From Cocaine to Avocados: Criminal Market Expansion and Violence

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Abstract

Most of what we know about organized criminal violence comes from research about illicit narcotics markets. Yet, these groups also fight to capture markets for licit commodities, as evidenced by Sicilian lemons and South African abalone. When do criminal groups violently expand into markets for licit goods? We argue that rapid increases in the share of a good's export value create opportunities for immediate profit and future market manipulation. This provokes violence as groups expand their territorial holdings and economic portfolio. We test our argument cross-nationally using the Atlas of Economic Complexity, V-Dem, and UNODC. Increases in a country's share of global export value for agricultural goods are associated with more homicides– but only where criminal groups are present. We then provide subnational evidence of our mechanism using data on avocado exports from Mexico, and address reverse causality with Google Trends data about the popularity of avocado toast searches.

1 Introduction

Conventional wisdom suggests that criminal organizations—groups involved in a variety of criminal activities, whether it be drug cartels, gangs, or mafias (Lessing, 2020, 3)—emerge to violently capture rents from illicit goods sold illegally on informal markets (Misse, 2007, 140). In fact, much of what we know about criminal organizations and their behavior is connected to illicit drug markets (Snyder and Durán-Martínez, 2009; Durán-Martínez, 2017; Trejo and Ley, 2020; Lessing, 2017; Osorio, 2015). However, examples across time and space tell a different story: in the 1800s in Sicily, the mafia took over the market for lemons, and in the 1900s in New York, it sought to control the artichoke market. In the 1990s, street gangs in Cape Town, started encroaching on the abalone market, and in Mexico in the 2010s drug cartels took control of the lime and avocado markets (Dimico, Isopi and Olsson, 2017; Tiscornia, 2022; Linthicum, 2019; Critchley, 2008; García-Ponce and Lajous, 2014). If trading in illicit goods is highly profitable, why bother with artichokes, lemons, and shellfish?

Existing research shows that criminal groups attempt to control markets that seem profitable (Wainwright, 2016; Lessing, 2017). Yet, diversification into other markets has costs and it should not be assumed to be automatic: economies of scale are not always present, not all markets are complementary, and not all groups are equally risk-tolerant (Farfán-Méndez, 2019). Because research on the conditions for criminal diversification into licit markets is underdeveloped, it is unclear whether we should expect the drivers or the levels of violence associated with diversifying into licit markets to be the same as those in illicit markets. To fill this gap, we develop a theory of the conditions for the diversification of criminal economic portfolios by participating in markets for licit commodities, and in turn, when such expansion is likely to generate violence.

We argue that when the export value share of agricultural goods rapidly increases, criminal organizations will seek to profit from these newly lucrative, expanding markets. Positive price shocks to agricultural goods exported in high quantities by these organizations' home states present unique opportunities for profit, local territorial gain, and long-term control that merit the risk of diversification, or 'criminal market-capture'.

Organizations capitalize on these opportunities by engaging in coercive violence against agricultural producers, the state, and rivals to secure territorial and economic control. In developing our argument we address two interrelated questions: when does criminal diversification into markets for licit commodities happen? And, when does it produce violence?

Our work contributes to current research on organized crime in four ways. First, in centering on markets for licit commodities, we identify another area of criminal involvement. In specifying the conditions for diversification into licit markets we extend existing findings from research on illicit markets into an under-researched area. In doing so, we provide a more complete understanding of the motivations behind criminal groups' behavior and demonstrate that it is not only circumscribed to controlling illicit markets.

Second, in developing our theory of market diversification and violence we also contribute to new research on the drivers of informal mechanisms of criminal governance and coercion at the local level. Rather than the main goal, violence against civilians is a byproduct of profit maximization. Our theory applies to markets of licit agricultural commodities that are territory-bound. To control production as part of the process of market diversification, criminal organizations seek to control the territories where these commodities are grown. In turn, territorial control can require coercion and violence, which can increase future capacity to profit from the criminal underworld.

Our theory of market diversification ultimately points to the consequences of criminal attempts to control life at the local level, adding to our theoretical understanding of the phenomenon of criminal governance. When criminal organizations move from controlling drug markets to other spheres of life–namely, licit markets–they become a relevant political actor. Inasmuch as their behavior affects community behavior, it has important implications for our understanding of politics more generally (Trejo and Ley, 2020). Furthermore, criminal organizations today produce violence comparable to that of civil wars (Lessing, 2017). Understanding the conditions for the escalation of criminal violence is central to our overall understanding of peace and security.

Third, we generate a cross-national systematic explanation of criminal group behavior.

Existing knowledge comes primarily from case studies. We draw on this rich literature focused on theory development, to develop and test a cross-national account. To do so, we shed light on international agricultural markets as an important trigger behind criminal diversification. We contribute to existing research focused on dynamics of illicit markets and how these dynamics spark changes in criminal competition, violence, and control. Finally, our study has potential policy ramifications: if local violence can be triggered by changes in international markets of licit goods, policies to combat criminal organizations should not be circumscribed to illicit markets.

Our empirical strategy combines the statistical analysis of a global sample of countries between 1993 and 2018 with the in-depth analysis of the Mexican avocado market. To assess the validity of our argument in the broader sample we use data on agricultural production, criminal threats to the state, and homicides. Similarly, in developing our case study we combine data on criminal groups' territorial presence across Mexican municipalities, with data on avocado exports, and on homicides. We also complement our statistical analysis with evidence from secondary sources to demonstrate the mechanics of criminal market-capture in the market of Mexican avocados.

This strategy faces several challenges. First, we do not have a direct measure of our main theoretical mechanism–"criminal market-capture"–at the global level. To mitigate this challenge, we leverage the case study of Mexico. By zooming in on the avocado market we provide evidence of how criminal market-capture happens by: 1) incorporating extensive field research from secondary sources as an illustration, and 2) leveraging location-specific data about criminal presence in Mexico. Conversely, idiosyncratic features of the Mexican case may limit our ability to generalize, which we address with the cross-sectional analysis. By combining the analysis of time-series-cross-sectional data with a case study we draw on their respective strengths, providing additional confidence in our findings. We devise a general theory and test its applicability to a large number of cases, while also ensuring that our proposed mechanism and the implications of our argument are observable in a representative case.

A second challenge arises from features of our dependent variable. Homicide statistics

suffer from numerous limitations including under-reporting and lack of granularity in terms of perpetrators and targets. These limitations may lead to downward bias in our results, as well as an inability to distinguish between violence involving criminal organizations and other societal violence that also results in homicides. We accept this limitation and interpret our results with caution. A third challenge stems from the possibility of reverse causality. We posit that criminal organizations capture a market following changes in export price and export share. However, it could be the case that criminal groups first manipulate production and supply to influence export value and profitability in international markets. To address this concern we introduce a plausibly exogenous measure of increases in international demand for avocados: the number of searches for *avocado toast* on Google Trends.

Our theory is supported by the statistical results: unexpected increases in a state's share of agricultural goods' export value–an indicator of both immediate opportunities for profit and the plausibility of future market control–is associated with more homicides, but only where criminal groups threaten the state. The results from the Mexican case are also in line with our expectations: increases in a municipality's share of export value of avocados is associated with an increase in homicides where criminal groups are present. Overall, our results demonstrate that unexpected changes in international markets for agricultural commodities are an important driver of the domestic dynamics of criminal violence.

2 When is there criminal market-capture? And when does it produce violence?

Current research suggests that criminal organizations diversify to other markets when it is cost-effective. One mechanism to reduce costs is having a comparative advantage. Explanations emphasizing comparative advantages posit that criminal organizations will diversify to areas where their expertise allows them to reduce entry costs. For example, organizations that smuggle weapons over a border may utilize their knowledge and

access to routes to also smuggle drugs, or migrants (Wainwright, 2016; Scott and Marshall, 1998). Even though leveraging comparative advantages may drive diversification in markets for illicit goods, scholars disagree regarding its general applicability because not all illicit markets are the same. For instance, entry costs for naturally produced heroin are higher than those of synthetic drugs (Morrison, 1997). Furthermore, it is not clear that comparative advantages in illicit markets would apply to markets of licit goods in the same way. Criminal organizations may encounter additional challenges in markets of licit goods: being part of the regulated economy involves taxation and increased state controls, which significantly drives up entry costs and reduces the benefit for criminal organizations. The comparative advantage logic seems insufficient to explain why we observe criminal groups capturing markets of licit goods. To increase future profits, engagement in other markets requires focusing resources away from markets currently under their control. According to our theory, when a good becomes unexpectedly highly lucrative and offers opportunities for price manipulation in the future, organizations will prioritize that market because they can offset the cost of diversifying.

An implication of theories that emphasize comparative advantages is that because criminal organizations have a comparative advantage in the use of violence they will resort to it in order to diversify. Though the process of diversification frequently involves the use of violence, not all illicit markets are equally violent (Snyder and Durán-Martínez, 2009). There is general agreement among researchers that violence associated with criminal markets largely stems from the disruption of previous relationships among criminal groups, or between them and the state (Barnes, 2021; Lessing, 2017; Trejo and Ley, 2020). When state sponsored protection rackets—informal mechanisms for the selective application of the law (Snyder and Durán-Martínez, 2009; Trejo and Ley, 2020)—are disrupted, or when groups are unable to build structures to jointly extract rents (Meehan, 2011), levels of violence in illicit markets will increase. In short, opportunities for expansion can generate violence as organizations compete with one another and the state.

According to this line of research opportunities emerge from disruptive shocks that are political: for example, protection rackets are destabilized when corrupt public officials

are removed after elections, and disputes over the regulation of illicit markets trigger spirals of violence (Trejo and Ley, 2020). Either criminal organizations fight each other over control of illicit markets (Trejo and Ley, 2020; Yashar, 2018; Magaloni et al., 2020), or they fight the state, depending on how it prosecutes them (Durán-Martínez, 2017; Lessing, 2017; Blume, 2022). This body of research focuses on illicit markets, and it does not provide specific predictions for violence in markets for licit goods. Nor does it consider how other types of disruptions, besides political ones, may shape patterns of violence. We propose that changes in markets for licit goods provide a powerful trigger for variation in criminal violence as groups diversify.

Features of goods, particularly their lootability, represent another mechanism to increase cost-effectiveness. Scholarly research on resource lootability shows that characteristics of natural resources, such as their high value and relative isolation, make them attractive and easy to control (Dal Bó and Dal Bó, 2011; Ross, 2004). But a market's ease of capture and high value does not imply it is sufficiently attractive to merit diversification. To be desirable, it needs to add significant profit to a criminal group's existing portfolio.

Further, not all natural resources are equally lootable. For example, the exploitation of raw materials such as oil, or certain minerals, requires higher capital investment relative to agricultural commodities (Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013). In addition, when valuable minerals can be concealed, as with gold, criminal organizations need to develop additional surveillance and tax structures that increase, rather than decrease, the costs of control in the long run (Sánchez De La Sierra, 2020). Although agricultural goods are not inherently valuable like diamonds, gold, or oil, they require minimal up-front investment while providing a unique opportunity to advance organizations' long term economic goals. Because agricultural goods are territory-bound, controlling their production can bolster criminal organizations' ability to build informal governance structures through territorial control—both of which help deter challengers in the future and aid in additional economic investment. Thus, our theory explains how changes in the value of even unlikely goods can trigger diversification due to the perceived

opportunity for profit, expansion and control.

Theories of resource lootability also develop predictions about violence. Longstanding research indicates a strong association between commodities and conflict (Bazzi and Blattman, 2014; Ross, 2004). In this framework, because commodities are highly profitable, they trigger competition over their control, which increases violence (Herrera and Martínez-Alvarez, 2022). Other scholarly research casts doubt in terms of commodities' high value as a trigger behind violence. Research points to price shocks across different markets as a catalyst for violence. For example, negative price shocks in the international market of maize drove Mexican laborers into cultivation of illicit drugs, which in turn generated incentives for criminal organizations to violently dispute control over the illicit crops (Dube, García-Ponce and Thom, 2016). Still other research suggests that how changes in illicit commodity prices affect violence depends on whether such violence is produced primarily by the state or non-state groups (Estancona, 2021).

Since most of this research explores economic changes and variation in violence in specific countries and for specific, usually high-value, commodities, we lack a general understanding of the conditions for both diversification and violence across commodities and countries. For example, we know little about criminal actors' motivations for expansion into markets for licit goods. Building on existing findings we propose a refinement of existing literature. Much of the existing research zooms in on commodity price without also considering the size of the export market. We argue that where a state's export value share is sufficiently large, international price changes will incentivize criminal organizations to capture the markets for these commodities.

To summarize, we do not observe criminal diversification into all profitable markets, nor does diversification entail the same levels of violence when it does occur. According to our argument, rapid increases in price in markets with opportunities for future control provide windows of extreme profitability adding to the existing appeal of licit agricultural goods. We argue further that because these commodities are territory-bound, controlling production allows groups to build informal mechanisms of coercive governance with the ultimate goal of maximizing profit (Lessing, 2020). Violence, in turn, is the result of how

much resistance they face in the process. We develop this argument next.

3 A theory of violent criminal diversification

Criminal organizations trade in illicit commodities because of the immense profits derived from their control. To increase their profit, they may seek to diversify, that is, to capture additional markets of goods or services. Diversification may provide profit in the short-term, or socioeconomic control that allows for new profit opportunities in the long-term. Market capture is the process of establishing control over portions of the market for a commodity. In turn, control is decision-making power over the activities involved in a market, such as determining prices, establishing volumes to be sold, amounts to be harvested, or selecting wholesalers. We refer to 'criminal market-capture' as forcefully and illegally controlling portions of the market for a commodity, eventually manipulating production and prices.

Criminal markets emerge when brokers gain control by evading regulations and using violence in some part of the chain of production and distribution of a given good, but they do not require controlling the entirety of the chain (Giraldo Ramírez, Rendón and Duncan, 2014; Idler, 2020). For example, in the 1920's the Morello-Terranova mafiosi in New York leveraged their control over the *distribution* of artichokes coming from California because they controlled the rail line and imposed a 'tax' on artichokes arriving from California by train (Dash, 2011; Critchley, 2008). The Sicilian mafia sought to control the *production* of lemons and manipulated prices by controlling groves (Dimico, Isopi and Olsson, 2017, 1091-1098), and South African gangs leveraged their *storage* capacity to manipulate local prices in the abalone market (De Greef, 2014). Because it requires the least amount of investment and specialized knowledge, we focus on attempts at controlling production, and center on agricultural commodities that are territory-bound.

We would not expect criminal organizations to start exploiting a market in places that are not well suited to do so with minimal costs of entry. Exploiting territory-bound agricultural commodities vis-a-vis other natural resources reduces costs of entry: Be-

cause agricultural commodities are territory-bound and generally controlled by a small number of producers, capturing and controlling production becomes easier (Herrera and Martínez-Alvarez, 2022). Further, they typically require lower levels of technology, labor and tailored production knowledge. Existing shipping routes, infrastructure, labor, and local markets, also reduce up-front costs (Farfan Mendez, 2021). These features reduce the cost of diversification, and increase profitability making them ripe for criminal investment. Because controlling production of territory-bound commodities ultimately involves controlling producers, minimizing state involvement, and expelling other criminal competitors, we expect violence at this point of the chain of production and distribution to be higher than in other points (Blume, 2021; Koivu, 2016).

Because agricultural goods require land for growth and production, criminal groups must gain territorial access to profit from them. Controlling the markets of licit agricultural goods affords them opportunities to build criminal governance—informal mechanisms of control with the ultimate goal of profit maximization (Arias, 2017; Lessing, 2020; Trejo and Ley, 2020; Yashar, 2018). Through market-capture, criminal groups can get access to the local communities where these markets are embedded, and gain control over local institutions (municipal governments, producers' associations). Eventually, they may manipulate the electoral process through candidate appointments, or their elimination, ultimately ensuring control over policies that make illicit activity easier (Trejo and Ley, 2020; Herrera and Martínez-Alvarez, 2022; Arias, 2017).

We argue that criminal groups attempt diversification into the markets of licit commodities when there are unusually large increases in the export value of such goods produced where these groups operate. These disruptions in export markets bring attention to the newly high value of a commodity and create an opportunity to increase short and long term profits. Our argument zeroes in on countries' market share of agricultural commodities as an overlooked factor that creates incentives for criminal market-capture when the value of these goods changes. We emphasize that international price increases for agricultural commodities create a significant opportunity to profit when criminal groups operate in states that account for a large portion of the commodity's international market share.

Under these conditions, criminal groups will attempt to seize the opportunity for profit and eventual market control.

Because our goal is to provide an explanation of the initial impetus for market capture, rather than focusing on continued control, we focus on expansion into new markets following positive shifts in price. Even though criminals could capture a market after a negative shock, work to restrict production and increase prices (García-Ponce and Lajous, 2014), this process requires time and its outcome is uncertain. A rapid increase in price provides certainty that there will be dividends in the immediate future. Groups could also attempt diversification into the markets of high-price licit goods such as gold or gems in the absence of a shock, but this would require divesting from the illicit business. It would also require knowledge about which markets to attempt to control and significant up-front costs. Since criminal organizations' main goal is to maximize profit from illicit markets, we expect diversification to happen when a distinct opportunity arises: rapid increases in price in markets that criminals can reasonably seek to capture and eventually manipulate.

We posit that criminal groups seek to maximize both short-term payoff and long-term financial investment. Consequently, price shocks alone do not capture the whole story: a state's export share within a given global market matters. If criminal organizations are primarily focused on maximizing profit, capturing a market that only represents a small share of the international economy might temporarily allow them to increase their profit by reducing that of producers, but it would not allow them to manipulate prices as effectively. Several empirical examples provide descriptive support for our argument: South Africa is the world's third largest producer of abalone, a commodity targeted by criminal organizations (Tiscornia, 2022); at the end of the 19th century, Italy was a leading producer of lemons–a market that the Italian mafia targeted (Dimico, Isopi and Olsson, 2017); Mexico is the world's largest producer of avocados and the second largest producer of limes, two markets that criminal organizations have actively targeted (García-Ponce and Lajous, 2014). Export share, in combination with upward shifts in price, creates a lucrative window for immediate profit as well as incentives for market capture.

Criminal organizations are aware of the profitability of these markets internationally because they typically operate as brokers between sellers and international buyers, and as contract enforcers (Dimico, Isopi and Olsson, 2017; Tiscornia, 2022). In synthesis, criminal groups are most likely to enter licit agricultural markets when the state in which they are present accounts for a sufficiently large share of global agricultural production.

Criminal groups prefer to minimize violence as much as possible, to reduce the attention drawn to themselves (Magaloni et al., 2020; Blume, 2021; Barnes, 2017; Durán-Martínez, 2017). Nevertheless, when seeking control of newly profitable markets, groups may face tensions: other groups may also be trying to quickly gain control, producers may resist, or the state may seek to eliminate them. When criminal groups dispute markets, violence ensues as they fight each other for control (Trejo and Ley, 2020; Snyder and Durán-Martínez, 2009; Magaloni et al., 2020). Taking control of production also involves some level of violence against producers. For example, criminal groups may invade plantations and forcefully remove producers, which results in violence (Aspinall, Kenny and Shrestha, 2019; Palacios, 2012). They may also begin to regulate picking season, or force producers to sell their land to them (García-Ponce and Lajous, 2014; Moncada, 2021). But if groups build cooperative relationships with communities they can keep violence low (Blume, 2021; Magaloni et al., 2020; Dipoppa, 2023). The extent of violence against producers is also influenced by competition from other groups - if a good becomes newly lucrative, this can spark competition to seize profit as quickly as possible. Work on rebel governance tells us that when violent organizations compete, violence against civilians is more likely (Arjona, 2016). The rush to seize territory and profit may make criminal organizations more violent against one another as well as against producers.

Another potential source of confrontation and violence is the state. When the state confronts criminal organizations, either to reclaim spaces under criminal control, or because the security apparatus is protecting one group versus another, violence escalates (Yashar, 2018; Trejo and Ley, 2020; Lessing, 2017; Trejo, Albarracin and Tiscornia, 2018). But states also establish cooperative or non-confrontational relationships with criminal organizations (Barnes, 2017). If the state intentionally does not confront a criminal

organization–and there are no other competitors–, or when law enforcement is absent from a territory, violence will be minimized (Yashar, 2018; Snyder and Durán-Martínez, 2009; Durán-Martínez, 2017). Alternatively, when international demand rapidly increases for an important taxable product, the state may quickly engage in efforts to limit criminal involvement through the use of force.

Because agricultural commodities are generally situated in rural communities, which tend to be more isolated, state awareness of the presence of criminal organizations in these new markets, and subsequent intervention, is not automatic. Criminal groups have incentives to organize takeovers quickly, before the state has an opportunity to become an additional source of confrontation, or it needs to be bought out. Variation in violence is also a result of the type of relationship that groups have with the state (Yashar, 2018; Trejo, Albarracin and Tiscornia, 2018). Thus, we expect criminal violence as groups expand economically and territorially. Changes in goods' profitability and the expansion of their export markets can spark competition from other organizations, resistance from producers, and challenges from the state—all of which increase criminal organizations' use of violence.

Our argument, then, can be summarized in one hypothesis:

H1: Unexpected increases to a state's share of an agricultural commodity's export value are associated with an increase in organized criminal violence in that state.

3.1 Alternative or complementary explanations

While violence due to criminal diversification may result from our proposed mechanisms, there can be other possible pathways. We consider three alternative, but at times complementary explanations: substitution, 'camouflage,' and disruption. It is possible that violent diversification results from the need to substitute markets, rather than add new ones. For example, if drug markets are less lucrative, criminal groups may diversify to other more lucrative ones to make up for lost revenue. The empirical track record does not seem to provide support for this alternative path. According to the United Nations Office on Drugs and Crime (UNODC)'s World Drug Report (2022), which tracks trends

in drug markets, drug prices have remained stable, and even increased across a variety of substances, including cocaine and synthetic drugs.[1] Even if diversification stems from changes in drug markets, it does not invalidate our argument. We would still expect groups to choose markets that would allow them to maximize profits as much as possible, and we offer an explanation for *which* markets criminal groups choose for expansion. Further, diversification to new markets does not imply substitution. Changes in the value and export share of agricultural goods create an opportunity for market capture as a complement of, not a substitute for, drug markets. In fact, diversification may involve parallel processes of development in licit and illicit markets (Farfan Mendez, 2021). As we have argued here, in addition to the profit that can be made in drug markets, criminal organizations may also respond to opportunities resulting from shifts in markets of licit commodities.

Another plausible alternative explanation for diversification into legal markets is tied to the existence of surplus cash from illicit market activity that needs to be camouflaged as legitimate. In this case, whether the market captured has value in itself may be less consequential, and diversification should happen in the absence of violence. Criminal organizations may seek to launder their proceeds through legal businesses, diversification can be a mechanism to facilitate it. One example is the acquisition of gas stations by drug cartels in Mexico (Gagne, 2015).

Although the need to launder money may be a reason to diversify into the legal economy, there are strong incentives to engage in the legal economy beyond smoke screens; but patterns of investment for money laundering would be unlikely to follow the same patterns as investment for economic gain from the sale of goods. In fact, a recent report from the Financial Action Taskforce (FATF), an inter-governmental body set up as an alert mechanism to prevent money laundering and terrorist financing, suggests that there may be more efficient tools to launder large sums of cash than capturing territory-based commodities. These tools include outright smuggling cash, using money brokers, or directly using the banking system. Criminal organizations also resort to the dark web,

[1] The report is available here.

or they may create shell companies. [2] Because money laundering relies on secrecy and minimizing surveillance or traceability, using newly profitable and internationally popular goods to launder would present additional, unwanted challenges.

A third alternative explanation behind criminal diversification is as a response to disruptions in the illicit economy. Governments frequently target illicit markets, expansion into licit ones may have the objective of minimizing detection and loss of profit (Erickson and Owen, 2020). If this were strictly true, we should not observe criminal organizations engaging in illicit enterprises. Furthermore, if the goal was to minimize disruption, criminal organizations would have an incentive to avoid violence in licit markets altogether. Certainly, the risk of disruption in criminal markets is high. As evidenced by UNODC's report, cocaine seizures have increased worldwide over the last 20 years, but so has production, suggesting that increased disruption by law enforcement has not impacted groups' ability to continue to make a profit. Other research has demonstrated that drug prices temporarily increase domestically as a result of disruptions to the illicit economy, further increasing criminal organizations' profit (Castillo and Kronick, 2020; Caulkins and Reuter, 2010). Furthermore, states have strong added incentives to limit criminal involvement in licit markets because of loss of profit, which suggests we should expect higher disruption in these markets.

4 Cross-national analysis: Changes in export value share and homicides

To reiterate, we hypothesize that larger, unexpected increases in a state's share of a commodity's export value—how much profit criminal organizations could expect in the future from capturing a substantial portion of the good's international market—are associated with increases in criminal violence. To test our hypothesis at the cross-national level, we bring together several sources of data about the value of commodities, criminal groups' threat to the state, and the number of homicides per year. We posit that criminal

[2] The report is available here.

organizations seize opportunities for diversification into booming licit markets for agricultural goods, which require minimal initial investment in technology or expertise. To test the validity and generalizability of our claims, we analyze the relationship between changes in a country's share of a commodity's export value and changes in homicides at the country-year level. We use a global sample of countries between 1993 and 2018. This window represents the overlap of available years in our combined data sources and is limited by the availability of homicide data and relevant control variables.

To estimate if meaningful changes in commodity markets are associated with increases in organized criminal violence we first must address some empirical challenges. The areas where these commodities are present may be very different from those where they are not present. If these differences are correlated with our dependent variable they can induce bias in our analyses. We take a series of steps to ameliorate these endogeneity issues: following Herrera and Martínez-Alvarez (2022), we assume that global demand shifts in price, which drives changes in exporting countries' global share of markets, are exogenous to domestic violence levels. This allows us to analyze how unexpected changes in agricultural commodities' global markets affect violence within and across countries. We also lead our dependent variable by one year relative to all predictors. In addition, we employ two-way fixed effects to account for idiosyncratic variation across countries and over time.

Nonetheless, we lack information about criminal organizations' location relative to each product within each state. We also do not have knowledge *ex ante* about which products will experience significant shifts in global demand, and coding each prominent commodity for each country lies outside of the scope of this project. As such, our cross-national results should be viewed as evidence of a positive relationship between changes in a country's share of products' export value and homicides in the following year–but this relationship should only be present in countries with an active criminal threat. We see this global test as proof of concept that opportunities for expansion into export markets for licit goods can provoke increases in homicides where criminal groups threaten the state. We bolster our argument's causal logic in subsequent sections focused on a particular

product within specific territorial bounds: Mexican avocados.

When combined, our data sources yield a data frame of 47,652 observations covering a global sample of countries over the years 1993-2018. Our dependent variable—the count of homicides—takes on a wide range of positive values, making standard OLS an appropriate modeling strategy. In our analyses, we cluster our standard errors by country. Our model is as follows:

$$\begin{aligned}\text{Homicides} = \beta_1 \text{ country characteristics} + \beta_2 \text{ criminal presence} + \\ \beta_3 \ \Delta \text{ Export Value Share} + \\ \beta_4 \text{criminal presence} * \ \Delta \text{ Export Value Share}\end{aligned}$$

We discuss our data sources and measurement of these key concepts as well as confounding variables next.

4.1 Dependent variable

We operationalize our dependent variable—organized criminal violence—as the count of homicides per year by country, and we measure it using UNODC's yearly homicide data (UNODC, 2019). Our choice of dependent variable comes with limitations. A notable difficulty is that these data capture all homicides, rather than only those attributable to criminal organizations. While the UNODC also collects data about homicides attributed to criminal organizations, there are concerning levels of bias and extensive missingness in these data. The available country/years with counts of homicides attributable to criminal groups are but a small fraction of the broader homicide data, and they are notoriously missing or under-counting observations from countries where criminal presence may be rampant.

Nevertheless, using counts of homicides offers an important advantage: it allows us to capture the multiple ways in which organized criminal violence manifests. Homicides due to the presence of criminal organizations may result from confrontations between groups, but also with the state, with producers, or as an unintended consequence in the

death of bystanders. Even though criminal organizations may operate in the absence of homicides, when homicides occur in large scale, they are typically the result of an alteration in the status quo. For our purposes this is important, as we seek to capture the impact of unexpected changes in international markets on domestic violence levels. Previous work, such as Trejo, Albarracin and Tiscornia (2018) , Yashar (2018), and Yoo (2022), has used general homicide data as an indicator of organized criminal activity. We follow these scholars' lead in our use of this measure.

We also validate this choice by checking the simple correlation between homicides due to robberies in a limited sample of countries for which data is available (via UNODC) and changes in export value share. Homicides resulting from robberies are a distinct category from organized crime or gang homicides and are unlikely to follow the same patterns. Our primary concern is that if more 'random' violence such as that from robberies is also associated with changes in our independent variable, the effect we observe may be the result of other underlying economic changes or alternative explanations. However, robbery-driven homicides and changes to export value share are not significantly correlated in our sample. Further, in the Colombian context, where homicide values are high and criminal groups pose a significant threat to the state, the (non-statistically significant) association between robbery-driven homicides and increases in export value share is negative. While this is just one case and one alternative driver of homicides, this allows us to more confidently assert that higher homicide counts following increases in the share of agricultural products' export value are driven by organized criminal organizations rather than other sources of violence.

More importantly, although these data may similarly under-count homicides from criminal groups in particular due to the difficulty in observing clandestine criminal violence or the risk of retribution from reporting, under-reporting of homicides should bias *against* our findings. Finally, homicide data also offer an important advantage to conduct cross-national analyses over time, as they provide comparable information for a large number of countries, across many years.

4.2 Main independent variables

Following our theory, when the short and anticipated long-term value of key agricultural products increases, it provides criminal groups with the incentive to seize territory that yields these crops, often with violent consequences as groups threaten producers, rivals, or state forces. As a result, our primary independent variable must reflect changes in criminal groups' perceived opportunity to profit from these agricultural products. To this aim, we make use of the Atlas of Economic Complexity International Trade Data (The Growth Lab, 2019), which tracks information at the yearly level about countries' export value for individual goods, as well as countries' export diversity and trade sophistication. These data organize and refine information about export and import value and volume based on the United Nations' Statistical Division (COMTRADE) Standard International Trade Classification scheme of products. Specifically, we use the export value of a distinct set of goods. As our argument is about agricultural goods, we include SITC categories 00, 02, and 04, which encompass a subset of goods such as non-processed food products, raw paper materials, and animal or vegetable based oils. We then make several adjustments to capture moments of lucrative economic opportunity that criminal organizations may seize. For each country/year/product, we first calculate the following:

$$\frac{\text{Country Export Value}_t}{\text{Global Export Value}_t} - \frac{\text{Country Export Value}_{t-1}}{\text{Global Export Value}_{t-1}}$$

This operation gives us a measure of the change in each country's share of the export value of each good in the above categories (henceforth Δ_{ev}). Larger, positive values of Δ_{ev} indicate that the country's portion of the growth in export value of a particular agricultural good has increased substantially in the past year. We argue that large values of Δ_{ev} provide windows of opportunity for criminal groups to enter these newly booming markets with goals to gain immediate profit and eventual expansion into capture.[3]

[3] As an additional robustness check, in the appendix we also code positive shocks to our measure Δ_{ev}. We use a 3-year moving standard deviation to capture expected changes in export value share, and code any increase in Δ_{ev} greater than two standard deviations as a positive shock. We then create a dummy variable capturing if the country experiences a positive shock in their share of the export value of any agricultural goods in a given year. Results are robust to this alternate specification of 'large and rapid' changes.

In these instances, we expect that criminal organizations operating in or near territory that produce these booming goods will use coercive violence to quickly seize control of production and exports as a means of increasing both their income and local clout.

Our proposed mechanism centers around the presence of criminal organizations in countries profiting from increased agricultural export wealth. This indicates that increases in global export share of agricultural goods in countries without observed criminal presence should not be associated with an uptick in homicides. To distinguish countries under criminal threat from those in which there is no real criminal presence, we rely on data from the V-Dem project (Varieties of Democracy Project, 2021). We make use of the variable coding "anti-system" movements that are "heavily engaged in criminal activity, e.g. narcotics, bootlegging, illegal exploitation of natural resources, extortion, kidnapping" (196). The variable is averaged over coders' decisions of 0: no criminal threat or 1: the threat to the state is criminal in nature. Values close to 0 indicate that it is unlikely that criminal organizations are a significant threat to the state, while values closer to 1 indicate consensus that criminal organizations are present and active.

Because the majority of states do not see criminal groups engaging in a full "anti-system" threat against the central state, the mean value of this measure is close to zero (0.07). In contrast, states in which criminal groups present a significant challenge to governance score higher: Mexico averages a 0.38, Honduras a 0.36, Colombia a 0.72 and the Philippines a 0.54. This index can be seen as a conservative measure of criminal presence and threat, as countries where smaller criminal organizations operate but do not significantly challenge the state are likely to be under-scored (for example, South Africa averages only a 0.04). However, under-scoring certain criminal threats would bias against any statistically significant findings rather than amplify the relationship between criminal threat, changes in export markets for licit goods, and homicides.[4]

Our argument is that criminal groups engage in violence when expanding their terri-

[4]In the appendix, we employ an alternate measure of criminal group presence: whether or not the state is a major narcotics producer according to UNODC. Because many criminal organizations are active in illicit narcotics trade prior to (and during) diversification into markets for legal goods, this proxy should represent the presence of the largest criminal organizations but may similarly neglect smaller groups or groups not engaged in narcotics production. Results are robust to this proxy for criminal organization presence.

torial and economic presence in markets for licit goods, thus, we expect to see increases in homicides in countries with a clear criminal threat following growth in the local share of a commodity's export value. In contrast, countries without active criminal organizations should not experience a significant uptick in violence. Given this expectation, we interact the criminal presence variable with the change in products' export value share.

4.3 Key confounders

Several other country-level factors may influence changes in the number of homicides states experience in each year. We account for these possible confounders by including a set of additional explanatory variables in our models. We include a measure of GDP per capita to account for connections between country wealth and violence. Further, we control for a state's population given that more populous states experience more homicides. We also include the percent of the labor force employed in agriculture as an indicator of the importance of agricultural commodity production for a state's welfare. All these variables are taken from the World Bank's Development Indicators (World Bank, 2019).

We expect that the importance of a given commodity to the state's economic well-being impacts whether criminal organizations are able to compete both economically and territorially for its control. Export diversification promotes economic growth (Mudenda, Choga and Chigamba, 2014; Hamed, Hadi and Hossein, 2014; Hesse, 2009). Diversified export portfolios lead to stronger states, which are better able to provide access to more employment and economic opportunities to disincentivize involvement in crime. Stronger, more capable states might also be more effective at crime detection and deterrence. Conversely, when countries are dependent on few commodities, states may guard market entry for key products more closely, making it more difficult for criminal groups to take advantage of demand shocks for goods that are central to the economy. Therefore, we should expect higher competition, and violence, in countries with minimal export diversity. We include the Economic Complexity Index from the Atlas of Economic Complexity (The Growth Lab, 2019) as an indicator of a country's export diversity.

Whether a state is embroiled in violent conflict influences the overall level of violence,

therefore, we include a dummy variable that takes on a value of 1 if a country/year experiences civil war and 0 if it does not (Petersson and Oberg, 2020). Finally, a state's ability and willingness to enforce laws over their territory influences both criminal organizations' ambitions and the homicide rate. We include two measures from V-Dem to capture the extent to which laws are enforced and public officials are held accountable: an index of the rule of law and an indicator of how likely public officials are to engage in corruption.

4.4 Results

Our results provide strong evidence in favor of a positive relationship between changes in export value share and homicides in criminally threatened states. As the models in Table 1 show, when criminal organizations threaten the state, increases in that state's share of agricultural goods' export values are associated with a significant increase in homicides. Model 1 provides basic evidence of this relationship, while Model 2 includes the confounding variables discussed in the previous section. Larger increases in a country's export value share of agricultural goods correspond to much higher counts of homicides in countries where criminal groups are active in the following year.

Figure 1 illustrates the substantive results from the complete model in Table 1. The figure shows a sharp increase in homicides resulting from large, positive changes to products' export value share in countries where criminal groups threaten the state. Two issues are relevant for interpretation: First, the median homicide count is just over 300, while the maximum count is 65,000. Figure 1 demonstrates that in countries experiencing even a moderate criminal threat, a 15% change in a country's export value share of key products is associated with a predicted 10,000 homicides in the following year. When there is no change to export value share, fewer than 3,000 homicides are predicted. Further, in countries where the threat from criminal organizations is high, the predicted increase in homicides after a 15% change in an agricultural product's export value share in the previous year is quite stark - over 40,000 at the maximum level of threat. The states falling above the 'mean threat' level are prime examples of organized crime hubs—such as El

Table 1: Change in Export Value Share, Criminal Threat, and Homicides

	(Homicides)	(Homicides)
Δ Export Value Share	-0.681+	-0.590+
	(0.402)	(0.302)
Criminal Threat	0.143	0.159
	(0.177)	(0.175)
Δ Export Value Share x Criminal Threat	9.486*	8.592*
	(4.496)	(4.258)
Population		0.000
		(0.000)
GDPPC		0.000
		(0.000)
% Employed in Agriculture		0.005+
		(0.003)
Conflict Dummy		-0.023
		(0.017)
Economic Complexity		0.000
		(0.040)
Rule of Law		0.383
		(0.255)
Corruption		0.394+
		(0.236)
Num.Obs.	48510	47652
Std.Errors	by: Country	by: Country
FE: year	X	X
FE: Country	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Salvador, Honduras, or Colombia. Thus, in environments where criminal organizations are a salient threat, a larger increase in these states' export value share of agricultural products is associated with substantial increases in homicides.

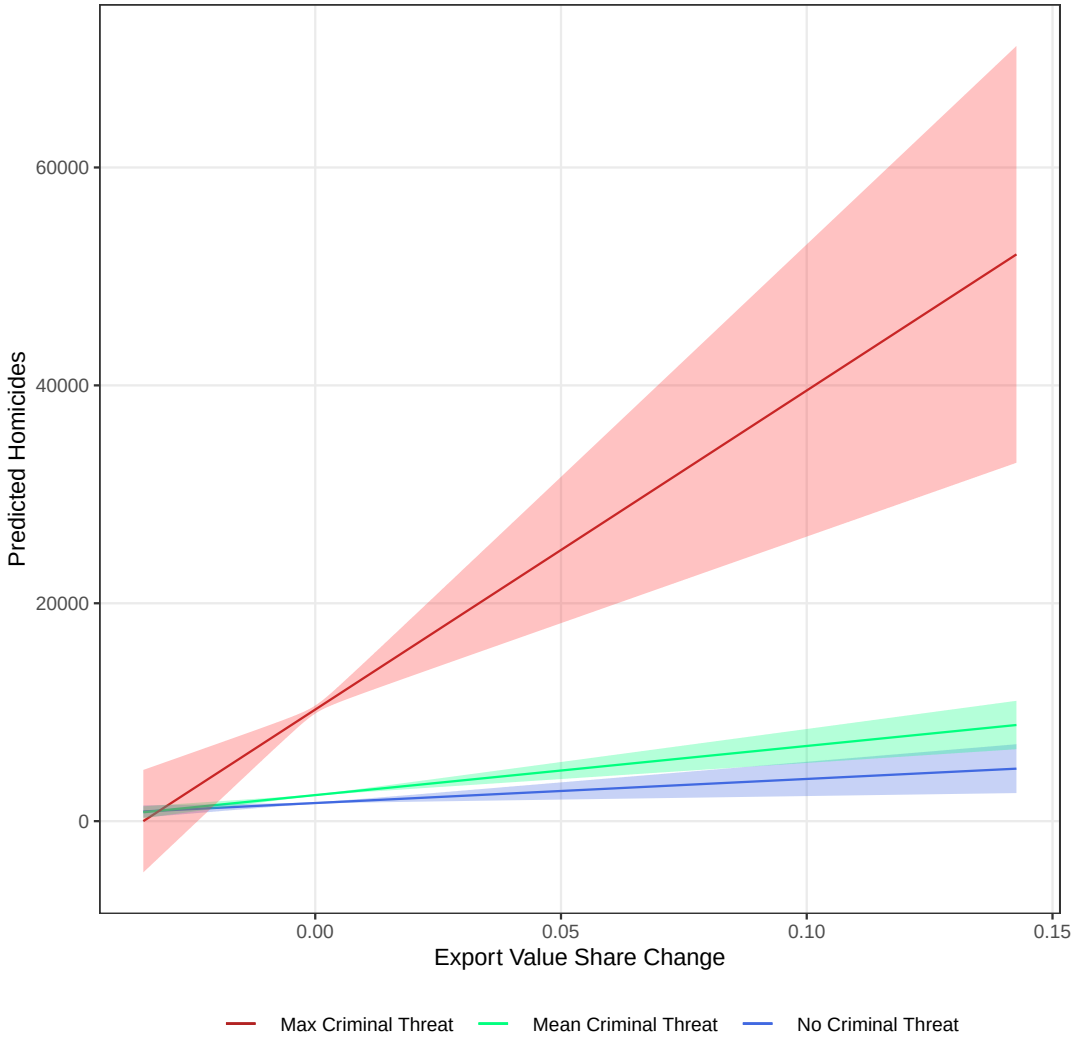

Figure 1: Predicted Homicides, Export Value Change and Criminal Threat (Produced from Model 2 in Table 1)

Our results corroborate the plausibility of our theoretical argument in a cross-national setting. In the next section, we complement our cross-national findings with an in-depth analysis of the Mexican case.

5 The case of Mexico

To illustrate our mechanisms of interest, we conduct sub-national analysis in the case of Mexico, combining qualitative evidence from secondary sources with data on criminal groups' territorial presence and information on avocado exports. The Mexican case offers important advantages: there is wide variation in terms of agricultural production, as well as variation in the presence of criminal organizations and levels of violence across sub-national units. In our design, Mexico can be characterized as a typical case. Typical cases are representative of a population defined based on the scope of a theoretical argument (Seawright and Gerring, 2008). Our argument is scoped to apply to states that are producers of agricultural products with active criminal groups.

As a way to illustrate where Mexico lies in relation to other cases in our sample, Figure 2 plots the average agricultural export value against average homicides. The cases that are labeled correspond to those countries above the threshold of 10 homicides per 100,000 population. This threshold separates countries with epidemic levels of violence, per the World Health Organization's definition, which are likely to face the presence of organized crime (Trejo, Albarracin and Tiscornia, 2018). As the Figure suggests, Mexico is not the only possible case for analysis. However, it is the case where data are available for our central analytical indicators: agricultural production, violence, and criminal group presence at the local level [5]. In addition, research on the dynamics of organized crime in Mexico is extensive, which allows us to triangulate our information and analyses with multiple other sources.

Mexico is one of the main world-producers of several commodities, has widespread presence of criminal organizations, and homicide levels are quite high. If our theory is correct, booms in market share of certain agricultural products should lead us to observe criminal attempts to capture these lucrative markets. In turn, if we observe these dynamics in the Mexican case, we should expect to see them in comparable cases. In the next section, we zoom in on the avocado market. We provide qualitative evidence

[5] Although indicators of the territorial presence of criminal organizations are also available for Colombia (Osorio et al., 2019), the database specifically tracks violent presence, which is more restrictive and also analytically closer to our dependent variable of homicides.

from existing research in Michoacán, the state that concentrates the majority of avocado production in the country, and quantitative evidence of the association between criminal diversification and violence for the market of avocados, which extends beyond Michoacán.

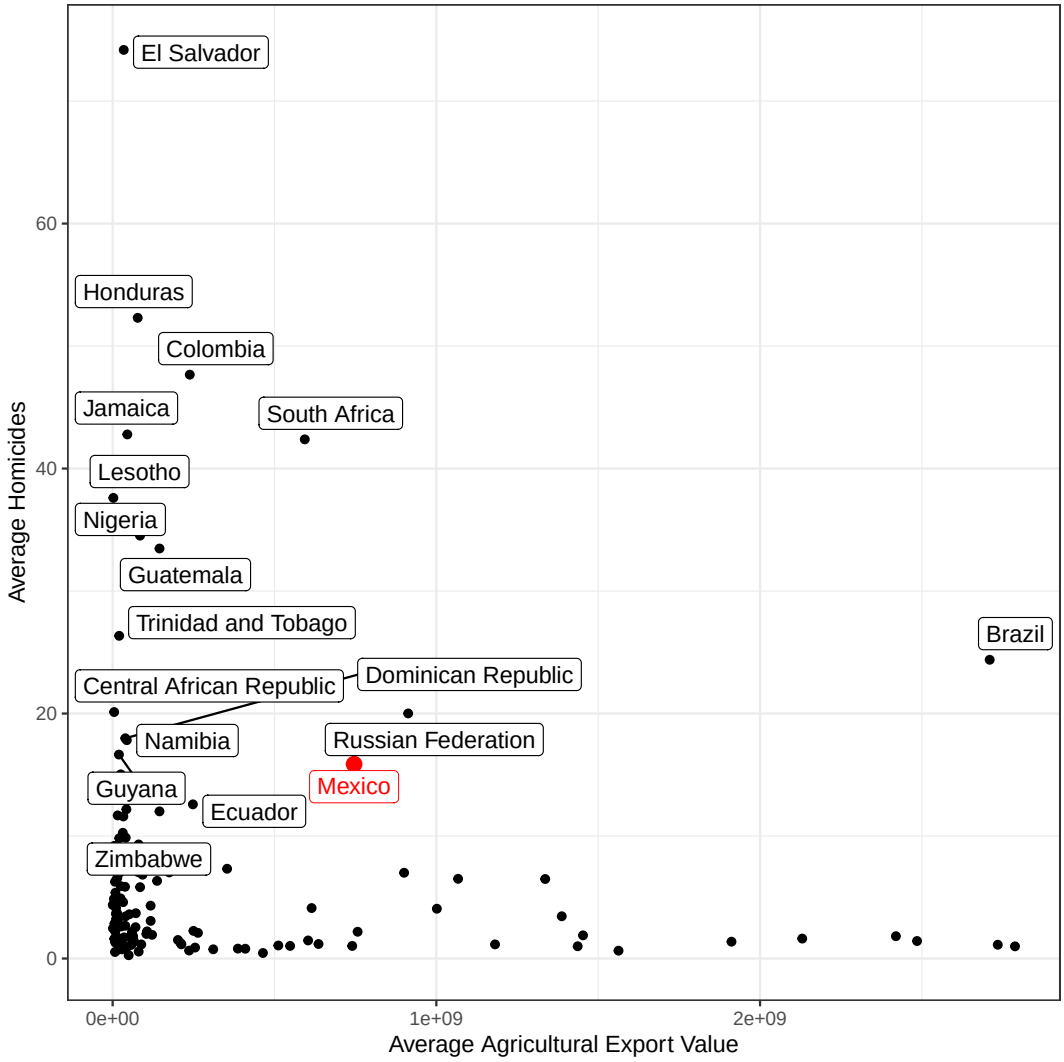

Figure 2: Case Selection

5.1 Avocado production and cartel violence in Mexico

Research on organized crime and violence in Mexico is extensive (Trejo and Ley, 2020; Durán-Martínez, 2017; Lessing, 2017; Osorio, 2015; Magaloni et al., 2020; Ley, 2018). Scholars have posited myriad mechanisms to explain the growth and violent expansion of criminal organizations in Mexico, primarily tied to changes in the international drug markets (Shirk and Wallman, 2015; Durán-Martínez, 2017), as well as factors connected to

the transition to democracy and the loss of networks of protection from the authoritarian period (Trejo and Ley, 2020). The breakdown of protection networks also increased inter-cartel competition and violent confrontations with the state associated with the control of illicit markets (Trejo and Ley, 2020; Lessing, 2017; Osorio, 2015).

As profitable as illicit markets are, evidence suggests that this is not all that criminal organizations in Mexico do. Early accounts of the connections between licit and illicit markets in Mexico date back to the late 1940s and the parallel development of the opium and tomato industries in the state of Sinaloa (Farfan Mendez, 2021). Recently, in states like Michoacán, organized criminal violence has been linked to the avocado, berry, and citrus industries. As Michoacán produces the majority of Mexican avocados, we would expect to observe the mechanics of our theory at play.

Criminal groups have been present in Michoacán for at least four decades, due to its suitability for drug cultivation and its privileged position as a transportation route (Ornelas, 2018). Violence associated with the drug trade dates back to the mid-1990s, driven by group competition and state and communal responses (Herrera, 2021). As Herrera (2021) and Moncada (2021) document, changes in criminal presence in Michoacán as groups move to capture new markets result in spirals of violence. The Valencia family, present in Michoacán in the late 1980s and into the 1990s, controlled the marijuana and poppy trade through a drug-trafficking group called Milenio. In early 2000s, they were displaced by the Zetas, who took control over the lucrative market of illicit drugs, which, by then, included cocaine and synthetic drugs (Moncada, 2021). The Zetas were violently eliminated by the Familia Michoacana a few years later. Avocado production existed in Michoacán since the 1950s, and began to rapidly increase in mid-2000s due to changes in international demand, which boosted export revenue. Even though criminal organizations were already present in the state, they had previously focused on controlling the drug markets.

In line with our theory, existing studies of criminal involvement in the avocado market situate it around the late-2000s, after the boom in exports (Yoo, 2022; Moncada, 2021). By the 2010s, the Caballeros Templarios, who displaced the Familia Michoacana, were

violently targeting avocado production directly. Because avocado producers kept detailed information about productivity, criminal groups knew how much profit they could make. They intimidated farmers to give up their lands, and threatened pickers so they would delay or halt harvesting(Moncada, 2021, 125-127). Those who resisted were killed.

At the time of criminal market-capture in Michoacán, prospects of continued control provided an important incentive. Criminal organizations' efforts to control commodities had the dual purpose of generating revenue and establishing criminal governance, ultimately affecting policy to continue to profit from illicit markets (Herrera, 2021; Herrera and Martínez-Alvarez, 2022). [6]

Beyond this powerful evidence at the micro-level, there is little systematic exploration of the relationship between changes in agricultural markets and criminal control in Mexico.[7] We probe our argument by focusing on the avocado market beyond Michoacán, combining homicide data at the municipality level with data on exports of avocados from Mexican municipalities and criminal presence. Figure 3 represents the spatial distribution of avocado cultivation and criminal presence. As the figure shows, in addition to Michoacán, Mexican avocados are produced in other states, and criminal organizations are present in many areas where avocados are grown.

According to our argument, Mexican cartels should be attracted to agricultural markets when there are large, rapid changes in export value of agricultural goods for which Mexico represents an important portion of the global market. Mexico now accounts for roughly 40 per cent of the world's supply of avocados and it exports them primarily to the United States [8]. Violence results from criminal organizations' economic and territorial expansion due to challenges from competitors, state security forces, or avocado producers.

Our Mexico-specific hypothesis is as follows:

[6]Even though groups engaged in extortion, existing evidence suggests that these practices also involve high levels of violence, including killings. It is unclear that extortion represents an alternative to outright capture of markets, or that it is more effective. Furthermore, if groups are concerned with competition from others, controlling markets, as opposed to merely taxing them, can provide more assurances in terms of future profits.

[7]For exceptions see Herrera and Martínez-Alvarez (2022) and Dube, García-Ponce and Thom (2016).

[8]See here: USDA 2020 Avocado

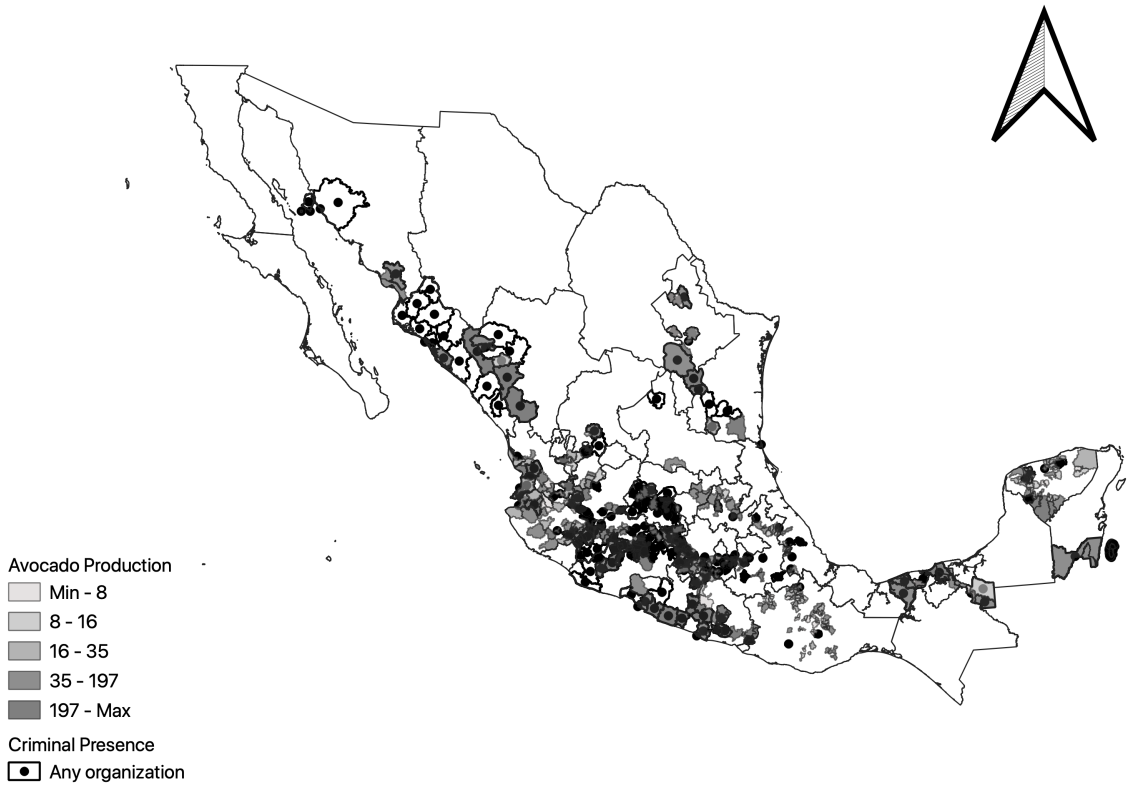

Figure 3: Avocado Production and Criminal Presence

H1$_{local}$: Increases to a municipality's share of avocado export value are associated with an increase in organized criminal violence in that municipality.

6 Sub-national analysis: change in avocado export value share and homicides

In the cross national analysis, we used increases in export value share of agricultural products as an indicator of a country's increasing competitiveness in the export market for these commodities. Such changes in export value share are associated with an increase in homicides where criminal groups threaten the state. Here, we assess the impact of change in the export market for an increasingly important export for Mexico—avocados—on criminal violence. Our argument is that criminal organizations observe *local* changes

in opportunity for economic capture and territorial control resulting from changes in a country's position within the global market for exports. Our cross-national approach allows us to establish a relationship between increases in countries' agricultural export value share of agricultural products and criminal violence. Our sub-national test more carefully addresses the proposed mechanism by testing how locally observable changes in a particular commodity's export value affect criminal groups' use of violence to capture economically strategic territory and the opportunity for market expansion.

Our data captures a 6-year span—2005 to 2010—and totals 11,440 observations at the municipality-year level for the full model. As our dependent variable is the number of homicides, we conduct OLS regressions with two-way fixed effects—municipality and year—and standard errors clustered by municipality. The dependent variable is led one year relative to all independent variables with the exception of a dummy indicator for municipal elections in the current year. Our model is as follows:

$$\begin{aligned}\text{Homicides} = \beta_1 \text{ municipal characteristics} + \beta_2 \text{criminal threat} + \\ \beta_3 \Delta \text{ avocado export value share} + \\ \beta_4 \text{ criminal threat} * \Delta \text{ avocado export value share}\end{aligned}$$

Our independent variables of interest are the change in a municipality's share of avocado's export value, taken from the Servicio de Información Agroalimentaria y Pesquera (SIAP), and the presence of criminal organizations, taken from Coscia and Ríos (2012). We use increases in municipality-level export share as a local indicator of territorial and economic attractiveness to criminal organizations seeking to profit from and possibly manipulate an expanding portion of avocado exports. Because avocados are grown in many Mexican municipalities and criminal organizations compete over control of these areas, (see Figure 3), we can expect organizations to respond to new opportunities to seize profit and territory. When an avocado producing municipality accounts for an increasing portion of Mexico's avocado exports, it should be seen as a particularly lucrative prize. Criminal organizations' use of violence to capture avocado-growing territory and export

profits depends on existing competition and other municipal characteristics.

We capture the degree to which each municipality is threatened by criminal groups with data from Coscia and Rios (2012). The authors use web content to identify areas of operation of Mexican drug trafficking organizations between 1990 and 2010. However, our additional independent variables–including avocado export information–are recorded only from 2004 onward, which limits our time frame to 2005-2010. To assess the extent to which criminal organizations threaten a municipality, we use the number of criminal organizations present in the municipality/year. Municipalities without criminal groups should see no increase in violence, while those in which criminal groups are present should see increased violence as groups compete with the state, other producers, and one another for market access and territorial control. [9][10]

For our dependent variable, we use information on homicides at the municipal level obtained from the National Institute of Statistics and Geography (INEGI).[11] As with our cross-national case, we recognize that unattributed homicides is an imperfect measure of criminal violence. However, if increases in homicides following changes to the avocado market are driven by factors other than criminal violence, we should not observe a difference in criminally-threatened municipalities vs. municipalities without criminal organizations. The raw count of homicides likely under-counts strategic criminal violence, making it a difficult test of our argument. We also control for population size, which can impact the baseline level of violence.[12] To account for state capacity at the local level, which we expect to influence competition from the state or other producers, we control for municipal income, as well as for the number of prosecutors at the municipal

[9]In the appendix we include models with an alternative measure of criminal threat. We code each municipality's percent of years in which at least one criminal group is present in the period 1990-2003. This coding strategy provides an indicator of the municipality's baseline attractiveness to criminal groups and how likely a municipality is to experience criminal presence. This alternative allows us to avoid post-treatment bias, but does not allow for a two-way fixed effects approach given that one of our primary independent variables does not vary temporally.

[10]Datasets such as the Mapping Criminal Organizations project, which cover a more updated set of years, capture criminal presence at the state, rather than the municipality level, or are available for only certain municipalities or a very limited time frame. While an extended and more recent set of years would be ideal, there is insufficient variation in criminal presence to test our hypotheses using state-level data.

[11]Available here.

[12]Data on population are from INEGI, available here.

Table 2: Change in Avocado Export Value Share, Criminal Threat, and Homicides

	(Homicides)	(Homicides)
Δ Export Value Share	-0.009	-0.006
	(0.006)	(0.005)
Criminal Threat	0.071***	0.047***
	(0.015)	(0.011)
Δ Export Value Share × Criminal Threat	0.007*	0.005*
	(0.003)	(0.002)
Election Year		-0.003
		(0.003)
Municipal Wages		0.940***
		(0.202)
Population		-1.342+
		(0.799)
Federal Prosecutors		-0.001
		(0.030)
Num.Obs.	13469	11440
Std.Errors	by: Municipality	by: Municipality
FE: Year	X	X
FE: Municipality	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

level, following Trejo and Ley (2021). [13] [14] Because research has shown that organized criminal violence is linked to elections at the local level (Trejo and Ley, 2021; Ley, 2018), we include dummy variables for local election years. [15] Table 2 presents the results of our subnational analysis.

Table 2 provides evidence in support of our Mexico-specific hypothesis. As anticipated, increases in a municipality's share of the export value of avocados are associated with an increase in homicides, but only in areas where criminal groups are present. Elsewhere, these sharp increases in production value have a dampening (albeit not statistically significant) effect on the count of homicides. Figure 4, produced using Model 2 in Table 2 illustrates the predicted homicides in municipalities with no criminal threat as the share of avocado export value increases vs. predicted homicides in municipalities with multiple criminal groups present. In municipalities that are threatened by criminal organizations—

[13] Data on municipal income comes from Maldonado and Grau (2013) and from INEGI, available here.
[14] Data on the number of prosecutors are from Maldonado and Grau (2013).
[15] Data on local elections are combined from Maldonado and Grau (2013) and from Magar (2018).

making it likely that these organizations observe opportunities to boost their profit and influence—increases in the municipality's share of avocado export value are associated with an increase in the number of homicides. This effect, however, is not observed when avocado export value increases in municipalities with no existing criminal threat. For reference, the median municipal/year homicide count is 3.[16] Meanwhile, municipalities that are highly threatened by criminal organizations and expanding their avocado exports may experience nearly 100 homicides per year—a sobering, but substantively significant effect.[17]

6.1 Avocado Toast and Endogeneity

A notable concern with our empirical strategy thus far is the endogeneity between criminal group presence, a municipality's production of avocados, and their corresponding international price. As part of our theory, we discussed how changes in the international demand for a product can prompt changes in export volume. We hypothesized that this change in both market share and price makes certain goods doubly attractive for criminal organizations, leading to violence as they compete with other groups, producers, or the state for access and control. However, it may be the case that criminal groups first seize the market for certain goods and then manipulate their supply and price. In the case of Mexico, this would mean that criminal organizations first manipulated the production and supply of avocados to influence their export value and profitability in global markets.

[16] While the median value is low because we have many municipality/year observations with no homicides recorded, the maximum amount of homicides is over 900. As expected, the larger values of homicides are found where criminal threat is high.

[17] The use of two-way fixed effects to generalize a difference-in-differences strategy over multiple time periods is common in economics and political science. However, the assumptions needed to claim a causal interpretation of these effects are rarely upheld. Notably, for homogeneity of treatment effects, all possible confounders should be observed and included and treatment should not vary across units or time periods. We are interested in the combination of two treatments—criminal presence and changes in avocado export markets, the nature of both of which make homogeneity unlikely. Further, our data are collected in an environment where missing values and non-observation of relevant variables is common (for example, we can only proxy for municipal-level corruption, which likely affects criminal presence and homicides). Given these challenges, we acknowledge that a causal interpretation of our two-way fixed effects approach should be taken with skepticism. Nonetheless, in Figure 5 in the next section, we demonstrate how trends in homicides across different types of municipalities (classified by their avocado growth and criminal threat) are similar until the mid-2000s shift in global, and especially United States, avocado popularity. While our treatment of changes in export value is applied over multiple units and time periods, we see this as the primary shift in the underlying cause of observed treatment.

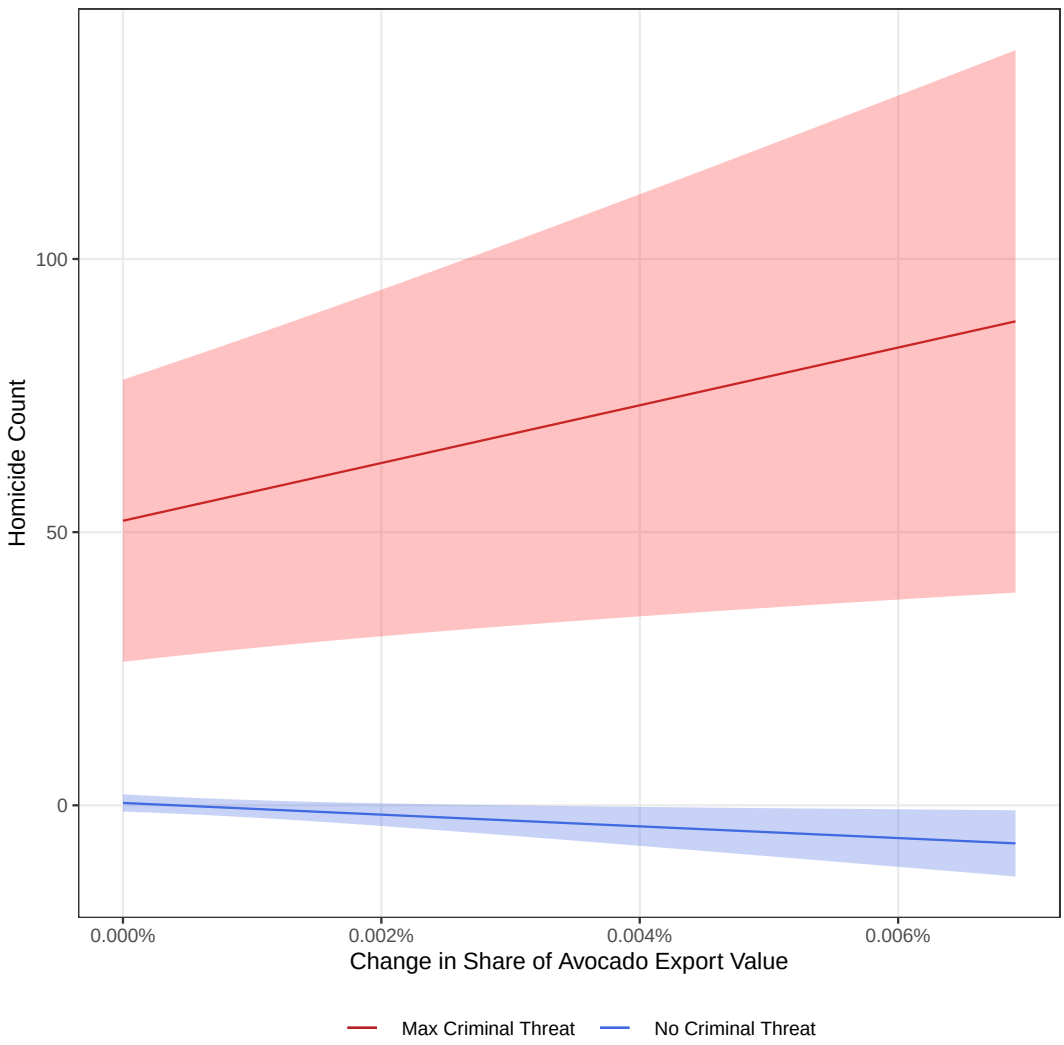

Figure 4: Predicted Homicides by Change in Avocado Export Share (from model 2 in Table 2)

In order to address concerns with endogeneity, we use an alternate, plausibly exogenous measure of export value share, which captures international demand for avocados that might spark changes in Mexico's production and export of this good. However, this measure must also be exogenous to criminal group manipulation. The second condition eliminates international avocado price, which changes based on both demand for avocados (plausibly exogenous) and supply (manipulable by criminal groups). Instead, we use the number of searches for "avocado toast" on Google Trends.

The increased demand for avocados in international markets is driven by consumer behavior, and the popularity of avocado toast illustrates one of these behaviors. Avocado toast gradually became a staple at trendy cafes through the mid-2000s and 2010s, with the

trend taking hold in the United States—Mexico's main avocado importer—in 2006-2007 (Orenstein, 2016). Figure 5 demonstrates the divergence in homicides by municipality type in Mexico following this shift in demand. To this day, the global phenomenon still inspires innovation on TikTok, with influencers and celebrities proposing new recipes or twists on the original. Google Trends captures "interest in a particular topic from around the globe" (*Trends Help*, 2022). Searches for "Avocado Toast" reflect the world's obsession with a new means of consuming avocados, which corresponds to overall trends in consumption. In the United States alone, per-capita consumption of avocados more than doubled in the 2010-2020 period (Manning, 2021). The Trends data scales the relative popularity of a search term over time from 0 to 100, providing information about global demand for avocados that is plausibly exogenous to other factors driving changes in criminal homicides. Although the overall popularity of avocados and avocado toast increases over this time period, there are fluctuations in the popularity of the search. To mimic our previous sections using changes in agricultural or avocado export value, we assess how changes in 'avocado toast' search popularity affect criminal violence in municipalities that export avocados as compared to elsewhere.[18]

Because the popularity of this search term is representative of the international demand for avocados, this measure is not municipality-specific. However, changes in international demand should only affect the attractiveness of municipalities which export avocados and have no effect elsewhere. Our other primary independent variable—criminal threat as captured by the number of criminal organizations—varies by municipality, but it is possible that factors driving changes in avocado exports also provoke changes in criminal presence. To avoid this complication, we use an alternate measure of criminal threat: the proportion of years prior to our observation in which criminal groups are present in a municipality.[19] This alternative measure allows us to avoid post-treatment bias from changes in the attractiveness of a municipality while assessing the impact of increases in international demand for avocados in municipalities with a criminal threat

[18]The minimum change in popularity is about -5 while the maximum change is about 20.

[19]In the appendix, we also provide a robustness check using the number of criminal organizations in the year prior. The results do not change.

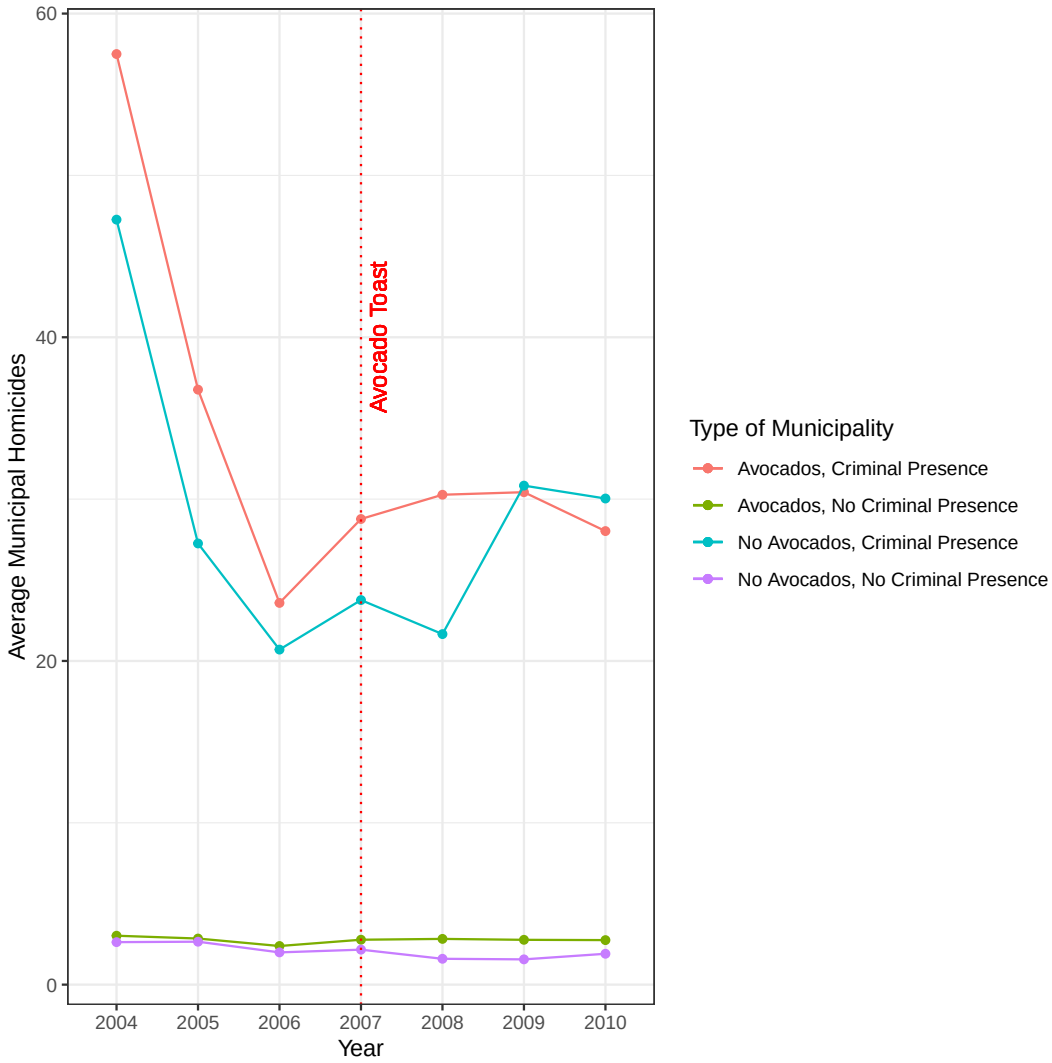

Figure 5: Avocado Production, Criminal Threat and Homicides Over Time

vis-a-vis those without. Our simple model is specified below.[20][21]

$$\text{Homicides} = \beta_1 \Delta \text{ 'Avocado Toast' searches} + \beta_2 \text{criminal threat} +$$

$$\beta_3 \Delta \text{ 'Avocado Toast' searches} * \text{criminal threat}$$

Table 3 and its corresponding Figure 6 provide support for our causal explanation: that changes in global demand for avocados made avocado exports a particularly lucrative business and provided an opportunity for criminal capture in growing areas. An uptick

[20]Because international demand cannot be observed at the municipal level, a classic instrumental variable approach is not appropriate here.

[21]Fixed effects are similarly inappropriate as our modeling strategy in this section intentionally reduces sources of variation across time or by municipality to test the direction of our proposed relationship between international demand, criminal presence, and homicides.

in the popularity of "Avocado Toast" leads to a predicted 250 more homicides in the subsequent year in avocado-exporting municipalities that face a criminal threat. Municipalities that do not export avocados - even those threatened by criminal organizations - are unaffected by these changes in global demand and see no change in homicides.

Table 3: 'Avocado Toast' Search Popularity, Criminal Threat and Homicides

	(Avocado Exports)	(No Avocado Exports)
Δ "Avocado Toast" Searches	0.022	-0.046
	(0.084)	(0.046)
Criminal Threat	313.169***	239.369***
	(6.410)	(4.005)
Δ "Avocado Toast" Searches x Criminal Threat	14.611***	0.045
	(0.913)	(0.567)
(Intercept)	4.107***	4.650***
	(0.596)	(0.327)
Num.Obs.	8241	21684

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

7 Conclusion

Research has predominantly focused on understanding diverse features of organized criminal groups and violence in connection with markets for illicit goods. This paper contributes to our understanding of criminal group behavior by shedding light on a comparatively less studied phenomenon: the conditions under which they might target markets for licit commodities. We develop and test a theory of criminal control of markets for licit goods focusing on the markets for agricultural commodities. We show that when there are positive value shocks that make targeting these markets valuable, criminal groups will attempt to do so with adverse consequences for violence levels. We provide two different sources of evidence, a cross-country analysis and a case study of Mexico. In both cases, the evidence supports our argument. By analyzing cross-national, cross-temporal data, we provide generalizable evidence of our proposed theoretical relationship. By analyzing the case of Mexico we provide direct evidence of the presence of criminal groups and their attempts to control markets beyond illicit ones. Using avocado toast as our measure of

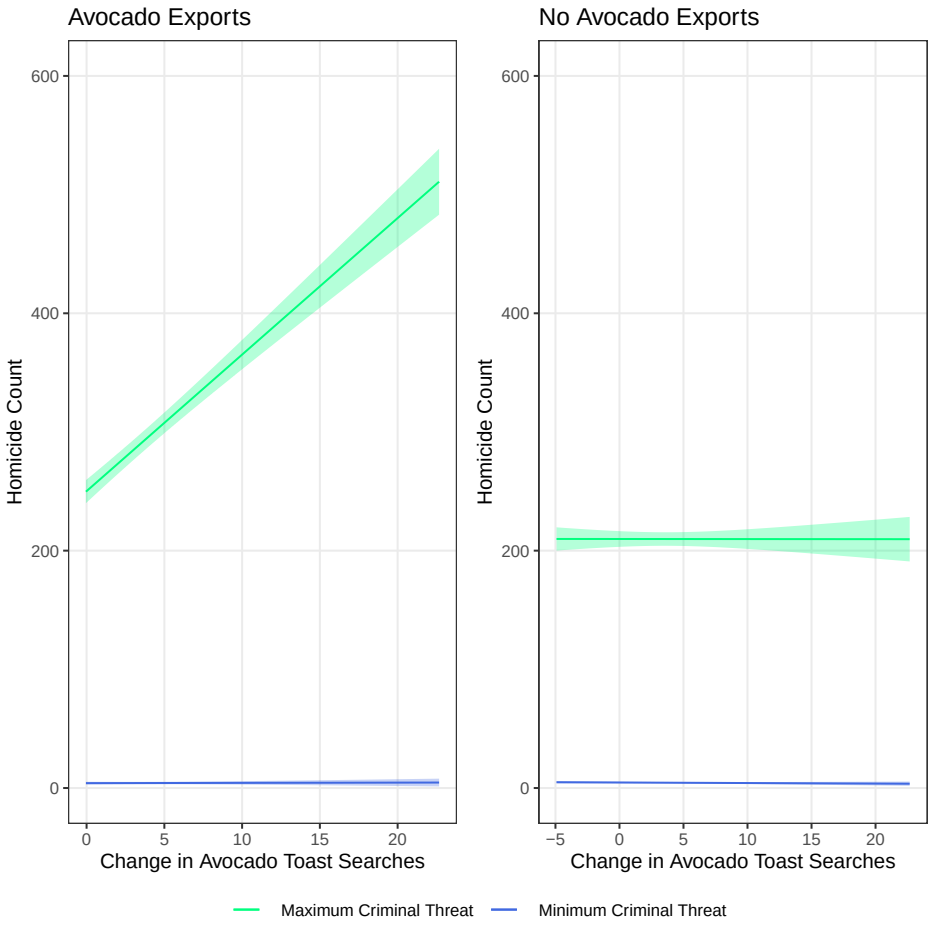

Figure 6: Predicted Homicides and Avocado Toast Search Popularity, Produced using Models in Table 3

international demand helps mitigate concerns about reverse causality.

In our analysis we show that violence is not only circumscribed to the underworld of illicit goods. By understanding why and how market capture of licit goods happens we shed light on when violence may arise in these contexts. Scholars have shown that criminal violence can be as deadly as civil war violence. However, these analyses are focused on illicit markets. By providing evidence of the conditions for violent takeovers of licit markets we extend our current understanding of organized criminal behavior and its consequences to a comparatively less understood area of research. We propose a specific mechanism linking these shocks to criminal group behavior: changes in price and export share. We argue that this is a better measure of groups' motivation to seize markets for immediate profit as well as eventual control and manipulation.

We also generate a systematic explanation of criminal group behavior in a cross-

national setting, currently an underdeveloped area of research. Existing knowledge comes primarily from case studies, which are very rich sources of theory development but limit our ability to generalize. We take advantage of an area where there is access to cross–national cross–temporal data to develop and test our argument.

Our project opens further questions about the nature of diversification and highlights the need for more data collection. There is little information about criminal organizations' revenue streams. Researchers focus on drug markets because they are very lucrative, but not all criminal organizations are powerful drug cartels. Criminal markets are, in the words of Trejo and Ley (2020), "global chains of local operations," and revenue flows at the top may not be the same as at the bottom of the chain. Diversification may be associated with accessing sources of cash that can be more easily distributed among group members at the local level. Because diversification is not necessarily about substitution but about long-term investment opportunities (Farfan Mendez, 2021), more research using fine grained data on group features, is necessary to better understand what types of groups are able to diversify. This points to a specific need to develop strategies for data collection about groups.

Finally, our research also contributes relevant insights for future research. Dominant accounts of organized crime describe it primarily as an urban phenomenon and as a drug-related phenomenon: we show here that this understanding of criminal behavior might be biased. Criminal organizations deal in a wide variety of products beyond drugs, the capture of natural resources implies that these dynamics extend to rural areas. Criminal organizations will compete for the illicit regulation of markets (both licit and illicit ones), but depending on the market, and the point in the chain of production and distribution, implications for violence may vary. Controlling agricultural production is tied to territory and people, and may require higher levels of violence than the production of certain illicit drugs. Variation in behavior has implications for what we know about criminal governance; whether the same mechanisms apply in rural and urban settings and across market segments is an open question for future research.

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Appendix

Table 4: Descriptive Statistics, Dep. Var. and Continuous Indep. Vars.

	Min.	Median	Mean	Max.
Population (Standardized)	0.00	0.03	0.18	4.79
GDPPC (Standardized)	0.01	0.17	0.41	2.82
Percent Employed in Agriculture	0.00	0.31	0.48	1.95
ECI	-3.83	0.13	0.21	2.87
Criminal Presence (Av. Coder)	0.00	0.00	0.07	0.86
Rule of Law	0.03	0.67	0.64	1.00
Corruption	0.00	0.39	0.41	0.96
Homicide Count (Standardized)	0.00	0.02	0.17	3.83

Table 5: Discrete Independent Variables

	No	Yes
Conflict	34584	6006
Shock to Export Value Share	15598	24992

Table 6: Export Value Share and Homicides, no Fixed Effects

	Dependent variable:
	Homicides
Shock in Export Value Share	-0.008^{*}
	(0.004)
Criminal Threat	0.428^{***}
	(0.023)
Shock in Export Value Share x Criminal Threat	0.191^{***}
	(0.027)
Population	0.503^{***}
	(0.003)
GDPPC	-0.058^{***}
	(0.005)
% Employed in Agriculture	-0.195^{***}
	(0.006)
Conflict Dummy	0.133^{***}
	(0.006)
ECI	-0.016^{***}
	(0.003)
Rule of Law	0.961^{***}
	(0.017)
Corruption	1.029^{***}
	(0.017)
Constant	-0.890^{***}
	(0.018)
Observations	40,590
Note:	*p<0.1; **p<0.05; ***p<0.01

Alternate Cross-National Specification: Shocks to Export Value Share and Criminal Threat

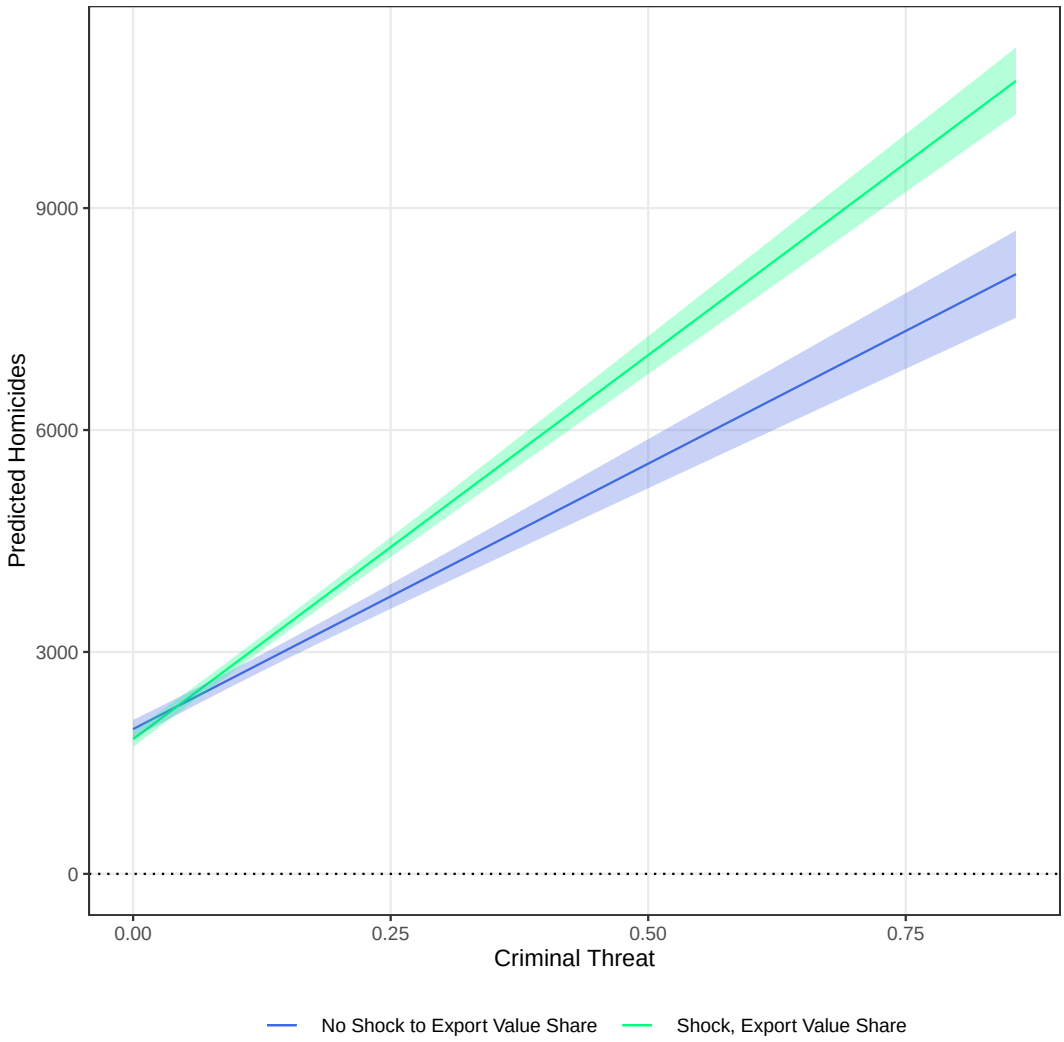

Figure 7: Predicted Homicides and Criminal Threat (Produced from Model 2 in Table 1

Alternate Measure of Global Criminal Threat: Narcotics

In addition to the measure of criminal presence used in the main text (criminal threat to the state coded by the V-Dem project) we also proxy for the location and activity of criminal organizations with a dummy for whether the country is a narcotics producer. We make this choice for two reasons. First, it matches well with our theoretical expectations and motivating examples in which extant drug cartels expanded into the legal market

Table 7: Homicides, Criminal Threat and Shocks to Export Value Share

	Dependent variable:	
	Homicides	
	(1)	(2)
Shock in Export Value Share	−0.002	−0.004***
	(0.001)	(0.001)
Criminal Threat	0.136***	0.153***
	(0.012)	(0.012)
Shock in Export Value Share x Criminal Threat	0.029***	0.018*
	(0.009)	(0.009)
Population		−0.230***
		(0.011)
GDPPC		−0.094***
		(0.010)
% Employed in Agriculture		0.229***
		(0.011)
Conflict Dummy		−0.028***
		(0.003)
ECI		0.003
		(0.003)
Rule of Law		0.387***
		(0.019)
Corruption		0.406***
		(0.017)
Constant	0.069***	−0.607***
	(0.010)	(0.024)
Observations	41,206	40,590
Fixed Effects?	Yes	Yes
Note:	*p<0.1; **p<0.05; ***p<0.01	
Note:	All Indep. Vars. $_{t-1}$	

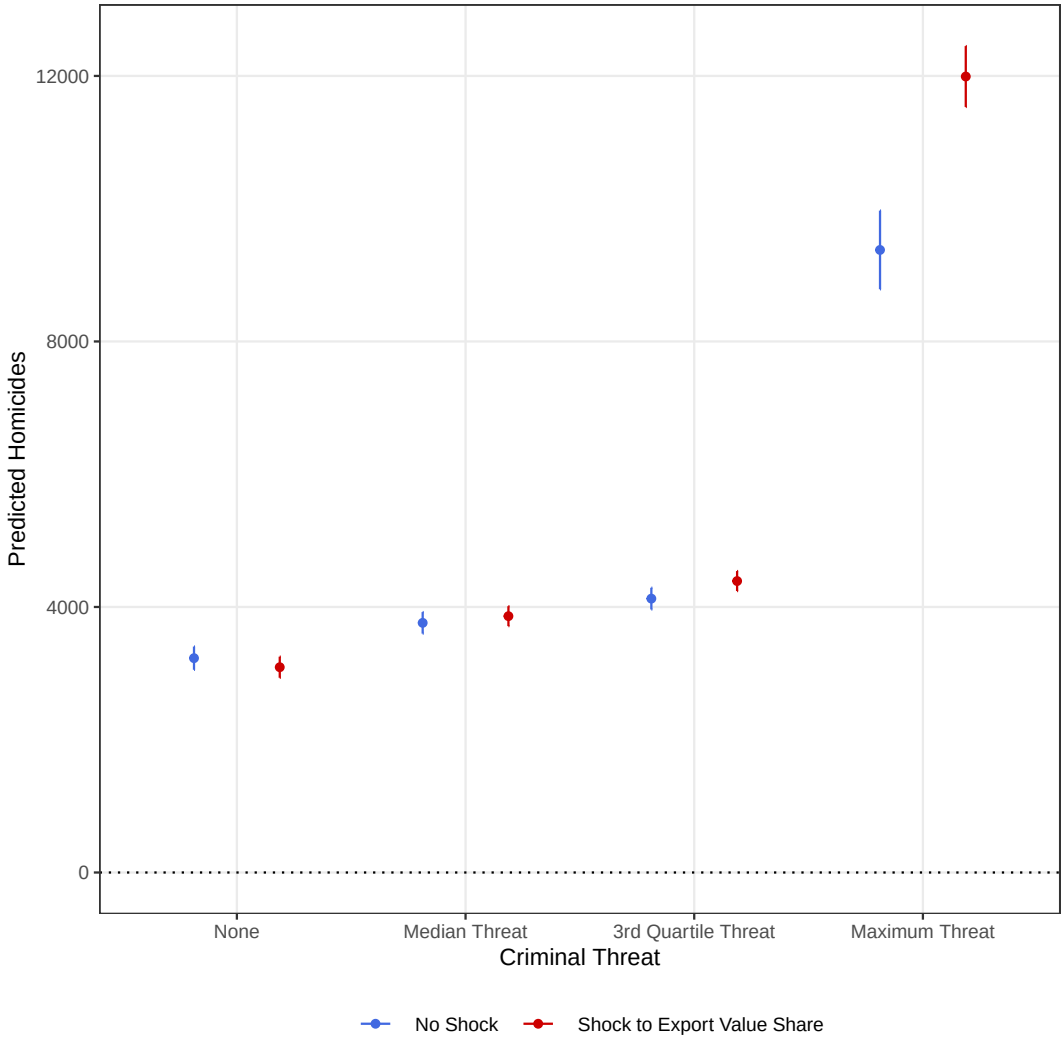

Figure 8: Predicted Homicides, Criminal Threat Categories (Produced from Model 2 Table 1)

for food products. Second, although drug production is not always an indication of organized crime, accounting only for criminal activity in the limited number of drug producing states should bias against our results. We interact this dummy indicator with the share of export value change. When positive shocks to agricultural export value share occur in drug-producing countries, we expect an increase in homicides as a result of criminal expansion. However, similar shocks in non-narcotic states where such groups are less likely to be present should not see a similar escalation of homicides. The results of these additional models - which confirm the results in the main text - can be found in table 8 below.

Table 8: Drug Producing Countries and Homicides, Shock to Export Value Share

	Dependent variable:	
	Homicides	
	(1)	(2)
Shock, Export Value Share	-0.004^{***}	-0.0004
	(0.001)	(0.001)
Drug Producing Country	0.138^{***}	0.043^{***}
	(0.014)	(0.014)
Shock, Export Value Share x Drugs	0.025^{***}	0.023^{***}
	(0.005)	(0.005)
Population	-0.221^{***}	
	(0.011)	
GDPPC	-0.086^{***}	
	(0.010)	
% Employed in Agriculture	0.229^{***}	
	(0.011)	
Conflict Dummy	-0.028^{***}	
	(0.003)	
ECI	0.004^{*}	
	(0.003)	
Rule of Law	0.414^{***}	
	(0.019)	
Corruption	0.418^{***}	
	(0.017)	
Constant	-0.719^{***}	0.062^{***}
	(0.026)	(0.011)
Observations	40,876	41,492
Fixed Effects?	Yes	Yes
Note:	*p<0.1; **p<0.05; ***p<0.01	

Alternate Measure of Criminal Threat in Mexico: Proportion of Years with Criminal Activity Pre-2004

This section supplements the Mexico analysis in the paper, in which we use the number of criminal groups present in a municipality as an indicator of criminal threat. Because criminal groups may move to a municipality due to changes in the market, this measure may suffer from post-treatment bias. We thus provide a robustness check here against this possibility by using the proportion of years in which a muncipality experiences criminal violence *prior* to our window of observation. This measure captures the attractiveness of a municipality for criminal violence prior to observed changes in avocado export value.[22] Results are consistent with those found in the main text.

[22]However, because this measure does not change during the time observed, a two-way fixed effect strategy including municipal fixed effects is not possible.

Table 9: Change in Avocado Export Value Share, Criminal Presence, and Homicides

	Dependent variable:		
	Homicide Count		
	(1)	(2)	(3)
Δ Export Value Share	−0.013	−0.009	−0.010
	(0.017)	(0.015)	(0.015)
Criminal Presence	0.562***	0.327***	0.328***
	(0.008)	(0.011)	(0.011)
Δ Export Value Share x Criminal Presence	0.017***	0.013***	0.014***
	(0.005)	(0.005)	(0.005)
Municipal Election Year		−0.003	0.0001
		(0.011)	(0.011)
Municipal GDP		0.390***	0.371***
		(0.045)	(0.046)
Population		−0.294***	−0.282***
		(0.033)	(0.034)
Federal Prosecutors		0.340***	0.340***
		(0.014)	(0.014)
Constant	−0.007	0.008	0.001
	(0.013)	(0.006)	(0.012)
Observations	7,517	3,806	3,806
Year Fixed Effects?	Yes	No	Yes
Note:		*p<0.1; **p<0.05; ***p<0.01	

Alternate Test of Avocado Toast Searches and Criminal Threat in Mexico

Our final empirical section relies on plausibly exogenous independent variables to test the direction of the relationship between increased international demand for avocados, criminal presence, and homicides. Specifically, we interact a measure of criminal presence that should not be affected by changes in the local market (the proportion of years a municipality experiences a criminal threat prior to the time period studied) with a measure of international demand for avocados that should not be manipulable by criminal

Table 10: 'Avocado Toast' Search Popularity, Number of Criminal Organizations, and Homicides

	(No Avocado Exports)	(Avocado Exports)
Δ "Avocado Toast" Searches	2.358	2.166
	(9.062)	(4.718)
Criminal Threat	17.503***	13.945***
	(1.148)	(0.737)
Δ "Avocado Toast" Searches x Criminal Threat	30.910**	11.552
	(11.519)	(7.553)
(Intercept)	-0.698	0.883
	(1.050)	(0.542)
Num.Obs.	3701	9768

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

organizations (popularity of 'Avocado Toast' as a search term). However, because our primary Mexico test uses another measure of criminal threat - the number of organizations present in a municipality - we provide a robustness check here interacting the number of criminal organizations present in a municipality in the year prior with the changes in Google Trends data. Results hold.