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Green Gold: Avocado price shocks and violence in Mexico

Katie Roett
katie.roett@gmail.com

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Department of Economics
University of San Francisco
2130 Fulton St.
San Francisco, CA 94117

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Abstract: The role of economic incentives in political armed conflict is well documented, but there is very little evidence on a growing and increasingly globalized form of violence: organized crime. Most existing research focuses on the impact of price shocks on wages and how this affects an individual's opportunity cost to join an armed group or political movement. However, unlike other violent groups, organized criminal groups do not compete for political power, but profits in illegal markets. In Mexico, these groups have more than doubled in the past two decades, leading to an explosion of violence and record high 35,000 people being murdered in 2019. Mexican cartels engage in rent-seeking behavior in both licit and illicit markets, especially in rural areas where illicit crop cultivation supports the drug trade. In this paper I use a differences-in-differences strategy exploiting variation in avocado and illicit drug prices from 2003-2018 to understand how price shocks to both legal and illegal commodities impact cartel competition in different markets. I find rising avocado prices have a significant effect on violent crime in avocado-growing municipalities at the monthly level. Cartels also are more likely to enter an avocado-growing municipalities as prices increase, and less likely to leave them. Avocados may also be complementary to illicit crop cultivation.

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E-mail: *kroett@dons.usfca.edu*

I. Introduction

The direct and indirect costs of the war on drugs have been immense. An estimated $1 billion per year is spent globally on the policing and interdiction of illicit drugs – a market conservatively valued at $330 billion.[1] According to the UNODC, there is little evidence that the prohibitionist tactics these expenses finance are effective, and often place the highest cost burden on producer nations and marginalized communities in the US and Europe.[2]

This paper seeks to contribute to this evidence gap by looking at how organized criminal groups in Mexico respond to different incentives to expropriate legal and illegal markets. I use the example of avocados to illustrate how positive price shocks to a high-value, export commodity crop can induce cartels to compete for rents in a similar way to illicit commodities. I also estimate the impact that these price shocks have on different violence outcomes. Finally, I observe if avocado prices induce any tradeoffs to cultivating this legal commodity vs. illicit crops. This paper is the second that I know of that empirically looks at how price shocks to a legal commodity impact cartel-related violence in Mexico.[3] It also supports Sobrino's (2020) novel work illustrating cartel competition as a mechanism for increased violence following a positive demand shock for heroin.

Avocados serve as an interesting example of how price shocks to a legal commodity may have similar effects as price shocks to illicit goods in regards to cartel presence and related violence. The combination of increasing international demand for avocados, cartel splintering following Mexico's drug war beginning in 2006 and decline of the drug trade's comparative profitability in some areas over the last two decades has led to reports of increased expropriation of the avocado industry via direct extortion, kidnappings and killings of avocado producers, as well as direct purchasing of avocado orchards by various criminal groups. Between 2009 and 2013 alone, these groups expropriated an estimated 13 percent – $770 million – of revenue from avocado producers.[4]

This has large implications for policymakers who are trying to curb cartel violence. I find that increasing avocado prices have a significant impact on violent crime, making it more likely for multiple cartels to enter and less likely to exit avocado-growing municipalities. Evidence also points to potential complementary effects of avocado and illicit drug cultivation. Anti-drug trafficking policies in the past have often focused on the eradication and seizure of drugs, or incentivizing farmers to cultivate legal crops, like avocados. But these strategies may just shift cartel incentives to expand into expropriating legal markets and potentially generate even higher negative externalities in communities, particularly in rural areas.

The rest of the paper is structured as follows: Section II gives further background on the growth of the avocado industry, cartels in Mexico, and literature on price shocks and violence. Section III reviews the data used in my estimations. Section IV reviews my empirical strategy, Section V outlays my main results and Section VI ends with concluding remarks and policy recommendations.

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[1] Global Commission on Drug Policy. Taking Control: Pathways to Drug Policies that Work. Rio de Janeiro, 2014. At: http://www.gcdpsummary2014. com/#foreword-from-the-chair)

[2] UNODC/WHO, International Standards on Drug Use Prevention, Second updated edition (Vienna, 2018)

[3] The first being Dube et al.'s 2016 work on maize price shocks and impact on illicit drug cultivation patterns

[4] Asmann, Parker. "Powerful Mexico Crime Groups Grew by Extorting Avocado Trade: Report." InSight Crime, November 19, 2017. https://www.insightcrime.org/news/brief/powerful-mexico-crime-groups-got-their-start-extorting-avocado-trade-report/.

II. Background

i. Commodity price shocks and violence

Price shocks to commodities like avocados can affect crime in violence through several mechanisms. Most economic literature addressing the effect of price shocks and crime approach it from an opportunity cost perspective (Becker, 1968). Depending on whether wages from legal employment or criminal activity are higher, workers will choose whichever option yields greater returns. Under this framework, positive price shocks to capital-intensive goods should increase violence through an appropriation effect. Conversely, a rise in the price of labor-intensive goods reduces conflict, since wage effects are large and more labor is needed. Several studies have found this true for price shocks to agricultural commodities (Dube & Vargas, 2013; Dube, 2016; Gehring & Langlotz, 2018) in Afghanistan, Colombia and Mexico.

Dal Bó and Dal Bó (2011) expand on Becker's theory beyond individual choice to account for social network dynamics by creating a general equilibrium model of a small open economy that comprises two productive sectors and a third "appropriation" sector that is a fraction of what is produced in the first two sectors. They found that exogenous increases in the price of capital-intensive goods will cause the appropriation sector to expand, but that social backlash of appropriation activities is sometimes so strong that positive shocks can actually make a conflict-free economy worse off.

However, much of this literature makes a big assumption about individual choice and one's ability to have the freedom to choose whether to engage in crime or not. It also ignores the role of non-formal institutions and social networks. In many states with weak property rights and institutions, non-state like organized criminal groups can have varying degrees of influence on local economies that can determine how price shocks affect different communities. As a result, some shocks – even if they are to labor intensive goods – can intensify violence or increase the probability of conflict when they benefit illegal organizations.

One recent study looks at price shocks from both an economic and state-formation perspective. The author analyzes rebel group behavior in the Democratic Republic of the Congo and models the impact of price shocks and how they affect decisions of different rebel groups to expropriate or not (Sánchez de la Sierra, 2020). Using historical survey data, the author looks at price shocks on gold (small and capital-intensive) and coltan (bulky and labor-intensive), finding that increases in the world price of minerals led to the establishment – or attempted establishment – of monopolies of violence,[5] but only if these minerals are easy to tax, as was the case with coltan but not gold. Unlike previous findings on price shocks, demand for labor-intensive commodities increased violence (since the violent groups sought to appropriate revenues) while it left the rates of pillages and arbitrary expropriations unaffected. This research suggests that the effect of price shocks are likely more nuanced than previously theorized, depending not only on individual utility but also heavily on local context, non-state group structure and non-political incentives of these groups.

ii. Avocado demand growth in the US

[5] A "monopoly on violence" in political science refers to the concept that the state alone has the right to use or authorize the use of physical force. A criminal organization or other non-state group operating in an area with weak formal state presence often compete with other groups to establish a "monopoly of violence" over an area, taking on state functions like taxation, providing social services, defending territory from invading groups, etc.

Nine out of every 10 imported avocados in the United States come from Mexico. Michoacán is the only state certified to export the fruit to the U.S., making up 80% of the state's total export market.[6] Between 2001 and 2010, avocado production tripled and exports increased tenfold, with sales valued at $2.8 billion in 2019 – surpassing both oil and estimated marijuana revenues.[7] More than 30,000 avocado orchards now cover 23 percent of Michoacán, far surpassing the next growing state (Jalisco, which grows about 17,000 hectares), making it the avocado capital of the world (Hansen, 2017).

This boom began following the North American Free Trade Agreement in 1994 and subsequent lift of a ban on avocados from Mexico three years later. Promotion programs have been credited as the main driver behind increasing demand and year-to-year sales increases through effective marketing for events like the Super Bowl and promoting the fruit as a nutritional "super fruit." Aggregate demand for avocados at the retail level is generally inelastic; an increase in shipments of 2% is predicted to decrease shipper prices by 10% under constant demand (Ambrozek et al. 2018).

iii. Cartels and illegal markets in Mexico

Economic theory on firm competition and anecdotal evidence from Mexico and other countries suggest that not only is violence used to compete in illegal markets, but that increasing prices of a commodity will induce criminal groups to compete for expected revenues (Sobrino 2020; Millán-Quijano 2019; Dimico 2017; Kugler, Verdier, and Zenou 2005; Donohue and Levitt 1998; Fiorentini 1995). Rates of violence increase because competing groups seek to enter new markets, increase their current market share, or try to deter the entry of new groups to their territory. This has been empirically shown in Colombia with cocaine (Millán-Quijano, 2019), Afghanistan with heroin (Gehring et al. 2018), Brazil with the illegal mahogany trade (Chimeli and Soares, 2017) and recently with heroin in Mexico (Sobrino 2020). This paper's empirical strategy relies on the assumption that cartels in Mexico behave like profit-seeking firms, and that violent crime increases though this competition mechanism, rather than the wage mechanism that drives violence in areas where groups rely on the local support of people or actively recruit local populations.

III. Data

For my monthly analysis corresponding to equation 1 I construct a panel dataset of 2,456 rural municipalities over the period of 2011-2018 to gauge the impact of price changes on a series of violent outcomes, including homicides, extortions and kidnappings at a monthly level (Table 1). Crime statistics are provided by Mexico's National Institute of Statistics and Geography (INEGI) and the Executive Secretariat of the National Public Security System (SESNSP). INEGI has measured monthly homicides by state and municipality since 1990, SESNSP provides state-level crime data going back to 1997, and municipal-level crime data going back to 2011. Avocado import value is measured in real USD and import quantity in metric tonnes. All import measures are provided by the United States Department of Agriculture's Global Agricultural Trade System (GATS). Agricultural production data at the municipal level is measured in metric tons and provided by Mexico's Secretariat of Agriculture

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[6] Larmer, Brook. "How the Avocado Became the Fruit of Global Trade." The New York Times. The New York Times, March 27, 2018. https://www.nytimes.com/2018/03/27/magazine/the-fruit-of-global-trade-in-one-fruit-the-avocado.html.

[7] Pérez, David Marcial. "La Maldición Del Aguacate." EL PAÍS. Ediciones EL PAÍS S.L., February 2, 2019. https://elpais.com/internacional/2019/02/01/actualidad/1549049608_676151.html.

and Rural Development (SAGARPA), and is. Population data comes from Mexico's National Population Council (CONAPO).

For data corresponding to the annual level regressions in equations 2-4, I look at the same municipalities but from 2003-2018 due to more availability of crime and agricultural data. For equation 3, crime statistics and US import data are aggregated from INEGI, SESNSP and GATS. International narcotic prices provided by the United Nations Office on Drugs and Crime (UNODC), with wholesale and retail prices in USD going back to 1990 in both Europe and the United States. Eradication of marijuana and heroin poppies is calculated by the Mexican military (SEDENA) at the municipal level, going back to 1990, and are used as a proxy for illicit drug production.

For equation 2, cartel presence is measured at the annual level by municipality from 2003 to 2018 and comes from a novel dataset constructed by Sobrino (2020) that scrapes Google News and uses natural language processing. I construct variables indicating cartel entry and exit into municipalities based on Sobrino's work on heroin price shocks and cartel violence using exogenous variation in demand for heroin from the 2010 OxyContin reformulation. Equation 3 uses the same annual-level avocado import and production data regressed on SEDENA eradication and seizure data to look at tradeoffs to cultivation, following Dube et al.'s (2016) framework on maize price shocks.

A critical problem with the crime data is underreporting – only 9 out of every 100 crimes result in convictions[8] – and unreliability in reporting due to corruption. There's also certain gaps in the data depending on what administration is in power and corresponding changes in policy of data collection, which need to be controlled for. For example, the Mexican attorney general reported early figures on "drug-related" homicides from 2000-2008, stopped for about 4 years and then resumed. One other issue is an endogeneity concern of using marijuana and heroin poppy eradication as a proxy for production in different municipalities, because eradication efforts can be due to local parties in power (officials from Mexico's National Action Party have more hardline drug war policies than other parties, and this shapes local strategy to fight cartels) or just proximity to army bases or police stations. Dube et. al. (2016) control for these factors in their research on maize price shocks and farmer decisions to grow marijuana, and find that even with endogenously targeted enforcement eradication still serves as a good proxy for production of illicit crops, so for the purpose of this analysis I will use the same measure.

IV. Empirical Strategy

This paper uses a differences-in-differences strategy exploiting time variation in US avocado import value and geographical variation in growing area within Mexico to estimate changes in violent crime, cartel presence and drug trade outcomes. For my main estimation I regress monthly US avocado import prices on municipal-level violent crime outcomes to determine whether changes in avocado prices disproportionately affect avocado-growing municipalities. The linear estimation of avocado prices on violent outcomes is given by:

$$(1)\ Y_{mt} = \lambda(Avo_m \times AP_t) + \propto_j + \beta_t + logpop + \varepsilon_{mst}$$

where Y_{mt} are violence measures including the log of homicides, extortions, kidnappings and burglaries in a given municipality m and month t, $\propto_j$ are municipality fixed effects, β_t are month-year fixed effects and $logpop$ is the natural log of population. I look at Avo_m is a 0/1 indicator variable indicating whether or not a municipality is producing avocados in a given

[8] "Impunity in Mexico: A Rising Concern." Justice in Mexico, May 4, 2017. https://justiceinmexico.org/impunity-mexico-rising-concern/.

year and AP_t is the natural log of the U.S. import value of avocados in month t. λ is the main coefficient of interest, measuring the differential effect of avocado value on the outcome in municipalities with avocado production. Robust standard errors are clustered at the municipal level. Homicides, extortions and kidnappings are the most common forms of cartel-related violence, while burglaries capture what home and business theft (i.e. stolen avocado trucks, avocadoes stolen from trees, etc.). I also look at the impact of log import value on financial crime (telephone scams, fraud, etc.), which should have no effect.

I then aggregate US avocado import value to the annual level and use a linear probability model to determine the likelihood of cartels entering or exiting an avocado-producing municipality given annual changes in import value:

$$(2)\ Car_{mt} = \lambda(Avo_m \times AP_t) + \propto_j + \beta_t + logpop + \varepsilon_{mst}$$

Where Car_{mt} is a dummy variable indicating the first occurrence of any cartel, a second cartel then third cartel entering a municipality *m* in year *t*. Then I look at the likelihood of the second and third cartel exiting, as well as more than one cartel being present in a given municipality and year. This is because as the value of avocadoes increase, the expectation is that cartels are driven by a "contest effect" to take control of avocado-growing territory, while also making it less likely for a given cartel to exit. $\propto_j$ are municipality fixed effects, β_t are year fixed effects and $logpop$ is the natural log of population. Avo_m is a variable indicating whether or not a municipality is producing avocados in a given year and AP_t is the natural log of the U.S. import value of avocados in year t. λ is the main coefficient of interest, measuring the differential effect of avocado prices on the outcome in municipalities with avocado production. Robust standard errors are clustered at the municipal level.

For my last two regressions I compare annual avocado production and price to that of illicit drugs by interacting international drug prices and production, proxied by eradication and seizures. I first regress the same annual-level avocado interaction, in addition to poppy and methamphetamine interactions, on logged violent outcomes. This allows me to see how violence generated by competition around avocado rents might compare to the main source of cartel revenue; drug trafficking.

$$(3)\ Y_{mt} = \lambda(Crop_m \times CP_t) + \propto_j + \beta_t + logpop + \varepsilon_{mst}$$

Here, all variables remain the same as equation 2, apart from $Crop_m$ and CP_t, where I separately regress the same annual avocado interaction, in addition to a poppy production variable represented by a dummy for whether or not poppy has been eradicated in a given municipality interacted with the log US average retail price of heroin (purity and 2017 inflation adjusted). I also interact an indicator for meth seizures with the log US average retail price of methamphetamine.

Finally, using Dube et al.'s (2016) strategy, I see if avocado prices have any impact on farmer decisions to cultivate illicit crops by regressing the same annual avocado interaction used in equation 2 on drug seizures and eradication.

$$(4)\ Drug_{mt} = \lambda(Avo_m \times AP_t) + \propto_j + \beta_t + logpop + \varepsilon_{mst}$$

Marijuana and poppy eradication are measured as log area eradicated per 10,000 hectares plus 1, and all drug measured as the log of kilograms seized plus 1. All other variables remain the same as equation 2. I also include several robustness checks outlined in Tables A1-6. I drop northern states from my sample (in case the drug war in those areas may have biased my results upwards), use alternate price measures at the national, municipal and producer-price level to compare to the impact of US import value, and also use several alternate specifications for fixed effects and two-way clustering.

V. Results

Monthly regressions reveal that variation in avocado prices have a small but significant effect on homicides, extortions and kidnappings – the three main forms of violence employed by cartels, as well as burglaries. There is no effect on financial crime, as expected. Table 1 shows that for every 1% increase in avocado import value, homicides increase by .026%, extortions by .015%, kidnappings by .006% and burglaries by .030%, with significance at the 1% level. If the monthly import value of avocados increases 20% in January in anticipation of the Super Bowl, this would result in an increase of .48% in homicides, .27% in extortions, .10% in kidnappings and .55% in burglaries in avocado-growing areas. Results hold using alternate fixed effect and clustering controls (Table A.1).

I also find that when aggregated at the annual level, cartels are more likely to enter avocado-producing municipalities as price increases, and less likely to leave them. The regressions from the linear probability model in Table 2 again show small but significant results. For every 1% increase in avocado import value the probability of a first cartel entering an avocado-producing municipality increases .0009%, a second cartel entering increases .0004% and a third cartel increases .0003%. The probability of more than one cartel being present in an avocado producing municipality increases .002%. Meanwhile, the likelihood of cartels exiting avocado-growing municipalities decreases, with the probability of the third cartel exiting decreasing .0002% and second cartel exiting decreasing .0007%. For reference, across the sample period (2003-2018) the total value of avocado imports from Mexico increased 40% on average year-to-year. These results are consistent with both previous empirical work on heroin price shocks conducted by Sobrino 2020, and with the literature on competition in illegal markets.

Results from annual-level avocado and drug outcomes in Table 3 are less conclusive. Avocado, heroin and methamphetamine prices all have a significant effect on homicides in municipalities where these commodities are grown (or processed for meth). For example, a 40% increase in annual avocado and heroin prices would increase homicides by .76% in avocado-growing municipalities, and .63% in poppy-growing municipalities, respectively. Results from previous research indicates this is likely a gross underestimation of the illicit drug trade's impact on violent crime, pointing to the need to include additional controls – weather conditions, trafficking routes, suitability indexes, etc. – in these regressions and future analyses for both legal and illegal commodities.

Finally, I apply Dube et al.'s (2016) method to see whether or not increasing avocado prices impact illicit drug cultivation patterns and farmer decisions, with opposing results. Where the authors in this paper find maize prices have an inverse relationship with drug eradication and seizures of raw outputs, I find that avocado prices have a significant direct relationship. In Table 4, for every 1% increase in avocado import value, marijuana and opium poppy eradication increase .031% and .046% respectively. Raw seizure of marijuana and opium gum also increase .017% and .005%. Meanwhile, apart from packaged marijuana, all other processed outputs have no effect or significance, which is in line with Dube et al.'s framework and the expectation that avocado prices impact planting and production decisions, but don't necessarily affect drug processing (since processing does not need to take place where crops are grown). These results suggest that there may be increasing economies of scale in avocado production that encourage illicit crop production; particularly given poppy and avocados have the same agroclimatic suitability. This is also in line with anecdotal evidence from farmers on companion planting practices with legal and illegal crops.

VI. Conclusion

This paper offers more insight on how variation in high-value, exportable commodities through the example of avocados can affect violence, cartel presence and the drug trade in the areas they're grown in Mexico. It also contributes to the literature on organized crime and the impact of price shocks on violence. Using several sources of data on commodity prices, violent crime and cartel presence, I show through variation in prices and regional production how municipalities producing avocados may be more susceptible to external price shocks and organized crime. Future research should continue to focus on both the role of legal and illegal commodities, as laws relating to drug control continue to shift in the US and abroad. The continued development of datasets like that developed by Sobrino (2020) should also be prioritized in order to study non-wage incentives of profit-motivated non-state groups.

Collecting evidence that deepens our understanding on the mechanisms and incentives of criminal groups will continue to be critical in Mexico, as cartel fragmentation and violence continues to rise.[9] It's particularly important for rural communities where these groups mainly operate. Globally, agriculture remains the main livelihood source for 36% of the world's total workforce (up to 50% in Asia and 75% in Africa), with 1.3 billion people working in farming.[10] As climate change continues to shift and limit where certain crops can be grown – especially high-value fruits, vegetables and spices[11] – policymakers need to be aware of the externalities associated with commodity price shocks in areas vulnerable to predation.

The evidence presented in this paper and other research on cartel competition indicate that policies that aim to create "drug-free" societies through eradication and seizure operations may not actually have an effect on curbing violence perpetuated by drug-trafficking groups. In addition, development initiatives that seek to encourage farmers to shift cultivation from illicit crops to legal commodities, like avocados, must take into account the fact that farmers may still be subject to extortion and other forms of violent rent capture.

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[9] 2019 was Mexico's most violent year yet to date (INEGI).

[10] Kuhn, Stefan, Santo Milasi, and Sheena Yoon. "World employment social outlook: Trends 2018." Geneva: ILO (2018).

[11] Similar dynamics are emerging with vanilla in Madagascar, where the spice is valued at $270 a pound — more than silver (NY Times).

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Appendix

Figure 1: Crime rates in Mexico (1997-2018)

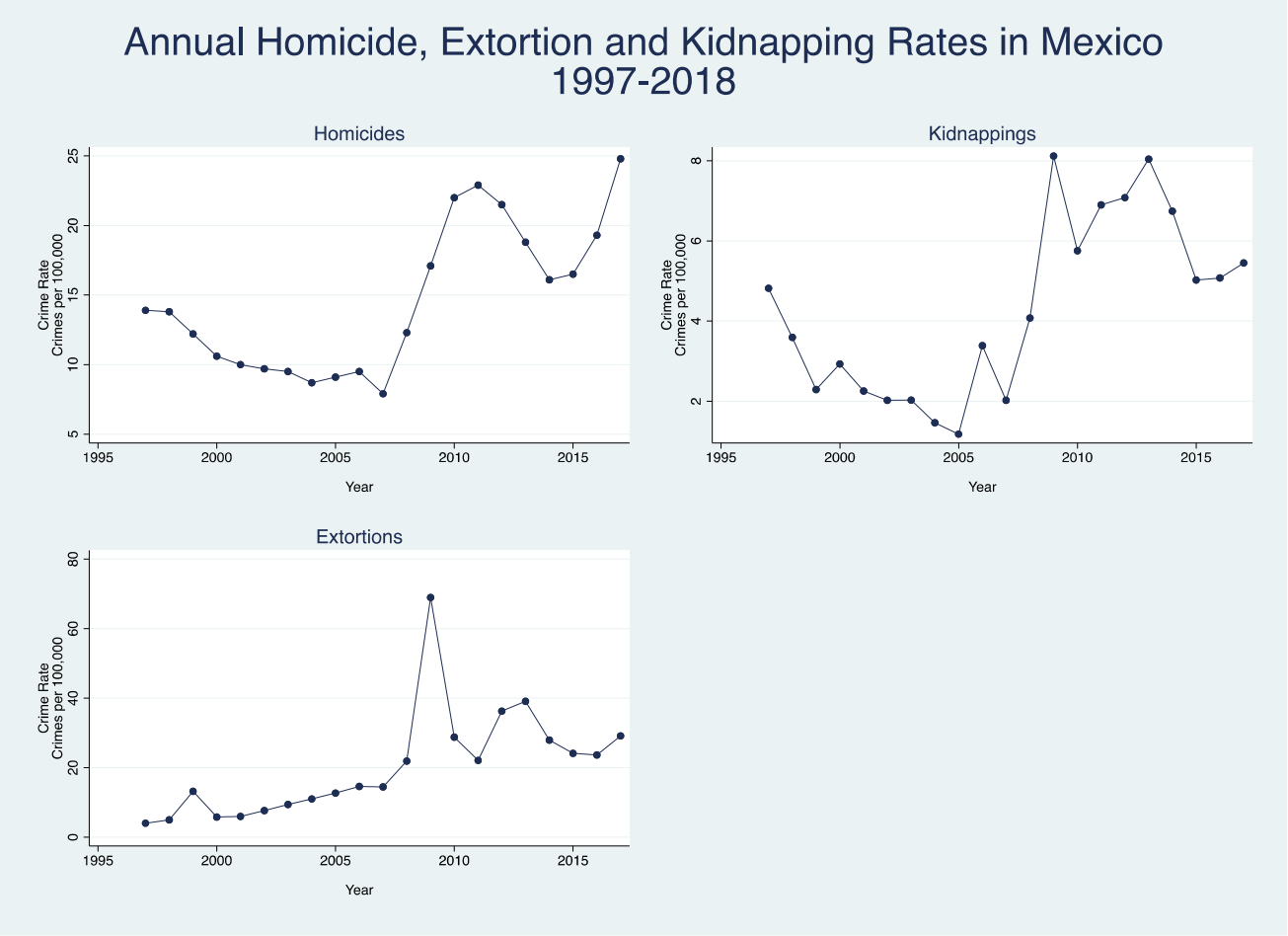


Figure 2. Avocado production by municipality (Lira-Noriega et al. 2018)

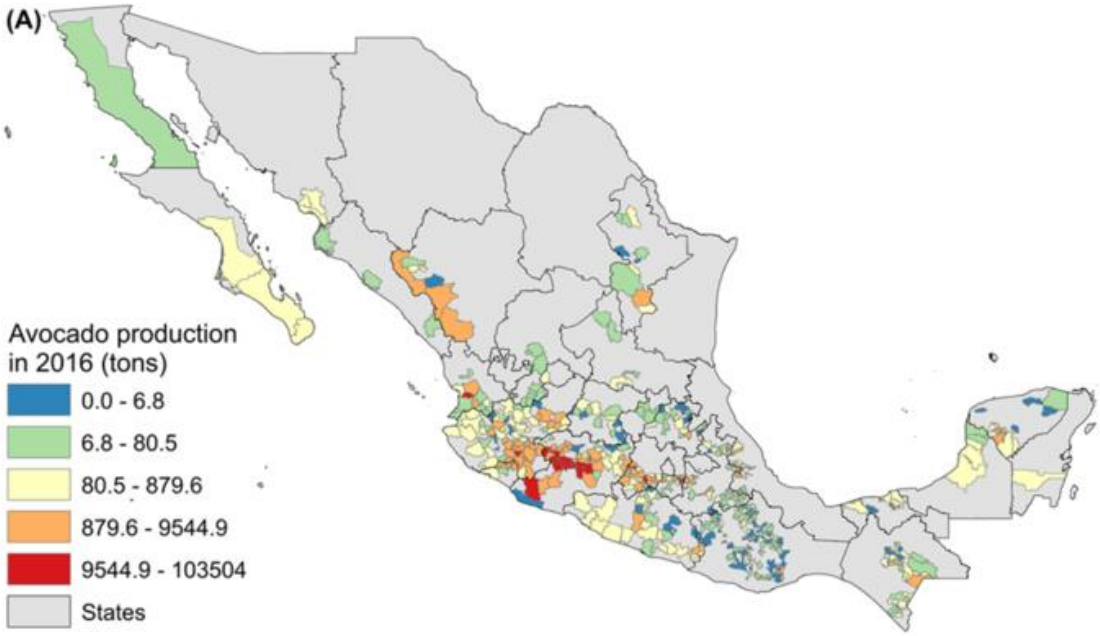
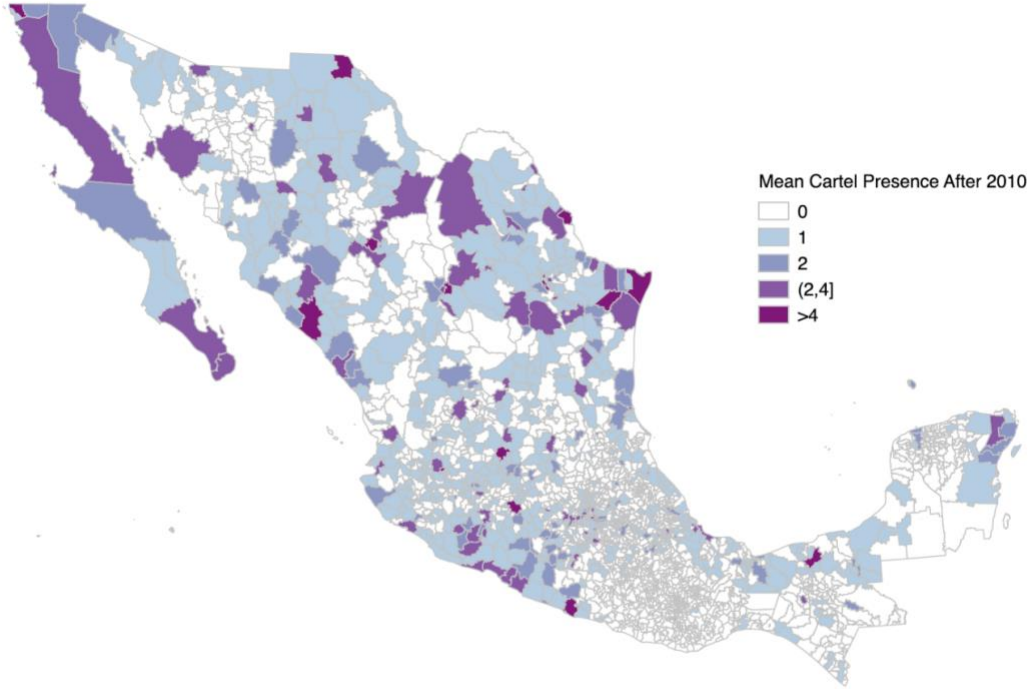


Figure 3. Mean cartel presence by municipality (Sobrino 2020)



(b) Mean Cartel Presence 2010-2016

Figure 1: Cartel Presence

Table 1: Descriptive Statistics

Monthly:	**Observations**	**Mean**	**Std. Dev.**
Log homicides	148,356	.484	.760
Log extortions	148,356	.109	0.37
Log kidnappings	148,356	.032	.173
Log financial Crime	148,356	.015	.148
Log burglaries	148,356	1.14	1.52
Log US avocado import value (USD)	180	18.55	.39
Log US avocado imports from Mexico (tonnes)	180	10.80	.431

Annual:	**N**	**Mean**	**Std. Dev.**
Log population	36,192	9.72	1.61
Log homicides	12,483	.484	.120
Log extortions	12,483	.109	.321
Log kidnappings	12,483	.032	.119
Log financial Crime	12,483	.015	.124
Log burglaries	12,483	1.14	1.46
Log US avocado import value (USD)	15	18.55	1.12
Log US avocado imports from Mexico (tonnes)	15	10.80	1.02
Log rural avocado price (pesos)	39,358	1.63	3.46
Log municipal avocado price (pesos)	39,358	2.47	5.32
Log national avocado price (pesos)	15	6.77	.221
First cartel	35,839	.064	.245
Second cartel	27,259	.021	.144
Third cartel	15,266	.011	.106
Third cartel exit	1,022	.011	.105
Second cartel exit	13,985	.98	.14
Multiple cartels present	36,970	.044	.206
Log marijuana eradication	39,250	.247	.965
Log poppy eradication	39,250	.173	.900
Log raw marijuana seizures	39,250	.156	.870
Log opium gum seizures	39,250	.026	.325
Log processed marijuana seizures	39,250	.755	2.31
Log heroin seizures	39,250	.010	.178
Log cocaine and meth seizures	39,250	.096	.716
Log US average heroin retail price (purity and 2017 inflation adjusted)	15	6.82	.146
Log US average meth retail price (purity and 2017 inflation adjusted)	15	5.80	.354

Table 2. Log monthly US avocado price, municipal production and crime (2011-2018)

	(1) Log Homicides	(2) Log Extortions	(3) Log Kidnappings	(4) Log Financial Crime	(5) Log Burglaries
Avocado x Price (Log US price)	0.026*** (0.006)	0.015*** (0.004)	0.006*** (0.002)	0.0006 (0.0013)	0.030*** (0.010)
Observations	148,356	148,356	148,356	148,356	148,356
R-squared	0.74670	0.59007	0.32070	0.13688	0.90125

Note: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included are municipality and year-month fixed effects and log population. OLS is used for monthly regressions. The avocado-price interaction represents a 0/1 indicator whether or not a municipality is producing avocados and log US import value (USD/tonne).
***Significant at the 1% level.

Table 3 . Annual avocado import price, municipal production and cartel activity (2003-2018)

	(1) First cartel enters	(2) Second cartel enters	(3) Third cartel enters	(4) Third cartel exits	(5) Second cartel exits	(6) More than one cartel present
Avocado x Price (Log US price)	0.090*** (0.008)	0.040*** (0.005)	0.025*** (0.004)	-0.020*** (0.003)	-0.065*** (0.005)	0.15439*** (0.008)
Observations	35,839	27,259	15,266	1,022	13,985	39,970
R-squared	0.06421	0.05320	0.04003	0.03826	0.01548	0.00969

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included are municipality and year fixed effects, and log population. Columns (1)-(3) represent a 0/1 dummy variable indicating the first occurrence of any cartel entering a municipality (1), then the first occurrence of a second cartel entering (2) and third (3). Columns (4)-(5) represent the second and third cartel exiting a given municipality, and column (6) represents any cartel being present. The avocado-price interaction represents a 0/1 indicator whether or not a municipality is producing avocados and log US import value (USD/tonne).
*** Significant at the 1% level.

Table 4. Annual avocado and illicit drug price, municipal production and crime (2003-2018)

VARIABLES	(1) Log Kidnappings	(2) Log Extortions	(3) Log Homicides	(4) Log Financial Crime	(5) Log Robberies
Avocado x Price	0.022***	0.059	0.187	0.036	0.021
(Log US price)	(0.007)	(0.075)	(0.013)	(0.008)	(0.026)
Poppy x Price	0.019**	0.344*	0.134*	0.003	0.002
(Log US heroin price)	(0.175)	(0.206)	(0.008)	(0.001)	(0.002)
Meth x Price	0.013**	-0.019**	0.074***	-0.00788***	0.00220
(Log US meth price)	(0.007)	(0.008)	(0.026)	(0.00253)	(0.00696)

Note: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown are municipality and year fixed effects, and log population. OLS is used for crime regressions. The avocado-price interaction represents a 0/1 indicator whether or not a municipality is producing avocados and log US import value (USD/tonne). Poppy represents a 0/1 indicator for whether or not poppy has been eradicated in a given municipality interacted with the log US average retail price (purity and 2017 inflation adjusted) of heroin. Meth x Price is an indicator for meth seizures interacted with the log US average retail price of methamphetamine.
***Significant at the 1% level. **Significant at the 5% level. * Significant at the 5% level.

Table 5. Avocado price, production and illicit crops (2003-2018)

	Raw Outputs				*Processed outputs*		
	Marijuana eradication	Poppy eradication	Raw Marijuana	Opium Gum	Packaged marijuana	Heroin	Other
Avocado x Price	0.03112***	0.04565***	0.01679***	0.00530**	0.07790***	0.00039	-0.00017
(Log US price)	(0.00738)	(0.01238)	(0.00608)	(0.00237)	(0.02033)	(0.00195)	(0.00878)
Observations	35,147	35,147	35,147	35,147	35,147	35,147	35,147
R-squared	0.57628	0.62227	0.42419	0.37990	0.51569	0.30808	0.39394

Note: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown are municipality and year fixed effects, and log population. Log marijuana and poppy eradication are measured as log area eradicated per 10,000 hectares plus 1. All drug seizures are measured as the log of kilograms seized plus 1. The avocado-price interaction represents a 0/1 indicator whether or not a municipality is producing avocados and log US import value (USD/tonne). The "Other" category is cocaine and crystal meth seizures.
***Significant at the 1% level. **Significant at the 5% level. * Significant at the 5% level.

Table A1. Alternate controls: Log monthly US avocado price, municipal production and crime (2011-2018)

	Log Homicides			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.026***	0.017***	0.177***	0.01696
(Log US price)	(0.006)	(0.005)	(0.003)	(0.01080)
Year-month FE	X		X	X
Year FE		X		
Month FE		X		
State FE			X	
Alt cluster				X
Observations	148,356	148,356	148,356	148,356
R-squared	0.74670	0.74648	0.80479	0.74648
	Log Extortions			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.015***	0.016***	0.067	0.01645**
(Log US price)	(0.004)	(0.003)	(0.004)	(0.00456)
Year-month FE	X		X	X
Year FE		X		
Month FE		X		
State FE			X	
Alt cluster				X
Observations	148,356	148,356	148,356	148,356
R-squared	0.59007	0.59003	0.44589	0.59003
	Log Kidnappings			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.006***	0.004***	0.00173	0.005**
(Log US price)	(0.002)	(0.001)	(0.00301)	(0.001)
Year-month FE	X		X	X
Year FE		X		
Month FE		X		
State FE			X	
Alt clustering				X
Observations	148,356	148,356	148,356	148,356
R-squared	0.32070	0.32065	0.34878	0.33066

Table A2. Drug War control: Log US avocado price, municipal production and crime (2011-2018)

	Monthly					
VARIABLES	Log Homicides		Log Extortions		Log Kidnappings	
Avocado x Price	0.026***	0.018***	0.015***	0.017***	0.006***	0.004***
(Log US price)	(0.006)	(0.005)	(0.004)	(0.003)	(0.002)	(0.001)
With northern states	X		X		X	
No northern states		X		X		X
Observations	148,356	140,052	148,356	140,052	148,356	140,052
R-squared	0.74670	0.73910	0.59007	0.57676	0.32070	0.32176
	Annual					
VARIABLES	Log Homicides		Log Extortions		Log Kidnappings	
Avocado x Price	0.187	0.017***	0.059	0.016***	0.022***	0.004***
(Log US price)	(0.013)	(0.005)	(0.075)	(0.003)	(0.007)	(0.001)
With northern states	X		X		X	
No northern states		X		X		X
Observations	12,483	11,671	12,483	11,671	12,483	11,671
R-squared	0.91623	0.88103	0.78580	0.71775	0.71710	0.50826

Table A3. Alternate pricing: Municipal annual avocado price, production and crime (2003-2018)

	Log Homicides			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.187	0.052	0.010*	0.030***
	(0.013)	(0.051)	(0.002)	(0.008)
Log US price	X			
Log MEX price		X		
Log municipal price			X	
Log producer price				X
Observations	12,483	12,483	12,483	12,483
R-squared	0.91623	0.91623	0.91623	0.01313
	Log Extortions			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.059	0.078**	0.002	0.042***
	(0.075)	(0.033)	(0.002)	(0.006)
Log US price	X			
Log MEX price		X		
Log municipal price			X	
Log producer price				X
Observations	12,483	12,483	12,483	12,483
R-squared	0.78580	0.78591	0.78582	0.00825
	Log Kidnappings			
VARIABLES	(1)	(2)	(3)	(4)
Avocado x Price	0.022***	0.01573	0.001	0.002**
	(0.007)	(0.01527)	(0.001)	(0.002)
Log US price	X			
Log MEX price		X		
Log municipal price			X	
Log producer price				X
Observations	12,483	12,483	12,483	12,483
R-squared	0.71710	0.71702	0.71723	0.00571

Table A4. Drug War control: Log heroin and meth price, municipal production and crime (2011-2018)

VARIABLES	Log Homicides		Log Extortions		Log Kidnappings	
Poppy x Price	0.134*	-0.022	0.344*	.323*	0.019**	-0.007*
(Log US heroin price)	(0.008)	(0.026)	(0.206)	(0.200)	(0.175)	(0.004)
Meth x Price	0.074***	-0.026**	-0.019**	.016**	0.013**	.016**
(Log US meth price)	(0.026)	(0.013)	(0.008)	(0.005)	(0.007)	(0.007)
With northern states	X		X		X	
No northern states		X		X		X
Observations	12,483	11,671	12,483	11,671	12,483	11,671

Table A5. Drug war & price controls: Annual avocado price, municipal production and cartel activity (2003-2018)

	(1) First cartel enters	(2) Second cartel enters	(3) Third cartel enters	(4) Third cartel exits	(5) Second cartel exits	(6) More than one cartel present
Avocado x Price (Log US price: No northern states)	0.038*** (0.014)	0.009** (0.043)	0.002*** (0.000)	-0.0006** (0.001)	-0.065* (0.022)	.077*** (0.036)
Avocado x Price (Log US price)	0.090*** (0.008)	0.040*** (0.005)	0.025*** (0.004)	-0.020*** (0.003)	-0.065*** (0.005)	0.15439*** (0.008)
Avocado x Price (Log MEX price)	0.00041** (0.00016)	0.00009 (0.00013)	0.0010 (0.00048)	-0.000 (0.000)	0.02149 (0.02579)	0.08527* (0.03581)
Avocado x Price (Log municipal price)	0.0002*** (0.000)	0.008* (0.006)	0.044** (0.000)	-0.023 (0.000)	-0.0001 (0.0002)	0.050 (0.007)
Avocado x Price (Log producer price)	0.007* (0.004)	0.043*** (0.003)	0.016* (0.013)	-0.006** (0.013)	-0.00037 (0.00061)	0.027 (0.003)

Table A6. Drug War & alternate price controls: Annual avocado price, production and illicit crops (2003-2018)

	Raw Outputs				*Processed outputs*		
	Marijuana eradication	Poppy eradication	Raw Marijuana	Opium Gum	Packaged marijuana	Heroin	Other
Avocado x Price	0.012***	0.010***	0.009***	0.003**	0.004	-0.045	0.0001***
(Log US price: No northern states)	(0.003)	(0.004)	(0.003)	(0.001)	(0.001)	(0.039)	(0.000)
Avocado x Price	0.031***	0.046***	0.0179***	0.005**	0.0780***	0.000	-0.000
(Log US price)	(0.007)	(0.012)	(0.006)	(0.002)	(0.020)	(0.002)	(0.009)
Avocado x Price	0.00046	0.00043	0.00071*	-0.00000	-0.00000	-0.00004	-0.00065
(Log MEX price)	(0.00038)	(0.00042)	(0.00038)	(0.00012)	(0.00088)	(0.00006)	(0.00045)
Avocado x Price	0.046**	0.043*	-0.071*	-0.000	-0.000	-0.004	-0.065
(Log municipal price)	(0.038)	(0.042)	(0.038)	(0.012)	(0.001)	(0.006)	(0.045)
Avocado x Price	0.069**	0.045**	-0.000*	-0.000	0.404	0.0009	0.007***
(Log producer price)	(0.033)	(0.026)	(0.000)	(0.000)	(0.096)	(0.0004)	(0.003)