



# **Are Avocados the Blood Diamonds of Mexico?**

*An empirical study on how increasing demand for Mexican  
avocados is related to cartel violence*

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## **Abstract**

Has the increasing demand for Mexican avocados caused an escalation of violence between Mexican cartels? I theorize that the cartels enter growing licit industries to diversify their revenue stream from the drug trade. Increasing demand for legal commodities possibly leads to higher territorial competition between cartels and higher rates of violence. Recent media attention suggests that avocados are implicated in the bloody cartel business. However, earlier research found a negative relationship between cartel-related crimes and licit industries. Based on the negative relationship observed in recent studies, using an OLS and IV design, I test the hypothesis that the growth in the Mexican avocado industry leads to a decrease in cartel-related violence in Mexican municipalities. In contrast with earlier research, I find a significant increase in the total number of reported cartel-related crimes as a consequence of Mexican avocados' growing production rates. Given the growth rate of global avocado demand, leading to an explosion of Mexican avocado production in the last decade, I interpret the result as coming from intensified territorial competition between Mexican drug trafficking organizations' splintered landscape. With the necessity for cartels to diversify their revenue streams in the aftermath of the war on drugs initiated in 2006, the avocado industry's profitability is expected to draw numerous cartels to the business, increasing the likelihood of territorial contestation and rates of violence.

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# 1. Introduction

Nineteen dismembered corpses, including nine hanging from a bridge located in Uruapan, were initially believed to be the consequence of a conflict between competing drug cartels. However, *Cártel de Jalisco Nueva Generación* (hereafter: CJNG), claiming the killings, is said to be battling for other commodities than drugs. The cartel wishes to dominate the local avocado business (Dehghan, 2019), as the global surge in demand for the fruit has fueled exports, constituting a multibillion-dollar industry for Mexico. Exports from Michoacán alone reached \$2.4 billion in 2018, explaining why locals label avocados as the “green gold” (Wagner, 2019).

Nevertheless, the exponential growth of global demand is evidently a mixed blessing for Mexican avocado farmers. The industry has become a prime target for cartels sinking their teeth into the profit, with reports of farm seizing and clearing of protected woodlands happen more and more frequently. From 2009 to 2013, Mexican cartels supposedly expropriated an estimated \$770 million from the avocado industry (Asmann, 2017). The risk analytics group Verisk Maplecroft has gone as far as to name avocado the possible next conflict commodity, similar to blood diamonds in Angola and Sierra Leone (Wagner, 2019).

At the same time as Mexican avocado production is reaching new heights, the crime rates are rocketing. In the aftermath of the war against drugs, initiated by the administration of Felipe Calderón (2006-2012), the major cartels splintered, leading to a shift in the location of violence (Atuesta & Pérez-Dávila, 2018). Today’s all-time high crime rates are most likely due to the growing variations in the modus operandi of Mexican drug trafficking organizations (hereafter: DTOs). Yet, several recent studies reveal that increasing profitability in the avocado industry decreases violence rates (Erickson & Owen, 2020; Dube et al., 2016).

In this thesis, however, I argue that the growing avocado industry leads to a significant increase in cartel-related crimes. Smaller enclaves of organized crime prey on local businesses and the increasing profitability of the avocado industry lead to a higher contestation level between rivaling cartels and civilians, suggesting avocados to be the blood diamonds of Mexico.

There is a large amount of anecdotal evidence concerning the involvement of Mexican DTOs in the avocado industry. Several articles in popular media claim the growing profitability of the avocado industry positively affects the level of crimes in Mexican municipalities (e.g. articles from the Guardian, Los Angeles Times, and the New York Times, Dehghan, 2019; Linthicum, 2019; Grillo, 2020).

Following the findings in popular media, DTOs involve themselves in the avocado industry. Therefore, the growing profitability of the “green gold” increases the DTOs' revenues. Furthermore, the revenue increase influences the incentive for Mexican DTOs to invest in vicious activities. Instinctively, DTOs cannot use legal institutions to settle disagreements, indicating the need to use violence to solve conflicts (Goldstein, 1985). Whether and how much cartels spend on violent activities varies positively on the sum of disputed returns in the market of interest (Gavrilova et al., 2019). If the development of avocado demands causes an increase in rents available to DTOs, I should observe increased violence. However, based on recent studies and the negative relationship between avocado production and violence rates found in these, I assume increasing avocado profitability reduces reported cartel-related crimes. As I expect cartels already present in avocado producing municipalities to bolster their defenses in an anticipation of territorial competition due to the growing avocado industry, the incentive to attack these municipalities is reduced, leading to lower rates of cartel-related crimes.

To test my theory, I implement an OLS and IV design, regressing annual avocado production on total crime levels in Mexican municipalities, covering the period 2011-2017. To test the relationship further, I regress avocado production on different subtypes of crime. Focusing on the values of extortion, assault, homicides, and robberies, I seek to illustrate the modus operandi of drug cartels and their relationship with the lucrative avocado industry. In order to explain the link between avocados and cartel crimes in more detail, I look at differences in geographic locations and differences in the size of avocado production.

As opposed to the expected result, I find a positive relationship between avocado production and cartel-related crimes. A standard deviation increase in avocado production leads to an increase of 14.145 reported crimes per 100 000. Surprisingly, I find a negative relationship between extortion and avocado production, equal to a decrease of 0.665 reported extortions. Homicides and assaults, on the other hand, increases with a reported value of 0.514 and 5.965, respectively. Focusing solely on Michoacán I find a decrease of 14.246 reported crimes per standard deviation increase in avocado production. For states outside of Michoacán, the result is an increase of 6.057 reported crimes. Lastly, a standard deviation increase in production leads to a decrease of 0.264 reported crimes in the municipalities with the lowest production in 2011. For the largest municipalities, the number is an increase of 14.744 reported crimes. The last result contrasts with the one seen in Michoacán and outside of Michoacán.

A possible explanation of the main result is the fractured structure of Mexican cartels, leading to a need for diversified revenue streams. Further, increasing territorial competition of rents in

the profitable avocado business increases violence. Extortion, on the other hand, is most likely reduced as Mexican cartels engage in direct cultivation. Such a process might increase the motivation to threaten Mexican inhabitants to give up their land or keep quiet about illegal deforestation and reduce the incentive to extort them.

The negative coefficient in Michoacán is most likely due to cartel presence in avocado producing municipalities from before 2011. Anticipating increasing territorial contestation with growing avocado profitability between cartels might have led these cartels to bolster their defenses. Such a defense-strategy results in a lower incentive for competing cartels to begin fighting for profitable areas.

Looking at the low producing states, I believe the negative coefficient exists because of a rise in legal job opportunities with increasing avocado production. Such a development might reduce the incentive to commit crimes, as farmers formerly forced to cultivate drugs can cultivate avocados. Further, I believe the production rate during the period of interest was too low for cartels to gain any interest in the area, leading to decreased violence rates.

Two closely related papers, Erickson & Owen (2020) and Dube et al. (2016), investigate the relationship between avocado production and crime. Using homicide data, Erikson & Owen find a significant negative relationship between avocado production and cartel-related crimes. I contribute by illustrating the different result between Michoacán and non-Michoacán exists due to differences in cartel presence from before 2011. Dube et al. (2016) consider the effect of increasing maize prices on homicide rates and drug cultivation, finding a negative relationship. I contribute by illustrating the difference on avocado profitability's impact in crime between low producing states and high producing states.

My research is essential to policymakers, as the positive relationship might lead to policy implications on public spending on law-enforcement and efficient import tariffs on Mexican avocados. Given the frequent reports of cartel involvement in the lucrative avocado industry and the positive relationship found in this thesis, consumers are responsible for evaluating how to respond to increasing violence rates in avocado producing municipalities. A boycott is most likely not the ideal answer, as the Mexican avocado industry sustains thousands of hard-working Mexicans. A boycott implies a destruction of their livelihood and will provoke criminal groups to prey on civilians even more violently to reduce the effect of the diminishing avocado income. A boycott of avocados might as well redirect the direction of cartels to other lucrative licit industries. Instead, consumers should “voice their expectations toward the companies they

buy goods from, to not remain silent bystanders to human rights crises” (Dehghan, 2019). As it is easy for the government to ignore a simple consumer, increased pressure from the private sector, investors, and other governments, might intensify the fight against cartel involvement in licit industries. Demanding traceability is key to securing the livelihood of thousands of civilians. Therefore, my result can affect trades between Norway and Mexico, as Norway imports Mexican avocados and is among the world countries most concerned with safeguarding and protecting human rights (FN-sambandet, n.d.).

The thesis is structured as follows. Section 2 describes the evolution of Mexico’s political landscape, DTOs presence in Michoacán, and the avocado industry. Section 3 approach the prevailing literature on criminal violence in licit and illicit industries, followed by the theoretical framework of interest, including a section about earlier research. Then, in section 4, a description of the data follows, with the belonging adjustments and the implemented research design. Finally, section 5 and 6 contain the outcome of the different regressions implemented on my data, including the accompanying discussions. To sum up, the conclusion describes possible threats and weaknesses to my analysis, with thoughts for future research, as seen in section 7.

## 2. Background

The rupture of major DTOs into rival factions of various sizes began in 2006. The emergence of various crime organizations, ranging from large transnational criminal organizations (TCOs) to smaller local cartels, has affected Mexico's crime situation. Organized crime groups' actions become more difficult to suppress and eradicate (CRS, 2020). In this thesis I use three different terms for the organized crime groups: Cartels, organized crime, and DTOs. To understand the splintering of the major DTOs and its effect on the upsurge in diversified revenue streams among organized crime in Mexico, I will first describe the war on drugs, focusing on Mexico's political landscape. Then, I explain the drug cartels' development in Michoacán from 2006 until today. Lastly, a description of the avocado industry follows to understand better its lucrative development and the subsequent interest from drug cartels.

### 2.1 The War on Drugs

The enormous growth of organized crime in Mexico, primarily since 2006, is often blamed on the Mexican politics' democratic development (Finnegan, 2010). For 71 years (1929-2000), the Institutional Revolutionary Party (PRI) controlled Mexico. According to Finnegan (2010), a silent collaboration between the government and the major DTOs saw drug trafficking explode while the crime rates were relatively low. The deep connections between the powerful PRI and organized crime clarified who controlled which territory and reduced the incentives to settle differences with violence (Finnegan, 2010). In 2000, a disruptive change in Mexico's political landscape took place when Vicente Fox of the National Action Party (PAN) won the election. Due to the introduction of extensive democratic processes all over Mexico, gang conflicts over territory and trafficking routes occurred more frequently as the collaboration between state and cartels collapsed (Finnegan, 2010). The process continued further with the victory of PAN candidate Felipe Calderón in 2006 when he declared war on the DTOs shortly after his victory (Lee, Renwick, & Labrador, 2019). According to Fernando Gómez Mont<sup>1</sup>, organized crime surged because of the PRI's fall and the cartel's institutional cover loss. As a consequence, the cartels had "to arbitrate their own differences with their rivals" (Finnegan, 2010).

The first act of Felipe Calderón, after announcing the war on drugs, was to deploy 6500 soldiers and federal police into Michoacán, shortly followed by deployments to other hot areas, including border cities of Tijuana and Ciudad Juárez (Finnegan, 2010). As a result, fifty

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<sup>1</sup> Former Interior Minister of the Calderón-government

thousand soldiers and twenty thousand federal police controlled Mexico's streets in 2010. Calderón successfully captured or killed twenty-five of the top thirty-seven drug kingpins in Mexico during his reign (Lee, Renwick, & Labrador, 2019). However, critics state the decapitation strategy resulted in smaller, more violent drug gangs (Agencies in Mexico City, 2012). The war against drugs splintered the organized crime landscape of Mexico, leading to a substantial shift in the location of violence (Rios, 2018). As security operations were focused on large cities, criminal organizations were forced to relocate to more rural areas (Rios, 2018).

Other critics state the knowledge and experience of the police force and the army were critically low. Soldiers not being trained to do police work and multiple cases of army abuses reduced the faith people had in the law-enforcement and increased the violence all over Mexico (Finnegan, 2010). According to Edgardo Buscaglia<sup>2</sup>: “To declare war on organized crime in Mexico’s situation, you need to declare war on your own society” due to the high level of corruption and weak law-enforcement (Finnegan, 2010). Furthermore, Buscaglia refers to the paradox of expected punishment, where DTOs, under the increased pressure experienced during Calderón’s reign, spent more of their resources on weapons, violence, and corruption (Finnegan, 2010). According to Justice in Mexico’s<sup>3</sup> *Organized Crime and Violence in Mexico*-report from 2019, the development led annual intentional homicides to increase from 10 452 in 2006 to 27 213 in 2011.

The successor of Felipe Calderón was Enrique Peña Nieto from the PRI-party (Calderón et al., 2019). Choosing a different approach than his predecessor, Nieto claimed he would reduce violence towards civilians and businesses rather than capturing drug kingpins (Lee, Renwick, & Labrador, 2019). However, evidence reveals that Nieto, as Calderón, relied strongly on the military and federal police forces in an attempt to fight the cartels (Felbab-Brown, 2014). Intentional homicides decreased in Mexico during the first years of the Peña Nieto administration, but according to Felhab-Brown (2014), the reduction was most likely not a result of government policies. Instead, it was the effect of new balances of power between DTOs in previously hotspots (Felbab-Brown, 2014, p. 6). From 2015 crime rates increased once more, and by the end of his term, homicide rates were at the highest level in modern Mexican history (Lee, Renwick, & Labrador, 2019). The development of crime rates seen under the Peña Nieto administration, experts blame on the continuing kingpin strategy and territorial feuds between

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<sup>2</sup> A law and economics professor at Columbia University

<sup>3</sup> Justice in Mexico is a group of researchers, students and professors working to improve citizen security, strengthen the rule of law, and protect human rights in Mexico (Justice in Mexico (A), 2020).

gangs (Lee, Renwick, & Labrador, 2019), among them the fights between Los Zetas, CJNG and the Sinaloa cartel.

To understand the development of cartel-related crimes, Figure 1 illustrates the evolution of homicides per 100 000 in both Mexico and the state of Michoacán, ranging from the disruptive political change in 2000 through Calderón and Nieto's reign.

**Figure 1** – Number of Homicides per 100 000 – Total vs. Michoacán



*Notes:* Data extracted from SESNSP. Red line is data for Michoacán. Black line is data for all of Mexico. Time span: 2000-2018

There is a significant increase in homicides after Calderón declare his war on drugs in 2006, as seen from the total value. As discussed above, there is a decrease in homicide levels from 2011 to 2013, before the reported homicides increase once more. The Michoacán-value increased somewhat earlier than the national number because of the introduction of La Familia Michoacana in 2006. Due to La Familia Michoacana's fall of power in 2010, Michoacán's homicide value is lower than the national level in this period. The substantial increase around 2013-2015 results from self-defense groups fighting the Knights Templar, and the introduction of CJNG and other highly violent DTOs in the state of Michoacán. The development of homicides in Mexico and Michoacán illustrates the relationship between the failed kingpin strategy and organized crime.

Finally, Andres Manuel Lopez Obrador succeeded Peña Nieto in 2018, announcing the end of the war on drugs. He claimed to prioritize reducing homicide rates over his predecessors' failed kingpin strategy (Quackenbush, 2019). Nevertheless, by introducing a new national guard to increase safety, Obrador appears to follow his predecessors' failures (Lee, Renwick, & Labrador, 2019). One of the challenges the administration of Obrador faces today is the diversification of the businesses conducted by Mexican DTOs, a development described in the next section.

## 2.2 The History of Drug Cartels in Michoacán

According to the U.S. Drug Enforcement Administration's *National Drug Threat Assessment 2019*, Mexican drug trafficking organizations remain the primary threat to the United States (DEA, 2019). When Calderón won the presidential election in 2006, there were four main DTOs in Mexico: the Tijuana/Arellano Félix Organization (AFO), the Sinaloa Cartel, the Juárez/Vicente Carrillo Fuentes Organization (CFO), and the Gulf Cartel (CRS, 2020). In the following years, these four major DTOs fractured into multiple smaller organizations. According to some analysts, there are 20 major DTOs and over 200 criminal groups fighting to control drug routes and other lucrative industries in Mexico today (Muggah, 2020).

To comprehend the relationship between the avocado business and the Mexican drug cartels, I seek to explain the development of drug cartels in Michoacán, the largest avocado producing state, from 2006 until today. During this period, Michoacán has seen the following major cartels blossom and wither: La Familia Michoacana (2006), the Knights Templar (2011), and CJNG. These organizations have covered multiple illegal activities and affected licit industries and local governments in an effort to increase their revenues.

Growing rates of violence in the state of Michoacán led to the introduction of La Familia Michoacana (hereafter: LFM) in 2006, declaring its mission to protect the people of Michoacán from drug traffickers. Their primary objective was to remove the violent Zetas from the state (CRS, 2020, p. 25). LFM was known for its extreme, symbolic violence and a religious justification for its existence (CRS, 2020, p. 25). The drug-running unit of LFM consisted of marijuana and opium poppy before they specialized in methamphetamine production and smuggling (CRS, 2020, p. 25; Finnegan, 2010). LFM began to cash in on the avocado market in 2009 by extorting local avocado farmers, murdering farm employees, displacing farmers, and appropriating their land (Lohmuller, 2014). From 2010 and onwards, the cartel lost territory



and control, and in the aftermath of the alleged capture of their leader, “El Chayo”, the Knights Templar appeared (Ornelas, 2018, p. 767).

The Knights Templar started as a separated section from LFM, declaring its presence in Michoacán in 2011 (CRS, 2020, p. 26). As a result of the high rate of violence in Michoacán, the Knights Templar originated as a vigilante group to protect inhabitants of Michoacán from organized crime. Furthermore, the group was known for trafficking and manufacturing methamphetamine plus moving cocaine and marijuana into the U.S. (CRS, 2020, p. 26). In addition to dealing with drugs, the Templars extorted businesses, controlled local governments, and regulated licit economic activities in Michoacán, as seen in the paper of Ornelas (2018, p. 769): lime farmers in La Ruana; avocado producers in several municipalities; sawmills in Coalcomán; mines in Aguililla and Lázaro Cárdenas; and meat and cheese businesses in Tepalcatepec. The Knights Templar's modus operandi was to take or “buy” properties and goods at a reduced price and extort producers by charging a small amount on each hectare of lime crop or avocado crop. In other words, the Knights Templar intended to exercise control over licit economic activity through duress.

According to Ornelas (2018), the Knights Templar charged non-exporting avocado farmers a yearly charge of 1500 pesos per hectare of avocado trees, and exporters an annual amount of 3000 pesos. The Knights Templar charged producers 100 pesos per ton avocado produced as well. Ornelas (2018) report a total avocado-extortion value of 119 400 000 pesos in 2013. Additionally, by corrupting Local Plant Health council members in Michoacán, the Knights Templar achieved complete access to all municipal avocado production permits granted (Ornelas, 2018). These permits were crucial for exporting avocados to the U.S., Europe, and Asia, and access to information about these was highly valuable (Ornelas, 2018).

Between 2009 and 2013, criminal organizations earned an estimated \$770 million from Michoacán's avocado industry (Asmann, 2017). As a reaction to the extortion, kidnapping, and theft, vigilante groups of avocado farmers took up weapons to defend themselves from criminal organizations attempting to exploit the lucrative industry. In 2013, the avocado growers of Tancítaro, a municipality in Michoacán, formed a self-defense group, protecting the valuable avocado business from organized crime (Flannery, 2017). The Knights Templar controlled the area, but the introduction of self-defense groups freed the municipality of criminal organizations (Woody, 2017). In the following years, however, many self-defense groups were infiltrated by criminals, increasing the local businesses' vulnerability once more. Even though

the Knights Templar has declined, Michoacán has seen new criminal organizations emerge – as the powerful CJNG.

Today, multiple cartels fight for control of the drug trade and avocado production in Michoacán – CJNG, Nueva Familia Michoacana, Tepalcatepec Cartel, and Zicurián Cartel (Henkin, 2020). As CJNG is one of the most notorious and brutal criminal organizations in Mexico and beyond (Erickson & Owen, 2020), I choose to focus on this cartel. With its unique mix of the traditional Sinaloa-style drug trafficking with the extreme brutality of Los Zetas, the CJNG is one of the leading distributors of synthetic drugs and allegedly responsible for trafficking cocaine and methamphetamine (BBC News, 2019). With the entrance of CJNG into Uruapan, the competition to make rents from the avocado business has become increasingly violent (Henkin, 2020). In 2019, CJNG killed 19 members of the Viagras (a former self-defense group, evolving to an armed wing of the Nueva Familia Michoacana) and hung nine of them from a bridge. A banner hanging next to them said: “Lovely people, carry on with your routines. Be patriotic and kill a Viagra” (Todd, 2019). The massacre gained international awareness as the link between cartel violence and avocado production became evident. Though these horrific acts of violence and the growing amount of robbed avocado cargos (minimum four truckloads per day) keep making front-page news, the less noticeable viciousness and insecurity of extortions encountered by ordinary Mexicans in Michoacán and beyond are mostly ignored (Henkin, 2020).

As evidenced by Ornelas (2018), extortion is a way for cartels to diversify their revenue streams. In Mexico, extortion is related to the use of intimidation or violence by DTOs and the abuse of power by corrupted officials to demand payments for protection or other services (Henkin, 2020). In addition to increasing their revenue streams, cartels use extortion as a method to establish authority. In regards of the avocado business, extortion takes the form of rents, where DTOs demand compulsory fees under the pretense of security (Henkin, 2020). Being confirmed in the case of the Knights Templar (Ornelas, 2018), an avocado producer must pay a monthly amount calculated based on the number of hectares cultivated and the number of kilograms exported. If a farmer fails to pay, more extreme forms of violence, or death, follows.

Being characterized as rational actors and profit-maximizing organizations, Mexican DTOs diversify their involvement in illicit and licit industries, as seen above (Clark, 2016). Different reports claim DTOs seek to diversify and operate in many industries, making it difficult to see at which point criminal organized violence begins, and licit production ends. Examples are mining, logging, crops, human trafficking, and oil (Castillo, 2014; Erickson & Owen, 2020;

Stargardter, 2018). Given the continuing global avocado boom, cartels like CJNG will maintain its incentives to blackmail avocado farmers and exploit the avocado industry. Simultaneously, there is evidence of cartels establishing avocado growing fields. Confiscating land, logging, planting, and growing orchards of avocados might lead to even greater manipulation and abuse of the avocado industry.

The disruption of Mexican cartels and the increasing pressure from both governments and society increased the necessity of diversified revenue streams for the DTOs, as former drug trafficking operations were complicated for many of the cartels due to their ruptured structures. As evidenced above, the diversification of cartel operations introduced the profitable avocado industry to the DTOs. As an explanation of the increasing profitability of the avocado industry and the reasoning behind cartels' interest in the business, the following section describes the global avocado business's development.

## 2.3 Global Trends of the Avocado-Business

Parts of Mexico provide the ideal conditions for avocado production, as avocados require mineral-rich soil and sufficient rain and sun for optimal growth. Avocado production has boomed in Mexico the last decade, with Michoacán alone exporting avocados at a value of \$2.4 billion in 2018. In the following, I seek to explain why Mexican drug cartels might be interested in the industry. I describe the increasing demand and profitability of the avocado business, focusing on the U.S., as the U.S. is by far the largest importer of Mexican avocados. Then I introduce the Mexican avocado-landscape, and a short description of NAFTA, with its effect on Mexican avocado-export.

The hashtag #avocado on Instagram has increased approximately 40% from 2018 (Kelly, 2018), returning over 11.7 million posts today (November 2020), and according to Vogue, 3 million new pictures of avocado are posted on Instagram every day (Henderson, 2017). In the U.S., avocado demand has increased significantly from roughly 1 kilogram per capita in 2000 to 3.63 kilograms per capita in 2018 (AgMRC, 2018; USDA, 2020), an average yearly growth of 7.4%. According to the Hass Avocado Board, Americans consumed 73.5 million kilograms of avocado during the Super Bowl in 2019 (Ailworth, 2020). The last decade's increasing popularity of avocado coincides with the rise of clean eating, a millennial instafriendly way of living, with a diet based on green juices and salads (Ash, 2019). Avocado as a superfood, and the creative diversification of its use (avocado-toasts, smoothies, salads, soups, etc.), has led demand for the fruit to new heights. According to a report developed by Transparency Market

Research, global revenue generated from the avocado market was valued at \$13,641.2 Mn in 2018, with a predicted value at \$21,561.8 Mn in 2026 (2018).

Mexico is the world's largest avocado producer by far, producing 33.9% of the world's avocado in 2019 (Rodriguez, 2020). The country reportedly represents 55 to 60 % of total planted surface areas of the fruit, with an estimated planted area of 223 700 hectares (ha) in 2018 (Hass Avocado Board, 2019). The annual growth rate in cultivated regions from 2014 to 2018 was at more than 12 000 ha, indicating an expanding industry (Hass Avocado Board, 2019). According to data from the Mexican government, Mexico produced 2.32 million tons of avocado in the marketing year 2019/2020 (Zang, 2020), of which the U.S. imported 76%.

The annual avocado report by the USDA Foreign Agricultural Service states that the export of Mexican avocados has been increasing due to the positive trend in global demand and Mexican production's competitive advantage, with its year-round production basis. The value of Mexican avocado-exports for the marketing year of 2017/18 generated \$2.8 billion, an increase from \$2.5 billion in 2016/17. Considering that the value of Mexican drug traffic in the U.S. was approximately \$6 billion in 2010 (Kilmer et al., 2014), the Mexican avocado-market appears to be a valuable substitute for drug trafficking operations. Figure 2 illustrates the total Mexican avocado production development and the average avocado wholesale price in the U.S.

**Figure 2** – Total Mexican Avocado Production and Average Wholesale Price in the U.S.



*Notes:* The figure is based on data from SIAP (production) and Agronometrics (price).  
 Left: Development of total Mexican avocado production from 2003 to 2018 in metric tons  
 Right: Development of the average avocado wholesale price in the U.S. from 2000 to 2018 in \$, including average growth

The total Mexican avocado production increased from 931 626.65 tons in 2003 to 2 278 454.14 tons in 2018, a yearly growth of 6.14 percent. During the same time-frame, the average wholesale price of avocado in the U.S. had an increasing trend. The development implies a

growing profitability in the Mexican avocado industry, especially for Michoacán, cultivating more than 75% of Mexico's avocado production. In 2018, almost 60% of all agricultural earnings in the state were estimated to originate directly or indirectly from the avocado industry (Pape, 2018). Furthermore, the industry provides 100 000 direct jobs and indirectly creates an additional 200 000 in Michoacán (Pape, 2018).

Moreover, the avocado-business pays its workers considerably better than most jobs in Mexico, with an estimated daily salary of \$60 (Linthicum, 2019). The minimum wage, on the other hand, is \$5. The increasing global demand for avocados does not appear to stop soon, suggesting a continuing value-growth in the Mexican avocado-business, earning the fruit the nickname "green gold". Different reports claim the fruit yields more profit per acre than nearly all other crops, among them marijuana (Henderson, 2017). Despite the profitability of the crop, the problem in Mexico's case is unpalatable social and environmental costs because of growing amounts of avocado harvesting. To use the words of Violet Henderson (2017): "It is Mexico's widely publicized tragedy that where there is money made, drug cartels circle, savvy to the opportunities of business diversification".

### *2.3.1 The USDA APHIS Mexican Hass Avocado Import Program*

The highly profitable Mexican avocado industry was under substantial restrictions in earlier days. Due to avocado seed weevils in Mexico, the U.S. plant health officials restricted Mexican avocado trade from 1914 to 1993 (USDA, 2001, p. 2). With the onset of NAFTA, the trading agreement between Mexico, the United States and Canada in 1994, the U.S allowed the export of Mexican avocados into the U.S. As a consequence of strict production-, packaging- and shipping-requirements, only 24 municipalities from Michoacán were initially allowed to export avocados into the U.S. (Dehghan, 2019).

By June 2016, a new policy announced by the USDA in 2015 became fully enacted. The new policy made it possible for all Mexican states to export avocados to the U.S. if they met the guidelines set up to reduce the risk of importing pests (Erickson & Owen, 2020, p. 12). In the initial policy-update by the USDA, Jalisco was the only possible new avocado-exporter to the U.S. The update made production grow faster in Jalisco than in any other Mexican state (Erickson & Owen, 2020, p. 13).

Given the growing export of Mexican avocados to the U.S., the Mexican avocado business's profitability increases, resulting in rising interest from organized crime. As seen above, there is evidence of extortion in the avocado-business. How can we understand the escalation in cartel violence related to the avocado industry? Is the relationship just an outcome of anecdote? Or is there an empirical pattern to investigate as the news report about more and more cartels turning their attention to the profitable avocado business?

### 3. THEORY

The business of drug trafficking is a multi-billion dollar industry imposing significant social costs (Dell, Feigenberg, & Teshima, 2019). Mexico, with its vast landscape of organized crime, has seen drug-related conflicts in the last two decades transforming the country into a major hotspot for global violence – in 2016, Mexico was the world’s second most lethal conflict zone, only beaten by Syria (International Institute for Strategic Studies, 2017). But what is organized crime, and which traits make a licit business attractive for organized crime? Lastly, why are diversification of revenue streams vital for Mexican drug cartels? The next sections seek to explain the theory used throughout the thesis by answering the questions above. Additionally, the description of earlier findings and the preparation of the hypotheses of interest follows.

#### 3.1 Organized Crime

According to Kalyvas (2015, p. 1518), we can understand organized crime as “a phenomenon comprising hierarchically organized groups of criminals with the ability to use violence, or the threat of it, for acquiring or defending the control of illegal markets in order to extract economic benefits from them”. Schelling (1971, p. 645), on the other hand, draws a characteristic of organized crime by using the term monopoly. According to Schelling, organized crime seeks no competition. Rather than extending itself broadly, organized crime increase the pressure on local industries, both licit and illicit. Therefore, whether it is the Italian mafia, Chinese triads, or Mexican drug cartels, a common trait of organized crime is the search for exclusive influence in the territory of interest.

#### 3.2 The Avocado Industry and Organized Extortion

Schelling (1971) argues that monopolized or territorial control allows organized crime to obtain criminal activities' full economic structure, both in the legal and illegal economy. In his paper, “What is the business of organized crime”, Schelling (1971) looks at possible legal business-targets for organized extortion. Lavezzi (2008), discussing the Italian mafia’s economic structure, draws on Schelling's insights and lists four key traits attracting criminal organizations to a business. Three of them are related to the avocado industry:

1. The firm is small
2. The firm belongs to a traditional and/or low-tech sector
3. The firm is engaged in activities strongly related to the territory
4. The firm is active in an area where the legal institutions are weak

The Mexican avocado history date back to about 10 000 years ago, and clearly, it is a traditional sector. The sector still uses rather traditional harvesting and packaging methods, and the avocado industry can be described as a low-tech sector. Further, the avocado industry is related to territory, increasing the likelihood of territorial contestation between criminals. Finally, as seen in ENVIPE 2018, a national survey on victimization and perception of public safety, the fear of corruption in both the police and the government suggests weak legal institutions in Mexico. As a result, we can understand how branching out to the avocado market thus is a profitable domain for cartel extortions. The territorial specificity enables DTOs to exert absolute physical authority over an established area while reducing extortion expenses in a low-tech sector with weak legal institutions.

### 3.3 The Curse of Natural Resources

The weak institutions of Mexico might affect how efficient sectors consisting of valuable natural resources, as the avocado industry, are. Idrobo et al. (2014) discusses the curse of natural resources' abundance looking at gold mining and organized crime in Colombia. Collier and Hoeffler (1998), for instance, conclude that the duration of conflicts increases with resource dependence and Caruso (2010) uncovers that the possibility of civil war increases with the size of the mining and agricultural sector. Most authors agree the curse of natural resources is mostly a result of poor institutions, allowing criminal organizations to obtain a part of the profit due to corruption and a low level of law-enforcements (Idrobo, Mejía, & Tribin, 2014). Given the competitive advantage of the Mexican avocado production, the weak Mexican institutions, and the avocado business's valuable size, resource-abundance curse theory indicates a higher level of violence in avocado producing municipalities because of increasing territorial competition.

As stated in the introduction, this thesis explores whether increased avocado production in Mexican municipalities leads to a significant decrease in cartel-related crimes. I expect DTOs to diversify their revenue streams towards licit markets with similar traits as the drug trade, such as the agricultural industry, when these industries increase their profitability. Based on Schelling's (1971) theory, I assume DTOs attempt to monopolize production in these industries and pursue market power. Given the immobility of the agricultural sector and Mexico's weak institutions, the DTOs' monopolizing strategy could result in reduced incentives for territorial competition, thus decreasing the level of cartel violence. The reduction in incentives for competing cartels is explained in the next section.



### 3.4 Previous Research and Contribution

Idrobo et al. (2014) find a statistically significant increase in homicide rates caused by the increase of illegal gold mining in Colombia. Idrobo et al. (2014) interpret that the profitability-increase of illegal mining triggered a fight over territorial control between organized crime groups to monopolize gold mining. In my setting, I observe municipalities enter the avocado trade and offer a new profitability option for cartels. Such an observation allow me to cross-validate the findings of Idrobo and find whether differing levels of response exist between different sources of alternative profitability for DTOs.

Erickson & Owen (2020) found a different result in Mexico, looking at the relationship between a positive shock in demand for avocados and the level of cartel violence. Their initial assumption, in harmony with the findings of Idrobo et al., was that the increasing demand for avocados, given the cartels' comparative advantage in agricultural production and violence, should lead to cartels fighting to exploit territorial control and dominate production, and in such increase the level of violence. Looking at the rise in demand for Mexican avocados due to the implementation of the extended version of the U.S. phytosanitary policy for agricultural goods from Mexico, Erickson & Owen (2020) found a significant decrease in cartel homicides. The explanation of the surprising result, according to the authors, is interpreted as an effect of cartels anticipating increased territorial competition. As such, given the anticipation of increased competition from other cartels, cartels already present in avocado producing municipalities strengthen their defenses, reducing the incentives for territorial contestation (Erickson & Owen, 2020). As the findings of Erickson & Owen conflict with Idrobo et al. (2014), I look at another paper regarding the relationship between legal commodities and organized crime.

Dube et al. (2016) contributed to the literature of legal commodities and their effect on Mexico's drug trade by comprehending how economic incentives affect illegal drug production. Looking at exogenous movements in the Mexican maize price, they found that lower prices of maize differentially increased the cultivation of marijuana and opium poppies in the municipalities more suited to grow maize. Moreover, Dube et al. (2016) demonstrate a negative relationship between maize prices and cartel presence, including killings perpetrated by the cartels. Their findings indicate price fluctuations to affect cartels' strategic decisions, seeing DTOs move into economically depressed regions where farmers are willing to produce illicit crops. Dube et al. seem to find similar results to Ericson and Owen. So, most likely, we have to expect similar

results to the new literature on agriculture vs. DTOs, indicating I should find a negative relationship between avocado production and rates of violence.

Leaning on earlier research, I seek to find an answer to empirical questions similar to those researched by Erickson & Owen (2020). However, I try to understand how avocado production's evolution affects violence in all avocado producing states using an OLS and IV design. The notable difference is my focus on all Mexican avocado producing municipalities. As a consequence of the rapid avocado production growth in many parts of Mexico, I check whether cartels direct their focus to the avocado industry outside of the major producing municipalities. Another interesting aspect is whether inhabitants in states with small avocado production levels change their livelihood from illegal activities to avocado production. As the industry is becoming increasingly more worth, this would follow the ideas of the rational choice model of crime (Becker, 1968). Another difference is the cartel-related crimes of interest. Earlier research has focused on homicides and extortion (Erickson & Owen, 2020; Ornelas, 2018; Dube et al., 2016; Idrobo et al., 2014), while I look at the relationship between increasing avocado production and the total cartel-related crimes, in addition to ten different subtypes of crime related to cartel activities.

My work contributes to the literature on organized crime and licit production by looking beyond the largest avocado producing municipalities and in more detail at the total crime level and the different subtypes of crime. The significance of this thesis for related studies of licit industries and organized crime, is the use of solid theories and empirical work. Further, I believe the thesis can be used for comparative researches of other countries with comparable issues, e.g. the blood diamonds of Sierra Leone, or the avocado industry in Chile.

### 3.5 Hypothesis Development

Based on the concepts of Schelling, Lavezzi, Becker, Erickson & Owen, Ornelas, and Idrobo et al., this thesis postulates that higher production of avocado in Mexican municipalities decreases the level of violence. Seeing the exponential growth in avocado production, I expect cartels already present in avocado producing municipalities to bolster their defenses as they anticipate increasing territorial competition over the profitable industry. In turn, the defense bolstering should decrease the level of violence, as strengthened defenses reduces the incentive for competing cartels to involve themselves in avocado producing areas already controlled by a cartel.

In addition, the avocado business has been growing through the sample years. While Michoacán has been a highly valuable avocado state since the implementation of NAFTA, other regions are entering the trade. Therefore, there might be a different level of violence associated with the conflict of a new crop. As Michoacán had a valuable avocado industry in 2011, I assume a negative relationship in Michoacán, and higher rates of violence in states outside of Michoacán. The latter is due to an assumption of lower cartel presence in these states' avocado industry in 2011. As Michoacán is the largest avocado producing state by far, covering 75% of total surface areas in Mexico in 2019 (Hass Avocado Board, 2019), I expect the state to be highly influential for the main regression. The negative value expected in the first hypotheses is mostly based on the expectation of a negative relationship in Michoacán.

Lastly, looking at the growth rate in production for the 25% lowest producing municipalities in 2011, I expect a positive relationship between avocado production and cartel-related crimes in these municipalities. The positive expectation is given by the high growth rate from 2011 to 2017, which is being thoroughly explained in section 5. I expect a lower effect on crime in the 25% highest producing municipalities in 2011, as I assume a high cartel presence in these municipalities in 2011.

To ideally examine the abovementioned assumptions, I will look at four different hypotheses.

1. Increased avocado production decreases the reported number of total cartel-related crimes.
  - 1.1 Increased avocado production decreases the reported number of each subtype of cartel-related crimes. But, as seen in section 3.2, I expect increasing extortions with growing avocado production.
2. The effect of increased avocado production is higher for municipalities outside of Michoacán than for municipalities from Michoacán.
  - 2.1 The effect of increased avocado production on the level of crimes is higher for the municipalities with the lowest avocado production in 2011 vs. those with the highest avocado production in 2011.

## 4 Methodology

This thesis's primary goal is to explore whether increasing avocado production in Mexican municipalities causes a significant decrease in cartel-related crimes. The growing public concern of cartel involvement in the Mexican avocado industry, as seen in numerous newspaper reports, indicate an empirical pattern to investigate. To test the hypothesis of increased avocado production since 2011 being causally related to a decrease in cartel-related violence, I implement a quantitative deductive approach in line with earlier research. Next is a description of the data sampling, followed by a description of the data adjustments. Then, I discuss the validity of the data used, and finally, I describe the research design implemented in this thesis.

### 4.1 Data

The data section describes the sampling of data used in the analysis. All data is secondary data, collected by different Mexican official organs. I first describe the crime data, which includes the variables used as dependent variables in the analysis. Then a description of the production-variable, as well as the control variables, follows. Table 1 presents a summary of the mean value of each of the six data sets implemented in the thesis. The differences will be used to discuss the results seen in section 5 and 6.

**Table 1: Summary Statistics – Mean of Each Data set**

Variable	Trimmed sample (2)	Full sample (3)	Michoacán (4)	Non-Michoacán (5)	Low quartile (6)	High quartile (7)
<b>Panel (a): SESNSP</b>						
Total crime rate	214.312	211.546	142.091	225.453	224.859	177.064
Homicide rate	15.778	15.804	17.935	15.377	17.995	17.902
Extortion rate	2.813	2.873	2.525	2.943	3.082	3.108
Kidnapping rate	0.988	1.021	1.411	0.942	1.263	1.174
Road theft rate	2.065	2.027	1.355	2.162	1.100	1.200
Sexual crime rate	8.523	8.405	6.022	8.882	9.343	7.187
Fraud rate	22.516	22.318	11.288	24.527	22.999	17.502
Bank robbery rate	0.261	0.254	0.140	0.277	0.388	0.127
Regular theft rate	53.878	53.412	38.367	56.424	71.099	36.197
Threats rate	29.809	28.838	9.285	32.754	36.841	18.867
Violence rate	77.680	76.594	53.764	81.165	70.091	80.986
<b>Panel (b): SIAP</b>						
Avocado production	916.126	4916.318	25138.932	867.245	156.477	3254.532
Avocado price*	2.625	2.625	2.625	2.625	2.625	2.625
<b>Panel (c): Control variables</b>						
Population	72133.602	71979.269	55340.315	75310.803	52040.401	49389.121
Population density	178.052	174.875	110.030	187.859	134.317	238.139
Average educational level	7.216	7.216	6.907	7.278	7.203	6.935
Employment rate	0.461	0.462	0.474	0.460	0.451	0.473
Portion of age: 15-19	0.098	0.098	0.097	0.098	0.096	0.101
Portion of age: 20-24	0.088	0.088	0.090	0.087	0.083	0.089
Portion of age: 25-29	0.072	0.073	0.075	0.072	0.070	0.072
Portion of age: 30-34	0.068	0.068	0.067	0.069	0.067	0.068
Share of men	0.489	0.489	0.485	0.490	0.492	0.488
Lack of access to health services	0.177	0.181	0.260	0.165	0.168	0.199
Deprivation due to quality and housing spaces	0.215	0.216	0.212	0.216	0.202	0.226
Lack of access to social securities	0.773	0.772	0.785	0.769	0.744	0.813
Lack of basic services to home	0.439	0.433	0.337	0.452	0.409	0.466
Lack of access to food	0.271	0.271	0.323	0.261	0.237	0.307
Income below welfare line	0.347	0.341	0.282	0.353	0.356	0.358
Observations	2027	2134	356	1778	424	453
Standard deviation	2 277.825	22 391.06	49 780.66	2 898.732	665.680	3 719.908

*Notes:* The first panel presents statistics from SESNSP (SESNSP, 2020), the second panel presents statistics from SIAP (Servicio de Información Agroalimentaria y Pesquera, 2020) and Agronometrics\* (2020). The last panel presents the control variables extracted from INEGI and CONEVAL. ALL SESNSP crime statistics are measured as the number of reported crimes per 100,000 inhabitants. The second column presents the mean for the trimmed sample. The third column presents the mean for the full sample. The fourth and fifth column presents the mean for municipalities in Michoacán and outside of Michoacán, respectively. The sixth and seventh column presents the mean for the municipalities with the lowest and highest production in 2011, respectively.

### ***4.1.1 Crime Data – Dependent Variable***

The criminal data refers to the alleged occurrence of crimes registered in previous investigations initiated or ongoing investigations, reported by the Attorney General's Offices and Attorney General's Offices (SESNSP, 2020). The data include information on different crime categories and consists of monthly crime data from 2011 to 2017 on a municipality level extracted from the sites of the Mexican Executive Secretariat of the Public Security National System (SESNSP). The categories most commonly associated with cartel violence are selected. Based on the research of Widner, Reyes-Loya & Enomoto (2011) and Pan, Widner & Enomoto (2012), the cartel-related crimes of interest are intentional homicides, intentional assaults, kidnappings, frauds, extortions, violent regular robbery, violent robbery on the road, bank robbery, threats, and sexual crimes (excluding rape). Table 1 presents the mean on SESNSP data in panel (a). The most common crimes are intentional violence, robberies, threats, frauds and homicides. Yet, we see the mean of total crime from Michoacán (column (4)) is much lower than the other data sets, followed by the high producing municipalities found in column (7).

### ***4.1.2 Avocado Production (Independent Variable) and Avocado Prices***

The independent variable is total avocado production in Mexican municipalities from 2011-2017, in metric tons. The data is extracted from the Mexican government's agricultural department (SIAP and SAGARPA) for 2003-2018. The avocado price is based on the average wholesale avocado price on the U.S. market, extracted from Agronometrics, a market intelligence instrument from the fruit and vegetable market using data from USDA – The United States Department of Agriculture (Agronometrics, 2020). The summary statistics for the relevant categories are presented in panel (b) of Table 1. As expected, the average avocado production value is much higher for Michoacán, than for the other data sets. Another aspect to notice is the low average production value for the municipalities with the lowest production in 2011, found in column (6).

### 4.1.3 Control Variables

I use several control variables to increase my model's explanatory power and find a more accurate relationship between avocado production and crime. The control variables are extracted from the National Institute of Statistics and Geography (INEGI) and the National Council for the Evaluation of Social Development Policy (CONEVAL). Each independent control variable is known to correlate with the crime rate (Kanazawa & Still, 2000; Tauchen, 2010). The control variables of interest are: INEGI - (1) population, (2) population density, (3) average educational level, (4) employment rate, (5) age distribution, (6) share of men; CONEVAL - (7) lack of access to health services, (8) income below the welfare line, (9) deprivation due to quality and housing spaces, (10) lack of access to social securities, (11) lack of access to food, and (11) lack of basic services to home. A description of each control variable from CONEVAL is found in the appendix (section 8.1). The summary statistics of the control variables are presented in panel (c) of Table 1.

## 4.2 Data Adjustment

The data adjustment section describes the different adjustments done to the data described in section 4.1. All data were collected in Excel, and adjusted and merged with R. Following is the adjustment-description for the dependent variables, independent variable, and control variables, respectively.

### 4.2.1 Crime Data – Dependent Variable

As the different variables are in months and years, it is necessary to harmonize them by annualizing the data. The annual data is defined as the sum of each month. To control for possible scale effects, each crime-type is standardized per 100 000 inhabitants using the municipality's population variable from the control variables. The primary dependent variable, total crime per 100 000, is defined as the sum of each crime subtype.

As a consequence of missing values, I removed all municipalities with at least three missing values over the sample period. Erickson & Owen (2020) chose a more extreme measure, due to the large number of municipalities with missing data, by dropping all observations from 2011-2013. Given the focused sample of municipalities in Erickson & Owen's paper I choose only to remove the municipalities with missing values and keep the period of interest. Furthermore, I verify if the results are robust to dropping only the NA-values, not the entire municipality.

Remaining in the data set was two NA-values (municipality 10002 and 31041 in 2011) I removed, keeping the six lasting values of both municipalities.

Further, the initial data set had major errors in the 2016-value of the state of Michoacán. As Michoacán is the largest avocado producer in Mexico, removing the municipalities with errors was not an option. The Mexican government updated the data set after I made them aware of the errors, and the data set applied is therefore corrected and without issues for Michoacán.

## *4.2.2 Avocado Production (Independent Variable) and Avocado Prices*

As the main idea of this thesis is to find the causal relationship between avocado production and cartel-related crimes in Mexico during 2011-2017, the municipalities with 0 or NA production for the entire sample period is removed, and the final data set exists of municipalities with at least one year of production. Given the period of interest, the production data from 2003-2010, and 2018, are removed. The production data consists of 4613 values, implying 659 different municipalities with at least one production year.

The average wholesale price is calculated from the shipping prices in U.S. Dollars from Mexico, Peru, New Zealand, Florida, Chile, Caribbean Basin, and California. The data set has values from 2000-2019, but because of the years of crime-data, the period of interest is 2011-2017.

## *4.2.3 Control Variables*

### *4.2.3.1 INEGI*

The following section explains the process of creating the control variables extracted from INEGI. For readability purposes, each variable is explained separately:

**Population** consists of data in 2010, 2015, 2016, and 2017. By using linear interpolation, the values for 2011-2014 were created based on the linear relationship between 2010 and 2015.

**Population Density** is calculated based on the **population** data and the square kilometer size of each municipality, extracted from Panorama Sociodemográfico 2015 for each state. Linear interpolation is used on the values between 2010 and 2015.

**Share of Men** is calculated based on the number of men in 2010, 2016, and 2017 divided by the same year's population. The remaining years, 2011-2015, have been found by using linear interpolation.



**Average Educational Level** consists of data in 2010 and 2015. By using linear interpolation, I found the values for 2011-2014. To predict the remaining values (2016 and 2017), linear extrapolation is used (prediction of values based on a linear relationship with earlier values).

The **Age Distribution** data set consists of actual values in 2010 and 2015, for each municipality, in 5-year spans: 00-04, 05-09, ..., 75 and above. The share was calculated based on the total value of the population. As before, linear interpolation and extrapolation were used to find the remaining values. The article “Why Men Commit Crimes (and Why They Desist)” (Kanazawa & Still, 2000) explains that the proportion of young men aged 15-34 strongly predicts the incidence for many types of crime across all societies of the world. These findings support the age-crime curve of Hirschi and Gottfredson (1983). As a result of the two articles mentioned, the age spans of interest in this thesis are 15-19, 20-24, 25-30, and 30-34.

**Employment Rate** consists of values for 2010 and 2015. The remaining values are calculated with linear interpolation and extrapolation.

#### **4.2.3.2 CONEVAL**

The data from CONEVAL is extracted from the same data set, consisting of values for 2010 and 2015. With the information from the data set, I have two estimates over time for each multidimensional poverty measurement indicator for the country’s municipalities (CONEVAL, n.d.). The missing values for each variable are found by linear interpolation and linear extrapolation. Finally, the value of 2010 is removed, as it is outside the period of interest. Each negative value and values above 1 are limited by setting a lower and upper limit of 0 and 1.

#### **4.2.4 Additional Calculated Variables**

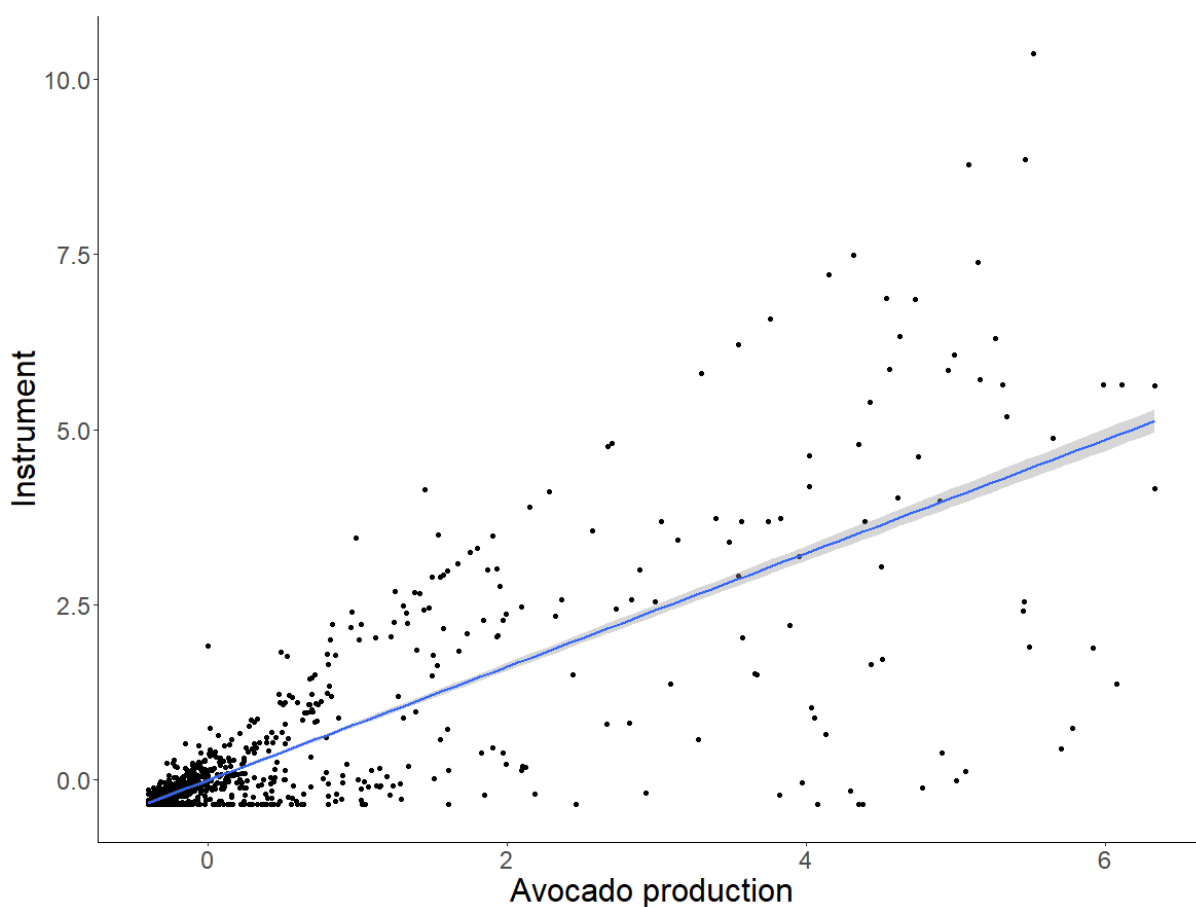
The following variables have been created based on the available data above. The reasoning behind each variable is described below.

As a consequence of extreme values in the variables of production, instrument, population, and population density, I transform these variables using z-transformation. By doing so, the coefficients of the regression-analysis are readable and easier to implement. Using Z-transformation, the regression coefficient is implemented as the effect of one standard deviation increase in avocado production on the reported number of crimes per 100 000. Given the large standard deviation of 22 391.06 tons in the full sample, I trim the data set by removing the 5% largest production values. The evaluation of which data set to use exists in section 4.4.

Additionally, to answer my hypotheses, I create four data sets. These four data sets are: (1) Michoacán, (2) Outside of Michoacán, (3) the 25% lowest producing municipalities in 2011, and (4) the 25% highest producing municipalities in 2011. Each data set has updated z-transformed values.

To decide which regression model to use, I need to create an instrument variable. The instrument is measured as the avocado price in year  $t$  multiplied with avocado production in municipal  $m$  in 2011. Figure 3 below reveals the relationship between the instrument and avocado production.

**Figure 3** – Instrument and Avocado Production



*Notes:* Z-standardized instrument and production, calculated in R. Production data extracted from SIAP, avocado price data used in the Instrument extracted from Agronometrics

As seen, there is a positive relationship between the two variables, indicating an increasing profitability in the avocado industry, and a valid instrument affecting the value of the independent variable.

To check for province-fixed effects, I create a variable by extracting the ID-variable's two first values. All municipalities from e.g. Michoacán will therefore have a province-variable equal to 16.

In addition, I create the following variables per 100 000 to find the effect of increasing avocado production on the modus operandi of Mexican drug cartels, based on the data set conducted from SESNSP.

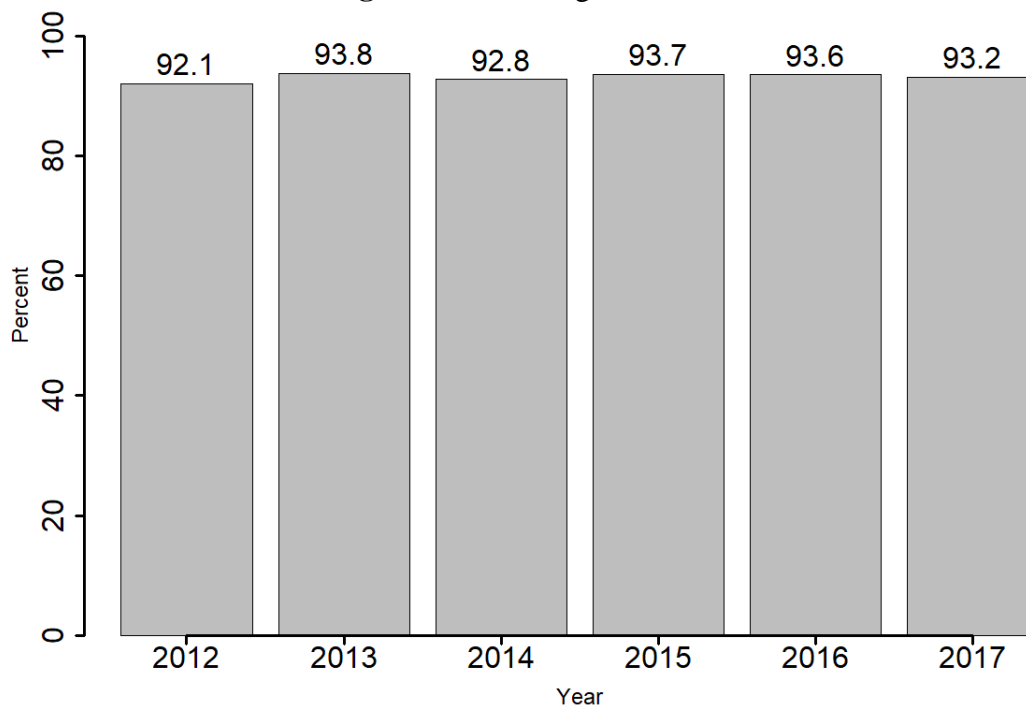
1. Intentional homicide and assault
  - a. Homicide and assault with the use of a firearm
  - b. Homicide and assault with the use of a cold weapon
  - c. Homicide and assault with the use of no weapons
2. Robberies – regular, road, bank
  - a. Violent
  - b. Non-violent

### 4.3 Data Validity and Reliability

Section 4.3 discuss possible issues with the data described above. The main focus is the dependent variable – crime data. The first issue of interest is the dark figure of crime. Secondly, I comment on the possibility of corrupted measures in crime data. Finally, the use of linear interpolation and extrapolation is discussed.

#### 4.3.1 *Dark Figure of Crime*

Crimes reported to officials only include a fraction of the actual number of crimes committed, and crime reports struggle with underreporting. The Encuesta Nacional de Victimización y Percepción sobre Seguridad Pública 2018 (ENVIPE) obtain information with representativeness at the national and state level to make estimates on crime prevalence, the levels of crime incidence and the dark figure of crime in 2017. The term “dark figure of crime” is the amount of unreported or undiscovered crimes (Biderman & Reiss, 1967). Likewise, the report seeks to obtain information on the perception of public security and the performance of the institutions in charge of public security and justice (INEGI, 2018). Figure 4 below illustrates Mexico's dark figure of crime at a national level in percent, from 2012 to 2017.

**Figure 4 – Dark Figure of Crime**

*Notes:* Data extracted from ENVIPE 2018, page 30 (INEGI, 2018).

These numbers, from 2012 to 2017, demonstrates the level of unreported and uninvestigated crimes in Mexico. The value 93.2 percent (2017) is calculated based on the following numbers: According to ENVIPE 2018, an estimate of 10.4 percent of crimes was reported. Of these, only 65.3% were investigated, uncovering an investigation of only 6.8 percent of all estimated crimes in 2017, leading to 93.2 percent of unreported or undiscovered crimes (INEGI, 2018). What are possible reasons for the high level of undiscovered crimes?

The first reason might be the outcome of investigated cases. Of the investigated cases in 2017, equal to 6.8% of all estimated crimes, 55.9 percent have no result or no solution, indicating a 3% solution rate of all crimes committed in 2017. Such a low number might decrease the motivation to report a crime, as the possibility to solve the issue is critically low.

The ENVIPE-report finds that 64.5 percent of the unreported crimes are due to authority attributes. The number is tied to the issue of weak legal institutions, which in turn might increase the level of cartel involvement in licit industries, as seen in section 3.

The final interesting output from the ENVIPE-report is the reported level of perception about authority corruption in 2017. 77.7 percent believe the traffic police are corrupt, while 68.1 believe the municipal preventive police are corrupt. Other interesting figures are that 67.6 believe judges are corrupt, and 64.3 percent believe the state police are corrupt. These numbers

propose possible issues with reporting cargo-theft, extortion, kidnappings, and threats, some of the most common cartel-related crimes.

Nevertheless, the high level of unreported crimes should not bias our results. As revealed in Figure 4 above, the dark figure of crime is almost constant, indicating that the measurement error is constant, with a mean equal to zero after adjusting for municipality-fixed effects. In the fixed-effects models, the measurement error is not an issue, other than the sole effect of lowering my results' significance as the measurement error adds noise.

### ***4.3.2 Corrupted Measures***

According to Transparency International (2020), Mexico rank as number 130 of 198 in a measure of corruption in 2019. The high value of corruption might affect multiple values of the data extracted for the analysis. It is unlikely the measurement error correlates with avocado production and therefore it should not affect the results of the thesis. Again, looking at the development of all variables over time reduces the chance of biased results. As there is a high chance of corrupted measures during the entire period of interest, I assume the level of corruption does not change during these years. Further, the municipality-fixed errors capture corruption, and time-fixed effects absorb the national shocks to corruption, leaving me with enough variation to estimate the trend credibly.

### ***4.3.3 Linear Interpolation and Extrapolation***

Data sets with missing values can create bias because of systematic differences between observed and unobserved data (Noor et al., 2015). As a result, it is essential to estimate the missing values in an ideal way and validate the data's quality. Noncomplete data sets may cause significantly different results than the complete data set results (Hawthorne & Elliott, 2005). The approach used to solve issues with missing data is the adoption of imputation techniques (Junninen et al., 2004), and given the nature of most of the variables used in the analysis, I use the technique of linear interpolation and extrapolation. Due to the popularity of the imputation technique, the validity of the fixed variables is considered satisfactory.

## **4.4 Research Design**

This thesis applies an OLS and IV strategy exploiting time and geographical variation in avocado production within Mexico to estimate changes in cartel-related crimes. For my main estimation, I regress annual avocado production on violent crime outcomes to study whether

the level of violent crime exacerbates or decreases by increased avocado production on a municipal level. As a consequence, I propose the following empirical model:

$$(1) y_{mt} = \beta_0 + \beta_1(Avo_{mt}) + v\chi_{mt} + \alpha_m + \gamma_t + \varepsilon_{mt}$$

where  $y_{mt}$  is the outcome variable of municipal  $m$  in year  $t$ .  $Avo_{mt}$  is a z-transformed value of avocado production in municipal  $m$  in year  $t$ .  $\beta_1$  is the leading coefficient of interest, measuring the effect of increased avocado production on the level of crime in a given municipality.  $v\chi_{mt}$  is a vector of the control variables (see section 4.1.3) at a municipal level in year  $t$ .  $\alpha_m$  is municipal-fixed effects.  $\gamma_t$  is time-fixed effects. Using both entity- and time-fixed effects eliminate bias from non-observables that vary over time but are equal over entities, and it controls for factors that vary across entities but are equal over time (Hanck et al., 2020). Finally,  $\varepsilon_{mt}$  is the error term. The outcome variable used in the main regression is the total crime rate per 100 000 inhabitants. Clustered standard errors are clustered at a municipal level, using heteroskedasticity and autocorrelation-consistent (HAC) standard errors.

The estimation of the model in equation (1) by OLS may suffer from endogeneity issues and based on the work of Dube et al. (2016) and Idrobo et al. (2014), I implement an IV-regression to overcome the issue. The endogeneity source could be a result of reverse causality between cartel-related crimes and avocado production or omitted variables, as crime might influence avocado production practices. For example, I can expect businesses producing avocado to have fewer incentives to locate in more violent areas, implying that new avocado producers search for geographical areas with less violence. Another possible bias in the estimation of avocado production on the level of crime originates from potential omitted bias. Assuming an increase in avocado production leads to more violence, it is likely the increase of violence causes a change in the institutions at the municipal level (Idrobo, Mejía, & Tribin, 2014), which in turn might affect the following exploitation of the fruit. To circumvent the possible endogeneity issue, I implement an IV-strategy exploiting changes in the average wholesale avocado price on the U.S. market. The instrument of interest is created by multiplying the price in year  $t$  with avocado production in municipal  $m$  in 2011 (see section 4.2.2). By applying an F-test, it is possible to control for weak instruments in the full sample. Table 2 below illustrates the result of an F-test equal to 18.605, exceeding the threshold of 10 (Stock & Yogo, 2002), indicating a strong instrument.

**Table 2: Weak Instrument Test**

Dependent Variable: Total Crime Rate per 100 000	
	Full sample
Instrument	0.194*** (0.045)
F-statistic	18.605
Observations	2 134
Standard deviation	22 391.06

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Checking for weak instruments using an F-test. An F-statistic above 10 implies no weak instruments.

The fitted first stage regression of our IV-model is given by:

$$(2) \widehat{AVO}_{mt} = \alpha_0 + \alpha_1(\text{production}_{m2011} * \text{price}_t) + v\chi_{mt} + \alpha_m + \gamma_t$$

where  $\widehat{AVO}_{mt}$  is the fitted endogenous z-transformed production-value. The variable  $\text{production}_{m2011}$  is the value of avocado production, and it varies across municipalities, but not over time. The instrument is z-transformed.  $\alpha_1$  is the instrument-coefficient.  $v\chi_{mt}$  is a vector of the control variables at a municipal level in year t.  $\alpha_m$  is municipal-fixed effects, and  $\gamma_t$  is time-fixed effects.

The first stage of the IV-regression is represented by equation (2), where I instrument the above-mentioned endogenous variable with a value composed of avocado production in 2011 and the wholesale price of avocado on the U.S. market. The following model presents the second stage of the IV-regression:

$$(3) y_{mt} = \beta_0 + \beta_1(\widehat{AVO}_{mt}) + v\chi_{mt} + \alpha_m + \gamma_t + \varepsilon_{mt}$$

where  $\widehat{AVO}_{mt}$  is the fitted first stage value.

With the econometric model given by equation (3), the estimation allows me to correct for possible endogeneity issues using variables with an exogenous variance. However, after comparing the OLS and IV estimates, their difference is meager, as seen in Table 3.

**Table 3: OLS vs. IV**

	Dependent Variable: Total Crime Rate per 100 000	
	FS-OLS (1)	FS-IV (2)
Avocado production	56.755*** (19.686)	68.004 (47.511)
F-statistic	0	18.605
Observations	2 134	2 134
Standard deviation	22 391.06	22 391.06

*Clustered standard errors in parentheses*

*\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$*

*Notes:* Column (1) = OLS-regression. Column (2) = IV-regression.

The OLS-regression coefficient is given in column (1), while the IV-regression coefficient is given in column (2). Due to the similarity in the coefficients, the problem of endogeneity is possibly insignificant. As a result, I implement a Wu-Hausman test to formally check if there are any endogeneity issues in the data. The Wu-Hausman test results in p-values of 0.835 and 0.558 for the full and trimmed sample, respectively. As a consequence, it is impossible to reject the null hypothesis of consistent variables, and hence there is a minimal endogeneity bias in the OLS estimates. Therefore, it is no need to use an IV-regression and instrument the production-variable. Because of the Wu-Hausman test, the OLS-model given by equation (1) is the primary model of interest. Considering that IV-regression adds noise to the estimation of the standard error, the OLS-regression is the optimal choice.

The next step is to consider whether to use the full sample, a trimmed sample, or simply look at municipalities from Michoacán. The description of the full sample is in the data-section. The trimmed sample is trimmed at the 95th percentile of avocado production, as some of the municipalities have extreme values of avocado production. The data-trimming reduces the data set with 107 observations. The standard deviation of the trimmed sample is equal to an avocado production of 2 277.825 tons. For readability purposes, because of the trimmed sample's lower standard deviation compared to the full sample, the data set of interest is the trimmed sample. Furthermore, as more than three-quarters of Mexico's avocado production occurs in the state of Michoacán (Mondragón & López-Portillo, 2020), I implement an OLS-regression on a data set consisting of all municipalities from Michoacán, based on the full sample. The latter is consistent with the papers of Ornelas (2018) and Erickson & Owen (2020) and makes it possible



to compare my results with earlier research. To be able to answer the final hypothesis, I compare a data set consisting of both the 25% lowest producing municipalities in 2011 and the 25% largest producing municipalities in 2011. Table 1 presents the mean of each variable in these two data sets in column (6) and (7).

To be able to evaluate the effect of increasing avocado production on different types of crime, consistent with the papers of Erickson & Owen (2020), Idrobo et al. (2020), and Dube et al. (2016), I use an OLS-model similar to equation(1). The outcome variable  $y_{mt}$  is based on the subtypes of crime described in section 4.1.1.

Lastly, I implement different OLS-models to evaluate the modus operandi of drug cartels based on the difference in violent vs. non-violent crimes, and the estimation-difference between homicides and assaults committed with firearms, cold weapons, and no weapons.

## 5. Results

The critical question of interest is whether the increased global demand for avocados and the subsequent radical increase in avocado production in Mexico has led to a significant decrease in cartel violence rates. With increasing news-reports of cartel violence in avocado producing municipalities, I seek to understand whether the relationship is just an outcome of anecdote or if I can find an empirical pattern between production and crime. The following part presents the results of the different OLS-regressions implemented, based on the four hypotheses I intend to answer, focusing on commenting upon the resulting coefficients. The discussion of the results described below follows in section 6.

*Hypothesis 1: Increasing production of avocado decreases the level of total cartel-related crime*

For the first research question, I examine if an increase in avocado production leads to a significant decrease in the reported number of total crimes per 100 000, as expected by the result of Erickson & Owen, and Dube et al. The following regression result demonstrate avocado production's estimation on the primary dependent variable of interest – total level of cartel-related crimes per 100 000.

**Table 4:** Main OLS-Regression on Trimmed Sample

Dependent Variable: Total Crime Rate per 100 000	
	TS-OLS
Avocado production	14.145** (5.795)
Observations	2 027
Standard deviation	2 277.825
<i>Clustered standard errors in parentheses</i>	
<i>*p&lt;0.1; **p&lt;0.05; ***p&lt;0.01</i>	

*Notes:* OLS of avocado production on total level of cartel-related crimes using trimmed data.

Table 4 demonstrate the positive avocado production-variable, being significant at the 5 percent level, indicating an increase in the total value of cartel-related crimes with growing production. The positive result contrasts with the effect found in earlier research, suggesting the data's difference majorly affects the results. The positive coefficient indicates that the Mexican DTOs are interested in a piece of the avocado industry's profitability and increases their presence in

avocado producing municipalities. The coefficient demonstrates that for an increase in avocado production of the standard deviation of 2277.825 tons, the number of crimes reported increases by 14.145. Looking at the development of Mexican avocados exported to the U.S. in the build-up to the Superbowl, typically the most significant day for avocado consumption in the U.S, imports increased by 16% to a projected value of 217 000 million pounds, or 98 429.544 tons from 2018 to 2019 (Koger, 2019). The increase is equal to approximately 13 576 tons of avocado and would result in a rise of 84.34 reported cartel-related crimes based on the result in Table 4. The positive relationship between avocado production and cartel-related crimes is similar to the finding of Idrobo et al. (2014) on illegal gold mining and violence in Colombia.

*Hypothesis 1.1 – Increased avocado production decreases the reported number of each subtype of cartel-related crimes. But, as seen in section 3.2, I expect increasing extortions with growing avocado production.*

To understand the estimation's underlying movements on the total crime level, I create an OLS-regression using the different crime subtypes as a dependent variable. Table 5 presents the regression.

As seen in Table 5 below, seven out of ten columns have a positive coefficient, suggesting a positive relationship between avocado production and the given subtype of crime. The positive coefficient contrasts with the expected result, based on earlier research. However, extortion, kidnapping, and road robberies all have a negative sign. Further, the coefficients of extortion, regular thefts, and assault are significant on a 5% level. The coefficients of kidnapping and fraud are significant on a 10% level.

The negative relationship between production and extortion (column (2)) is surprising, as it suggests cartels extort farmers less with increasing avocado production. The positive coefficient of homicides (column (1)), even if it is not significant, is similar to Idrobo et al. (2014), who found a positive relationship between illegal mining and cartel homicides in Colombia. Dube et al. (2016), on the other hand, found a 11% decrease in total killings with an 8% increase in maize prices in high vs. low maize-suitable municipalities.

**Table 5:** Subtypes of Crime per 100 000, Trimmed Sample

	Dependent variable: Subtypes of crime per 100 000									
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.514 (0.683)	-0.665** (0.304)	-0.323* (0.186)	-0.458 (0.279)	0.173 (0.358)	0.031 (0.065)	1.753* (1.011)	6.019** (2.929)	1.135 (1.421)	5.965** (2.731)
Observations	2 027	2 027	2 027	2 027	2 027	2 027	2 027	2 027	2 027	2 027
Standard deviation	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825	2 277.825

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Each subcrime is extracted from SESNSP and based on the period 2011-2017.

*Hypothesis 2 – The effect on crime is higher for municipalities outside of Michoacán*

The third assumption suggests that the impact of increased avocado production on cartel-related crimes is higher for municipalities outside of Michoacán. The assumption is based on Schelling's monopolization theory and the findings of Erickson & Owen, as production in Michoacán already was high in 2011 compared to the rest of Mexico. Their reasoning behind the negative result is based on an assumption of cartels already present in Michoacán and Jalisco anticipated increased territorial competition and therefore bolstered their defenses (Erickson & Owen, 2020). The following regression, given by Table 6, aims to answer the question, revealing avocado production's estimation on the total level of cartel-related crimes in Michoacán and outside of Michoacán.

**Table 6:** Michoacán vs. Non-Michoacán – Total Crime Rate per 100 000

	Dependent Variable: Total Crime Rate per 100 000	
	Michoacán (1)	Non-Michoacán (2)
Avocado production	-14.246 (38.618)	6.057 (5.210)
Observations	356	1 778
Standard deviation	49 780.66	2 898.732

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

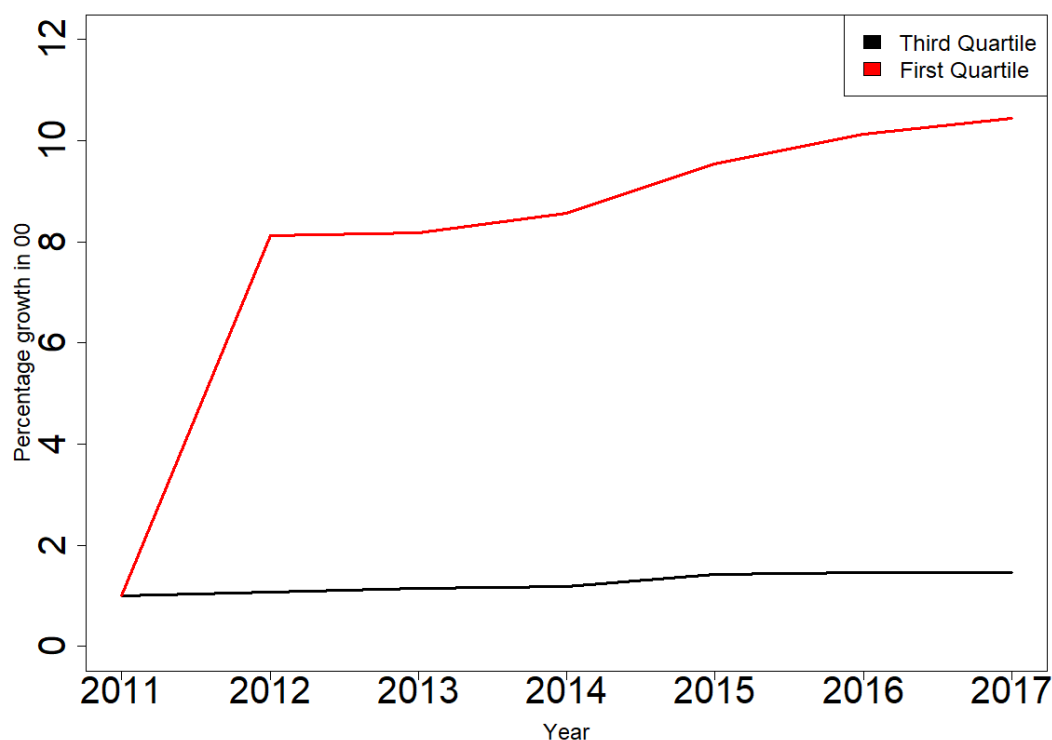
*Notes:* The estimation of avocado production on total level of cartel-related crimes in Michoacán (1) and outside of Michoacán (2). The two subsets are created using the full sample.

The result in Table 6 confirms the third assumption that increased avocado production has a higher effect on cartel-related crimes for municipalities outside of Michoacán. As anticipated, based on the work of Erickson & Owen, the coefficient of column (1) is negative and indicates a negative relationship between avocado production and reported cartel-related crimes in Michoacán. Further, as predicted based on the positive coefficient of the regression in Table 4, column (2) is positive and implies an increase in crime rates with growing production. However, as none of the coefficients are significant at a 10% level, it is impossible to draw any clear conclusions based on Table 6. The regression results on each subtype of crime for the two data sets are found in the Appendix (Section 8.2).

*Hypothesis 2.1 – The effect on crime is higher for the municipalities with the lowest production in 2011, compared to those with the highest production in 2011*

The final assumption, the effect on crime rates should be higher in municipalities with the lowest production in 2011 versus those with the highest production in 2011, results from the two data sets' growth rates. The municipalities with the lowest production in 2011 (the lowest 25%) have an annual average production growth rate of 91.24% from 2011 to 2017. The municipalities with the highest production in 2011 (the highest 25%) have an annual growth rate of 7.64%. Figure 5 illustrates the difference below.

**Figure 5 – Average Growth in Avocado Production, 2011-2017**



*Notes:* The red line illustrates the yearly growth in the 25% lowest producing municipalities in 2011. The black line illustrates the yearly growth in the 25% highest producing municipalities in 2011.

The red line demonstrates annual percentage growth in average avocado production in the first quartile, where a move from 1 to 2 on the y-axis is equal to an increase of 100%. Given the difference in the first and third quartile growth rate, I am interested in checking whether the relationship with cartel-violence found in Table 4 is significant due to a minimum production value. The regression result is demonstrated in Table 7 below.

**Table 7:** Low vs. High Quartile – Total Level of Crime per 100 000

	Dependent Variable: Total Crime Rate per 100 000	
	Low quartile (1)	High quartile (2)
Avocado production	-0.264 (5.198)	14.744* (7.608)
Observations	424	453
Standard deviation	665.680	3 719.908

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* The estimation of avocado production on total level of crime. Column (1) illustrates the result of the lowest quartile, while column (2) illustrates the results of the highest quartile. The lowest quartile is based on the trimmed sample's 25% lowest producing municipalities in 2011. The high quartile is based on the trimmed sample's 25% largest producing municipalities in 2011.

Column (1) reveals the relationship between avocado production and crime rates for the lowest quartile, while column (2) represents the relationship between avocado production and crime rates for the highest quartile. The coefficient of the lowest quartile is negative, implying a negative relationship between production and crime rates. A one standard deviation increase in avocado production leads to a decrease in total crime rates of -0.264 reported crimes. However, as the coefficient is nonsignificant, I cannot draw any conclusions based on the estimation. The highest quartile coefficient is positive and significant, producing a 14.744 increase in reported crime rates with a one standard deviation increase in avocado production.

The result contradicts Table 6, suggesting cartel competition in municipalities with established producers instead of municipalities with small but fast-growing avocado production. The positive coefficient in the high-producing municipalities indicates cartel competition of access to the valuable avocado production. The territorial contestation is confirmed by the significant positive coefficient of assault, as seen in column (10) in Table 17 in the Appendix (Section 8.3).

## 5.1 Robustness Checks

In an effort to validate the robustness of the trimmed sample, I compare the OLS-coefficient of the full and trimmed sample. Table 8 presents the result.

**Table 8:** Robustness Check of Trimmed Sample

	Dependent Variable: Total Crime Rate per 100 000	
	FS-OLS (1)	TS-OLS (2)
Avocado production	56.755*** (19.686)	14.145** (5.795)
Observations	2 134	2 027
Standard deviation	22 391.06	2 277.825

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Comparing the coefficient of the trimmed sample, with the coefficient of the full sample. OLS-regression. Similar signs indicate robustness to the result.

The initial feature of the two columns is the similar sign. By dropping the 5% largest avocado production-values, the effect of increased production on crime rates is still positive. The result's similarity signifies the development and confirms the relationship between avocado production and crime rates to be robust for removing large outliers.

Table 9 illustrates a robustness check of crime data adjustments. As described in section 4.2.1, all municipalities with at least three missing observations in their crime data are removed from the data set. For the robustness check, instead of eliminating all municipalities with at least three missing values, only the NA-values are removed, keeping the registered values. This implies that for a municipality with NA-values for 2011-2014, the remaining reported values from 2015-2017 persist in the data set. The total crime-value is demonstrated in Table 9, while the subtypes of crime are found in Table 18 in the Appendix (Section 8.4).

As seen in column (1), the total crime coefficient is still positive and robust for changes in the data set, despite the lower value compared to Table 4.



**Table 9:** Robustness Check of Total Crime Rate

Dependent Variable: Total Crime Rate per 100 000	
	TS-OLS
Avocado production	5.765 (4.140)
Observations	2 673

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Removing NA-values. Keeping observed values in each municipality.

To confirm the relationship between production and crime rates, I implement a regression removing all control variables, illustrated by equation(4).

$$(4) y_{mt} = \beta_0 + \beta_1(Avo_{mt}) + \alpha_m + \gamma_t + \varepsilon_{mt}$$

Looking at avocado production on crime rates, with municipal- and time-fixed effects, as well as an error term, results in the regression seen in Table 10, which is positive and significant at a 5% level, almost equal to the outcome in Table 4.

**Table 10:** OLS – Without Control Variables

Dependent Variable: Total Crime Rate per 100 000	
	TS-OLS
Avocado production	12.606** (5.995)
Observations	2 027
Standard deviation	2 277.825

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Using trimmed sample. Removing all control variables to see the effect of avocado production on total crime rate.

## 6. Discussion

The evolving patterns seen in the avocado industry and Mexico's drug cartels have led to a possible relationship between organized crime and licit industries. To answer the initial problem: "Are avocados the blood diamonds of Mexico?", I seek to clarify the following central questions by discussing the outcome of my four hypotheses:

*What is the relationship between the increasing production of licit crops and the presence of organized crime in Mexican municipalities? In particular, has the increasing production of Mexican avocado encouraged drug cartels to move into the avocado market, either through extortion or production? Further, if the latter is true, has the involvement of cartel activity in avocado producing municipalities increased the level of violence between rival DTOs in an effort to control important territories, or are my results similar to the ones of Dube et al. and Erickson & Owen?*

### 6.1 Hypothesis Evaluation in Light of the Results

*Hypothesis 1: Increased production of avocado decreases the level of total cartel-related crimes*

Table 4 demonstrated a significant increase of 14.145 reported crimes with a standard deviation increase in avocado production. The result is the opposite of the one found in Erickson & Owen, and Dube et al. The main reason for the difference in result is most likely due to the difference in municipalities of interest. Earlier research has focused on Michoacán, while I look at all avocado producing municipalities.

A possible explanation for the positive relationship between avocado production and cartel crimes is the curse of natural resources. As evidenced above, Mexico struggles with weak legal institutions, increasing the likelihood for organized crime involvement in profitable licit sectors, as the avocado industry. With the continuing growth in global avocado demand and the subsequent development of Mexican avocado production, splintered drug cartels with the need for diversified revenue streams, exploits Mexico's weak legal institutions, and involve themselves in the lucrative avocado industry. As described in section 2.2, the Knights Templar achieved complete access to all municipal avocado production permits granted, giving them an "x-ray" of the avocado orchards. Weak legal institutions and the subsequent cartel-involvement in the avocado industry will most likely lead to violent clashes between civilians and the cartels, explaining a positive relationship between the two variables.

The latter is in harmony with Ornelas's (2018) research, who found that in an environment where the legitimate government fails to ensure property rights, economic agents have a greater incentive to invest in destructive measures against criminal organizations. Evidence from Michoacán reveals such an incentive, with the avocado farmers of Michoacán redirecting productive resources to protection as they could not trust the law enforcement authorities (Ornelas, 2018, p. 769). Such investments led to an upsurge of vigilantes protecting avocado farmers in situations where local and federal authorities were unable or unwilling to do so (Woody, 2017). Following the example described in section 2.2, the formation of a specialized police force in Tancítaro is such a vigilante group (Woody, 2017). Before its construction, Tancítaro was controlled by the Knights Templar, who at some point diversified its income stream to the point where drug trafficking was not among its top source of income (Castillo, 2014). The clashes between organized crime and self-protecting groups in Tancítaro increased the level of violence for a period. But, due to the protection of the “avocado police”, Tancítaro achieved an appearance of stability. Such a development implies a reduction in violence at places where vigilantes manage to “destroy” the cartels.

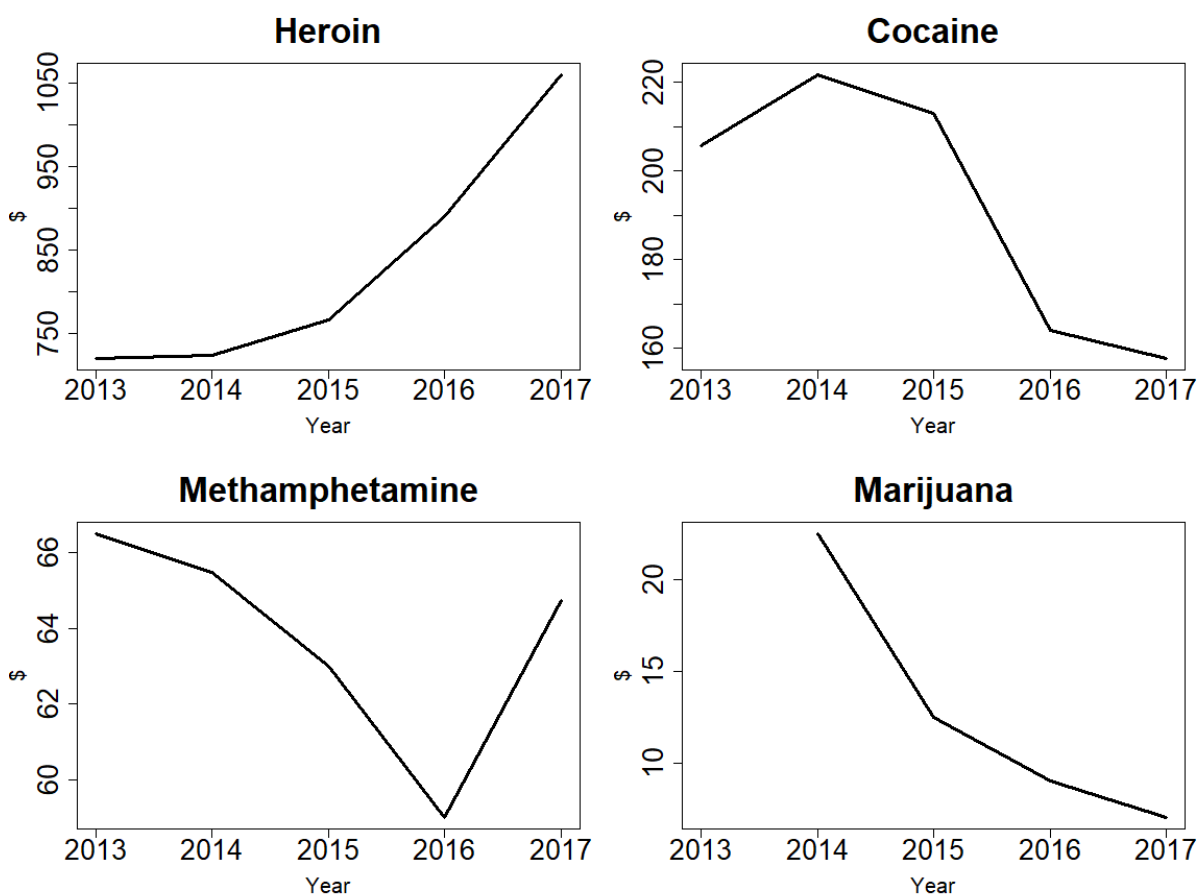
However, as seen in multiple news articles, vigilante groups protecting civilians and licit businesses start to abuse their power as the profitability of interest grows. Cartels infiltrate the ranks of self-defense groups, and what was supposed to be a protection group continues the violence of the cartels. There were reports of a new cartel in Michoacán in 2014, made up of disparate criminals and vigilantes (Parkinson, 2014). The cartel, named H3, was known for extraordinary violence (Henderson, 2017). Another relevant example of a former self-defense force turning evil, is Los Viagras. The gang started operating as a self-defense force in 2014, being requested to support the government to locate and capture the leader of the Knights Templar (Mexico News Daily, 2019). Today, the cartel is known as one of the most vicious drug gangs in Mexico, as well as being involved in the avocado industry (Erickson & Owen, 2020). These reports validate the fear of Mexico’s self-defense forces criminalizing. In addition, evidence has demonstrated criminals reacting even more violently, being provoked by vigilante justice (Asfura-Heim & Espach, 2013)

Further, because of the war on drugs in 2006 and Calderón and Nieto's kingpin strategy, the major cartels fractured into smaller organizations. Counter-drug efforts and clashes with rival organizations accelerated DTOs' rupture into smaller, more locally-concentrated operations (Justice in Mexico, 2020). As a consequence of these organizations being more localized, they have a smaller ability to evolve into transnational criminal enterprises, opposite of the Sinaloa

Cartel, the Gulf Cartel, and CJNG. Therefore, in a supplement of small-scale drug operations, Justice in Mexico finds that small DTOs are more likely to participate in destructive crimes, as extortions, kidnappings, robberies, etc. (2020). As such, the splintering of organized crime has led to more frequently vicious violence in avocado producing municipalities.

Following the pressure on drug-trading operations, organized crime saw the need for diversified revenue streams. As the global demand for avocados has made “the green gold” more valuable than cannabis in Mexico (Pape, 2018), it is evident that the avocado industry is a desirable business for cartels with the need for new operational areas. The increasing pressure on drug operations may have led to increased pressure on avocado farmers in the form of assaults, homicides, threats, and robberies. Figure 6 illustrates the development in drug prices for some of the most trafficked drugs by Mexican DTOs.

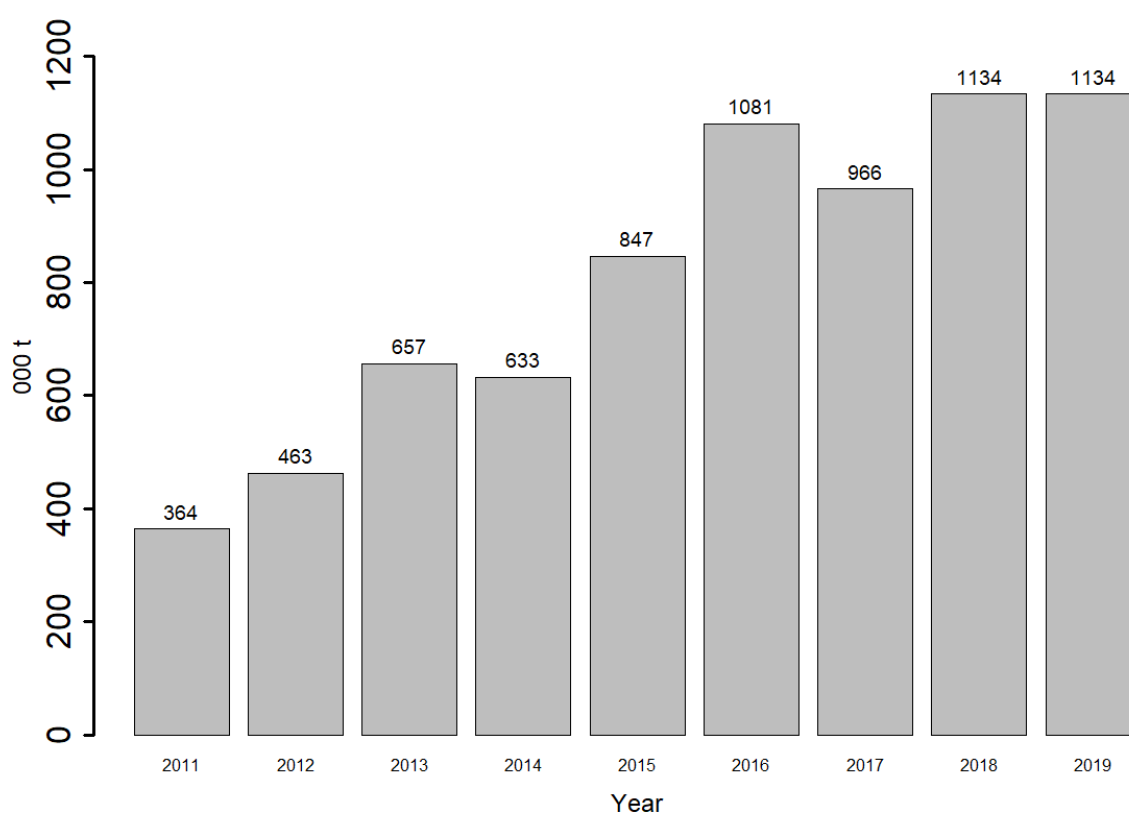
**Figure 6 – Development in Drug Prices per Pure Gram in \$**



*Notes:* Heroin, Cocaine and Methamphetamine prices are based on the 2019 National Drug Threat Assessment (DEA, 2019), given by DEA domestic purchases, reported on a quarterly basis. I annualize the data by finding the mean of the reported values each year. Marijuana prices are estimated on the retail price per gram of legal marijuana in Washington state illustrated in a table in the Washington Post (Humphreys, 2017). The values were reported quarterly, and I annualize the data by estimating the mean of reported values each year.

Despite the increasing value of heroin prices, there is a decreasing trend in cocaine, marijuana and in parts methamphetamine prices. Focusing on the price of marijuana, the steep decline in retail price since 2014 is due to the legalization of medical marijuana in multiple U.S. states. The legalization has possible repercussions for Mexican DTOs, as the illegal cannabis market shrinks with legalization of the substance. The development seen in Figure 6 increases the pressure on DTOs even more and clarifies the need for diversified revenue streams. Demonstrating the development in 000 tons of Mexican avocado exports from 2011 to 2019, Figure 7 can be used as an explanation of why Mexican DTOs are attracted to the industry.

**Figure 7** – Exports of Mexican Avocados in 000t



*Notes:* Annual data found in The Hass Avocado Board - Mexico report in 2019 (Hass Avocado Board, 2019). Data in 1000 ton.

Seeing the value of Mexican avocado exports triple from 2011 to 2016 indicates a massive profitability growth in the industry. Comparing the development with the development in drug prices, while keeping in mind the growing development in avocado prices as seen in Figure 2, it is clearly why Mexican DTOs see the avocado industry as an attractive substitute for drug trafficking. The development of avocado profitability and drug income might lead to cartels fighting each other to increase control and access in avocado producing municipalities. A relevant example supporting the line of thought is the fight between Los Viagras and CJNG in

Michoacán. As described earlier, CJNG killed 19 members of Los Viagras to win territorial control in essential avocado producing municipalities (Linthicum, 2019).

Compared with large drug trafficking organizations, which are complex and require supervising control from harvesting to trafficking to sale, the fractured new criminal enterprises are similar to local businesses. Such a structure lowers the bar to enter different local industries. Examples outside of the avocado industry are criminals who fight for access to oil pipelines in Guanajuato, which has led to tripled homicide rates. Further, in Guerrero, DTOs control access to gold mines, similar to the findings of Idrobo et al. (Linthicum, 2019). Another example of cartel involvement in the avocado industry is given by Mayco Ceja, a Mexican avocado picker. His team of avocado pickers was forced to pick avocados for seven hours without payment at a farm run by gang members (Linthicum, 2019). Another incident happened with criminal organizations barring pickers from working. The scarcity in supply led to increased prices, as well as a higher share of cartel-produced avocados, and in such higher profits for the cartels.

The positive relationship between avocado production and cartel-related crimes seems to exist due to fractured DTOs, weak legal institutions, a higher pressure on drug-trading operations increasing the need for diversified cartel operations, and cartel contestation for avocado producing municipalities.

By including a province-fixed effect, and thus implementing the regression on another model, it is possible to check whether it is differences between municipalities or provinces that drive the outcome seen in Table 4. The result is seen in Table 11.

**Table 11:** Province-Fixed Effects

Dependent Variable: Total Crime Rate per 100 000	
	TS-OLS
Avocado production	4.240 (5.030)
Observations	2 027
Standard deviation	2 277.825

*Clustered standard errors in parentheses*

*\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$*

*Notes:* Including province-fixed effects to check if the significance is due to differences on a municipality level, or differences on a province level.

As seen in Table 11, the coefficients' signs are the same, but the significance is gone. The disappearing significance implies that the identifying variation seen in Table 4 most likely exists due to differences between provinces within a given year. The relationship indicates avocado- and cartel-related decisions happen at a province level. Examples of such decisions might be avocado production decisions, such as permits and verification stamps, or cartels dividing their territory based on provinces. Such a territory division is logic, as it is cheaper for cartels to corrupt only one province government and more profitable for cartels to excess control in an entire province, rather than just a single municipality. Figure 8 below illustrates the Stratfor cartel map by region of influence, giving a still-picture of the situation of major DTOs' location in 2020. As seen, the cartels divide regions between themselves while affecting larger areas than just a single municipality.

**Figure 8** – Cartel Map by Region of Influence (Stratfor Global Intelligence, 2020)



Source: Main source: Stratfor Global Intelligence, “Tracking Mexico’s Cartels in 2020”, published in January 2020, <https://worldview.stratfor.com/article/stratfor-mexico-cartel-forecast-2020>  
 Map copied from: CRS, “Mexico Organized Crime and Drug Trafficking Organizations, July 28, 2020, <https://fas.org/sgp/crs/row/R41576.pdf>

Notes: The map reveals territory of influence and origin of Mexico’s DTOs

The fracturing of the major cartels in the aftermath of the war on drugs has probably made it expensive for the smaller DTOs to corrupt more than one province government. In an interview with the Guardian, Falko Ernst describes the model of Mexican organized crime: “Today, the model is this: you control a given territory, and within in it you exploit whichever commodity is locally available. That includes avocados, but also limes, papayas, strawberries, illegal logging, and mining, to name a few” (Dehghan, 2019). Ernst's statement supports the idea of my result being significant at a province level. Cartels exert control over a given territory, as seen in Figure 8, and try to protect it at all costs, increasing the level of violence. The finding is in accordance with Schelling's research and his idea of monopolization within organized crime.

*Hypothesis 1.1 – Increased avocado production decreases the reported number of each subtype of cartel-related crimes. But, as seen in section 3.2, I expect that rising avocado production leads to an increase in extortions.*

To evaluate the relationship between avocado production and cartel-related crimes, I focus on extortion, homicides, assault, and the different types of robberies in the following paragraphs.

As addressed in the implementation of Table 5, there is a negative relationship between extortion and production, implying that a standard deviation increase in avocado production leads to a decrease of 0.665 reported extortions. Given the numerous reported incidents regarding extortion in the avocado industry (e.g. Ornelas (2018)) and the economic theory on the field, such a result is surprising.

A possible explanation of the negative relationship between extortion and production is the positive threat-coefficient, found in Table 5, column (9). The positive yet insignificant coefficient implies threats to increase while extortion declines with avocado production. The relationship's initial suggestion is that extortion is reduced as Mexican cartels engage in direct cultivation, either on land taken from local growers or from illegal deforestation of protected woodlands (Wagner, 2019). The process might reduce the incentive to extort avocado farmers but increase the incentive to threaten Mexican inhabitants to give up their land or keep quiet about illegal deforestation.



Another explanation of the negative relationship is the implementation of self-defense enclaves in parts of Mexico. Ioan Grillo, a journalist from The New York Times, finds less extortion in Michoacán with such enclaves than under the days of the powerful Knights Templar (Grillo, 2020). Given the rupture of the larger Mexican DTOs, the self-defense enclaves might have a much larger possibility of fighting a small, organized crime fraction than the Sinaloa Cartel, the Knights Templar, or the Gulf Cartel. The splintering of DTOs will probably reduce the number of extortions and kidnappings registered but increase the numbers of homicides and assaults, as seen in Table 5.

Finally, as seen in Figure 4, the level of crime underreporting in Mexico is critically high. As I find a positive relationship between avocado production and cartel-related crimes, one can assume increasing levels of cartel presence in avocado producing municipalities from 2011 to 2017. As cartels often threaten their victims to keep quiet about their crimes, e.g. with corpse messaging – typically consisting of a mutilated body and a handwritten sign to scare others from talking (Finnegan, 2010), one can expect reported extortions to decline with higher levels of cartel presence. Such a result exists based on the fear of repercussions from the DTOs. Therefore, the possibility of bias results due to underreporting seems to exist when focusing on a single type of crime rather than the total crime rate. As seen in ENVIPE 2018, the underreported level of extortions in 2017 is estimated to be 98.2 % (INEGI, 2018).

Further, to evaluate the coefficients of homicide and assault given by columns (1) and (10) in Table 5, it is interesting to check the cartels' modus operandi. In order to do so, I implement a regression analysis on intentional homicides and assault, divided by the type of weapon used in the reported crime. The different weapons are (1) firearm, (2) cold weapon, and (3) no weapons. The assumption for the regression is a higher relationship between homicides and assault on avocado production for the reported crimes using a firearm and cold weapons than no weapons. The use of these types of weapons is typical for organized crime. The results of the three models are seen below in Table 12.

**Table 12:** Modus Operandi – Intentional Homicides and Intentional Assaults

	Dependent Variable: Total Crime Rate per 100 000		
	Firearm (1)	Cold weapon (2)	No weapons (3)
Avocado production	0.795 (0.851)	0.766** (0.331)	0.241 (1.640)
Observations	2 027	2 027	2 027
Standard deviation	2 277.825	2 277.825	2 277.825

*Clustered standard errors in parentheses*

*\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$*

*Notes:* Column (1) – Firearm. Column (2) – Cold weapons as knives and machetes. Column (3) – No weapons.

Column (1) represents the regression based on the use of a firearm, column (2) represents the regression based on the use of a cold weapon, while column (3) is based on the use of no weapon. As seen in column (1) and (2), the coefficients are positive and much larger than the coefficient seen in column (3). Additionally, the estimation of column (2) is significant at a 5% level. Assuming smaller enclaves do not have the necessary connections to buy a firearm, as larger DTOs do, the significance of column (2) possibly exist as smaller enclaves are involved in the avocado industry and are more likely to use cold weapons. A significant relationship between avocado production and the use of cold weapons strengthens the results seen in Tables 4 and 5. Most of the fractured cartels will likely not have the resources to use firearms. Further, the failed kingpin strategy indicates the significant result being due to cartels' need for diversified operations, including the avocado industry.

Another interesting idea is to check if the robbery-coefficient, consisting of robberies on the road (e.g., theft of cargo), frequent robberies, and bank robberies, is different when looking at violent robberies vs. non-violent robberies. Based on the description of organized crime, as seen in section 3.1, I assume violent robberies have a higher coefficient than the non-violent robbery type. Based on the resource-curse theory, the avocado industry might be a victim of violent robberies, and the result of the two regressions are seen below in Table 13.

**Table 13:** Modus Operandi – Violent Robberies vs. Non-Violent Robberies

	Dependent Variable: Robberies	
	Violent (1)	Non-Violent (2)
Avocado production	5.586* (2.967)	-3.320 (6.123)
Observations	2 027	2 027
Standard deviation	2 277.825	2 277.825

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

*Notes:* Column (1) – Violent robberies. Column (2) – Non-violent robberies. Robberies are a total of regular robberies (from private homes, people, etc.), road robberies (cargo-theft, from private cars in traffic, etc.) and bank robberies

Column (1) represents the violent robberies' value, while column (2) represents the non-violent robberies' value. A standard deviation increase in avocado production leads to a rise of 5.586 reported violent robberies (being significant at the 10% level). In contrast, a standard deviation increase in avocado production leads to a decrease of 3.32 reported non-violent robberies. The difference between the two coefficients supports the idea of cartel-related crimes being positively related to increasing levels of avocado production and can thus be used as a robustness check of the positive relationship seen in Table 4.

*Hypothesis 2 – The effect on crime is higher for municipalities outside of Michoacán*

Following the results of Erickson & Owen (2020), the relationship between cartel-related crimes and avocado production in Michoacán is negative. I believe the negative result is coming from cartels present in Michoacán anticipating increased territorial competition. The anticipated increasing contestation from competing cartels is in accordance with the main traits of businesses attracting criminal organizations. Three of the four characteristics Lavezzi (2008) mentions are relatable to the Mexican avocado industry. The Mexican avocado industry is, as described before, a traditional sector in the Mexican agricultural industry, as well as being territorial dependent. Finally, Mexico's legal institutions are weak, with issues regarding corruption being present, as seen in ENVIPE 2018.

Due to the avocado industry's attractiveness to Mexican DTOs based on the traits mentioned above and the increasing profitability of the avocado sector, the explanation of the negative relationship described by Erickson & Owen seems to fit my result. As cartels already present in Michoacán expect increasing territorial competition with the increasing profitability of the

avocado industry, the cartels increase the amount and effort spent defending their territories. I assume the growing amount used on defenses reduces incoming and competing cartels' incentives to attack these territories. Coscia & Rios (2012) revealed that DTOs were present in 45 percent of Michoacán and Jalisco's municipalities in 2010. This implies cartels already controlled a large share of these two states' municipalities before my period of interest. Consequently, as described in Erickson & Owen (2020, p. 23), there is a larger share of Michoacán's municipalities to protect than to claim in 2011-2017.

However, when looking at the municipalities outside of Michoacán's coefficient, seen in Table 6, column (2), there is a positive relationship between increasing avocado production and cartel-related crimes. The major difference between Michoacán, and all other states, is that Michoacán had a highly valuable avocado industry before 2011 on average. Based on the data extracted from SIAP, the average avocado production in Michoacán was 23746.6 tons in 2011. In contrast, the average avocado output outside of Michoacán was 546.9 tons in 2011. In 2017, these numbers were 25670.4 ton and 1186.1 ton, respectively. The growth rate in Michoacán was 8.1 percent on average in total, while the growth rate outside of Michoacán was 116.9 percent on average in total. The difference, both in initial production data and growth rate throughout the period of interest, suggests that the cartel presence in the avocado industry was low in 2011 outside of Michoacán as the profitability was low. The growing production rate in these states might have drawn the attention of multiple cartels fighting to gain access and control in the belonging municipalities. The increasing violence follows Yashar's (2018) theory, and her results of extreme violence levels in areas with a high level of territorial competition.

Yet, as both coefficients are insignificant, it is impossible to draw any clear conclusions based on the trends seen in Table 6. Therefore, further studies, i.e., looking at a more extensive timeframe, should be performed to verify the trends.

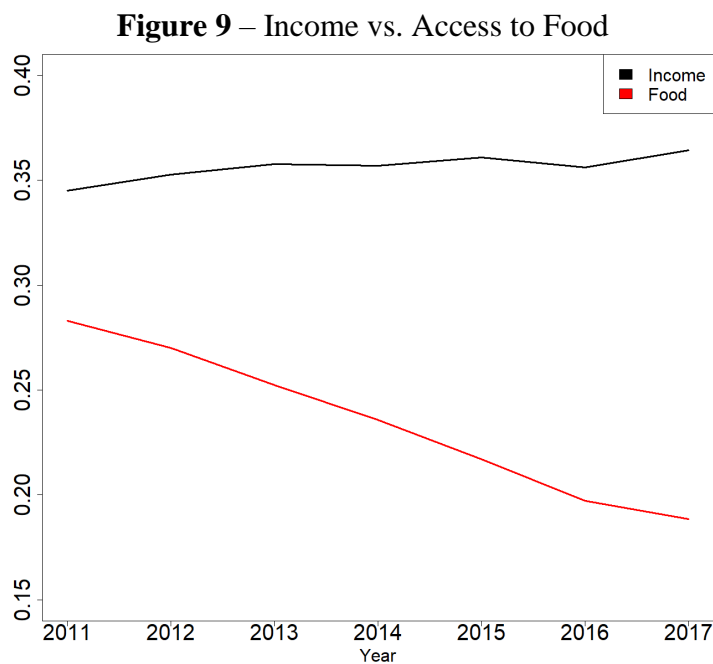
*Hypothesis 2.1 – The effect on crime is higher for those municipalities with the lowest production in 2011, compared to those with the highest production in 2011*

As opposed to the result found in Table 6, Table 7 demonstrates a negative relationship with cartel violence in low-producing municipalities. High-producing municipalities, on the other side, have a positive relationship with cartel violence. An explanation of the result seen in the low producing municipalities, contradicting the result found in Tables 4 and 6 (municipalities outside of Michoacán), is the avocado production volume in the low quartile municipalities. The average production in 2011 in the lowest producing quartile was 8.31 ton, increasing to

406.6 ton in 2017. Despite the enormous growth from 2011 to 2017, the production value is probably too low for cartels to initiate any interest in these production sites.

Looking at the crime subtypes found in Table 16 in the Appendix (Section 8.3), common theft (column (8)) is driving the negative value of the total crime coefficient in Table 7, column (1). Following Becker's ideas and his rational choice model of crime, the enormous percentage increase in avocado production from 2011 to 2017 in the municipalities with the lowest quartile of production in 2011 has probably affected the licit job opportunities in these municipalities. The outcome in the municipalities of interest seems to follow Becker's idea. As avocado demand rises, there are increased legal job opportunities, initiating a shift in farmers' activity. The change might be from drug cultivation and theft to avocado production, potentially leading to less cartel existence and less violent crimes. Joaquin "El Chapo" Guzman, the former kingpin of the Sinaloa cartel, explained in an exclusive interview the reasoning behind his initial involvement in the drug business: "from the age of 15 and on [...] in that area, and up until today, there are no job opportunities" (Guzman, 2016). He followed up his answer by saying, "The way [...] to be able to buy food to survive is to grow poppy and marijuana". Hence, growing job opportunities will possibly reduce the need for illegal activities.

Figure 9 below illustrates the development in the average income level below the welfare line and the average lack of food access in the low producing municipalities from 2011 to 2017.



*Notes:* Data extracted from CONEVAL. The red line illustrates the development in the average level of lack of access to food. The black line illustrates the development in the average level of income below the welfare line

Looking at the development of the two lines, a possible explanation of the negative coefficient is the positive effect of increasing avocado production on food access. The reported lack of access to food is sharply declining in the period of interest. At the same time, the income below the welfare line is relatively steady. Such a development in the two poverty-measurements suggests the increasing avocado production is used as food for the farmers, rather than as a sale item. The increasing production might lead to less hunger, reducing the need to steal for survival. As avocado cultivation seems to be for personal use rather than for sale, cartel interest in the area is most likely low. Thus, the negative value seen in Table 7 is expected, despite the initial contradiction to earlier results.

The result seen in large producing municipalities is surprising, as it contrasts with the negative value found in Michoacán. Such a contradiction implies a major difference in crime levels between municipalities with and without cartel presence from 2011. A large part of the high producing municipalities found outside of Michoacán will most likely have a low cartel presence in 2011, based on the result found in Table 7. As exports grow, and avocado prices both domestically and internationally increases, the profitability of high producing municipalities surges, leading to the same result found in both the main regression on the trimmed sample (Table 4) and the municipalities outside of Michoacán (Table 6, column (2)).

Seeing the positive coefficient of large producing municipalities in conjunction with the result of province-fixed effects, seen in Table 11, a possible explanation of the difference between Michoacán and large producing municipalities is the number of municipalities with a high production rate within a state. As seen in Table 11 and Figure 8, DTOs most likely corrupt entire provinces. As Michoacán has numerous high producing municipalities, the avocado industry has probably been attractive for cartels before 2011. For large producing municipalities outside of Michoacán, there also exists numerous low producing municipalities in the different provinces indicating a lower interest for cartels within the state. In such, as production grows in the entire state, the development catches the cartels attention, leading to territorial competition in the largest avocado producing municipalities within a given state. Further, the data set used for the high quartile regression is trimmed, removing the 5% largest avocado producing municipalities, which can influence the result, as the 5% largest avocado producing municipalities in 2011 are from Michoacán. However, implementing the regression analysis on the 25% largest producing municipalities applying the full sample does not change the result.

## 7. Conclusion

This master thesis's overall premise was to evaluate whether increased avocado production in Mexican municipalities decreased the level of cartel-related crimes. The short answer to the question is that the reported number of cartel-related crimes is positively correlated with increasing avocado production.

I report four main results. Implementing an OLS design, I find a significant positive effect of avocado production on total cartel-related crimes. A one standard deviation increase in avocado production increases total crimes with 14.145 reported crimes per 100 000. Looking beyond the total crime value, I find a negative relationship between extortion and avocado production, resulting in a reduction of 0.665 reported extortions per standard deviation increase in avocado production. The third main result reveals the difference between Michoacán, the largest avocado producing state by far, and all other avocado producing states. Michoacán has a negative relationship between total cartel-related crimes and avocado production, as expected based on the result of Erickson & Owen, and Dube et al. The other states, on the other hand, have a positive relationship between production and crime. Michoacán and outside see a result of -14.246 and 6.057 reported crimes per standard deviation increase in production, respectively. Finally, I find a negative relationship between an increase in avocado production and total cartel-related crimes in the municipalities with the lowest avocado production in 2011. Given the enormous growth in these municipalities' production, the negative result is the opposite of the initial assumption. In contrast, the municipalities with the highest production in 2011 have a significant positive relationship between avocado production and crimes.

Possible explanations of the different results are firstly given by Mexico's political landscape and its effect on the DTOs' modus operandi. As the powerful cartels splintered into smaller organizations because of the failed kingpin strategy of Calderón, large drug trafficking operations have been difficult to maintain. The drug cartels have involved themselves in the lucrative avocado industry to diversify their revenue streams, increasing territorial competition between DTOs and boosting violence levels. Furthermore, weak legal institutions have initiated a need for self-defense groups among avocado producers, possibly rising violence-rates as clashes between the vigilantes and the cartels occur.

The surprising result of the negative extortion value is possibly due to Mexican DTOs engaging directly in cultivation, either on land taken over from local growers or illegal deforestation. As the cartels begin to cultivate the fruit, the need for extortion is reducing. By seeing the result in

conjunction with the positive threat-coefficient, it seems like cartels reduce the extortion of avocado farmers but threaten Mexicans to give up their land or keep quiet about illegal deforestation. Another possible explanation is the introduction of self-defense enclaves. Ioan Grillo, a journalist from The New York Times, finds less extortion in Michoacán with such enclaves than under the days of the powerful Knights Templar (Grillo, 2020).

Further, following the research of Erickson & Owen, I believe the negative relationship between production and crime in Michoacán is due to a high level of cartel existence in the avocado industry from 2011. The cartels anticipate increasing territorial competition following the massive growth in avocado profitability and bolster their defenses. The assumed upgrade reduces the incentive to attack these municipalities and thus reduces the level of violence in the municipalities of Michoacán. The positive relationship between production and other states than Michoacán might be present because of the rapid growth of production from 2011 to 2017 in these states. The assumption of low cartel presence in these states indicates a growing industry with low expropriation values. The high production growth rate might therefore draw the attention of cartels fighting to control avocado farms.

Finally, the difference in result between low producing states in 2011 and high producing states in 2011, despite the tremendous production growth rate in the low quartile, is most likely due to a rise in licit job opportunities and low profitability in the low producing states. In accordance with Becker's ideas, a surge in legal job opportunities reduces the incentive to commit a crime. Moreover, the production growth might reduce the incentive to steal as the lack of food is reduced with increasing avocado production. Increasing profitability in the avocado industry might reduce the incentive to cultivate drugs for cartels, similar to the findings of Dube et al. Such a cultivation-reduction reduces cartels' presence and the level of violence. Given the low measure of avocado production even in 2017, I believe the profitability is too low for cartel involvement in the production despite the high growth rate. The difference in result between the high producing municipalities and Michoacán is most likely due to differences in the share of high producing municipalities within a state. For the highest quartile in 2011, many of the municipalities outside of Michoacán are located in provinces with numerous low producing municipalities, reducing the incentive for cartel involvement. As cartels most likely divide territories based on provinces, the growing production rate attracts cartels to provinces with low average production in 2011, infiltrating the municipalities with the highest production in a state, leading to territorial competition between cartels.



Looking at these four results together, low-producing municipalities producing below a certain amount are less attractive for the drug cartels to exploit unless production surpasses a certain threshold. On the other side, municipalities with production sites already particularly valuable from the beginning of 2011 (in provinces with a major share of high-producing municipalities) most likely experienced cartel involvement in the avocado industry from before 2011. Possibly, they have seen cartels bolster their defenses to reduce the incentive of territorial competition. This results in the following context between avocado production and cartel-related crimes:

*Municipalities with avocado production above a certain amount and without a major cartel present from the beginning of 2011 seem to experience territorial competition between cartels and thus increased violence rates.*

The main caveats of this thesis are the results' low significance levels and the issue of crime underreporting. My main result is only significant at a 5% level, and lower significance levels indicate a requirement of more robust evidence to conclude if it exists a relationship between increasing avocado production and the level of cartel crimes. However, as my results are consistent between tables, the reference is reliable, reducing the issue of lower significance. Secondly, as described earlier, Mexico struggles with high crime underreporting levels, indicating the results to be the lower limits for expected effects on crime. Given the steady dark figure of crime throughout my period of interest, it seems the measurement error is constant and does not create any bias in my results when I focus on the level of total cartel-related crimes.

Given the positive relationship in the main regression, and the assumption of massive cartel presence in Michoacán during the period of interest, it is possible the avocado is the new conflict commodity. The blood diamonds of Sierra Leone and Angola fund rebel organizations, implying an equal relationship as witnessed in Mexico with the drug trafficking organizations seeking to diversify their revenue streams. Keeping in mind the stigma linked to the blood diamonds of Africa, it is essential to continue the investigation of possible relationships between Mexican DTOs and the profitable avocado industry.

In addition, there might be an idea to evaluate the relationship between environmental crimes and the avocado business in Mexico. Given the development of global warming and the subsequent increase in average temperatures, environmental issues are among the most critical problems on the agenda today. The increasing demand for avocado has led farmers to expand their harvest fields, with evidence of illegal deforestation as a result. According to Global Forest Watch (2019), 98 percent of deforestation in Mexico was due to the expansion of agricultural

harvest fields in 2016. Simultaneously, avocado production is exceptionally water-intensive, and there is evidence of water violations in the avocado industry. Reports from Chile found that plantation owners illegally deprived local villages of water access via at least 65 illegal underground water pipes (Milne, 2019).

I suggest two other possible future avenues for research in addition to the environmental issues: Avocado production used for (1) money laundering and (2) drug transportation. Do cartels use the avocado industry for money laundering, as brought to light in Linthicum's article (2019)? Or do cartels use avocados' increasing popularity to transport drugs to the U.S.'s valuable drug market? On February 15, 2018, Mexican soldiers in Sonora stopped a cargo truck full of avocados. Closer inspections of the cargo detected 800 kilograms of cocaine heading north towards the U.S. (Pape, 2018). Using avocado production data on known drug transporting routes might demonstrate a relationship between avocado transport routes and drug transport sites.

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## 8. Appendix

### 8.1 Explanation of Control Variables from CONEVAL

#### Data extracted from CONEVAL:

Following is an explanation of the methodology for each variable, directly copied from the brochure of the National council for the Evaluation of Social Development Policy (CONEVAL).

The value of **Lack of Access to Health Services** is decided by whether an inhabitant has an affiliation to receive medical services from institutions providing them. Examples of institutions are Seguro Popular, IMSS, ISSSTE, Pemex, Army, Navy or other private medical services (CONEVAL (A), n.d.).

The value of **Lack of Access to Basic Services** is decided by whether the water is obtained from a well, river, lake, stream, pipe; or, if the piped water is obtained by hauling it from another home, or from the public tap or hydrant. Further, they do not have a draining service, or the draining has a connection to a pipe that goes to a river, lake, sea, ravine or crevasse. Additionally, they do not have electricity, and the fuel used to cook, or heat food is firewood or charcoal without a chimney. (CONEVAL (A), n.d.)

The value of **Deprivation due to quality and housing spaces** is decided by whether the materials of the floor of the house is earth, the material of the roof of the house is cardboard sheet or waste, and that the material of the walls of the house is made of mud, reed, bamboo, palm, cardboard, metallic, asbestos or waste material. Additionally, the ratio of people per room (overcrowding) is greater than 2.5 people. (CONEVAL (A), n.d.)

The value of **Income below welfare line** is decided by whether the income is lower than the monthly cost of the aggregation of the basic food basket with the basic non-food basket, that includes food, transportation, education, health, entertainment, and goods and services of regular consumption (CONEVAL (A), n.d.).

The value of **Lack of Access to Social Securities** is decided by whether the mechanisms designed to ensure people's subsistence in case of contingencies such as accidents, illnesses or circumstances such as old age and pregnancy are missing. This measure takes into considerations that salaried economically active people has the following employment benefits: (1) Medical service at IMSS, ISSSTE, state level ISSSTE or PEMEX. (2) Retirement Savings

System or enrollment in a Retirement Funds Administrator. (3) Disability benefits. (CONEVAL (A), n.d.)

The value of **Lack of Access to Food** is decided by whether, during the last three months, as a result of lack of money or lack of other resources, households had a diet based on a very small variety of foods, stopped having breakfast, lunch or dinner, ate less than what he/she thinks they should eat, were left without food, felt hungry but did not eat or ate just once a day or stopped eating for a whole day. (CONEVAL (A), n.d.)

## 8.2 Subtypes of Crime: Michoacán vs. Non-Michoacán

**Table 14:** Michoacán – Subtypes of Crime

Dependent variable: Subtypes of crime per 100 000										
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.692 (7.818)	-1.932 (1.696)	-0.382 (1.286)	2.291 (2.264)	5.405** (2.335)	-0.705 (0.493)	-10.977* (5.700)	16.460 (23.188)	-16.077*** (6.141)	-9.020 (20.169)
Observations	356	356	356	356	356	356	356	356	356	356
Standard deviation	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66	49 780.66

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table 15:** Non-Michoacán – Subtypes of Crime

Dependent variable: Subtypes of crime per 100 000										
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.254 (0.567)	0.342 (0.312)	-0.130 (0.089)	-0.256 (0.263)	0.311 (0.324)	0.080 (0.078)	2.296* (1.318)	-0.210 (2.059)	-0.097 (1.052)	3.466* (1.954)
Observations	1 778	1 778	1 778	1 778	1 778	1 778	1 778	1 778	1 778	1 778
Standard deviation	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732	2 898.732

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

## 8.3 Subtypes of Crime: Low Quartile Sample vs. High Quartile Sample

**Table 16:** Low Quartile – Subtypes of Crime

Dependent variable: Subtypes of crime per 100 000										
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.573 (2.027)	-1.271 (1.907)	-0.092 (0.299)	-0.101 (0.398)	-0.757 (1.009)	0.901* (0.467)	1.328 (2.489)	-5.228 (9.076)	-0.568 (3.365)	3.554 (6.302)
Observations	424	424	424	424	424	424	424	424	424	424
Standard deviation	665.680	665.680	665.680	665.680	665.680	665.680	665.680	665.680	665.680	665.680

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table 17:** High Quartile – Subtypes of Crime

Dependent variable: Subtypes of crime per 100 000										
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.102 (0.904)	-0.690** (0.308)	-0.127 (0.169)	-0.315* (0.176)	0.679 (0.461)	-0.063 (0.045)	1.760 (1.546)	3.933 (2.874)	-1.049 (1.252)	5.478** (2.545)
Observations	453	453	453	453	453	453	453	453	453	453
Standard deviation	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908	3 719.908

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

## 8.4 Robustness Check: Subtypes of Crime

**Table 18:** Robustness Check of Subtypes of Crime

Dependent variable: Subtypes of crime per 100 000										
	Homic (1)	Extor (2)	Kidn (3)	Road (4)	Sexual (5)	Bank (6)	Fraud (7)	Theft (8)	Threats (9)	Assault (10)
Avocado production	0.731 (0.591)	-0.379 (0.302)	-0.242 (0.172)	-0.492* (0.271)	0.145 (0.338)	0.065 (0.053)	-0.050 (0.990)	2.606 (2.151)	0.139 (0.964)	3.243* (1.925)
Observations	2 673	2 673	2 673	2 673	2 673	2 673	2 673	2 673	2 673	2 673

*Clustered standard errors in parentheses*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$