Blood Avocados:
Cartel Violence Over Licit Industries in Mexico

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Abstract

Has growing demand for licit goods caused an increase in violence among Mexican criminal organizations? We theorize that cartels enter licit markets to supplement and diversify revenues from the drug trade, and that the incentive to do so changes with revenues in licit markets. Given their comparative advantages in agricultural production and violence, we expect cartels to react to increasing demand in agricultural markets by fighting to maximize territorial control and monopolize production. Using a difference-in-differences design, we test the hypothesis that a positive shock in demand for avocados from municipalities in the states of Michoacán and Jalisco led to an increase in cartel violence. We ultimately find the opposite of what we expect. The enactment of a U.S. phytosanitary policy in June of 2016, which extended U.S. demand for avocados to municipalities formerly unable to export to the United States, led to a significant decrease in cartel homicides compared to municipalities that were unaffected by this policy. Given that cartels were present in most areas of Michoacán and Jalisco before the policy, we interpret this result as coming from cartels anticipating increased territorial contestation. Since cartels expect others to challenge their territory, they bolster their defenses, reducing incentives for territorial contestation.

1 Introduction

Avocados are all the rage. So-called Instagram influencers peddle the benefits of avocados' natural fats on skin and hair treatments, stylish brunch locations capitalize on the craze and charge $12 for a bit of avocado on a slice of bread, warm spring and summer months inspire people to sit on patios with margaritas and guacamole, while some derisively liken spending on avocados among millenials to foolish overspending on caffeinated drinks with long-winded names. In wealthy areas, avocados are arguably a symbol of trendiness and health-conscious consumption.

But reports from some avocado producers in Mexico suggest adverse effects of this trend. They claim that by simulating the market, increasing demand has lured organized crime and violence to the avocado industry. Some trade associations and towns have even formed armed groups to protect themselves from the cartels (Linthicum 2019). Indeed, cartels in Mexico are now overrunning the lucrative industry – avocados generate up to $2.4 billion of revenue for Mexico, and rival gangs are violently carving out a share from this "green gold" (Dehghan 2019). Two Mexican narco-gangs – Jalisco New Generation and Los Cuinis – funded the startup of their criminal enterprises through extorting and kidnapping avocado farmers (Congressional Research Service Report 2019). And now new cartels have entered the market. A web query by Coscia & Rios (2012) suggests that at least seven different cartels were operating in both Michoacán and Jalisco in 2010.

Yet avocado consumption is only increasing – in 1994, Americans consumed approximately one pound per person annually; today, U.S. consumers take in approximately seven pounds of avocados per year (U.S. Department of Agriculture [USDA] 2018). From the onset of the North American Free Trade Agreement (NAFTA) in 1994 to 2016, only 24 of the 113 municipalities in the Pacific state of Michoacán were able to export avocados to the United States to prevent the spread of certain quarantine pests (USDA 2018). However, with new phytosanitary procedures in place and a demonstrated ability by producers to prevent infestations, the USDA has relaxed such restrictions on sources that adopt proper

labeling, safeguard, and sanitation practices (USDA 2016). Now other municipalities in Michoacán and beyond strive to enter this lucrative market by working to meet the certification requirements to export to the United States.

These emerging patterns present an empirical puzzle: to what extent do increases in demand for licit goods facilitate violence between criminal organizations? Specifically, has the expansion of the avocado market in Michoacán and Jalisco incentivized criminal groups to enter this market or extract rents from producers; and, if so, has this led to an increase in violence between cartels as they strive to gain control over territory? In this article, we argue that increases in avocado demand actually reduce cartel violence. With a difference-in-difference (DID) design, we demonstrate that municipalities that were treated with a positive demand shock due to a U.S. import policy experienced significantly less cartel homicide rates than municipalities that were unaffected by the policy.

This project proceeds as follows. We first offer a background of the history of avocado production in Mexico's largest avocado-producing state, Michoacán, and the evolution of cartels in this region. We then discuss the prevailing literature on criminal violence in illicit and licit industries, and we develop a theoretical framework to understand why we see cartels corner the agricultural market and exercise violence in these industries. Next, we estimate a DID model to examine the difference in homicide rates between treated and untreated municipalities, whereby the treatment is the policy that allows for more municipalities to export the United States provided they meet strict sanitary regulations. We discuss our results in the following section. We conclude with a discussion of the potential shortcomings to our analysis, implications of our findings, and avenues for future research.

2 A Brief History of Cartels and the Avocado Industry

Avocados are temperamental – they require mineral-rich soil and ample rain and sun for healthy growth (Linthicum 2019). Situated on the Pacific coast of Mexico on the edge of

the Trans-Mexican Volcanic Belt, Michoacán provides the perfect conditions for avocado production. Ultimately, Michoacán has accounted for 80 percent of total production in Mexico and almost half of the global avocado supply at 43 percent (USDA 2018). Such wealth should trickle to the individual – farmers could earn up to $60 a day compared to the $5 minimum wage (Linthicum 2019). Yet some claim that violence in Michoacán has undercut growth. Indeed, its long narco tradition is similarly a function of geography, with "territories of difficult access without the presence of public authority, the agricultural vocation of its economy, the availability of land for illicit crops, and its offer of ports to transport goods on a large scale, make it a region suitable for the drug business" (Guerrero Gutiérrez 2014). Cartels that once operated exclusively in the drug market are infiltrating the avocado industry, and now we are continuing to see increasing rates of homicide in the region. In 2019, the average rate of intentional homicides in Mexico was 15.60 per 100,000 people with a total of 36,685 deaths; in Michoacán, it was 20.55 per 100,000 with a total of 2,062 deaths.[1]

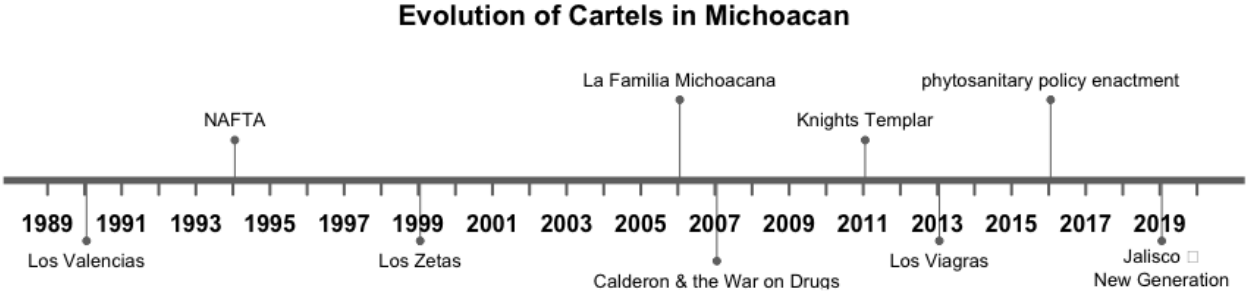

Figure 1

To understand the avocado industry and the cartel activity surrounding it today, one must go as far back as pre-NAFTA. Though far from peaceful, the Milenio Cartel of the Valencia family maintained a relatively uncontested order in Michoacán in the 1980s. The

[1]Data available at: https://en.www.inegi.org.mx/.

Valencias maximized contacts in the transnational drug market by colluding with Colombian suppliers and U.S. buyers. They ultimately were able to expand their drug empire from the production and trafficking of cocaine to marijuana, opium poppy, and methamphetamines (Ornelas 2018: 766).

The onset of NAFTA in 1994 allowed for the expansion of lucrative licit industries in Mexico. In particular, NAFTA lifted a trade ban on avocados that was originally enacted in 1914 to prevent the spread of weevils, scabs, and other invasive pests and diseases. However, in all of Mexico, only 24 pest-free municipalities were authorized to export avocados to the United States, Puerto Rico, and Hawaii. And all of these municipalities were in Michoacán.

Another significant shock to the market occurred in 2006. Felipe Calderón won the 2006 presidential election amid a controversial electoral process. Calderón swiftly enacted the Mexican Drug War after his ascension to leadership on 1 December 2006 (Finnegan 2010). Of first order was Operation Michoacán on 11 December 2006, where the federal government deployed more than 7,000 police and military forces to neutralize drug cartels in the Pacific region (Finnegan 2010). Calderón touted that the Mexican Drug War would create a blanket crackdown on all cartels, though violence only intensified and became more lethal and brazen. Such low-intensity criminal violence eventually surpassed conflict-related deaths in Afghanistan, Iraq, and Yemen (Lessing 2012).

It was in this context that we saw the rise of the Knights Templar. This cartel brought even more violence and extortion to the avocado market in Michoacán than their predecessors, such as Los Zetas in 1999 and La Familia Michoacana in 2006. Indeed, as the Mexican Drug War destabilized the drug market, cartels have sought to corner the avocado industry. The Knights Templar intervened in the avocado trade through extorting both the producers and packing plant personnel (Ornelas 2018). Though exact rates are uncertain, at the height of power the Knights Templar allegedly charged avocado exporters up to 3,000 pesos (approximately $150) per year per hectare, and eventually they charged farmers 100 pesos per ton of avocados produced (Ornelas 2018: 773). Though these funds

may seem meager, in 2013 the Knights Templar "extorted the total amount of 119,400,000 pesos, which represents 0.5 percent of the total value of the avocado production of that year" (Ornelas 2018: 773). Ultimately, the Knights Templar on average siphoned off between 1 to 4 percent of revenue from avocado producers with respect to the total value of avocado production.

And yet another shock to the market happened after the rise and peak of the Knights Templar, one that we seek to leverage in this analysis. In 2015, the Animal and Plant Health Inspection Service of the USDA released a proposal to amend the regulations surrounding quarantine pests that formerly restricted the avocado trade to only 24 municipalities in Michoacán (USDA 2016). Provided states and municipalities meet the strict regulations for the certification, sanitation, inspection, and safeguards preventing the spread of pests, they are able to enter the avocado industry and export to the United States, Puerto Rico, and Hawaii. This proposal was enacted in June 2016.

Now, two cartels are vying for control within Michoacán – Los Viagras and Jalisco New Generation. Los Viagras evolved from a self-defense force in the Tierra Caliente region of Michoacán in 2014 to the larger crime syndicate it is today. And Jalisco New Generation, founded in 2009 and primarily based in the state of Jalisco, has swiftly rose in the ranks of cartels in Michoacán and is now one of the most notorious and violent criminal organizations in Mexico and beyond. Its growth can be attributed to its unique blend of the "traditional Sinaloa-style drug trafficking with the ultra-violence of the Zetas Cartel, who used paramilitary tactics to diversify into criminal enterprises" (Jorgic & Hosenball 2020). Evidence of Los Viagras's and Jalisco New Generation's aggression in the avocado market was exposed in August 2019. Avocado-related rivalry led members of Jalisco New Generation to shoot nine members of Los Viagras in an amusement arcade in Uruapan (Linthicum 2019). Authorities found the nine members of Los Viagras hanging from an overpass, and ten more bodies hacked up and dumped by the side of the road. On the overpass, Jalisco New Generation hung a banner reading: "Lovely people, carry on with your routines. Be a patriot, kill a

Viagra."

How can we make sense of the increase in cartel violence surrounding the avocado market? Are these trends and observations simply a product of anecdote? Or do they represent an empirical pattern we can test and predict as we see more cartels entering the lucrative avocado industry?

3 Theorizing Trade and Cartel Violence

3.1 Prevailing Literature

The literature on violence caused by criminal organizations in Latin America continues to grow alongside increasing rates of such violence. Since 2000, the region has seen over two million violent deaths, amounting to over one-third of murders in the world though the region contains only eight percent of the world's population (Andreas 2019: 485).

Scholars are trying to make sense of what is seemingly senseless violence. At a baseline, the ways in which we understand criminal violence must differ from the ways in which we understand conflict-related violence. Though criminal violence falls along the spectrum of ordinary crime and political violence, using such models to understand these "coups d'street" would be insufficient (Mitton 2018). Organized crime could thus be understood 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" (Kalyvas 2015: 1518). But perhaps this definition is too constraining, for we see cartels enter and profit from the legal market as well.

And yet, crime in the illegal market provides a launching point for many, who answer questions such as: What illegal markets are ripe for organized crime, and who dominates them? What types of crime are associated with the illegal market? What is the relationship between control in the illegal market and governance over civilians? The literature on cartels

and illicit industries provides a useful baseline for theorizing cartels and licit industries. For example, Yashar (2018) explores why we have seen an increase of organized crime and violence in developing democracies in Central America. She develops a tripartite argument, claiming we are currently seeing an alarming increase in killings for three reasons: the transnational illicit economy drives groups to control lucrative territories and transit routes, weak and complicit states facilitate crime, and contested territories enable the most severe levels of violence.

As these illicit industries become more profitable, Kronick (2020) evaluates how booms impact levels of violence. Indeed, the 1990s experienced a surge of cocaine transiting Central America, and corridors between Colombia and the United States became flooded with traffickers. But a state-led counternarcotics campaign in Colombia forced traffickers to seek out other transport routes, primarily in neighboring Venezuela. Kronick (2020) finds that the Venezuelan municipalities along the notorious Pan-American Highway, a major drug pipeline, experienced higher rates of violent deaths compared to municipalities not directly on the trafficking route.

Pivoting away from the literature on illicit industries and crime costs in microeconomic terms – such as lost wages, damaged property, and diverted security spending from the private sector – Ornelas (2018) adopts a macroeconomic approach by examining the effect of organized crime on the legal economy. Specifically, she examines the effect of rent-seeking activity in Michoacán's avocado market on economic growth in the state. Ornelas (2018) embarks on the ambitious venture of measuring actual rates of extortion by calculating the annual fees producers paid to the Knights Templar against the value of total annual avocado production (774). The resulting measure is the proportion of payments that cartels have extracted from avocado producers with respect to the total value of annual production.

Ornelas's (2018) fundamental contribution to the literature is this unique measure, which she leverages to unsurprisingly find that crime has a negative impact on economic growth. In addition to the informal "tax on the economy" inherent in extortion, crime also

discourages investments, reduces business competition, reallocates resources unproductively, and generally creates an environment of uncertainty and inefficiency. Economic agents will ultimately divert resources to what Ornelas (2018) describes as appropriative or destructive activities – "defensive measures designed to protect their resources" (764).

For example, cartel violence has forced select towns to set up informal security bodies to protect farmers. Avocado growers in Tancítaro, Michoacán's largest avocado-producing town, founded the Tancítaro Public Security Force (CUSENT), a militarized force operating exclusively as an "avocado army" (Fisher & Taub 2018). Inspired by the notorious leaders of the *autodefensa* vigilante movement that emerged in response to the Knights Templar such as El Americano, Papa Smurf, and Doctor Mireles, this volunteer militia wages urban combat against cartels. Dressed down in hip-hop t-shirts and baggy jeans and maintaining checkpoints made of breeze blocks and sandbags, CUSENT personnel represent a new face of order in Mexico. These so-called destructive activities ultimately cause greater distortions in the economy of the cartel-controlled territory, scaling up to generate negative distributional impacts in the regional economy (Ornelas 2018).

3.2 Theoretical Framework: Why Avocados and Why Violence?

We similarly investigate the avocado market in Mexico, yet we look at the inverse of the question Ornelas (2018) explores – instead of examining how organized crime affects economic growth, we focus on how economic growth affects organized crime. To answer this puzzle, we must understand why cartels have oriented themselves towards the avocado market, and why see a subsequent spike in cartel violence.

We expect cartels to engage in "concentric diversification" to achieve economies of scale yet to reduce costs (Wainwright 2016: 196). Consider how a pizza restaurant serves calzones, for example. Or, more specifically, consider the Coca-Cola company, which branched out to wine in 1977. These examples demonstrate how "a company makes use of its expertise in one area to launch a product line aimed at new customers" (Wainwright 2016: 196).

Branching out to a licit industry is revenue-maximizing for cartels. These industries provide cartels with a longer time horizon because they do not risk top-down disruption to the extent of the illicit economy. Additionally, cartels are able to tap into existing infrastructure when mapping onto existing licit industries, thereby reducing start-up and operating costs.

Consequently, cartels seek to diversify and operate in a range of licit industries – we have seen the Cártel de los Quesos capture the cheese trade between Honduras and El Salvador, and the Knights Templar tax the iron-ore industry in other parts of Mexico. Yet Schelling (1971) provides the logic for why we see cartels corner the avocado market in particular, in which we are seeing an appalling spike in media attention and reporting. Schelling (1971) outlines four primary traits that attract organized crime to legal markets: "1) businesses in traditional sectors of the economy with a high degree of territorial specificity; 2) a relative small size of firms; 3) a relatively low technological level; and 4) a region where the public sector is relatively large and legal institutions are weak" (Ornelas 2018: 762).

Given such logic, one could see how branching to the agricultural market thus becomes a fruitful domain for cartels to operate. In the context of avocados, territorial specificity allows cartels to maximize physical control over a fixed domain and to minimize costs in an industry with low technological input in an environment with low levels of state capacity. And as cartels seek to control these territories, there continues to be high levels of violence.

In addition to internecine fighting among powerful syndicates, cartels wage violence against the population as well. First, unlike insurgents in other types of war, cartels are not looking for conquest at the national level – "for cartels, even outright military victory over the state would not lock in their preferred policy or distribution of rents. In the current international system, an overt narco-state granting itself a monopoly on cross-border trafficking is basically unthinkable" (Lessing 2015: 1494). Instead, power is equated with violence itself. By being able to freely exercise authority in the form of looting, kidnapping, and murder, cartels will continue wielding such violence as long as there is a stock of victims to pay for prevention.

Moreover, violence in this licit industry can be understood in terms of cartel control and contestation over territory. In the spirit of Kalyvas (2006), our initial assumption is that cartel violence will be more intense in territories where a single cartel does not monopolize control. In examining patterns of homicidal violence during the Vietnam War, Kalyvas and Kocher (2009) find that combatants use different types of violence, whether indiscriminate or selective, in different zones of control – in particular, we are likely to see violence peak in zones of shared control where groups exercise variable levels of power. Similarly, by exploiting the logic of territorial control and considering how it is consequential for violence, it becomes clear that cartels carry out violence in terms of extortions, kidnappings, and homicides to gain control over lucrative territories and industries.

4 Empirical Analysis

We expect that cartels will orient themselves towards licit markets requiring similar knowledge and skill sets as the drug trade, such as licit agricultural markets, as those markets grow and become more profitable. When cartels partake in these markets, they will pursue market power by attempting to monopolize production. Since agricultural production is immobile, efforts to monopolize production translate into competition over territory. Competition over territory among cartels should then lead to an increase in cartel violence. To evaluate our prediction that the recent increase in demand for avocados is causally related to an increase in cartel violence, we use a difference-in-differences design to estimate the effect of a change in U.S. avocado import restrictions in June 2016 on cartel violence in areas affected by the change.

4.1 The USDA Mexican Hass Avocado Import Program

From 1914 to 1993, the United States banned the import of avocados from Mexico, primarily due to fears of quarantine pest infestation (USDA 2001). In particular, avocados from Mexico

risked carrying avocado seed weevils, and thus U.S. consumers were limited to crops from California and Florida. By 1993, the Animal and Plant Health Inspection Service (APHIS) of the USDA partially lifted this ban when it allowed producers to export Mexican avocados to Alaska (USDA 2001).

By 1994, rules relaxed even further. NAFTA allowed for the year-round import of Mexican avocados to all states. However, only 24 municipalities in Michoacán were allowed to export avocados to the United States at this time – Acuitzio, Tancitaro, Uruapan, Tingüindin, Salvador Escalante, Nuevo Parangaricutiro, Periban de Ramos, Ario, Los Reyes, Apatzingan, Taretan, Tacambaro, Tingambato, Madero, Cotija de la Paz, Erongaricuaro, Tocumbo, Tuxpan, Irimbo, Hidalgo, Turicato, Ziracuaretiro, Paracuaro, and Tangamandapio (USDA 2018). For this reason, Michoacán dominated the market by providing 80 percent of total avocado production in Mexico, or 43 percent of global avocado production.

However, the USDA announced a proposal in February 2015 that altered the landscape of avocado production and export in Mexico (USDA 2016). APHIS announced a new policy that allowed for broadening the areas that could export to the United States from Michoacán only to all other Mexican states, provided they meet strict guidelines to reduce the risk of transmitting quarantine pests. Such guidelines included "requirements for orchard certification, traceback labeling, pre-harvest orchard surveys, orchard sanitation, post-harvest safeguards, fruit cutting and inspection at the packinghouse, port-of-arrival inspection, and clearance activities" (USDA 2016). Notably, in this initial statement, early action would only apply to Jalisco, the northern neighbor of Michoacán.

This policy became fully enacted by June 2016. With the potential to open up other production sites that abide by phytosanitary regulations, other municipalities within and outside Michoacán have had the opportunity to become competitive in the international market by increasing production. For example, at the end of 2015, Michoacán dominated the market; Jalisco trailed behind in a far second place at 6 percent of total avocado production (USDA 2018). After the policy announcement in 2015, production in Jalisco grew faster

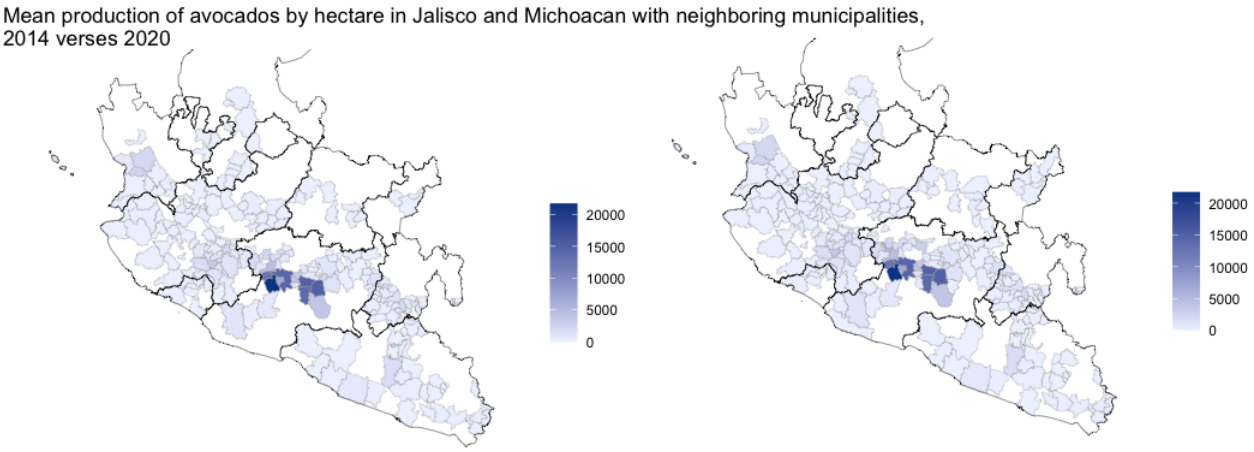

Figure 2

than any other state, given it was the initial site to become eligible to trade in international markets. In Figure 2, we provide a map for the distribution of avocado production in 2014 and 2020 at the municipality level in Jalisco and Michoacán with nearby municipalities. What is notable is the expansion of production between the two time periods to municipalities that did not produce avocados in earlier periods.

At the aggregate level, we can see how the USDA Hass avocado import program truly impacted avocado production, measured by the value of total avocado exports. In Figure 3, it is clear that the June 2016 cutoff yields a discontinuity in the value of exports, where the pre-policy average value of exports is lower than the post-policy average. This ultimately evidences that the policy change had an immediate impact on avocado production and exports in Mexico.

4.2 Data and Variables

Our main independent variable is the treatment variable. Initially, this takes on the value of one when a municipality was treated with a loosening in restrictions for the export of avocados to the U.S after 27 June 2016, and zero otherwise. Although theoretically any municipality should be able to export avocados to the United States after the rule change so long as it meets the predetermined phytosanitary criteria, for our analysis we only consider

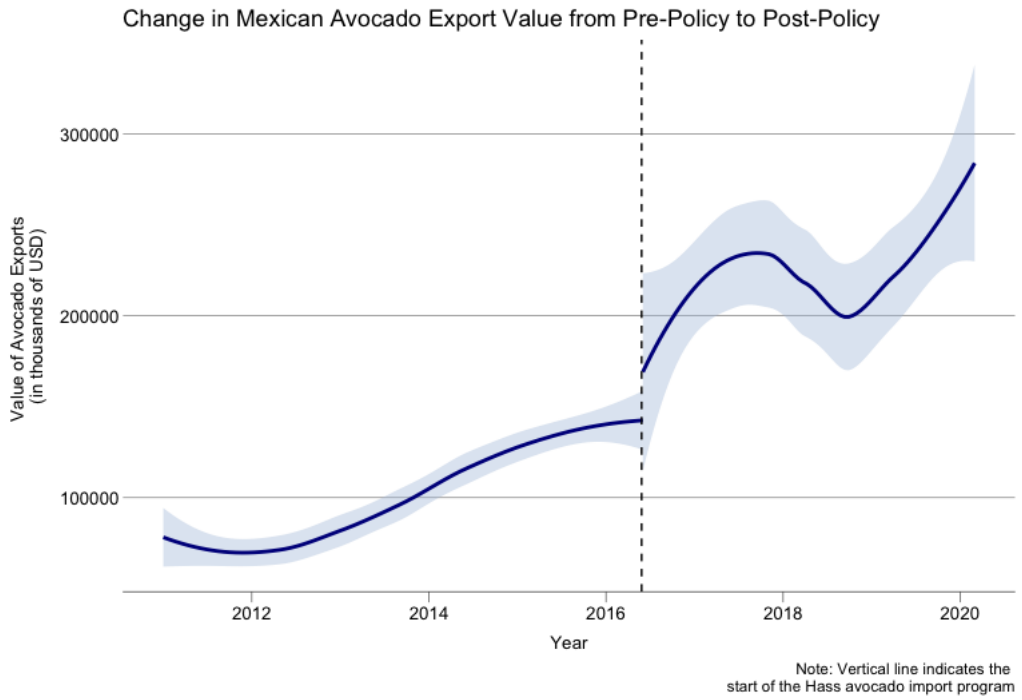

Figure 3

municipalities in Michoacán and Jalisco to be treated by the rule change. This is because Michoacán and Jalisco were the only two states realistically capable of complying with the U.S. phytosanitary regulations in the first few years following the rule change (USDA 2016). We then interact this treatment indicator with a proxy for a municipality's avocado production potential to create the treatment variable used in our analysis, the idea being that the treatment effect should be greater the more potential a municipality has for avocado production.

To proxy for production potential, we use the maximum ever sown hectares of avocados in any given month between 2014 and 2019 for each municipality. We log this variable for a more normal distribution. Data on avocado production is from the Agricultural and Fisheries Information Service (SIAP) of the Government of Mexico.[2] To note, one hectare contains approximately 80-160 avocado trees, with each avocado tree producing 300-800 kilos per year (Ornelas 2018: 771). Avocado production is concentrated on the Pacific coast,

[2]Data available at: http://infosiap.siap.gob.mx.

specifically in Michoacán, and surrounding states to a lesser extent that fall within the Trans-Mexican Volcanic Belt that provides mineral-rich soil ideal for avocado growth.

Our outcome variable of interest is cartel homicides. From December 2006 to September 2011, the Office of the Mexican Attorney-General recorded municipal-year data on homicides presumably related to rivalries between drug trafficking organizations (DTOs). While this data on DTO-rivalry homicides is not available during the time period in which we are interested, we use as proxies multiple other measures of homicides which we find to be strongly correlated with this data. These measures are from crime data provided by Mexico's Executive Secretariat of the National Public Security System (SESNSP).[3] The measures we use to proxy for cartel rivalry homicides are homicides with a firearm (*homicidios con arma de fuego*), intentional homicides with a firearm (*homicidios dolosos con arma de fuego*), and intentional homicides (*homicidios dolosos*). The correlation coefficients between each of these homicide measures and the government's cartel-rivalry homicide data are all just above 0.91. To calculate these correlations we aggregate the municipal-year data on DTO-rivalry homicides up to the state-year level to match the state-year data on crime available before 2011. Further, we only use the years 2007-2010 since the data on DTO-rivalry homicides for 2006 and 2011 are not for the full year. Scatterplots of these correlations are included in Appendix 1. This results in an n-size of 128 for each of the correlation coefficients.

The data we use for these three measures in our analysis, however, is at the level of the municipality-month from 2011-2020. The SESNSP states that there was a change in methodology in 2015, however this change is only reflected in different aggregate crime groupings and has no impact on the relatively specific measures in which we are interested. Data for the old methodology is available from 2011-2017, while data for the new methodology is available from 2015-2020. We combine these datasets and use the old methodology from 2011-2014 and the new methodology from 2015-2020. We adjust these measures for 2015 data on the population of each municipality to be per 100,000 people.[4]

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

[4]Data available at: https://www.citypopulation.de/Mexico-Cities.html

With these variables, we create municipality-month level panel data from 2014 to 2019 to estimate our model. We drop the years 2011-2013 from our data because a large number of municipalities have missing data for this period and enter the data in 2014. We create a balanced panel to prevent the composition of our treatment and control groups from changing over time by subsetting this data to municipalities for which there is data for the entire period of 2014-2019. We then subset to municipalities nearby Michoacán and Jalisco to get comparable treatment and control units. We do this by first subsetting to Michoacán, Jalisco, and bordering states. We then calculate, for both the treatment and control groups, the distance between each municipality's centroid and the centroid of the nearest municipality in the other group. We then subset to municipalities who are no more than 72 miles (the median) from a municipality in the opposite group. After all this, and given missing data, the resulting dataset we construct contains 95 municipalities in 7 states with 72 time periods each, totalling 6840 observations. Of the 95 municipalities, 31 are never treated (control), 58 become treated by the policy, and 6 are always treated (always allowed to export avocados to the U.S.).

4.3 Model

The difference-in-differences model we estimate to determine the effect of the U.S. avocado import policy on cartel homicides is as follows:

$$y_{it} = \delta_t + \alpha_i + \beta_1(treat_{it} * p_i) + \epsilon_{it},$$

where y_{it} is the proxy for cartel homicides per 100,000 people for municipality i and month t, δ_t is a vector of time fixed effects, α_i is a vector of municipality fixed effects, $treat_{it}$ is the treatment indicator, p_i is the logged production potential of each municipality, and ϵ_{it} is the error term. β_1 captures the treatment effect of the relaxation of U.S. avocado import regulations on cartel homicides.

To provide a visual check of trends, Figure 4 displays rates of intentional homicides across time. The pre-trend graphs for the alternative dependent variables are similar and can be found in Appendix 2. We also conduct a test for differences in pre-trends and find no significant differences (Table 1). It is quite clear visually that pre-trends are parallel before the relaxation of import restrictions. With the enactment of the phytosanitary policy in June 2016, however, the treated municipalities appear to experience a relative decrease in intentional homicides compared to the control municipalities.

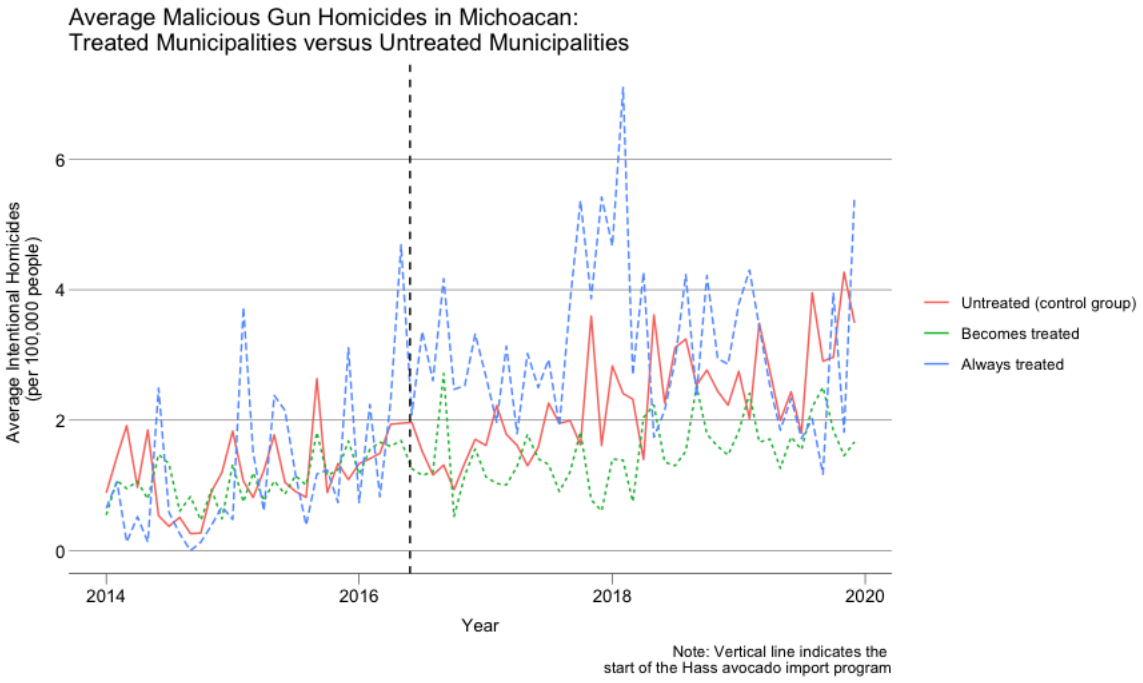

Figure 4

4.4 Results

Table 2 presents regression results of the three indicators of cartel homicides. The results are unsurprisingly similar across the models, given the strong correlation among the three variables. The DID contrasts the change in homicide rate between treated and untreated municipalities, given the policy that allowed for the expansion of avocado exports. With a 1 percent increase in hectares of avocado production potential, the U.S. import policy

leads to a change of about -0.141 intentional homicides per 100,000 people. For the median municipality in our dataset, with an avocado production potential of 127 hectares, this means a reduction of 0.68 intentional homicides per 100,00 people. This effect is large, given that the average gun homicides per 100,000 people in the pre-treatment period was 0.83. In aggregate, we estimate that this policy had the effect of about 20 less cartel homicides in the treated municipalities during the post-treatment period. In a hypothetical counterfactual, we estimate that the aggregate effect of the policy on the control municipalities would have been about the same (see Figure 5).

Table 1

	Intentional Gun Homicides	**Gun Homicides**	**Intentional Homicides**
	Model 1	**Model 2**	**Model 3**
Becomes Treated * p_i	−0.035	−0.040	−0.009
	(0.098)	(0.098)	(0.097)
Always Treated * p_i	−0.010	−0.009	0.022
	(0.067)	(0.066)	(0.056)
N	2755	2755	2755
R-squared	0.082	0.082	0.088
Adj. R-squared	0.039	0.039	0.045
Residual Std. Error (df = 2630)	2.517	2.568	2.999
F Statistic (df = 124; 2630)	1.897***	1.903***	2.058***

***p < .001; **p < .01; *p < .05

Two-way fixed effects with clustered standard errors.

Table 2

	Intentional Gun Homicides	**Gun Homicides**	**Intentional Homicides**
	Model 1	**Model 2**	**Model 3**
$treat_{it} * p_i$	-0.116^{*}	-0.115^{*}	-0.141^{*}
	(0.050)	(0.050)	(0.058)
N	6840	6840	6840
R-squared	0.138	0.138	0.142
Adj. R-squared	0.117	0.116	0.121
Residual Std. Error (df = 6673)	2.863	2.903	3.399
F Statistic (df = 166; 6673)	6.435^{***}	6.410^{***}	6.665^{***}

***p $<$ .001; **p $<$ .01; *p $<$ .05

Two-way fixed effects with clustered standard errors.

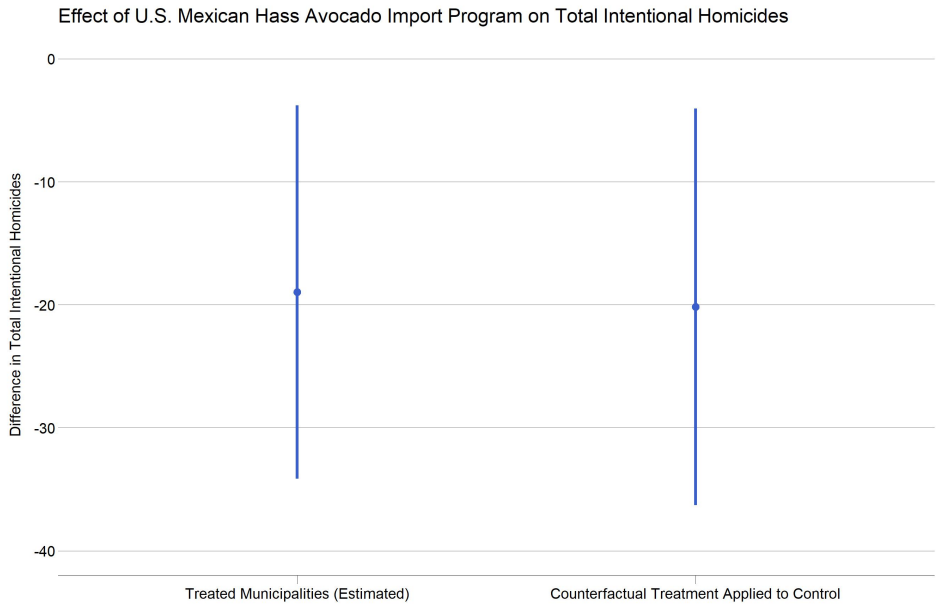

Figure 5

Figure 6 plots the average pre-post change in intentional gun homicide rates. Plots for the other two measures for cartel homicides – gun homicides and intentional homicides – are in Appendix 3. The dashed line represents the counterfactual scenario when assuming common trends. That is, it depicts the rate of intentional gun homicides in the treated municipalities if the phytosanitary policy had not been enacted. We can confidently make this assumption of parallel pre-intervention trends given the pre-trend plot – homicide rates between the two groups seem to follow a common trend until the intervention, when they diverge. The logic behind this counterfactual captures the essence of a difference-in-differences design. It demonstrates what would have happened in a world if, absent the policy, conditions in the treated municipalities evolved in the same way as the untreated municipalities. However, the steep slope of the line for the treatment group demonstrates the significant effect of the change in avocado production versus no change.

The dotted line represents the overall treatment effect, which is the DID estimator, β_1. This effect ultimately tells us the difference between what really happened and what would have happened if the treated and untreated groups evolved in parallel. The plot

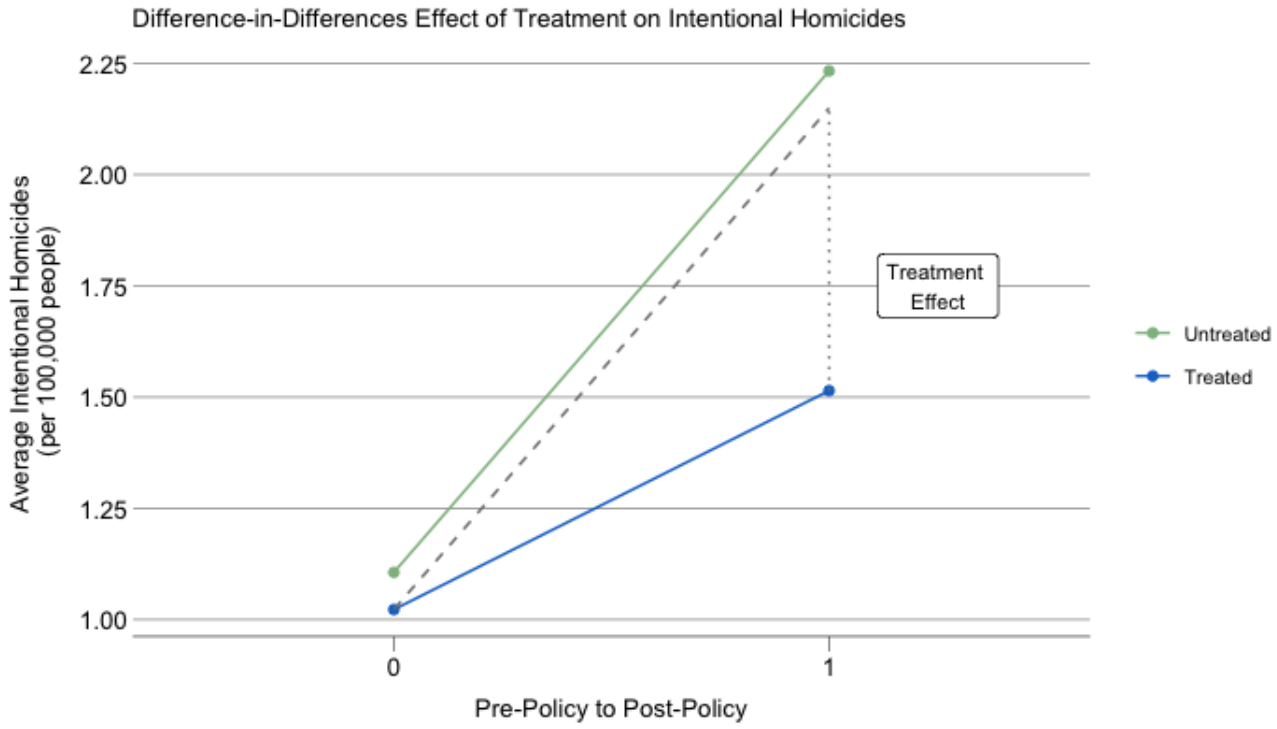

Figure 6

lends credence to the significance of the effect of the phytosanitary policy – which ultimately allowed for the expansion of avocado production to municipalities formerly unable to export avocados – on homicide rates.

5 Conclusion

In this paper we tested the hypothesis that the increase in demand for Mexican avocados has led to an increase in cartel violence. Using a DID design, we have found a significant negative effect of avocado production on cartel homicides in municipalities treated with the relaxation of U.S. import restrictions when a new phytosanitary policy was enacted

in 2016. What explains this result? One interpretation is that as avocados become more lucrative to grow, farmers previously involved in growing drugs for the cartels switch to growing avocados, resulting in less cartel presence and therefore less violence. Indeed, others have found that economic incentives determine whether individuals work for the cartels (Dube et al. 2016; Dell et al. 2019). We believe, however, that Figure 2 demonstrates relative stability in avocado production from 2014 to 2020, making it unlikely that this is the mechanism driving the results we see. Instead, we believe that this result still fits well within our theory. We argue that cartel violence decreases because cartels anticipate territorial contestation as a result of the import policy change. Because cartels expect that others will attempt to take their territory as the avocado industry becomes more lucrative, cartels put more resources and effort into defending their territories, having the effect of actually reducing incentives for territorial contestation. This makes sense given that cartels were likely present in most territories Michoacán and Jalisco before the import policy change. Data from Coscia & Rios (2012) suggests that cartels were present in 45 percent of municipalities in Michoacán and Jalisco in 2010. With this being the case, most municipalities were likely already established as controlled by a certain cartel before the policy change, meaning that there was more territory for cartels to protect than for cartels to claim. While reports from avocado producers suggest increases in violence in some areas, it appears to be the case that our original theory holds, and that our original hypothesis holds in some cases. Our analysis indicates, however, that the average effect of the policy was a reduction in cartel violence.

In developing this project further, we hope to investigate the effects of the policy on other key outcome variables such as avocado producer incomes to see if the policy change has a clear effect of increasing incomes or if most of the gains from increased demand go to cartels to build our case that the decrease in violence is because cartels are involved in the avocado market. We also hope to replicate the web query designed by Coscia Rios (2012) in measuring cartel presence to see if the policy had a differential effect in municipalities controlled by one cartel versus municipalities contested by multiple cartels or without any

cartel presence before the policy change.

Though we examine the nexus of trade and violence, this project opens up a wide breadth of future research as we note additional linkages between trade, violence, environmental concerns, and other industries. Instead of focusing solely on violence, environmental concerns and climate change would be rich subjects within the scope of this project. For example, the opening of markets with NAFTA fueled a year-round demand for avocados despite them being a summer fruit, which farmers have responded to by increasing the size of their farms and producing avocados year-round (Larmer 2018). This has led to illegal environmental practices including deforestation, such as farmers covertly trimming back the forests and planting avocado trees under the canopy, thereby increasing greenhouse gas emissions as forests are thinned to make way for more orchards.

Avocado production is additionally water-intensive and we have seen an increase of water violations in avocado-producing regions (Facchini & Laville 2018). The Water Footprint Network estimates that two thousand liters of water is needed to produce just one kilo of avocados. In the drier regions of Latin America, the required amount is even larger, for very cultivated hectare requires 100,000 liters of water per day, an amount equivalent to what a thousand people would use in a day. As such, in 2011, Chile's water authority published an investigation conducted by satellite that showed at least 65 illegal underground channels bringing water from the rivers to private agriculture plantations. Many avocado plantations in Chile have installed these illegal pipes and wells to divert water from rivers to irrigate crops. Consequently, villagers claim that rivers have dried up and groundwater levels have fallen, causing a regional drought, and they have been forced to consume often contaminated water delivered by truck.

Additionally, instead of focusing on the avocado trade, we can map these theories onto other industries that could be easily captured by illicit groups. Although the avocado trade is salient and we see more reporting on this industry, we can see how groups corner various illicit markets such as forestry and mining. These industries indeed offer analytical

purchase because they fit the new model cartels are exploiting, whereby they control territory and monopolize the production and trade of the natural commodities unique to the region.

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Appendices

Appendix 1

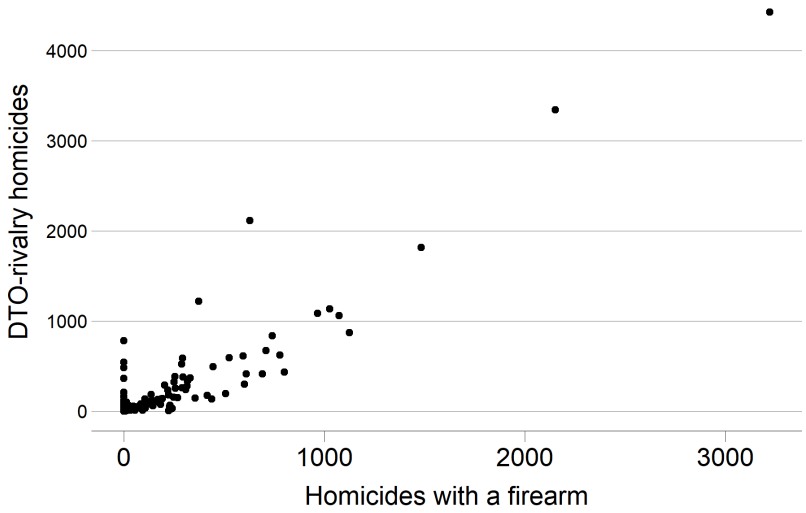

Figure 7

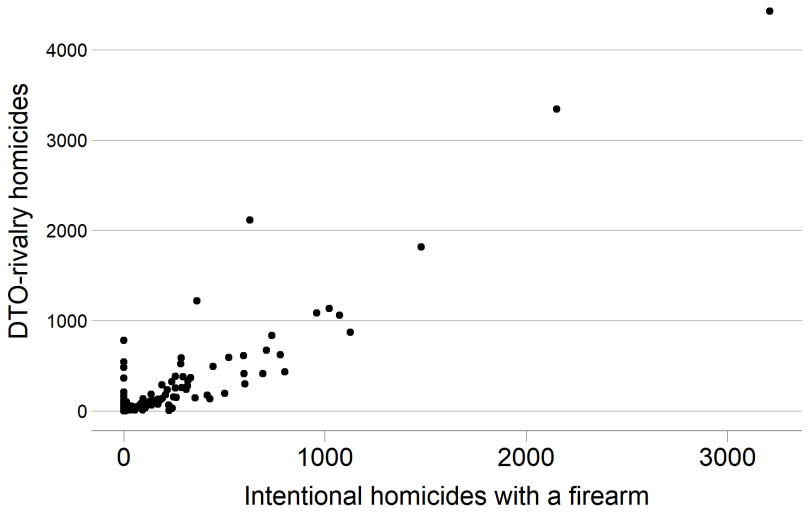

Figure 8

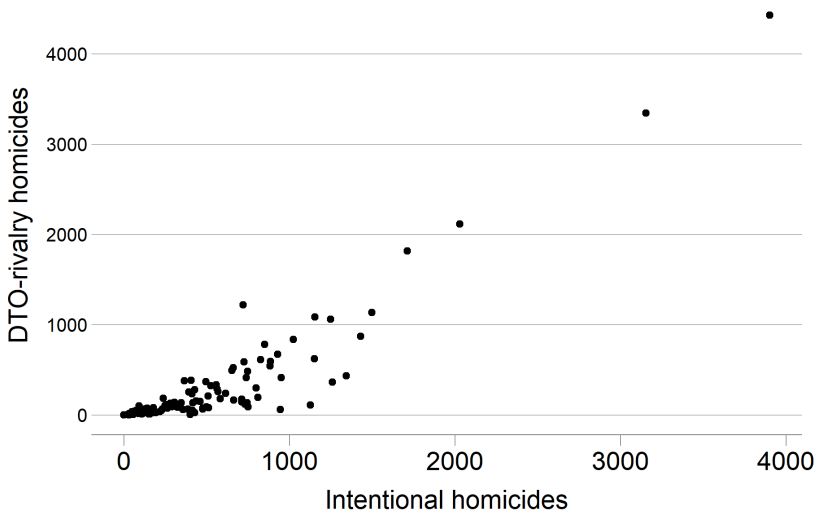
DTO-rivalry homicides
4000
3000
2000
1000
0
0
1000
2000
3000
4000
Intentional homicides

Figure 9

Appendix 2

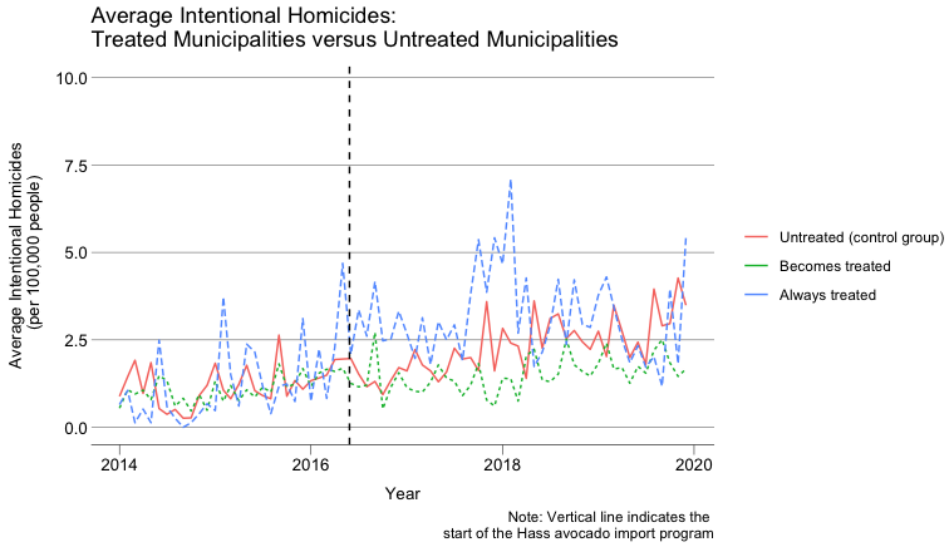

Figure 10

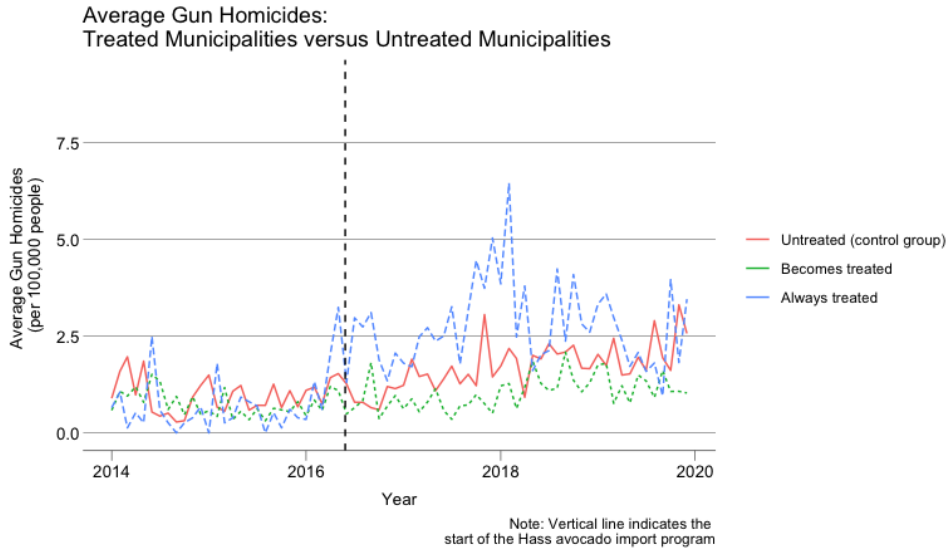

Figure 11

Appendix 3

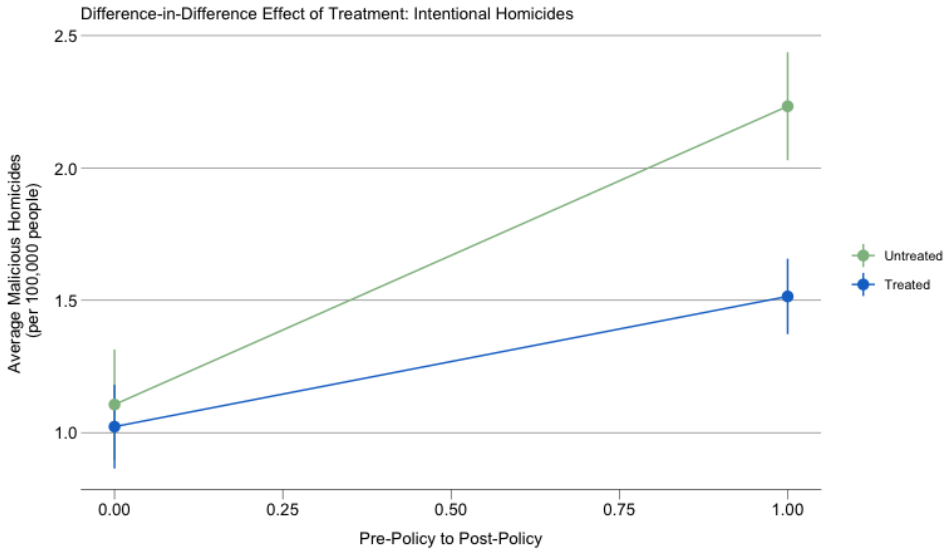

Figure 12

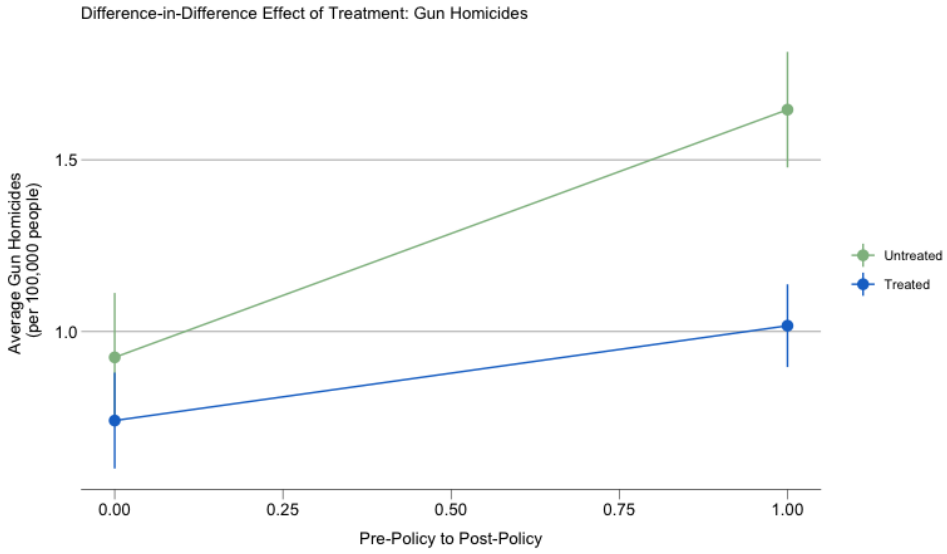

Figure 13