What started out as eight men, *Moviemiento de Vigilancia* eventually encompassed all of Nuevo San Juan who "organised themselves into special neighbourhood watch groups, created scheduling mechanisms to manage an expanding web of checkpoints, and developed a communications system to facilitate mass collective action in case of need" (Wolff, 2020, 46), eventually driving out El Gastòn.

Second, other scholarship (Ornelas, 2018; Moncada, 2021) suggests that cartels may engage in exploitative activities that serve to reduce violence by cooperating with actors in the market. Participants in the avocado market in Michoacàn have formed large collectives where producers, packaging plants owners, and exporting companies work together to accomplish certification and to promote avocados. These collectives, known as Juntas Locales de Sanidad Vegetal (JLSVs) oversee production and harvesting processes and provide municipal-level data to federal and state authorities for certification (Moncada, 2021). Moncada (2021) documents how victims of extortion have either provided cartels with information of where to extort along the commodity chain, or they have even operated with cartels to collect criminal taxes themselves.

The community of avocado producers see these actors as victims rather than criminal actors engaging in collusion (Moncada, 2021). Indeed, the producers that cartels extract information from or force to collect taxes often were kidnapped to be later released, and so they had no other choice but to act in service of the cartel. Feasibly, because cartels identify points of extortion ex ante by exploiting previous victims, they do not need to use violence because the threat alone is sufficiently compelling.

Conclusion

In sum, we have tested dual hypotheses predicting the effect of market shocks on violence. First, the rapacity argument holds that violence will increase because competition over resources leads to conflict. Second, the opportunity cost argument holds that violence will

decrease because increases in employment opportunities and wages from labor-intensive commodity booms reduces returns from appropriation. We ultimately find that expanding access to international markets for avocado producers in Mexico significantly decreased cartel violence in producing regions. This reduction largely supports the opportunity cost hypothesis, though we observe evidence in support of two potential alternative mechanisms as well. First, some communities have pooled resources to create and support bodies for armed resistance to crime. Second, cartels may cooperate to reduce violence in order to maintain the market.

This article thus speaks to a broader literature of crime in licit markets, specifically related to trade liberalization in areas of low state capacity. We build upon the common assumption held by Gambetta (1996), Bandiera (2003), and Reuter (2009), among others, that organized crime syndicates act as firms that integrate within legitimate markets in areas of newfound growth where formal state institutions are weak. We claim that cartels corner expanding licit markets to fund and facilitate violent enterprises. Specifically, trade liberalizing policies lure cartels to the licit world as markets become more lucrative. While market expansion draws labor to the avocado industry and away from illicit markets, violence may also decrease as criminal competition over licit resources is contested by local communities, or if organized crime has a vested interest in limiting violence in the industry.

The implications of this analysis are twofold. First, empirically, we provide evidence of a phenomenon that goes against media expectations. Indeed, sensationalist media headlines have us distressed over buying luxuries such as chocolate,[12] vanilla,[13] and watermelons.[14] It is thus justifiable to assume that violence increases in areas of low state capacity

[12]e.g. *The Two Faces of Chocolate: Food of the Gods and the Harbinger of Violence* (https://chocolateclass.wordpress.com/2020/03/29/the-two-faces-of-chocolate-food-of-the-gods-and-the-harbinger-of-violence/).

[13]e.g. *Madagascar's vanilla wars: prized spice drives death and deforestation* (https://www.theguardian.com/environment/2018/mar/31/madagascars-vanilla-wars-prized-spice-drives-death-and-deforestation).

[14]https://www.powercorruptspodcast.com/episodes#/blooddiamondbloodchocolate/.

where we see growing wealth from liberalizing policies. However, this analysis finds the opposite. We find that trade liberalization can lead to a decrease of violence even in areas of low state capacity.

Second, this article offers a fundamental contribution in terms of policy. Although there was a reduction of violence in areas that were granted access to international markets, this is not to say there was an overall decrease in violence during the period of our study. Indeed, areas of low state capacity create a permissive environment for violence, for criminal groups are able to emerge and fill the power vacuum left by weak states. This becomes particularly appealing in areas that are positively impacted by globalization due to the influx of capital. Policymakers should therefore pursue policy interventions to mitigate adverse domestic consequences of globalization. But, as Mexico's War on Drugs has taught us, top-down strategies to address cartels only exacerbate crime and violence, implying that bottom-up strategies may instead be more effective. This not only involves reinforcing security and reducing corruption at the local level, but it also means allowing local communities to themselves acquire the resources and develop the institutions necessary to challenge organized crime.

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Appendix

	I.h./Pop	I.h./Pop	C.h./Pop	C.h./Pop	M.p./Pop	M.p./Pop
Mexican cert.	-0.07^{**}	-0.01	-0.02^{**}	-0.00	0.00	0.00
	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
U.S. trade	-0.07^{**}	-0.07^{*}	-0.02^{**}	-0.02^{*}	-0.00^{**}	0.00
	(0.02)	(0.03)	(0.01)	(0.01)	(0.00)	(0.00)
Mun. time trends	N	Y	N	Y	N	Y
R^2	0.52	0.56	0.53	0.57	0.04	0.07
Adj. R^2	0.51	0.55	0.52	0.56	0.03	0.04
Num. obs.	23220	23220	23220	23220	14264	14264
N Clusters	235	235	235	235	186	186

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table A1: Difference-in-differences models with time and municipality fixed effects. I.h. is intentional homicides; C.h. is our imputed measure of cartel homicides; and M.p. stands for missing persons. All outcome variables divided by 2015 population. Standard errors are clustered by municipality.