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MARKET STRUCTURE AND EXTORTION: EVIDENCE FROM 50,000 EXTORTION PAYMENTS

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ABSTRACT

How do gangs compete for extortion? Using detailed data on individual extortion payments to gangs and sales from a leading wholesale distributor of consumer goods and pharmaceuticals in El Salvador, we document evidence on the determinants of extortion payments and the effects of extortion on firms and consumers. We exploit a 2016 non-aggression pact between gangs to examine how collusion affects extortion in areas where gangs previously competed. While the non-aggression pact led to a large reduction in competition and violence, we find that it increased extortion rates by 15% to 20%. Much of the increase in extortion rates was passed-through to retailers and consumers: retailers experienced an increase in delivery fees leading to an increase in consumer prices. In particular, we find an increase in prices for pharmaceutical drugs and a corresponding increase in hospital visits for chronic illnesses. The results point to an unintended consequence of policies that reduce competition between criminal organizations.

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1 Introduction

Organized crime and associated extortion is a pervasive aspect of life in many countries. Because extortion is often a main revenue source for organized crime, extortion acts as a driving force behind competition and violence between gangs worldwide (Global Initiative Against Transnational Organized Crime 2019; Konrad and Skaperdas 1998). Extortion can be a significant cost for firms and may have significant implications for markets in countries with criminal organizations. Despite the prevalence of extortion in weak states, extortion is rarely reported to the police and is difficult to measure systematically.[1] Due to the considerable challenges of measuring extortion, little is known about how gangs determine extortion rates, how competition between gangs for territory impacts extortion, and the resulting economic effects of extortion.

Understanding the impacts of competition between gangs on extortion is particularly important given that governments have often facilitated cooperation between criminal organizations in order to reduce violence.[2] In addition, gangs will often collude and negotiate non-aggression pacts on their own. *Ex-ante*, it is unclear how truces between gangs affect extortion. On the one hand, truces between gangs may lead to a decreases in extortion if extortion is primarily used to finance confrontations for territory.[3] On the other hand, truces between gangs may increase extortion if they allow gangs to shift resources away from fighting other gangs for territory and towards increasing extortion revenues.

In this paper, we exploit the 2016 non-aggression pact between gangs in El Salvador to provide the first causal evidence on how collusion between gangs affects extortion, and to document the downstream effects of extortion on firms and consumers.[4] We leverage unique administrative data on extortion payments combined with detailed sales data for all goods shipped by a major Salvadoran wholesale distributor of consumer goods and pharmaceutical drugs. The data have information on over 50,000 extortion payments in which truck drivers were stopped by gangs while making deliveries to over 36,000 retailers between 2012 and 2019. Using these data, we show that that collusion between gangs increased extortion rates. We further show that firms respond by passing-through the increase in extortion to retailers,

[1] In El Salvador, only a very small fraction of extortion incidents are reported to the police due to fear of retaliation and lack of confidence in the police response. One survey suggests that only about 15% of victims of extortion by gangs ever report an incident to the police, and that reporting of extortion is even rarer for those that repeatedly pay extortion (FUSADES 2016).

[2] Examples include truces in El Salvador, Honduras, Haiti, South Africa, Trinidad and Tobago, Japan, and Jamaica. See, for instance, Kan (2014) and Cockayne et al. (2017).

[3] Additionally, stability in territory may lead to less short-term extractive practices by gangs and thereby reduce extortion. This closely follows the arguments of Olson (1993) and Tilly (2017).

[4] In El Salvador, as in much of Northern Central America, estimates suggests that upwards of 70% of businesses in gang-controlled territories report paying some sort of extortion (Martínez et al. 2016).

increasing prices for consumers. These results provide new evidence on the downstream consequences of gang collusion and extortion on firms and consumers.

We start with a simple theoretical framework to highlight the role of competition and price discrimination in the market for extortion. The model combines insights from the literature on competition and conflict between gangs (e.g., Garfinkel and Skaperdas 2007; Castillo and Kronick 2020) with the industrial organization literature on vertical markets with market power (e.g., Spengler 1950). In the model, gangs collect extortion from firms operating in the territory they control. The gangs may compete for territory using violence in order to increase extortion revenue. However, gangs can realize higher profits if they can cooperate and agree not to compete for territory, freeing resources for collecting extortion. The model implies that collusion between gangs increases extortion while decreasing violence, especially in markets where the firm being extorted faces high (inelastic) downstream demand. The model also implies that collusion between gangs increases downstream prices.

We then use the distributor data to first provide a descriptive analysis of the main correlates of extortion. We link administrative data on extortion payments made during deliveries to sales data with information on the revenue and margin of each product being delivered. Consistent with the model, we find that extortion is higher when local characteristics suggest higher (or more inelastic) demand for the goods being delivered by the distributor. We also show cross-sectional evidence that competition between gangs is associated with higher extortion rates. However, as illustrated in the model, competition is endogenous given that gangs are likely to compete over territories with larger returns from extortion.

To provide causal estimates on the effect of gang collusion on extortion rates, firms, and consumers, we focus on the March 2016 non-aggression pact between gangs. After the pact, gangs agreed to respect each other's existing territory rather than compete for territory over which to extort firms. This resulted in a large reduction in violent competition between gangs, reducing the homicide rate in El Salvador by nearly half. In order to determine how this collusion between the gangs affected extortion, we examine the effect of the non-aggression pact in municipalities in which gangs previously competed compared to areas in which a gang had a monopoly or near monopoly on territory. We show that the non-aggression pact mainly reduced violence in areas with previous competition, helping validate our difference-in-difference approach.

Examining the 2016 non-aggression pact, we find that gang collusion increased extortion rates by 15% to 20% percent in areas with previous gang competition relative to control areas. The effect of competition on extortion rates is robust to a number of specifications, including alternative definitions of competition. The results are especially large in areas with high

development prior to the pact, which see an increase in extortion of 24%. While we consider a number of explanations, we find evidence that the increase in extortion rates is due to gangs diverting resources to extortion collection after the pact, including increasing threats related to extortion. This is consistent with both qualitative accounts and the theoretical framework that highlight that it is costly for the gangs to both collect extortion and fight rival gangs in contested territories, implying that collusion allows gangs to focus resources on extortion.

We then provide evidence on how firms respond to higher extortion rates due to the non-aggression pact. We find no evidence that the firm adjusts its deliveries in the short run in response to the increase in extortion, consistent with the fact that the firm has long-standing relationships to supply retailers. However, we show that the distributor adjusts prices in response to extortion. There is substantial pass-through of extortion to retailers. We estimate that the increase in extortion causes the wholesale costs for the nearest retailer to increase by 12%. The costs for retailers further away from the location of the extortion payment also increases, but by less. We also find support for the theoretical prediction that the response depends on downstream demand for the good being extorted. In particular, we find larger price increases for inelastic goods such as staple food products, suggesting that the increase in extortion due to gang collusion may disproportionately impact poorer households.

To provide additional insight into the effect on consumers, we focus on pharmaceutical markets given that we observe detailed administrative data on consumer prices at pharmacies. In addition, El Salvador has among the highest drug prices in Central America, potentially reducing access to drugs and affecting health (Yamagiwa 2015). We find that the non-aggression pact increased retail prices for drugs by 7%. The increase in drug prices affects a wide range of drug classes and is likely due in part to the increase in wholesale costs because of the increase in extortion. We then examine hospital visits and find that for chronic diagnoses potentially affected by drug adherence, visits increase by 8%. There is no effect for visits unaffected by high drug prices such as injuries, indicating that the increase in visits is likely due to the increase in drug costs. These results highlight that an increase in extortion rates for upstream firms can lead to large negative welfare effects for consumers.

Our results have several broader implications. First, the Salvadoran case provides an opportunity to understand how extortion may affect firms and consumers. Our results highlight that certain goods—namely those with inelastic demand, such as staple products—are more likely to be impacted by extortion. Governments could pay particular attention to protecting these goods from extortion, as this would reduce gang profits and the incentives to

compete for territory. Second, while truces may generate a short-run decline in violence, the increase in extortion may instead allow criminal organizations to become more entrenched and can impose significant costs on firms and consumers.[5] Finally, our results are relevant for settings outside Central America. Gang violence and extortion have led millions of refugees to migrate from El Salvador, Guatemala, and Honduras towards developed countries (Clemens 2021; Sviatschi 2018).[6] Thus, policies that inadvertently increase extortion and consumer prices may have important policy spillovers for developed countries.

Our study contributes to several strands of the literature. First, we contribute to the literature on the development consequences of organized crime. Several papers have examined the effect of gangs on economic development via their impacts on human capital accumulation, labor markets, and state capacity (Angrist and Kugler 2008; Sviatschi 2018; Melnikov et al. 2020; Blattman et al. 2021). Our study highlights an additional mechanism through which organized gangs negatively impact economic development: the distortionary effects of extortion on downstream firms and consumers. We show how an increase in extortion rates is passed-through to firms and consumers. This is especially important for the case of pharmaceutical drugs, where there are significant concerns about affordability and efficient supply chains (Seiter 2010).[7]

Second, our study is related to the broader literature on the economics of illicit markets. One influential subset of this literature has focused on the market for government corruption (e.g., Shleifer and Vishny 1993; Bliss and Di Tella 1997; Ades and Di Tella 1999; Olken and Barron 2009; Amodio et al. 2021). Shleifer and Vishny (1993) argued theoretically that corrupt officials should be thought of as profit maximizing agents and point out that competition between government officials can reduce bribery.[8] Olken and Barron (2009) empirically highlighted the role of market structure in government bribes in their study of bribes at checkpoints; they find that the payment amount depends on the number of checkpoints, consistent with a model in which the officials at each checkpoint act as monopolists in a vertical chain.[9] A related strand of this literature has studied competition between criminal

[5]Our results help reconcile recent survey evidence that shows that a vast majority of the population of El Salvador does not support gang truces despite the substantial drop in violence (Cawley 2013a).

[6]In addition, the two main gangs we study, MS-13 and Barrio 18, are not only present throughout Central America, but are now also present in other countries such as in Mexico, Spain, and the United States.

[7]Studying the distortionary effects of extortion is particularly relevant for El Salvador because, unlike criminal organizations in other settings, gangs in El Salvador rely primarily on extortion for financing and do not collect significant revenue through the drug trade (Papadovassilakis and Dudley 2020).

[8]There is also a separate literature, starting with Becker and Stigler (1974), focusing on the principal-agent problem in the context of corruption or extortion. See Konrad and Skaperdas (1997) and Garoupa (2000) for theoretical examples related to extortion.

[9]As we discuss in Section 2, extortion by gangs has different implications than bribes by a vertical chain of government officials due to how extortion is collected in our setting.

organizations in illicit drug markets (e.g., Levitt and Venkatesh 2000; Dell 2015; Castillo and Kronick 2020; Bruhn 2021). However, despite being a key revenue source for organized gangs worldwide, there is little work studying the market for extortion and how gangs compete for extortion. In this paper, we leverage unique administrative panel data on individual extortion payments, including the amount of each payment, from a large distribution firm to provide new evidence on the determinants of extortion and on the causal effect of collusion between gangs.[10]

Finally, our work speaks to the broader industrial organization literature on collusive agreements between firms. There is a long history of comparing non-aggression pacts and peace agreements to collusive agreements between firms (Waltz 1979). In the case of criminal organizations in El Salvador, these parallels are even more stark given that the gangs are thought to be essentially profit-maximizing entities deriving the majority of their revenue from extortion. Like the criminal organization in El Salvador, collusion between firms in standard markets may involve assigning exclusive territory to increase joint profits (Rey and Stiglitz 1995). Despite the fact that collusive agreements between firms are often surreptitious, a number of empirical studies have examined cartels convicted by antitrust authorities or cartels operating in a jurisdiction in which they are legal (e.g., Porter 1983; Röller and Steen 2006; Asker 2010). Firms may use violence or threats of violence to enforce collusion or deter entry when incumbents collude (e.g., Clark and Houde 2013; Clark et al. 2018). A growing literature has also examined issues related to collusion and competition in developing countries (Houde et al. 2020; Bergquist and Dinerstein 2020). We provide new empirical evidence on collusion in an illegal market where gangs compete for territory. Unlike collusion in standard settings, collusion between criminal organizations reduces violence, allowing gangs to increase extortion rates.

The remainder of the paper is organized as follows. Section 2 provides background information on gang violence, collusion, and extortion in El Salvador, and describes the distributor's sales and extortion data. Section 3 presents the theoretical framework. Section 4 provides a descriptive analysis of the main determinants of extortion. Section 5 presents the estimates of the the non-aggression pact on extortion. Section 6 presents the pass-through estimates using the distributor data. Section 7 presents the effects on pharmaceutical prices and hospital visits. Section 8 concludes.

[10]Previous work has relied on self-reported data on whether individuals have paid extortion (FUSADES 2016; Magaloni et al. 2020b).

2 Background, Institutional Setting, and Data Sources

In this section, we first provide background information on gang violence and extortion in El Salvador and describe the 2016 non-aggression pact. We then present relevant details on the wholesale distributor that provided us with sales and extortion data. We explain the firm's business model, how extortion payments work in this setting, and describe the data on sales and extortion. Finally, we provide information on additional data sources we use in the subsequent analysis.

2.1 Gang Violence, Extortion, and Collusion in El Salvador

With a murder rate of 103 per 100,000 inhabitants—the highest murder rate worldwide in 2015—El Salvador has become known as one of the most violent peacetime countries in the world (Gagne 2016). This violence is due to the territorial reach of highly organized gangs, which are estimated to be present in 247 out of the country's 262 municipalities (ICG 2017b). The two main gangs in El Salvador, Mara Salvatrucha (MS-13) and Barrio 18, account for 87% of gang membership and are estimated to have over 60,000 members and a support base of 500,000, equal to 8% of El Salvador's population (Aguilar et al. 2006, ICG 2017b).[11]

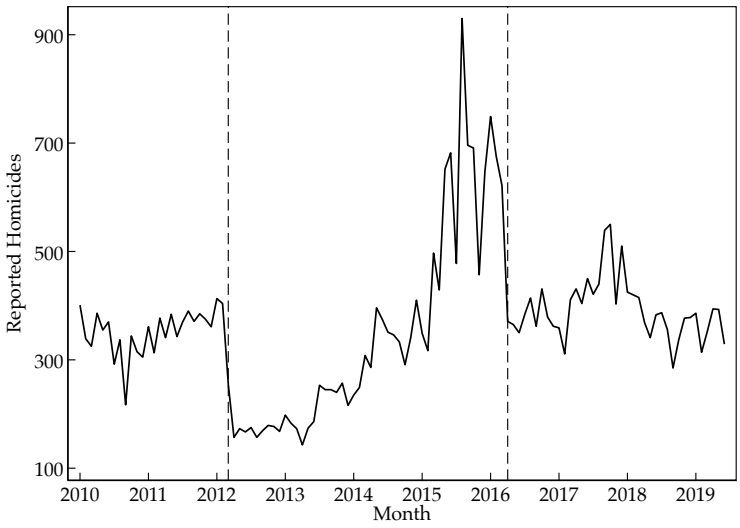
The high violence in El Salvador is largely driven by territorial wars in which the two major gangs fight to dominate extortion rackets (Papadovassilakis and Dudley 2020). Extortion represents the largest share of gang income, and is described as the "economic engine" behind the gangs and violence (ICG 2017a).[12] Estimates suggest that gangs extort about 70% of all the businesses in the territories where they are present, with distribution and transport firms being particularly affected (Martínez et al. 2016). Information on gang earnings is sparse; however, wiretapped conversations revealed that MS-13 earned about $600,000 in a single week of 2016 (Martínez et al. 2016). Estimates from the Salvadoran Central Bank count the direct cost of extortion to businesses at over $700 million a year, equivalent to 3% GDP, and the indirect costs of criminality at upwards of $4 billion a year (16% of GDP) (Peñate Guerra et al. 2016). These estimates are based on surveys and police reports, which have significant limitations.

Part of gangs' success at territorial control, violence, and extortion owes to their decentralized organizational structure. Both MS-13 and Barrio 18 have national leaders (*ranfleros*)

[11] For a discussion of the history of gangs in El Salvador, and the role of deportations, see Sviatschi (2019).

[12] Gangs in El Salvador also earn revenue from drug-trafficking, but this is thought to be much lower than the revenue from extortion. This is because, unlike criminal organizations in neighboring countries, gangs in El Salvador do not have direct control over the drug trade and are thought to only have sporadic "sub-contractual relationship" with drug traffickers (ICG 2017b).

Figure 1
Homicides and Collusion Between Gangs



Notes: Chart shows reported homicides in El Salvador by month. Vertical lines show start of gang truce (March 2012) and non-aggression pact (April 2016).

that often dictate and negotiate larger gang policies, including the 2012 truce and 2016 non-aggression pact. Operations on the ground are organized around neighborhood cliques (*clicas*). A clique, which may comprise ten to hundreds of members, is tied to a set geographic perimeter within a municipality, often a neighborhood (*colonia*) in urban settings (Dudley et al. 2018). In large urban areas, such as the capital San Salvador, there are often numerous cliques from both MS-13 and Barrio 18.[13]

To combat gang violence and extortion, the Salvadoran government has alternated between violent confrontations and direct negotiations with gangs (ICG 2017a; Holland 2013). Most prominently, the government negotiated a controversial truce between the two main gangs—MS-13 and Barrio 18—in March 2012. The immediate effect was less violence, with homicides falling by more than half (see Figure 1).

The 2012 truce was officially called off by the government in June 2013 in response to both growing opposition within the government and across civil society as the 2014 election neared (Vuković and Rahman 2018). Following the 2014 election, the newly elected government returned to a policy of violent confrontation with the gangs, and violence between gangs subsequently increased. However, gang representatives from MS-13 and Barrio 18

[13]In our context, the delivery firm may pay extortion to multiple cliques from the same gang within one municipality.

continued to meet informally using the meeting venues and dialogue mechanisms originally put in place to negotiate the truce (Martínez 2016a).

On March 26, 2016, the leaders of the main gangs in El Salvador unexpectedly announced a non-aggression pact that prohibited the invasion of other gangs' territories and violence targeting members of rival gangs (Ditta 2016; Martínez 2016a). Unlike the 2012 truce, the 2016 non-aggression pact was negotiated directly between gang representatives without the aid of government intermediaries and was not supported by the government.[14] In many ways the pact resembled a classic collusive agreement. For instance, the gangs set up a 12-member "coordinating committee" that would continue to meet to coordinate action and maintain exclusive territories (Martínez 2016a). As one gang representative described the pact and the role of the committee: "At present, we have a non-aggression pact between us, the idea being that boundaries will be respected. There are always problems that have to be resolved. It is not perfect. There's always someone that shoots, but that is why we are here" (Martínez 2016a).

Following the announcement of the non-aggression pact, homicides immediately fell by nearly half in the three subsequent months, as seen in Figure 1. It was reported that this drop in homicides was due to less competition between gangs: an MS-13 spokesman said at the time that "if you have seen the reduction in homicides, it is because the [gangs] are not attacking each other" (Martínez 2016a). There is little information about the status of the non-aggression pact in subsequent years; however, the homicide rate has remained low relative to the period before the pact. This has led many to speculate that the non-aggression pact was still in place as of the end of our sample period (Papadovassilakis 2020).

While it is well known that both the 2012 truce and 2016 non-aggression pact affected homicides, it is also possible that extortion rates were affected. Some have speculated that cooperation between the gangs could allow gangs to grow stronger and increase extortion. For instance, Dudley (2013) notes that "one theory [is] that the gang truce was really an effort by larger criminal interests to grant the MS-13 and Barrio 18 more breathing room for their operations." Collecting extortion requires constant monitoring of trucks and retailers, negotiating payment amounts, and credibly threatening violence (Neu 2019). MS-13 and Barrio 18 have a limited number of gang members, and there is anecdotal evidence that when they compete for territory, they have fewer resources to collect extortion.[15] In particular, the truce may have freed up gang members to more credibly threaten violence, increasing the

[14]The pact may have been negotiated in response to increased enforcement measures being debated by the government at the time (Ditta 2016). Importantly for our identification, we do not observe differential changes in violence between treated and control municipalities before the pact.

[15]Martínez (2016b) gives an example of a school that faces low extortion because it is in disputed gang territory, unlike surrounding area.

ability of gangs to request high extortion payments. In addition, it may be more dangerous to collect extortion when gang members are being targeted by a rival gang. These issues suggest that it is costly for gangs to both compete for territory and collect extortion. After the non-aggression pact, gangs may have been able to focus their resources on collecting extortion (ICG 2020). We explore these issues in the theoretical framework we present in Section 3 and empirically in Section 5.4.

2.2 Extortion and Sales for Distribution Firm

We use extortion payment data and sales data for all goods delivered by a leading wholesale distributor in El Salvador for the period 2012 to 2019.[16] The distributor is a major supplier of both consumer products and pharmaceuticals. The company buys these goods in bulk from domestic and international manufacturers and resells the products to local retailers and pharmacies. The firm has exclusive licensing rights with major multinational brands, allowing them to be the sole distributor of these goods in El Salvador.

For the distribution of products, the company operates primarily under a sub-contractor system for drivers and trucks. Each day, a truck is assigned a route with a predetermined number of stops. There are about 450 unique routes which reach all parts of the country. Per company policy, all trucks leave the San Salvador Metropolitan Area in the morning and must return at the day's end. These trucks tend to be midsize box trucks, often bare of visible advertisement or company identification. Over the sample period, the trucks go on 93,387 trips, making 2.2 million deliveries to retailers and pharmacies.

The extortion payment data contain records on the amount and location of each payment made to a gang on each route from 2012 to 2019.[17] The data also contain information on the date and shipment route, allowing us to link extortion to information about deliveries. These data were collected after the firm set up a robust security team headed by an ex-senior police officer to monitor trucks and negotiate with gangs. Other firms in El Salvador often use a similar approach (Martínez et al. 2016).

According to conversations with the firm's security team, extortion payments work as follows. Prior to making a delivery in gang-controlled territory, a driver will stop and meet with a gang representative who collects extortion. At this point they must call the security team, put them through with the gang representative, and have both the representative and the driver confirm the receipt of payment and the payment amount. This is done to

[16] Due to a confidentiality agreement with the firm, we do not name the firm.

[17] Information on extortion is missing for 1/2013, 2/2013, 4/2013, 5/2013, 4/2014, 4/2015, 11/2017, and 12/2017. Only two of these months are during our main period of analysis surrounding the non-aggression pact.

reduce fraudulent claims of payments by drivers, or coordination between the driver and a gang representative. The security team then records the payment amount and the location of payment; data on the gang receiving the payment was not collected until 2019.[18] In some cases, the extortion amount is pre-negotiated for a given period, often a month or less. While gangs are known to use violence or confiscate goods when negotiations break down, the gangs generally prefer consistent extortion payments over extreme measures that deter trucks from returning to an area in the future. Over the sample period, the distributor noted that they were generally successful at avoiding violent confrontation with the gangs, ensuring that drivers were safe and could make timely deliveries.[19] We provide additional details on the mechanics of extortion in Appendix A.

It is important to note that extortion payments generally give the distributor rights to deliver to retailers rather than rights to pass through a territory. Trucks are often stopped on side streets prior to a delivery rather than on a main road, implying that a firm could pass through the area without paying extortion if they did not make a delivery. This can be contrasted with government bribes at police checkpoints which allow firms the right to pass through an area (e.g., Olken and Barron 2009). In general, gangs have exclusive control of territory, and the distributor does not choose which gang to pay when making a delivery. In this way, gangs compete over territory rather than directly compete to provide "protection." Competition is particularly intense in municipalities that have a border between territory controlled by different gangs. While the distributor only pays one gang at a time in a given location, the gang that they pay may change over time depending on who controls the location. These features of extortion in El Salvador guide our model in Section 3.

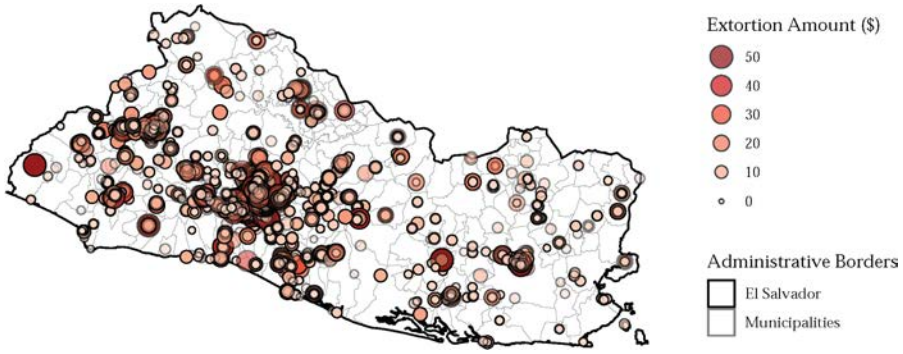
Figure 2 shows a map of all the extortion payments recorded by the company's security team between March, 2012 and March, 2019—a total of 51,576 extortion payments. While many extortion payments occur in the San Salvador Metropolitan Area, the firm frequently makes extortion payments across many different regions of the country.[20] Table 1 presents summary statistics for the extortion data (Panel A) for the sample period a year before and after the 2016 non-aggression pact, a period with 24,342 extortion payments. Individual extortion payments to the gang vary between \$0.50 and \$140. Conditional on paying extortion, the average truck pays \$14 per route in a day, equal to roughly half the daily labor cost of a truck driver.

[18] In addition to using these records for their own accounting, the distributor reports extortion payments to the Attorney General's Office.

[19] Prior to 2010, there were cases in which the firm used armored trucks and heavy security details when delivering in gang territory in order to avoid paying extortion. This was an expensive and dangerous approach.

[20] Appendix Figure A-2 presents a map of total and average extortion paid by the firm across municipalities.

Figure 2
Geography of Extortion



The sales data have detailed information on what was delivered by each truck over the period 2009 to 2019. The unit of observation is a product type delivered to a retailer or pharmacy on a given trip. The data include the revenue amount for each product delivered, the cost paid by the firm to obtain each product, and the corresponding gross margin for each product delivered—the difference between the cost paid to acquire the product and the amount charged to the retailer at delivery. The data also includes the product name, retailer name, and retailer addresses where the product was delivered. Table 1 presents summary statistics for the sales data (Panel B).[21]

We combine the sales data with the extortion data from the firm's security team using information on the route, truck, and location. Extortion payments are often made in close proximity to a delivery location. To provide a visual example of the combined data set, Figure A-1 presents a map of all of the deliveries made by the firm on a single day in 2016. The map shows the vast geographic scope of the firm's operations within a day and the prevalence of extortion payments across El Salvador.

2.3 Additional Data Sources

2.3.1 Homicides and Incarceration Records

To construct measures of gang competition, we use data on homicides and incarceration records. Individual-level homicide data for the years 2010 to 2017 was obtained from El Salvador's National Civil Police (PNC) through a "freedom of information" request. The data include information on the date and location of each homicide recorded by the police

[21] Appendix Figure A-3 presents a map of total and average delivery values across municipalities for deliveries made by the firm. Deliveries occur in almost all municipalities of El Salvador.

force. The data also include information on which gang committed the homicide if the police were able to make a determination.

The PNC marks a homicide as gang-related relying on the investigative and intelligence information at their disposal, often leveraging mapped-out gang boundaries or on-the-field cues. For instance, tattoos commonly indicate gang membership since they are often a requirement for joining a gang.[22] Additionally, accurate gang affiliation information is critical as the government uses this information after an arrest to separate prisoners by gang affiliation. For these reasons, there is less concern about measurement error in gang classification. For gang-related homicides, the police were able to determine the gang responsible for 75% of cases.[23] Table 1 Panel C presents summary statistics for the homicide data aggregated to the municipality-month level for the sample period a year before and after the 2016 non-aggression pact.

Finally, as an additional validation for our measure of competition, we obtained anonymized information on all incarcerated individuals in 2015 from the Ministry of Justice and Public Security. These data include information on general demographics, crimes committed or accused, date of arrest, gang affiliation, and municipality and department of birth and residence.

2.3.2 Pharmacy Sales and Hospital Visits

In order to examine the downstream effects of extortion on consumers, we focus on retail prices at pharmacies and health outcomes. The distributor is a major supplier of drugs to pharmacies, and, unlike other retail goods, there are detailed administrative data on pharmacy sales and health outcomes.

Retail pharmacy sales data for the years 2014 to 2017 are provided by the National Directorate of Medicines (DNM) of El Salvador. Due to high drug prices relative to comparable countries, the government started collecting sales data from pharmacies in 2014 with the intent of monitoring drug prices and increasing price transparency for consumers. Starting in 2014, the sales data were collected at the semi-annual level, however, this was increased to the monthly level in 2016.

The data contain information on quantity and revenue by pharmacy for over 10,000 pharmaceutical product. The sample includes all pharmacies for which the government was able

[22]The PNC has also been mapping gangs' territorial reach since the 2000s. Gang-related graffiti also helps in the classification; graffiti and tattoos are common tactics utilized by gangs to delineate their boundaries and show their affiliation, respectively.

[23]Nevertheless, to deal with this potential concern, we analyze whether the share of homicides with no gang affiliation per municipality is correlated with our measure of gang competition defined in Section 5. We find that this correlation is statistically insignificant, with an estimated coefficient of -0.006 (p-value of 0.806).

Table 1
Summary Statistics

	Mean	SD	Min	Max
Panel A. Extortion payments:				
Extortion payment	8.10	10.62	0.50	140.0
Total extortion by trip	15.60	19.07	1.00	290.0
Total extortion by route-month	127.12	129.97	1.00	745.0
Total observations		50,695		
Panel B. Distributor sales by retailer-product-trip:				
Amount charged to retailer	31	369	0.0	189,276
Cost	26	335	0.0	187,317
Amount by trip	3,467	9,548	0.0	357,849
Cost by trip	2,921	8,154	0.0	293,858
Amount by route-month	107,362	264,033	28.8	2,773,948
Cost by route-month	90,444	211,085	23.4	2,117,466
Unique products		6,038		
Unique retailers		36,020		
Total trips		93,387		
Total observations		10,552,876		
Panel C. Homicides by municipality-month:				
Homicides by MS-13	0.69	1.26	0	17
Homicides by Barrio-18	0.55	1.23	0	15
Total homicides	4.06	5.63	1	75
Total observations		2,411		
Panel D. Pharmacy sales by drug-pharmacy-month:				
Revenue (all pharmacies)	20.7	61.4	0.0	16,171
Cost (all pharmacies)	4.0	36.9	0.0	11,703
Price (all pharmacies)	14.5	20.2	0.0	2,620
Revenue (pharmacies supplied by distributer)	19.8	65.3	0.0	13,894
Cost (pharmacies supplied by distributer)	3.8	33.1	0.0	6,596
Price (pharmacies supplied by distributer)	14.3	20.9	0.0	2,446
Unique pharmacies		323		
Unique drugs		10,756		
Total observations		1,935,960		
Panel E. Hospital visits by municipality-month:				
Hospital visits	143	225	1	2,314
Hospital visits (injuries)	8	12	0	106
Hospital visits (diabetes)	4	8	0	115
Hospital visits (respiratory)	1	2	0	52
Hospital visits (hypertension)	2	4	0	39
Hospital visits (coronary)	1	2	0	40
Total observations		18,611		
Panel F. Municipality characteristics:				
Nightlights	0.86	2.11	0	17
Population density	4.21	9.04	0	64
Age	26.93	1.72	23	34
Female share	0.52	0.01	0	1
Literate share	0.91	0.05	1	1
Employed share	0.29	0.10	0	1
Educated	1.51	0.07	1	2
Total observations		263		

to obtain data. We discuss the sample of drugs and sample of pharmacies in more depth in Section B-3. Table 1 presents summary statistics for the pharmacy data (Panel D) for the sample period a year before and after the 2016 non-aggression pact.

In order to examine how changes in pharmaceutical prices affect health, we use individual-level data on hospital visits at public health facilities for the years 2012 to 2019 obtained from the Health Ministry of El Salvador (MINSAL) and Salvadoran Social Security Institute (ISSS). MINSAL is the main public hospital system and operates 30 hospitals, while ISSS operates 11 hospitals and covers workers in the formal sector and their dependents. The data do not include information for the approximately 30 private hospitals in El Salvador; however, only 5% of the population has private health insurance and can readily access private hospitals. Records have information on the hospital, municipality, visit date, patient characteristics (age and gender), and diagnosis code as defined by the International Classification of Diseases (ICD-10).[24] Table 1 (Panel E) presents summary statistics for the hospital visit data for the sample period a year before and after the 2016 non-aggression pact.

2.3.3 Municipality Characteristics

We use various sources to construct municipality characteristics that might be correlated with extortion payments. We construct yearly municipality-level measures of nightlight intensity and population density using data from National Oceanic and Atmospheric Administration (2020) and WorldPop (2020), respectively. Additionally, we use the 2007 population census of El Salvador to calculate municipality-level literacy and employment rates (Dirección General de Estadística y Censos 2007). We present summary statistics for these municipality characteristics in Table 1 (Panel F) for the sample period a year before and after the 2016 non-aggression pact. We provide a description of ancillary household survey and crime data in Appendix B.

3 Model of Gang Competition and Collusion

To help guide our empirical analysis, we start with a simple theoretical framework. In the model, gangs compete over extortion territory. The model shows conditions under which extortion increases when gangs collude. Motivated by discussions with our partner firm and fieldwork, we focus the fact that it may be costly for gangs to both compete for territory and collect extortion. By colluding and assigning exclusive territory, gangs can focus on

[24] We observe admission date in the MINSAL data and discharge date in the ISSS data. Otherwise, the two data sources have the same information.

collecting extortion. When the gang increases extortion for the firm, the firm charges higher prices to consumers.

3.1 Model Setup

A firm is the sole supplier of a homogeneous good. In the empirical setting, this firm is a distributor that sells goods to retailers.[25] The firm has marginal cost normalized to zero and faces linear demand $Q_d(p_d) = \alpha_d - \beta p_d$ in each period, where p_d is the price and Q_d is total quantity. Demand may differ across municipalities indexed by d and the firm may set a different price, p_d, in different municipalities.

If gang g operates in municipality d, they charge extortion rate e_{gd} to the quantity sold by the downstream firm in the municipality. The firm must pay given the threat of violence by the gang. The firm chooses its price (or output quantity) to maximize profit after the gang commits to an extortion rate.[26]

Assume there are two identical gangs that may operate in a municipality.[27] Each gang chooses violence level, h_{gd}, and the extortion rate, e_{gd}. When gangs compete, they use violence to obtain exclusive territory. Territory share is increasing in chosen violence but there are decreasing returns to violence. This assumption is common in the theoretical literature on conflict and gangs (Skaperdas 1996; Castillo and Kronick 2020). For simplicity, we assume that territory share is given by $s_{gd} = h_{gt}^{1/2}$ in a period in which gang g uses violence h_{gd}. If the gang controls share s_{gd} of the territory, they can apply extortion to share s_{gd} of the firm's demand in that territory.

Gang cost is increasing in violence and extortion. Furthermore, motivated by the discussion in Section 2.1, we assume that it is especially costly for gangs to both fight the rival for territory and collect extortion. This assumption about diseconomies of scope is motivated by the fact that gangs may have a limited number of gang members that specialize in activities, making it costly to both engage in extortion and fight for territory. In addition, conflict with a rival gang may make all activities more dangerous, effectively increasing the cost of collecting extortion. We assume that gang cost is given by $\phi h_{gt} e_{gt}$ where $0 < \phi < 1$ is a cost shifter representing police enforcement.

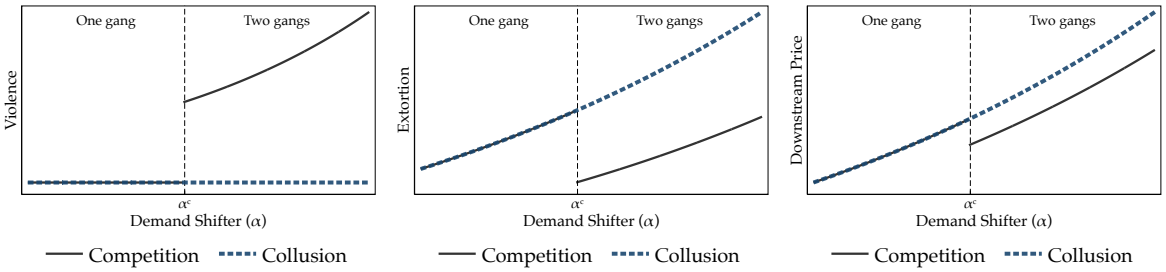
Gang profits are determined by extortion revenue in their territory, $s_{gd} e_{gd} q_{gd}(e_{gd})$, minus cost. When gangs compete, they choose the level of violence, h_{gd}, and extortion, e_{gd}, to

[25] In the context of the model, the retailers are assumed to be perfectly competitive.

[26] In this way, the gang acts like an upstream firm while the distributor is the downstream firm. This vertical structure is related to the canonical model of supply-chains proposed by Spengler (1950).

[27] In several contexts, gangs are duopolists. For example, in Northern Central America, MS-13 and Barrio 18 are the two main gangs in most countries. In addition, illicit markets in Brazil are characterized by the presence of duopolists (Magaloni et al. 2020a).

Figure 3
Simulated Extortion, Prices, and Violence as a Function of Demand
Under Competition and Collusion



a. Violence (h_{gt}) b. Extortion (e_{gt}) c. Price (p_{gt})

Notes: Charts show simulated outcomes for $\beta = 1$, $\phi = 0.2$, and $F = 17$. The x-axis shows $\log(\alpha)$ for α in interval $[6, 12]$. The vertical line shows the threshold, α^c, for entry by a second gang.

maximize profit given by

$$\max_{h_{gd}, e_{gd}} \left[\frac{1}{2} h_{gd}^{1/2} e_{gd} (\alpha - \beta e_{gd}) - \phi h_{gd} e_{gd} \right]. \tag{1}$$

Furthermore, we assume there is a fixed cost of entry, F, for gangs to operate in a municipality. A gang will operate in the municipality when the variable profit exceeds this fixed cost.

We provide additional details and derivation of the model in Appendix C. We summarize the implications of the model below.

3.2 Model Implications and Discussion

First, we can consider areas with low demand for the good being extorted. When demand is low, a second gang cannot profitably enter a municipality since variable profits do not cover the fixed cost. This is the case when α_d is below a threshold α^c. See Appendix C. In this case, a monopolist gang will charge extortion rate $\frac{\alpha_d}{2\beta}$. There is double-marginalization and extortion is partially passed-through to downstream prices paid by consumers, which are $\frac{3\alpha_d}{4\beta}$ with extortion and $\frac{\alpha}{2\beta}$ without. In these municipalities, collusion between the gangs has no effect on violence, extortion rates, or downstream prices since the gang is already charging the monopoly extortion rate. This can be seen in Figure 3, which shows that these outcomes are the same when $\alpha_d < \alpha^c$. Areas with a gang monopoly form our control group in our empirical analysis.

Second, we can consider areas with relatively high demand for the good being extorted. In these areas, there is incentive for both gangs to enter since variable profits are high enough to cover the fixed cost. When the gangs compete and each maximize profit, violence is given by $\frac{\alpha_d^2}{36\phi^2}$. Equilibrium extortion and downstream prices are then $\frac{\alpha_d}{3\beta}$ and $\frac{2\alpha_d}{3\beta}$, respectively. When gangs collude they maximize joint profit and split the market rather than compete for territory, implying $s_{gt} = \frac{1}{2}$. In this case, gang profit as a function of the extortion rate is given by $\frac{1}{4}e_{gt}(\alpha_d - \beta e_{gt})$. When gangs maximize profit, this implies extortion is $\frac{\alpha_d}{2\beta}$, the same as the case with a monopolist gang. This results in gang profits of $\frac{\alpha_d^2}{16\beta}$, higher than the case when gangs compete.

Figure 3 shows how violence, extortion, and prices change when there are two gangs (when $\alpha_d \geq \alpha^c$) and they go from competing to colluding. Figure 3 Panel a shows that violence declines when gangs collude. This is consistent with the large and well-documented reduction in homicides and other violence after the start of both the 2012 truce and 2016 non-aggression pact. The model implies that violence is a byproduct of competition over extortion territory and is unnecessary when gangs can agree on an allocation of territory. Furthermore, violence under competition is increasing in α_d, which corresponds to demand that is relatively less elastic. In other words, there is greater incentive for the gang to fight rivals for territory when there are larger returns due to more inelastic demand.

Relative to the case with gang competition, collusion increases extortion by $\frac{\alpha_d}{6\beta}$ in areas where both gangs are present. This can be seen in Figure 3 Panel b. When gangs collude, they focus on extracting extortion from firms in their territory rather than expanding territory. This in turn increases prices for consumers by $\frac{\alpha_d}{12\beta}$. In general, the degree of pass-through of extortion to downstream prices depends on the specific demand function and is ultimately an empirical question.

Gangs may price discriminate when demand differs across markets or products. Figure 3 Panel b and Panel c show extortion and prices as a function of α_d. When the demand curve in a market is more inelastic, there is more scope for the gang to charge high extortion. This effect is exacerbated when gangs collude. An important caveat is that gangs may lack full information about demand, making it difficult to perfectly price discriminate.

Taken together, the model offers several implications. The model highlights that gangs use violence to both compete for extortion territory and to collect extortion. It further suggests that if gangs collude and agree not to compete for territory, this frees resources for collecting extortion. Thus, the assumption that it is especially costly for the gang to both collect extortion and fight the rival gang plays a critical role in predicting that colluding over territory will increase extortion; ignoring qualitative evidence regarding gang-side dis-

economies of scope would lead to model predicting that collusion decreases extortion or does not impact extortion. The model also implies that collusion between gangs increases extortion and downstream prices while decreasing violence, particularly in markets where the firm being extorted faces high (inelastic) downstream demand. This implies that the cost imposed on firms and consumers when gangs collude may depend on the good being extorted.

4 Descriptive Analysis

We provide a descriptive analysis of the determinants of extortion. We first examine route-level extortion and deliveries and explore how extortion rates vary with respect to the value of each delivery. In line with accounts from the company's security team, we show two main results. First, extortion is higher for higher value deliveries. Second, gangs use local and observable proxies for demand when setting extortion rates. These results shed light on how gangs use price discrimination across locations. We then analyze what municipality-level characteristics are correlated with extortion rates. These results provide initial correlational evidence consistent with the theoretical model in Section 3 and motivate our empirical strategy.

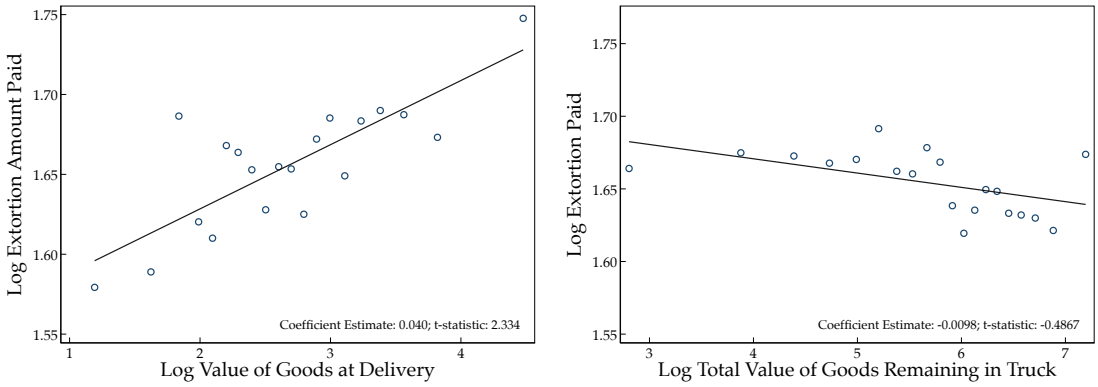
4.1 Route-Level Analysis of Extortion

We use the route-level data that combines deliveries and extortion payments to examine the correlates of extortion payment rates. Figure 4 presents binscatter charts showing the relationship between the log extortion payment made by the firm upon a delivery and the log value of the nearest delivery (a.) and the log value of all goods in the truck at the time of the nearest delivery (b.).

Finding 1: ***Extortion is increasing in delivery values***

Figure 4 a. shows that there is a positive relationship between the value of the goods being delivered and the extortion payment. This result implies that extortion is not a fixed fee per delivery but varies according to what is being delivered. Furthermore, it suggests that gangs have some information about demand for the good being delivered and set an extortion rate accordingly, consistent with distributor's accounts and the model presented in Section 3. However, the correlation between extortion and delivery values is modest, with an estimated elasticity of extortion that implies that a 1% increase in the value of delivery is associated with a 0.04% increase in extortion.

Figure 4
Relationship Between Extortion Rates and Delivery Values



a. Value of Goods at Delivery

b. Value of Goods in Truck

Notes: The figure presents binscatters between the log of the extortion amount paid by the firm upon delivery and the value of goods delivered (a.) and the total value of goods delivered by the truck on the date (b.). The unit of observation is an extortion payment-delivery pair. The bottom-right of each figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the delivery route level.

Finding 2: ***Extortion rates depend on local observable characteristics***

What characteristics do gangs use to proxy for demand and price discriminate across locations? First, we ask whether gangs set local extortion rates based on all deliveries made on a route on a given day (including outside gang territory) or based on local characteristics of the deliveries/retailers. To explore this, Figure 4 b. examines whether there is a relationship between extortion and the value of goods remaining in the truck. We find that there is little relationship between the total value of goods remaining in the truck upon delivery and the extortion payment paid by the firm. This suggests that gangs do not generally set extortion based on the trucks' contents. This is consistent with conversations with the firm, where they noted that gangs rarely look inside the firm's truck before setting an extortion demand. Instead, they noted that gangs focus more on proxies of the value of a delivery (e.g. the characteristics of the retailer that is receiving the delivery) instead of vehicle contents.

To investigate the extent to which variation in extortion can be explained by local characteristics, Table A-1 presents regression estimates for the relationship between extortion amounts and the value of deliveries when we include various fixed effects. Column 1 presents estimates with no fixed effects, while columns 2-4 sequentially include municipality, route, and retailer fixed effects, respectively. Conditioning on these time-invariant characteristics increases the adjusted R^2 from less than 0.01 in column 1 to over 0.54 in column 4. The results in Table A-1 suggest that retailer characteristics explain a considerable

amount of the variation in extortion amounts, consistent with gangs using local proxies for product demand to price discriminate.

Finding 3: ***Extortion is unrelated to extortion payments elsewhere on a route***

How are extortion payments related to the number of extortion payments made elsewhere along a route? If gangs set extortion rates primarily using local characteristics (rather than the delivery firm's characteristics), then we would expect the amount of extortion paid to be unrelated to extortion payments elsewhere on a route. However, if gangs set extortion in a centralized manner using knowledge of the firm's delivery routes, they might extract higher extortion payments along routes facing fewer extortion payments. Similarly, if gang extortion acts as a vertical chain of "tolls", then we would expect that gangs extract more extortion along routes with fewer extortion payments. Figure A-11 presents the relationship between extortion rates and the number of extortion payments made elsewhere on a route. We find that there is little relationship between extortion rates and the number of extortion payments made elsewhere on route. The result suggests that gangs do not determine extortion rates using characteristics of the firm's delivery routes.[28]

4.2 Municipality-Level Analysis of Extortion

Finding 4: ***Extortion is positively correlated with proxies for downstream demand***

We examine how municipality-level proxies for economic development are correlated with extortion. We regress the log of the average extortion paid by the firm in a municipality per year on various municipality-level characteristics related to firm delivery values and economic development.

Table 2 presents the regression estimates. In column 1, we explore the relationship between extortion and delivery values. In line with the findings in Section 4.1, extortion is higher in municipalities with higher delivery values. Column 2 of Table 2 examines how economic development is correlated with extortion. The independent variables included are the log of average nightlights per year, the log of population density per year, the percent of the population that is literate, and the percent of the population that is employed (according to the 2007 census). The results show that higher levels of economic development, which is likely correlated with higher demand for goods, are associated with higher extortion. This result provides evidence that gangs set extortion rates that depend on downstream demand.

[28]The result is consistent with conversations with the security team, who noted that extortion payments granted the firm the right to deliver to a gang-controlled area (rather than acting as a chain of "tolls" along their routes).

Given that development is endogenous to gangs, we next examine how extortion is related to gang competition. This motivates our empirical strategy in Section 5.1.

Table 2
Relationship between Extortion Rates & Municipality Characteristics

	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)
Delivery Characteristics:				
log(Value Delivered Per Year)	0.571**			0.019
	(0.282)			(0.182)
Development Characteristics:				
log(Nightlights)		1.221***		1.153***
		(0.252)		(0.230)
log(Population Density)		0.594**		0.452*
		(0.291)		(0.266)
% Literate		4.669		3.382
		(3.681)		(3.463)
% Employed		4.698**		1.855
		(2.193)		(2.023)
Violence Characteristics:				
log(Homicides Per Year)			1.694***	0.897***
			(0.182)	(0.148)
𝟙(Homicides By Both MS-13 & B18)			−1.118***	−1.344***
			(0.390)	(0.297)
Outcome Mean	0.78	1.95	0.79	1.96
Adjusted R2	0.021	0.514	0.343	0.575
Observations	231	231	230	230

Notes: The unit of observation is a municipality. 𝟙(Homicides By Both MS-13 & B18) is an indicator variable equal to 1 if a municipality has homicides committed by both MS-13 and Barrio 18 in an average year. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

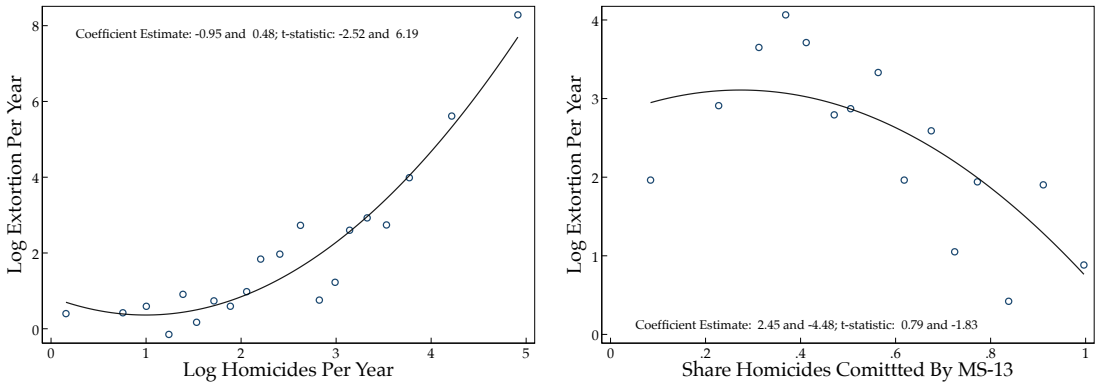
Finding 5: ***Extortion is positively correlated with higher gang violence and competition***

Figure 5 presents binscatter charts showing the relationship between (a.) the average (yearly) extortion paid by the company in a municipality and average homicides, and (b.) the share of homicides committed by MS-13 (for homicides committed by either MS-13 or Barrio 18).[29] Figure 5 a. shows that there is a positive relationship between extortion and homicides. This relationship appears to be non-linear: extortion is particularly higher in places with very high levels of violence. However, from Figure 5 a. only, it is unclear whether extortion is high in places with more violence due to one gang having a monopoly of violence (and extortion), or higher gang competition. In Figure 5 b. we examine how extortion is correlated with a measure of gang competition — the share of MS-13 or Barrio 18 homicides committed by MS-13 — and find that higher gang competition is associated with higher extortion. In particular, extortion appears to be highest in municipalities where both gangs commit an

[29] Binscatter charts fit a quadratic relationship, which provides a better fit to the underlying data in both cases.

equal share of homicides, and decreases in municipalities where gangs compete less.[30] This result is broadly consistent with the correlation between competition and extortion found in surveys (Magaloni et al. 2020b).

Figure 5
Relationship Between Extortion Rates and Gang Violence



a. Homicides b. Share Committed by MS-13

Notes: The figure presents binscatters between the log of the extortion amount paid by the firm upon delivery and the log of the number of homicides per year (a.) and the average share of homicides committed by MS-13 out of homicides committed by MS-13 or Barrio 18 (b.). Both figures fit a quadratic relationship. The unit of observation is a municipality. The text on the top-right of figure (a.) and bottom-right of figure (b.) presents the estimated coefficients and t-statistics.

However, from these descriptive results, it is difficult to determine whether gang competition causes higher levels of extortion, or whether some omitted variables determine both extortion rates and gang competition (e.g. downstream demand). In particular, the model presented in Section 3 implies that in markets with high α, there is greater incentive for gangs to both charge higher extortion and compete for territory using violence. This is consistent with the positive correlation between gang competition, homicides, and extortion. Yet, the model also predicts that a reduction in gang competition due to collusion will cause an increase in extortion. Therefore, even though there is a positive correlation between competition and extortion rates across municipalities, the causal effect of collusion could imply that competition has a negative effect on extortion. In Section 5 we present an identification strategy to provide causal evidence on the role of competition between gangs by examining the non-aggression pact.

[30] Columns 2 and 4 of Table 2 presents regressions estimates for how gang violence and competition is correlated with extortion amounts.

5 Effects of the Non-Aggression Pact on Extortion

To examine the causal effect of a change in competition between gangs on extortion, we focus on the 2016 non-aggression pact between gangs. We first detail our baseline empirical strategy and show that the non-aggression pact did induce a significant decrease in gang competition as measured by gang-related homicides. We then show how the 2016 non-aggression pact impacted extortion. In Section 6 and Section 7 we use the same variation to examine the downstream effects.

5.1 Empirical Strategy

We exploit two sources of variation to estimate the causal effect of gang competition on extortion and prices: the timing of the 2016 non-aggression pact between the two main gangs of El Salvador, and cross-sectional variation in gang competition prior to the pact. This difference-in-difference design is motivated by the theoretical framework in Section 3 and the fact that the pact likely did not affect areas in which one gang already had a monopoly on extortion. We explore impacts at both the intensive and extensive margin.

In this setting, we expect that the non-aggression pact primarily affected the intensive margin of extortion for the distributor. This is because the distributor consistently and frequently paid extortion in gang territories prior to the pact, gangs are present in most municipalities, and there is likely little benefit from stopping the same truck multiple times in a territory. Therefore, we first examine the amount paid for each extortion incident as the outcome of interest. Examining outcomes at this level also allows us to take advantage of the richness of the administrative distributor data and link individual extortion payments to specific deliveries, routes, and trucks. This lets us finely account for potential omitted variables and to subsequently explore the direct downstream effects of extortion payments in Section 6 and Section 7.

The baseline specification is given by:

$$y_{dtri} = \beta(NonAggr_t \times Comp_d) + \theta X_{dt} + \gamma_t + \gamma_d + \epsilon_{dtri} \tag{2}$$

where y_{dtri} is the outcome of interest (e.g. extortion rates) for an extortion payment i made along route r in municipality d at month t; $NonAggr_t$ is an indicator variable equal to one if month t follows the non-aggression pact agreement made on April, 2016, and zero otherwise; $Comp_d$ is an indicator variable equal to one if the municipality d had gang competition prior to the pact, defined in more detail in the next section. We include municipality fixed effects, γ_d, which control for time-invariant factors that may be correlated with extortion rates and

gang competition. We also include month fixed effects, γ_t, which control for time-varying factors that may be correlated with aggregate changes in extortion across time. Specifications also include time-varying municipality-level controls, X_{dt}—including annual nightlight intensity and population density, and 2007 census municipality characteristics (gender, age, literacy, education, employment) interacted with year—to improve precision, but we show results with and without these controls. In more demanding specifications, we also include route by municipality fixed effects and route by $NonAggr_t$ fixed effects to exploit only within route changes in trends in extortion across municipalities over time.[31] Finally, ϵ_{dtri} is a vector of idiosyncratic random errors. To account for correlation within a municipality across time in extortion and prices, standard errors are clustered at the municipality level.

When examining the extensive margin effects of the non-aggression pact, we modify equation (2) and estimate effects aggregated to the municipality-route-month level.[32] For outcomes of interest that are count variables, we estimate effects using Poisson regressions.[33]

When estimating the effect of the non-aggression pact on extortion, we focus on a relatively short period around the non-aggression pact, June 2015 to January 2018, for two reasons. First, there was a change in how extortion was recorded in June 2015. Starting in June 2015, the distributor started validating extortion payments, making the data more reliable and reducing outliers. Nevertheless, we also conduct robustness exercises using data prior to June 2015. Second, using a relatively short period around the non-aggression pact addresses concerns about other policies that may have affected competition long after the pact or longer-run effects of the non-aggression pact.

The coefficient of interest in equation (2), β, is interpreted as the change in extortion rates due to the change in gang competition following the non-aggression pact. The main identifying assumption is that in the absence of the non-aggression pact, extortion rates would follow common trends in areas with and without competition. We use a number of methods to examine the validity of the common trends assumption, including examining trends prior to the non-aggression pact and a falsification test. In addition, for equation (2) to identify an effect of gang competition on extortion or prices, the non-aggression pact must

[31] In the following section, Section 6, we also show results including fixed effects for the nearest retailer to account for time-invariant factors at the retailer level that may be correlated with extortion rates. (See Table 5.)

[32] Specifically, we estimate the following equation:

$$y_{dtr} = \beta(NonAggr_t \times Comp_d) + \theta X_{dt} + \gamma_t + \gamma_d + \epsilon_{dtr} \tag{3}$$

where y_{dtr} is the outcome of interest (e.g. an indicator for any extortion payment) along route r in municipality d at month t. The rest of the terms are defined as in equation (2).

[33] Note that for some outcomes of interest (e.g., gang homicides), we do not have information at the municipality-route-month level. For these outcomes, we have to estimate results at the month m and municipality d level.

have meaningfully decreased competition between gangs. We start by examining this issue in Section 5.2.

5.2 Defining and Validating the Competition Measure

To create our measure of whether there is gang competition in a municipality prior to the non-aggression pact, we construct the Herfindahl-Hirschman Index (HHI) in each municipality. There is very limited information about the location of gangs over the period. Therefore, we use homicides committed by gangs prior to 2016 to define our primary measure of competition as these are an observable and meaningful outcome of gang competition. The basic intuition is that municipalities where both gangs are committing many homicides likely have gang competition.

To construct the gang HHI, we define $s_{d,ms13}$ and $s_{d,b18}$ as the share of homicides in municipality d committed by MS-13 or Barrio 18 in the three years prior to the non-aggression pact.[34] We remove municipalities with one or no homicides given that gangs may not be present in these areas and competition is not well-defined in these cases. However, we show that the results are robust if we treat these municipalities as having no competition when estimating our main results in Section 5.6. We construct the HHI for a municipality d as $HHI_d = \sum_{g=ms13,b18} s_{d,g}^2$.[35] For our baseline specification, $Comp_d$ is defined as an indicator for gang competition that is equal to zero if HHI_d is in the top quartile of the HHI for municipalities and one otherwise.

We validate this measure of gang competition in a number of ways. First, while it is well known that gangs assigned exclusive territories following the pact which reduced homicides by nearly half, we show that the non-aggression pact primarily affected gang-related homicides in areas defined as having competition in the pre-period. This is consistent with the idea that the non-aggression pact should have little or no effect in areas without gang competition prior to the pact. Figure A-4 presents the number of reported gang homicides in municipalities with gang competition and without gang competition as defined using the homicide HHI. We find that following the non-aggression pact in April 2016, there is a substantial decrease in gang competition in the form of lower gang homicides in municipalities defined as having gang competition. In areas defined as not having competition, there is

[34] Barrio 18 split into two factions in the early 2010s: *Revolucionarios* in the north and *Sureños* in the south. The data do not separate homicides committed by *Revolucionarios* or *Sureños* prior to 2015; however, as implied by the respective names, the two factions of Barrio 18 tend to be geographically separated and so there is limited competition between them (Amaya and Martínez 2015). Additionally, other gangs in El Salvador commit a very small share of homicides. For these reasons, we focus on competition between Barrio 18 and MS-13.

[35] Appendix Figure A-2 presents municipality-level maps of homicides and homicide HHIs and Appendix Figure A-5 presents the histogram of our homicide HHI measure.

little change in the number of homicides in which the two gangs were either perpetrators or victims. Figure A-4 also shows that while homicide rates were larger in competing areas before the pact, there was no differential pre-trend in violence in these areas relative to areas without gang competition.

Furthermore, Table A-3 presents the results from estimating equation (3) using the number of homicides in a municipality in which MS-13 or Barrio 18 was the perpetrator or victim. The estimates imply that the non-aggression pact significantly reduced gang-involved homicides by about 34%. These results provide evidence that the non-aggression pact meaningfully reduced gang competition in municipalities with prior competition relative to control areas.

Note that one strength of using the HHI measure to define competition—where we use the *composition* of homicides rather than homicide *levels*—is that it is more robust to concerns about mean reversion driving the drop in homicides following the non-aggression pact. Nevertheless, in Table A-4 we show that the results are robust to using an HHI defined various years before the non-aggression pact. This is consistent with the fact that the HHI measure is quite stable over time.

Second, we show that the non-aggression pact did not have a statistically significant effect on other crimes that are less likely to be associated with gang competition, such as domestic violence, petty theft, and robberies. We present the results in Columns 3 to 8 in Table A-3. This implies that the non-aggression pact mainly affected gang-on-gang competition and not crime levels more generally.

Third, we show that the homicide HHI measure is strongly correlated with an alternative HHI measures constructed using the affiliation and arrest location of inmates in prisons in El Salvador for individuals incarcerated in the three years prior to the 2016 non-aggression pact (see Appendix Figure A-10).

Finally, in Section 5.6, we also highlight that the results are robust to alternative definitions of gang competition, including alternative cutoffs and the continuous measure of competition (HHI_d).

5.3 Effect on Extortion

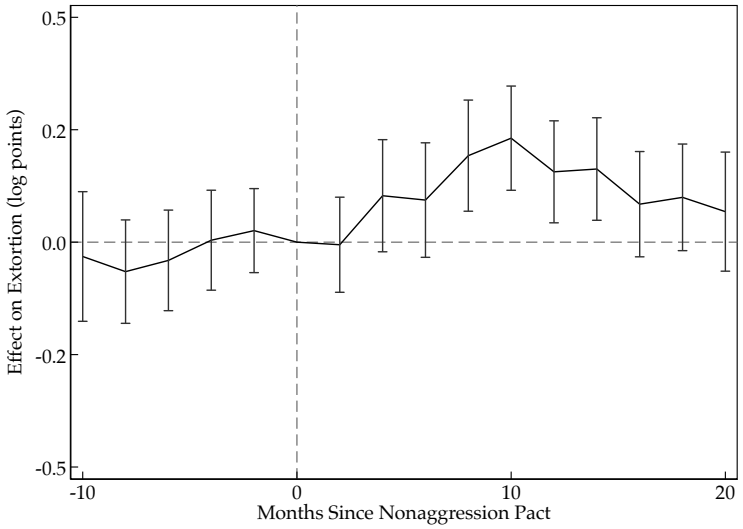
Figure 6 presents the estimated effect of the non-aggression pact on extortion by period with municipality and month fixed effects and the full set of controls.[36] We find that in the periods before the non-aggression pact, there is no significant difference in extortion in municipalities

[36]The specification used for Figure 6 is $\log(extortion_{dtri}) = \sum_t \beta_t(Period_t \times Comp_d) + \theta X_{dt} + \gamma_t + \gamma_d + \epsilon_{dtri}$ where $Period_t$ is defined bimonthly. The interaction with the period prior to the non-aggression pact is omitted.

with gang competition and those without competition. A test of the joint significance of the coefficients in the pre-period fails to reject the null hypothesis that they are all equal to zero (p-value = 0.66). This provides evidence that the municipalities with competition had similar trends in the period prior to the non-aggression pact as municipalities without competition, supporting the parallel trends assumption. In the Appendix, we also show results using a longer panel in Figure A-12.[37] These results also indicate no evidence of pre-trends.

Once the gangs agreed to the non-aggression pact, extortion increased in municipalities where gangs previously competed relative to those where gangs did not previously compete as seen in Figure 6. Interestingly, the increase in extortion was gradual and becomes significant about six months following the non-aggression pact, suggesting that there might be adjustment costs for gangs as they relocate resources. The effect on extortion initially increases over time, leading to a 20% increase in extortion, before reducing slightly in later periods.

Figure 6
Impact of Non-Aggression Pact on Extortion



Notes: Vertical line shows start of non-aggression pact (April 2016). Figure shows bimonthly point estimates using the difference-in-difference specification with log extortion amounts as the outcome. Specification includes month fixed effects, municipality fixed effects, and covariates as in the baseline specification (2). The period prior to the start of the non-aggression pact between MS-13 and Barrio 18 is omitted. Error bars indicate 95% confidence intervals using standard errors clustered at the municipality level.

Table 3 presents the average effect on extortion amounts following the non-aggression pact. In the preferred specification following equation (2) (column 3), we find that collusion

[37]This figure includes extortion payments that were not validated by the firm.

between gangs increases extortion by 19.2%. An alternative specification without covariates implies a 20.9% increase in extortion (see column 1).

We include route fixed effects in columns 2 and 4 and municipality by route fixed effects in columns 5 and 6 to control for differences across routes and find that results are robust to their inclusion, implying a 15% to 20% increase in extortion rates.[38] Furthermore, column 6 includes fixed effects for routes interacted with an indicator for the non-aggression pact to account for potential changes in routes post-pact. This specification compares the trend in extortion rates for the portions of a route that fall inside municipalities with high HHI_d to the trend along the same route for the portions of the route that fall in municipalities with low HHI_d. The results presented in column 6 imply that the non-aggression pact increased extortion rates by approximately 22%.[39]

We also look at the extensive margin effects of the non-aggression pact and find suggestive evidence that the non-aggression pact also had an effect on the extensive margin, though the results are imprecisely estimated. The results from estimating equation (3) on the probability of paying extortion are presented in Panel A of Table A-5. The point estimates imply that the pact increased the probability of at least one extortion in a municipality-route by 1.8%; however, these results are not statistically significant. We also examine the effects of the pact on the number of extortion incidents and find some evidence that the number of extortion incidents increased following the pact (see Panel B of Table A-5). These results suggest that not only did gangs increase extortion rates after the pact, they also began collecting extortion more often.

5.4 Understanding the Increase in Extortion

Overall, the results in Section 5.3 show that extortion payments substantially increase when gangs collude. The model and qualitative evidence highlight that gangs may shift resources towards extortion when gangs collude given that it is costly to both collect extortion and fight rival gangs (diseconomies of scope channel). In this section, we examine this mechanism empirically using a number of approaches. We also explore alternative mechanisms.

Diseconomies of Scope – To understand whether gangs devote more resources towards extortion following the pact, we conduct the following tests. First, as a proxy for the amount

[38] In addition, we do not find evidence that the distributor changes the routes over time after the pact (see Figure A-6).

[39] Additionally, recent work by de Chaisemartin and D'Haultfoeuille (2020) has highlighted that two-way fixed effects estimators estimate weighted sums of the average treatment effects in each period, where weights might be negative in the presence of treatment heterogeneity. Following their recommendations, we compute the regression weights for our estimator. We find that out of 490 average treatment effects, only 9 have negative weights, suggesting that treatment effect heterogeneity is unlikely to be a major concern in our setting.

Table 3
Effect of Non-Aggression Pact on Extortion
in Municipalities with Gang Competition

	Outcome: log(Extortion)					
	(1)	(2)	(3)	(4)	(5)	(6)
$NonAggr_t \times Comp_d$	0.209***	0.171***	0.192***	0.150***	0.198***	0.224**
	(0.048)	(0.066)	(0.065)	(0.056)	(0.066)	(0.093)
Municipality FEs	Yes	Yes	Yes	Yes	No	No
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Route FEs	No	Yes	No	Yes	No	No
Municipality-Route FEs	No	No	No	No	Yes	Yes
Route-$NonAggr_t$ FEs	No	No	No	No	No	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
Outcome Mean	1.60	1.60	1.60	1.60	1.60	1.60
Adjusted R2	0.188	0.271	0.191	0.272	0.323	0.325
Observations	15,001	15,001	15,001	15,001	14,924	14,924

Notes: The unit of observation is an extortion payment. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

of resources gangs devote to extortion collection, we examine whether reports of violent threats by gangs increase following the non-aggression pact.[40]We find a significant increase in reports of gang-related arrests for threats in Table 4 and no increase in non-gang related threats. This suggests that gangs devote more resources to threaten violence following the non-aggression pact, allowing them to increase extortion rates.[41] This is consistent with Olken and Barron (2009), who find that proxies for the threat of violence—such as the number of officers at checkpoints or whether officers have guns—are associated with higher extortion payments.

Second, we examine whether the degree of price discrimination by gangs changes following the non-aggression pact. If gangs are dedicating more resources to their extortion business, gangs might have better information on retailers and the associated demand for delivered goods, and might be able to better price discriminate. We present the results in Table A-8; we find that after the pact, gangs increase extortion more for deliveries at retailers with higher delivery values.

Third, we explore how firm delivery times change following the pact. If gangs are devoting more resources to negotiating high extortion rates, it is possible that delivery times will increase given that these negotiations often take time. We present the results in Table A-9; we find suggestive evidence that the time between extortion payments and deliveries increases following the pact, consistent with the idea that gangs are willing to spend more

[40]In Appendix A, we discuss how gangs use threats to ensure compliance and maximize extortion demands.

[41]We also find an increase in the number of kidnappings following the non-aggression pact. See Table A-7.

Table 4
Effect of Non-Aggression Pact on Arrests for Threats

	All		Gang-related		Non-gang related	
	Threats	Threats	Threats	Threats	Threats	Threats
$\text{NonAggr}_t \times \text{Comp}_d$	−0.005	−0.018	0.892**	0.881*	−0.081	−0.093
	(0.096)	(0.097)	(0.441)	(0.468)	(0.099)	(0.098)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes
Outcome Mean	1.21	1.21	0.10	0.10	1.11	1.11
Observations	4,495	4,495	2,945	2,945	4,495	4,495
Clusters	145	145	95	95	145	145

Notes: Results from Poisson regressions in which the outcome is the number of arrests for threats ("amenazas") in a municipality-month. Municipalities in which the outcome is zero for all periods are dropped. Covariates include nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

time demanding higher payments.

Changes in Downstream Demand— The model and the results in Section 4.2 highlight that higher downstream demand is associated with higher extortion. Therefore, extortion might have increased if the reduction in violence due to the non-aggression pact considerably increased downstream demand. In Appendix Tables A-14 and A-13, we directly examine the effect of the non-aggression pact on per-capita household incomes, expenditures, and nightlights and find no statistically significant effect in our sample period. This suggests that downstream demand did not increase substantially in the short-run following the pact.[42]

Composition Effects— We also explore whether the results might be explained by the firm adjusting delivery locations or routes following the non-aggression pact. We find little evidence that the firm adjusted the retailers served following the pact. In particular, we explore how the firm responds to the increase in extortion in detail in Section 6 and find that the distributor firm mostly adjusts via prices rather than along the extensive margin following the non-aggression pact. This is because the firm often has enduring delivery relationships with retailers, and is the sole distributor for many goods. These firm-level findings suggest that changes in the composition of retailers served is unlikely to explain the findings.[43]

Price Competition— It could be the case that, when there is gang competition, firms choose to pay the gang that provides "protection" for the lowest cost. However, conversations with the distributor highlight that the firms paying extortion cannot choose which gang to pay

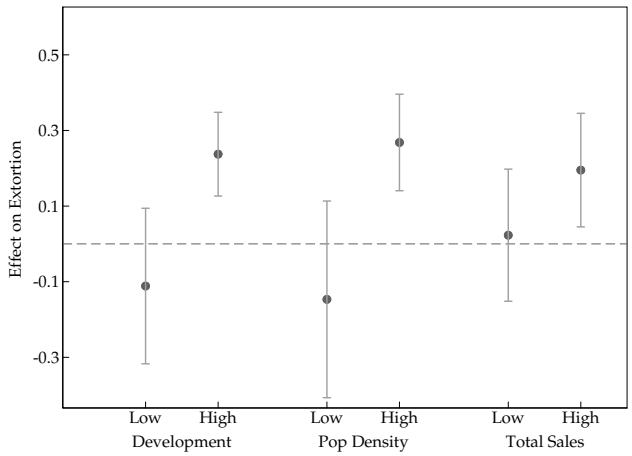
[42]Note that our main specification focuses on a relatively short time window before and after the pact. However, it is possible that demand could increase in the longer-run.

[43]Additionally, the effects on extortion are robust to including route fixed effects, route by municipality fixed effects, and route by post fixed effects, suggesting that the findings are also not driven by the additions of new routes. (See Table 3.)

for protection; instead, firms must pay whichever gang is in control of the territory where they are making a delivery. For these reasons, we argue that the increase in extortion was primarily because gang collusion allowed gangs to focus resources on extortion rather than fighting for territory.

5.5 Heterogeneous Effects on Extortion

Figure 7
Effect of Non-Aggression Pact on Extortion
Heterogeneous Effect by Geographic Characteristics



Notes: Shows point estimates and 95% confidence intervals for difference-in-difference model. Standard errors are clustered at the municipality level. Low (high) characteristics are defined as being below (above) the median value in the pre-period. Standard errors are clustered at the municipality level. All specifications include municipality fixed effects, month fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year.

One implication of the theoretical model is that collusion between gangs is predicted to have a larger effect on extortion in markets with higher demand for the goods being extorted. In order to examine this, we estimate separate regressions by geographic characteristics that are likely to reflect demand conditions.

Figure 7 shows the estimated effect on extortion by geographic characteristics. First, we examine the results by municipality development as measured by nightlights. The non-aggression pact is estimated to increase extortion by 24% in municipalities with above median development, but the effect is not statistically significant in municipalities with below median development. Similarly, there is a larger effect on extortion in municipalities with high population density. Finally, we examine total sales in the surrounding canton. The non-aggression pact has a larger effect in areas with above median total sales, although the difference is not statistically significant.

Taken together, these results suggest that the non-aggression pact allowed gangs to increase extortion most in regions with higher (or more inelastic) demand, consistent with the theoretical predictions in Figure 3 Panel B.

5.6 Robustness and Alternative Specifications

One of the primary concerns is that results are driven by the definition of gang competition prior to the non-aggression pact. We address this concern by estimating specifications using alternative measures of competition.

The cutoff used to define competition in our baseline estimates was chosen to reflect the areas most likely to be affected by the non-aggression pact. However, we examine how the estimated effect on extortion differs for a wide range of cutoffs for defining competition. The estimates, presented in Appendix Table A-11, are quite similar to the baseline, ranging from 17% (50^{th} percentile) to 24% (80^{th} percentile).

It is possible that areas defined as not having competition are still somewhat affected by the pact, leading to an underestimate of the effect. Rather than use a binary measure of competition, we also estimate an alternative model using HHI_d as a continuous treatment in the difference-in-difference model. The results, which are qualitatively similar to the baseline specification, are presented in Appendix Table A-12. The point estimates, which are all significant, imply that if a municipality were to go from a duopoly in which the two gangs split the market equally ($HHI_d = 1/2$) to fully collusive ($HHI_d = 1$), extortion would increase by approximately 30% to 50%. Relatedly, there is concern that areas without homicides should be included in the control group. Interestingly, results are quite similar to the baseline results when we include municipalities without homicides as part of the control group (see Table A-10).

A potential confounding factor is the implementation of Plan Secure El Salvador (PESS). The initiative increased police enforcement and was rolled out in select areas starting in 2015. In Table A-10 we directly control for the implementation of PESS in a municipality. While the program was only implemented in a small number of areas, interestingly, we find suggestive evidence that increased enforcement from PESS may have led to a modest decrease in extortion rates. This result is consistent with the theoretical prediction of a change in gang cost. Nonetheless, we find that the estimated effect of the non-aggression pact on extortion is robust to accounting for the implementation of PESS.

One possible concern with the intensive margin results is that they reflect the effect of the pact on extortion conditional on being visited by the firm. While we show in the following section that the firm did not adjust routes in the short-run following the pact, we also esti-

mate the effects of the non-aggression pact on extortion by aggregating the data to a fully balanced municipality-route-month panel comprised of all municipality-routes during the sample period.[44] We present the results from estimating equation (3) in Table A-6. Consistent with our findings of increases in both the intensive and extensive margins of extortion, we find that the non-aggression pact significantly increased extortion per municipality-route following the pact.

Finally, to address the concern that gang competition also varies within a municipality, we replicate our analysis using smaller geographic units of analysis. The 262 municipalities are subdivided into 2,286 cantons. Using the address of each homicide, we determine the canton for the event and construct our measure of gang competition at the canton level rather than the municipality level. We then replicate our previous analysis at the canton level and present the results in Appendix Section E. Despite concerns about measurement error due to geocoding, estimates are largely similar to the baseline specification at the municipality level. Point estimates imply an increase in extortion of between 10% and 17%, similar to the baseline specification. These results provide further confirmation that the results are not driven by the definition of competition.

6 Distribution Firm Response to Extortion and Gang Collusion

It is important to understand how extortion affects downstream firms and consumers in order to understand who bears the cost of extortion. In order to shed light on this issue, we begin by using the distributor sales data to examine the effect of the non-aggression pact on downstream retailers. In this section, we focus on how the margin over the manufacturer cost is affected by an increase in extortion. In Section 7 we directly examine the effect on consumer prices for a subset of the goods using administrative data from pharmacies.

Using the distributor's sales data, we show that the 2016 non-aggression pact and resulting increase in extortion led to an increase in distributor gross margins, increasing costs for retailers. We find no increases in the procurement costs paid by the distributor, implying that the increase in gross margins is driven by increases in delivery prices. We also find no significant change in the number of retailers served by the distribution firm, suggesting that, in response to higher extortion, distributors adjust mostly by increasing their prices, passing-through part of the extortion increase to downstream retailers in the form of higher prices. This is consistent with the fact that the firm has long-standing delivery contracts with retailers, and therefore prices are the most likely adjustment channel.

[44] In particular, we set extortion rates to be zero even for municipality-route-months that did not have a visit by the firm.

6.1 Effects of Extortion on Distributor Margins

To examine the causal effect of gang competition and extortion on the behavior of the distributor, we start by examining the reduced-form effects of lower gang competition. To take advantage of the richness of the distributor sales data, we modify our baseline difference-in-differences specification to estimate impacts on the company's gross margin. Specifically, we estimate the following specification:

$$y_{dtji} = \beta NonAggr_t \times Comp_{dj} + \theta X_{dt} + \gamma_t + \gamma_d + \gamma_j + \epsilon_{dtji} \tag{4}$$

where y_{dtji} is the outcome of interest (e.g. gross margin) for a delivery i for retailer j in municipality d at month t. We include retailer fixed effects, γ_j, to finely control for time-invariant unobservables. Since retailers are largely served by the same route, the retailer fixed effects subsume route fixed effects and municipality by route fixed effects. In particular, while we do not find evidence that the number of retailers served was affected by the non-aggression pact, we still include retailer fixed effects to address concerns that the non-aggression pact affected the composition of retailers. The rest of the variables are defined as in equation (2).

An increase in extortion may cause the firm to increase prices for retailers. A limitation of the distributor sales data is that we do not observe prices; however, we calculate the distributor's gross margin on each delivery—the difference between revenue amount (paid by the retailer to the distributor) and procurement cost (paid by the distributor to the manufacturer) for a given product. We focus on the distributor margin as our main outcome of interest. From the perspective of retailers, the distributor margin can be thought of as the delivery fee for a given product.

Table 5 presents the estimated effect of the 2016 non-aggression pact and the subsequent increase in extortion on the distribution firm's gross margin. In all cases, we link extortion and retailers for deliveries occurring on the same date and same route. In Table 5 we focus on retailers closest to an extortion payment, who are the most likely to be affected by an increase in extortion. In addition, because an extortion payment may also affect prices for multiple nearby retailers, we examine retailers 1km and 5km away from an extortion payment in Table A-15.

Columns 1 and 2 of Table 5 present the reduced-form effect of the 2016 non-aggression pact on the firm's gross margin. The estimates imply a 11.6% increase in the gross margin for deliveries that occur closest to extortion payments. The results provide evidence that the reduction in gang competition increased the firm's gross margin for retailers nearest to

Table 5
Effect of Extortion on Distribution Margin for Nearest Sale

	Reduced-Form		First-Stage	IVDD	
	Distributor Margin	log(Margin)	Extortion	Distributor Margin	log(Margin)
$\text{NonAggr}_t \times \text{Comp}_d$	1.369*	0.117**	1.647**		
	(0.719)	(0.054)	(0.637)		
Extortion				0.831***	0.072***
				(0.243)	(0.023)
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes
Retailer FEs	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes
Outcome Mean	4.17	1.03	7.41	4.17	1.03
Adjusted R2	0.566	0.443	0.464		
F-Stat				22.8	22.2
Observations	34,963	34,571	34,963	34,963	34,571

Notes: The unit of observation is a delivery. Distributor margin is defined as the difference between wholesale price and manufacturer price. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the extortion payments. Retailers further from the extortion saw a smaller increase in gross margins.[45]

These results provide additional evidence that extortion is not simply a lump-sum fee. If gangs used a lump-sum fee, theory predicts that the distributor would not adjust its pricing and downstream retailers would not be affected since the lump-sum fee would simply increase the distributor's fixed cost. In contrast, the assumption of linear pricing in the theoretical model presented in Section 3 implies that extortion leads to double-marginalization, increasing cost for retailers.

To quantify how extortion increases are passed through to distributor margins, we use an instrumental variable difference-in-difference (IVDD) approach. An important identifying assumption for this IVDD specification is that our instrument for extortion, $NonAggr_t \times Comp_d$, must only affect the company's gross margin through its effect on extortion. While the results should be interpreted carefully given the exclusion restriction assumption, we use a number of strategies to provide support to the validity of this assumption. First, because the reduction in violence might have led to a change in the retailers served, we include retailer fixed effects in the main specification. Second, the reduction in violence might have led to a change in demand that could have affected prices in the absence of extortion. However, as discussed in Section 5.3, we do not find evidence that demand increased in the short-run

[45]We find a 5.1% increase in the gross margin for deliveries within 5km of extortion payments, but the estimates are imprecisely estimated for sales that are further away. See Table A-15.

in affected municipalities.[46] These results provide some evidence in support of the exclusion restriction. However, it is still possible that distributor margins could be affected in the absence of the increase in extortion. This could be the case, for instance, if the decrease in violence lowered the firm's delivery cost directly. In this case, the estimated pass-through would be an underestimate. Given these issues, we consider the IV estimates as a 'rescaling" exercise to understand the role of extortion and for all estimations we present the reduced form estimates.

Column 3 of Table 5 presents the first-stage estimates for the IVDD approach. Consistent with the results in Section 5.3, the non-aggression pact significantly increased extortion. Columns 4 and 5 present the second stage estimates. The estimates imply that a $1 increase in extortion increases the firm's gross margin by $0.84 for the deliveries closest to extortion payments. Likewise, the estimates in Table A-15 imply that a $1 increase in extortion leads to a $0.23 and $0.18 increase in the firm's gross margin for deliveries 1km and 5km away, respectively, from the extortion payment.[47] These results provide evidence that increases in extortion due to reductions in gang competition are partially passed-through to retailers, consistent with the model presented in Section 3.

6.2 Heterogeneous Effects of Extortion on Distributor Margins

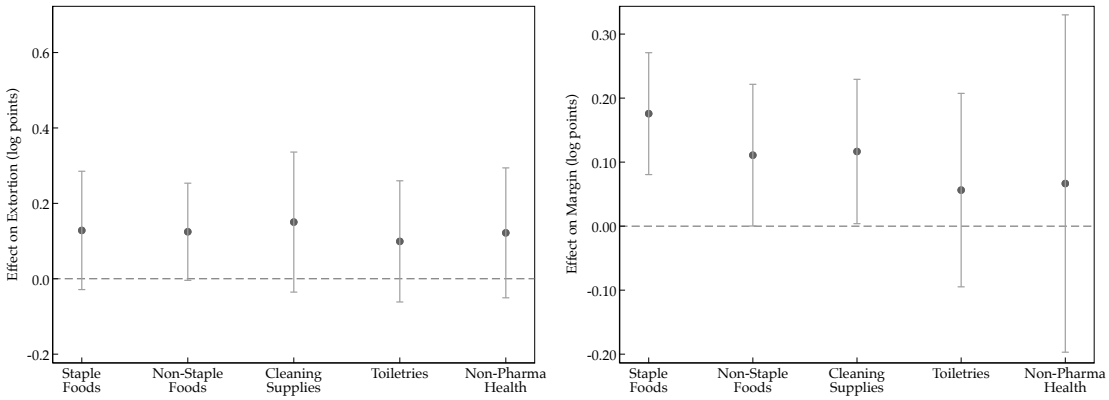
One implication of the theoretical model is that collusion between gangs is predicted to have a larger effect for products with relatively inelastic demand. In order to examine this, we estimate separate regressions by product groups that are likely to differ in their demand elasticity. To define product groups, we focus on the 500 most common products delivered by the distribution firm and divide them into five categories: staple food products, non-staple foods, cleaning supplies, toiletries, and non-pharmaceutical health products.[48] Figure 8 shows the estimated reduced-form effects on extortion and distributor margins by product groups. Figure 8 a. presents the effects on extortion, while Figure 8 b. presents the effects on distributor margins. The results in Figure 8 a. suggest that there is little evidence of heterogeneous effects on extortion by product type: the increase in extortion following the 2016 non-aggression pact is very similar across the product groups. These results are consistent with the idea that gangs use observable characteristics of overall demand to set

[46] In addition to the results discussed in Section 5.3, we also conduct a falsification test and show in Appendix Table A-2 that the average manufacturer procurement price paid by the firm across municipalities with and without competition does not change following the non-aggression pact. This suggests that the products delivered across these municipalities did not meaningfully change due to the reduction in gang competition.

[47] Interestingly, the estimated pass-through appears to decay for sales further away from extortion payments, consistent with the descriptive results in Section 4 that find that extortion is a very local phenomenon.

[48] We exclude pharmaceutical health products as we examine these directly in the Section 7.

Figure 8
Effect of Non-Aggression Pact on Extortion and Distribution Margins
Heterogeneous Effects by Product



a. Extortion b. Gross Margin

Notes: Shows point estimates and 95% confidence intervals for difference-in-difference model. Standard errors are clustered at the municipality level. Distributor margin is defined as the difference between wholesale price and manufacturer price. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level. All specifications include municipality fixed effects, month fixed effects, retailer fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year.

extortion (such as the characteristics examined in Figure 7) but do not set product-specific extortion rates.

However, the results in Figure 8 b. show evidence of heterogeneous adjustment effects by the distributor by product groups, with distributor margins increasing the most goods that likely have inelastic demand. In particular, the estimated effect on distributor margin is largest for staple food goods and smallest for toiletries and non-pharma health products.

Taken together, the results presented in Figure 8 suggest that the non-aggression pact did not lead to heterogeneous increases in extortion by product type, but did induce heterogeneous downstream adjustments by the distributor. In particular, the non-aggression pact and subsequent increase in extortion led to larger increases in distributor margins for inelastic products, consistent with the theoretical predictions in Figure 3 Panel C. Additionally, by affecting staple food products the most, the results suggest that increases in extortion due to gang collusion may disproportionately negatively impact poorer households, potentially exacerbating inequality and reducing economic development.

6.3 Effects of Extortion on Firm's Extensive Margin

In addition to adjusting prices, the distributor may respond to extortion by changing the quantity or type of deliveries. In Figure A-7 we examine the effect of the non-aggression pact by period on total cost, total deliveries, unique products, and unique retailers in a municipality-route-month as in equation (3). For each of these outcomes we find no evidence of pre-trends and no significant effect of the non-aggression pact. This is consistent with fact that the distributor is contractually obligated to make deliveries and is often the exclusive distributor for certain products. In particular, the distributor has long-standing contracts to deliver goods which are unlikely to adjust within our sample period. In addition, we also explore if the distributor changed the number of routes served per municipality after the pact and find no change (Figure A-6). Therefore, when extortion increases in a municipality, the distributor increases prices rather than adjusting deliveries.

7 Retailer and Consumer Response to Gang Collusion

Given that in the previous section we find an increase in distribution margins affecting retailers' costs, in this section we study the pass-through from retailers to consumers by analyzing multiple retailers' responses. On the one hand, it is possible that as their "delivery costs" increase, many retailers exit the market.[49] On the other hand, retailers may respond by increasing consumer prices. To analyze this question we focus on pharmacies, a subset of the retailers with detail information on prices. The distributor is a major supplier of both drugs from local manufacturers and international pharmaceutical companies. Drug prices in El Salvador have historically been substantially higher than in comparable countries, making drug prices the focus of much political debate. It is important to understand whether extortion is a factor driving high drug prices, especially given the potential implications for health.

7.1 Effect on Pharmacy Prices, Exit, and Entry

We employ a similar identification strategy as our baseline specification and examine the reduced-form effect of the 2016 non-aggression pact on pharmacy prices. Columns 1 to 3 of Table 6 present the effect for all drugs at all pharmacies in the sales sample. The preferred specification with detailed drug and retailer fixed effects implies that gang collusion resulted in a 7.2% increase in retail prices for pharmaceutical drugs. To address the concern that

[49] However, as shown in Figure A-7, the number of retailers does not change after the pact.

Table 6
Effect of Non-Aggression Pact on Consumer Prices at Pharmacies

	All Pharmacies/Drugs			Drugs for Managing Chronic Diagnoses		
	log(Price)	log(Price)	log(Price)	log(Price)	log(Price)	log(Price)
$NonAggr_t \times Comp_d$	0.079**	0.072***	0.054***	0.073**	0.073***	0.054**
	(0.031)	(0.023)	(0.020)	(0.029)	(0.026)	(0.024)
$NonAggr_t \times Comp_d \times Distr$	−0.008	0.005	0.004	0.009	0.005	−0.010
	(0.023)	(0.023)	(0.028)	(0.031)	(0.030)	(0.035)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Retailer FEs	No	Yes	No	No	Yes	No
Drug FEs	Yes	Yes	No	Yes	Yes	No
Drug×Retailer FEs	No	No	Yes	No	No	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Outcome Mean	-1.11	-1.11	-1.11	-0.93	-0.93	-0.95
Adjusted R2	0.870	0.880	0.931	0.823	0.834	0.900
Observations	1,755,366	1,755,366	1,617,314	122,100	122,100	112,325

Notes: The unit of observation is a drug-pharmacy-month. The second row shows the coefficient on the treatment interacted with an indicator for whether the distributor of the drug is the firm that is the focus of our prior analysis. For the period prior to January 2016, data is at the semi-annual level and the unit of observation is a drug-pharmacy-semi-year. The outcome is the price per unit (pill, milliliter, or gram depending on the product). Covariates include nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

results may be driven by changes in the set of drugs delivered to pharmacies over time, we also show results are robust to the inclusion of pharmacy by drug fixed effects in Column 3. Furthermore, Figure A-13 a. presents the estimated effect by period and shows no evidence of differences in trends in the pre-period.[50] In Appendix Table A-18 we examine individual drug categories and also find a significant increase price for each drug category.

Many of the pharmacies in the sample are supplied by other distributors that are likely to also pay extortion. We examine the differential effect for the distributor that is the focus of this study by interacting the treatment indicator with an indicator for whether the drug was supplied by the distributor that is the focus of this study.[51] The coefficients in the second row of Table 6 are very small and insignificant, implying no differential effect for the drugs supplied by this distributor. This result is consistent with all distributors being similarly affected by the increase in extortion rates. In this way, the results suggest that the distributor that is the focus of this study is representative of other distributors.

We also examine the subset of drugs that are important for managing chronic diseases, including diabetes, hypertension, and coronary heart disease. The cost of diabetes drugs

[50]Note that we cannot show the event study coefficients at the bimonthly level because the pharmacy data is at the quarterly level prior to 2016. Therefore, we show estimates using quarters as the time periods.

[51]We identify this subset using the name and location of pharmacies. Note that these pharmacies may have drugs supplied by multiple distributors; however, we are not able to identify the specific drugs supplied by the distributor given that the distributor sales data do not contain a comparable drug identifier.

are of particular concern given that 9% of the Salvadorean population has diabetes, almost double the world average.[52] There is concern that many drugs to treat chronic conditions are unaffordable given high drug prices in El Salvador relative to incomes. For this sample of drugs, we also find a positive and significant effect on prices due to the nonaggression pact. As shown in Table 6 Column 5, prices increased by 7.3%.

We also examine whether the non-aggression pact affected the extensive margin for pharmacies and present the results in Table A-20. We find no evidence that the non-aggression pact had an effect on the number of pharmacies or the set of pharmacies served by the distributor during our sample period following the non-aggression pact. It is important to note that in the long-run, an increase in extortion could potentially result in retailers exiting the market.

We argue that the results are largely due to pass-through of upstream extortion to final consumer prices for pharmaceutical drugs. The percent increase in wholesale prices is similar to the percent increase in retail prices after the nonaggression pact, implying a high degree of pass-through of extortion to retail prices.[53] One concern with this interpretation is that pharmacies could be directly affected by the nonaggression pact. For instance, the nonaggression pact could have affected the extortion that pharmacies pay to gangs directly.[54] However, according to the Ministry of Health, which oversees pharmacies, direct extortion of pharmacies is less common than extortion of suppliers. Other policies that were aimed at lowering drug prices are also unlikely to explain the result given our identification strategy.[55]

7.2 Effect on Health Outcomes

In order to examine whether the increase in prices due to the gang non-aggression pact affected health outcomes, we examine visits to public hospitals in Table 7. Given that the outcome of interest is number of visits, we employ Poisson regressions. We first examine visits for all diagnoses and find a small, statistically insignificant effect. This is not surprising

[52] See WHO Diabetes Country Profile.

[53] In Appendix Table A-17 we directly examine the effect of the nonaggression pact on distributor pharmaceutical margins and sales revenue. Point estimates imply an increase in margins and sales revenue of 10.6% and 13.3% respectively, however, results are imprecise. We focus on retail pharmaceutical prices given that the data are more detailed and quantity-adjusted price can be computed, increasing the precision of estimates.

[54] As discussed previously in Section 6, we rule out other potential channels for how collusion may lead to an increase in prices, such as a decrease in general crime levels and changes in demand. To the extent that the non-aggression pact affects demand directly due to lower violence, this is unlikely to explain the magnitude of the effect on pharmaceutical prices.

[55] The government implemented price caps on drugs in 2013. In practice, we find that these price caps are often not binding. The government also implemented a price transparency website with information about drug prices in May 2015. To the extent that the website lowered drug prices, it affected all municipalities and would be absorbed into month fixed effects.

Table 7
Effect of Non-Aggression Pact on Hospital Visits

	All Diagnoses		Injuries		Chronic Diagnoses Affected by Drug Adherence	
	Visits	Visits	Visits	Visits	Visits	Visits
$NonAggr_t \times Comp_d$	0.017	0.010	−0.017	−0.015	0.083***	0.081***
	(0.014)	(0.012)	(0.023)	(0.024)	(0.031)	(0.028)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes
Outcome Mean	233.11	233.11	12.29	12.29	13.27	13.27
Observations	4,588	4,588	4,588	4,588	4,588	4,588
Clusters	148	148	148	148	148	148

Notes: Results from Poisson regressions in which the outcome is the number of inpatient visits in a municipality-month. Covariates include nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

given that many hospital visits are unlikely to be affected by drug prices. In addition, the decrease in violence due the non-aggression pact may have decreased visits, counteracting the effect due to higher drug prices. Focusing on visits related to injuries, we find a negative effect on visits, albeit insignificant.

Focusing on visits for chronic conditions treated by the drugs analyzed in Table 6, we find that hospital visits increase by about 8%. As seen in Column 5 and 6, this result is significant and robust to including controls for demographic characteristics. In Appendix Table A-19 we estimate the effect on visits for individual diagnoses that may be affected by an increase in drug prices. While estimates for some diagnoses are imprecisely estimated, we find point estimates implying a 3% to 12% increase in visits.

The results are particularly large and significant for diabetes, a common chronic condition in El Salvador. This is consistent with the fact that, if untreated, diabetes can cause kidney failure, heart attacks, blindness, and stroke. For other individual diagnoses, which are less common, the effect on visits is positive but estimates are imprecise.

The fact that there is a significant effect on hospital visits for diagnoses plausibly affected by high drug prices and not for other diagnoses, such as injuries, helps confirm that the increase in visits is due to the effect of the non-aggression pact on drug prices. Finally, Figure A-13 b. examines the effect on visits for chronic conditions by period. Results imply that the effects are not driven by trends prior to the non-aggression pact.

Extortion may impose a large cost on consumers by increasing prices across a range of goods. We highlight that in the important case of pharmaceutical drugs, there was signif-

icant pass-through to consumer prices, potentially exacerbated by double-marginalization. While the non-aggression pact drastically reduced violence, the evidence implies health was indirectly affected by this increase in prices.

8 Conclusion

In countries with organized crime, governments have often facilitated cooperation between criminal organizations in order to reduce violence, an important externality of gang competition. In addition, criminal organizations may agree on exclusive territories on their own, also reducing the violence that results from competition. While some have advocated for truces to reduce violence, these truces tend to lack popular support or face political backlash.[56] In this paper, we highlight an additional effect of cooperation between gangs that has been largely ignored. When criminal organizations are able to collude, they significantly increase extortion.

We also shed light on the broader economic consequences of extortion. We find that consumers bear a large burden from upstream extortion given the pass-through to retailers and consumer prices. Consistent with theory, we present evidence that gangs price discriminate, charging extortion rates that differ depending on downstream demand. This has implications for the incidence of extortion. The results suggest that the non-aggression pact led to larger price increases for goods with inelastic demand, such as staple foods and many pharmaceutical drugs, implying that extortion may particularly impact poorer households and exacerbate unequal access to healthcare. Given that gangs often target upstream firms, double-marginalization may imposes additional efficiency losses when extorted firms have market power.

While this paper focused on the effect of the 2016 non-aggression pact primarily on one distributor, the results likely have broader implications. Other pacts between criminal organizations, including the 2012 truce in El Salvador, also reduced competition between gangs and the same mechanisms are likely important for understanding their effects. Furthermore, other distribution firms were likely also affected by an increase in extortion. Our results suggest a similar increase in prices for pharmaceutical drugs supplied by other distributors, implying that other distributors were similarly affected by the pact.

Extortion is present in many countries and there is a need to develop policies that target the root causes of extortion. We argue that considering the market structure for extortion is important for understanding extortion rates and the downstream consequences. Our model

[56]For example, in a public opinion survey conducted in El Salvador, 47% of Salvadorans said that the 2012 truce mainly benefited the gangs while only 16% said it benefited the general population (Cawley 2013b).

and findings also suggest that goods with inelastic demand, such as staple products, are more likely to be impacted by extortion, and protecting these goods from extortion could reduce gang profits and the incentives to compete for territory. Overall, these results show how insights from industrial organization can inform our understanding of criminal organizations and extortion.

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Online Appendix

A Extortion Logistics in El Salvador

Extortion is a complex activity that requires gangs to continually identify potential victims and collect extortion while evading authorities and credibly threatening violence or other repercussions if victims do not pay. In El Salvador, gangs rely on their extensive territorial control – often of whole urban neighborhoods – and an extensive network of collaborators and informants, to identify victims and continually collect extortion payments (Dudley et al. 2018; Global Initiative Against Transnational Organized Crime 2019). Given that extortion is a key revenue source sustaining gang members, their families, and their collaborators, extortion plans are carefully arranged and executed.[57] This often implies that gangs have to invest in a "relationship" with their victims, so they can maintain future extortion payments (Ponce 2021). Since "[v]ictims assess the seriousness of the threat at every contact to determine if it is safe to report the crime or not," the relegation of an extortion process to collaborators can, at best, mean lower extortion revenue, and at worst, the filing of a police complaint (Ponce 2021). For these reasons, collecting extortion is not a trivial task and can require a significant number of gang members and expertise.

After a gang identifies a potential victim, its members or collaborators often gather information on them that might become useful. An extortion demand is often coupled with threats meant to not only scare the potential victim, but also make it clear that they have no other option but to cede to it, or risk significant material damage or physical violence (Neu 2019). The wholesale distributor that is the focus of this paper uses trucks that do not identify the name of the company in order to try to have some anonymity. However, the company told us that certain gang cliques implied they knew where they had their warehouse and could inflict material damage if they did not agree to extortion demands.

It is useful to consider victim statements in court to illustrate a typical extortion incident. The following victim account is from an extortion-related sentence given in the First Court of Sentencing in San Salvador:

[57]Since extortion has become a part of daily life in countless neighborhoods in El Salvador, it has also lead to numerous copycats in which opportunistic individuals, usually non-gang members, imitate the gangs' extortion tactics (Global Initiative Against Transnational Organized Crime 2019). However, this is often less successful than extortion by gangs.

> "At approximately 5:28pm, [the victim] received WhatsApp messages through which a person wrote that they had to deliver the amount of seventy five dollars, for Wednesday, April 4 of the year two thousand and eighteen, otherwise they would receive their two children in black bags and that they should not dare to report what was happening to the police, because if they did, the victim would also appear bagged like their children, telling them in the messages that he knew where the victim worked, where their children studied and all the information of their relatives and that they had no way of escaping from them [*sic*]."[58]

The more information gangs have on their potential victims, coupled with their territorial control, the more credible the threat of repercussions if they fail to pay. Likewise, repeated interaction with and threats toward their victims can ensure greater on-time payment and higher extortion payments.

B Supporting Data Sources

B-1 Household Surveys

From DIGESTYC, we obtained the microdata for the annual household surveys (EHPM) administered between 2014 and 2018. Each year, DIGESTYC surveys around 15 thousand households. The surveys include a comprehensive set of questions related to demographic and socioeconomic household characteristics. To measure possible changes in demand, we analyze the information on household income and expenditure per capita. These variables draw from individual-level questions on income and expenditures, and are aggregated to the household level by DIGESTYC.

B-2 Crime Reports

The homicide data described in Section 2.3.1 ends in early 2017. We complement it with data from "scene of the crime" reports collected by the PNC from 2017 to 2019. These reports on homicides differ slightly from the homicide data described in Section 2.3.1, as the former is recorded as an event happens and the latter is an *ex-post* recollection.[59] Aside from this reporting difference, there are no major differences in the data sources: both collect the same variables, including date, time, geographic location, and potential gang involvement.

[58]The original text comes from sentence 238-3-2018 from the First Court of Sentence in San Salvador available through El Salvador's Judicial Documentation Center (accessed on July 13, 2021).

[59]Our results hold just using homicide data prior to 2017.

From the PNC, we also obtained event data on other crimes, including theft, robberies, and domestic violence. These data cover the decade from 2010 to 2017 and detail the date and municipality of occurrence.

B-3 Pharmacy Sales

From the National Directorate of Medicines (DNM), we obtained sales data from pharmacies. There are over 10,000 unique products, defined as a specific molecule-brand-size. Since different size pill packs for the same drug are defined as separate products, we standardize quantity by dividing by the number of pills per pack (or number of milliliters or grams). Drug products are then defined as a molecule-brand. Products that cannot be standardized, constituting 29 percent of the sample, are removed. While the government aimed to collect data from all pharmacies, there were some pharmacies for which the government was not able to obtain data. According to conversations with DNM, these tend to be small or niche pharmacies.

C Model Details

In this section, we provide additional details on the model and derivation of equilibrium violence, extortion, and downstream prices under competition and collusion. We also discuss the incentives for gangs to collude.

The downstream firm chooses its price (or output quantity) to maximize profit, $\tilde{\pi}_{gd}$, after gang g commits to an extortion rate e_{gd} in municipality d. Demand for the good being extorted is given by $Q_d(p_d) = \alpha_d - \beta p_d$. To ensure that the equilibrium behaves properly, we assume $\beta > 0$ and $\frac{1}{2} \leq (\frac{\alpha_d}{12})^2 \leq 1$. The first-order condition for the firm, $\frac{\partial \tilde{\pi}_{gd}}{\partial p_{gd}} = 0$, implies

$$p^*_{gd}(e_{gd}) = \frac{1}{2\beta}(\alpha + \beta e_{gd}), \quad q^*_{gd}(e_{gd}) = \frac{1}{2}(\alpha - \beta e_{gd}). \tag{A-1}$$

Gangs set the violence level, h_{gd}, and the extortion rate, e_{gd}, to maximize profit. Following Maskin and Tirole (1988), we assume they play an alternating-moves game, i.e. one gang chooses extortion and violence in odd periods and the other gang chooses in even periods. The sequential timing may reflect lags in information or implementation.[60] The sequential timing assumption makes the model tractable but is not essential—simultaneous timing would yield similar conclusions in this setting.

[60] Maskin and Tirole (1988) also offer additional justifications for the timing assumption.

Territory share controlled by gang g is given by $s_{gd} = h_{gd}^{1/2}$ in periods in which gang g moves. In periods in which the rival gang moves (defensive periods), territory share is given by $s_{gd} = 1 - s_{-gd}$ for $s_{-gd} \geq 1/2$, where s_{-gd} is the territory acquired by the rival gang. The assumptions that $\frac{1}{2} \leq (\frac{\alpha}{12})^2 \leq 1$ ensures that $\frac{1}{2} \leq s_{gd} \leq 1$. In periods in which a rival gang moves, a gang maintains its previous extortion level. A gang that controls territory share s_{gd} of the municipality at time t can apply extortion to all goods sold in that portion of the territory. We assume the downstream firm may charge different prices, p_{gd}, in territory controlled by different gangs depending on the extortion rate. Quantity sold in the territory controlled by gang g is given by $q_{gd} = s_{gd}Q(p_{gd})$.

Gang cost is given by $\phi h_{gd} e_{gd}$ where $0 < \phi < 1$. Gang profits are determined by extortion revenue in their territory, $s_{gd} e_{gd} q_{gd}(e_{gd})$, minus cost. In general, gangs wish to choose the vector of violence, $\mathbf{h}_{gd}$, and extortion, $\mathbf{e}_{gd}$, in the periods in which they move in order to maximize discounted profit over an infinite horizon given by

$$\max_{\mathbf{h}_{gd}, \mathbf{e}_{gd}} \sum_{t=1}^{\infty} \delta^{t-1} \left[\frac{1}{2} h_{gd}^{1/2} e_{gdt}(\alpha - \beta e_{gdt}) - \phi h_{gdt} e_{gdt} \right]. \tag{A-2}$$

where t indexes time. Given a fixed cost of entry, F, for gangs to operate in a municipality, we can now solve for three cases.

One Gang (Monopoly)

If variable profit is π_{gd}^{NC} when two gangs compete (under the non-cooperative equilibrium) in a municipality and π_{gd}^{M} when there is only one gang, then a second gang will not wish to enter in a territory when $\pi_{gd}^{NC} - \pi_{gd}^{M} < F$. In this case, a monopolist gang will charge extortion rate $\frac{\alpha_d}{2\beta}$. Downstream prices are $\frac{3\alpha_d}{4\beta}$ with extortion and $\frac{\alpha_d}{2\beta}$ without. Therefore, $\pi_{gd}^{M} = \frac{\alpha_d^2}{8\beta}$. Given π_{gd}^{NC} below, this implies there is threshold α_d^c such that $\pi_{gd}^{NC} - \pi_{gd}^{M} < F$ for $\alpha_d < \alpha_d^c$.

Non-Collusive Equilibrium with Two Gangs

Now consider the case in which $\pi_{gd}^{NC} - \pi_{gd}^{M} > F$, so there are two gangs that can profitable enter a municipality. We start by examining the case in which the two gangs compete. In a period in which a gang chooses violence and extortion, non-collusive profits are $\pi_{gd}^{NC} = (1/2) h_{gd}^{1/2} e_{gd}(\alpha_d - \beta e_{gd}) - \phi h_{gd} e_{gd}$. The first-order conditions, $\frac{\partial \pi_{gd}^{NC}}{\partial h_{gd}} = 0$ and $\frac{\partial \pi_{gd}^{NC}}{\partial e_{gd}} = 0$, imply

$$h_{gd}^{NC} = \left(\frac{\alpha_d}{6\phi} \right)^2, \quad e_{gd}^{NC} = \frac{\alpha_d}{3\beta}, \quad p_{gd}^{NC} = \frac{2\alpha_d}{3\beta}. \tag{A-3}$$

When a gang is on the offensive, they use violence to expand their territory and obtain territory share $\alpha_d/(6\phi)$. In the next period, their rival takes it back. This results in gang profits of $\pi^O_{gd} = \alpha_d^3/(108\phi\beta)$ when a gang is on the offensive and $\pi^D_{gd} = (\alpha_d^3 - 36\alpha_d\phi^2)/(108\phi\beta)$ when on the defensive. Average profits for each gang is then $\frac{1}{2}(\pi^O_{gd} + \pi^D_{gd})$. Relative to the case with no gangs, extortion increases downstream prices by $\alpha_d/(6\beta)$.

Collusive Equilibrium with Two Gangs

If identical gangs collude and maximize joint profit then they split the market in each municipality ($s_{gd} = \frac{1}{2}$), which we assume can be maintained without costly violence. Collusive profits for gang g are given by

$$\pi^C_{gd} = \frac{1}{4} e_{gd}(\alpha - \beta e_{gd}). \tag{A-4}$$

The first-order condition, $\frac{\partial \pi^C_{gd}}{\partial e_{gd}} = 0$, implies $e^C_{gd} = \frac{\alpha_d}{2\beta}$, the same as the case with a monopolist gang. This results in gang profits of $\frac{\alpha_d^2}{16\beta}$, higher than the case when gangs compete.

When do gangs have an incentive to collude? Assume that gangs sustain tacit collusion by punishing a deviation from the collusive equilibrium using a infinite reversion to the competitive equilibrium.[61] A gang has an incentive to collude if the discounted sum of profits from colluding are greater than the profit from deviating and increasing territory, then reverting to the equilibrium of the stage game:[62]

$$\sum_{t=1}^{\infty} \delta^{t-1} \widetilde{\pi}^C_{gdt} \geq \sum_{t=1,3,\ldots}^{\infty} \delta^{t-1} \pi^O_{gdt} + \sum_{t=2,4,\ldots}^{\infty} \delta^{t-1} \pi^D_{gdt}. \tag{A-5}$$

It is helpful to define the critical discount factor, $\frac{\alpha_d(8\alpha_d - 27\phi)}{8\alpha_d^2 - 27\phi\alpha_d + 288\phi^2}$, for which the above inequality holds. This is often used as a measure of the ease of collusion (e.g., Friedman 1971). As can be seen by the critical discount factor, relatively inelastic demand (higher α) increases the minimum discount rate that can sustain collusion. Conversely, an increase in ϕ decreases the critical discount factor, implying that policing can facilitate collusion.

Finally, we note that a feature of the model is double-marginalization, a coordination failure that arises in vertical markets when a downstream firm and upstream firm have market power and set margins independently (Spengler 1950). Double marginalization implies that downstream prices are higher than what would be set by gangs if they set prices directly. Consequently, double marginalization induces deadweight loss from extortion, especially

[61] Although we focus on tacit collusion here, we note that collusion is explicit if firms exchange information or communicate an agreement to play a tacitly collusive equilibrium, which is the case in our empirical setting.

[62] Without loss of generality, assume gang g moves in odd periods.

when gangs collude. Without extortion, deadweight loss is $\frac{\alpha_d^2}{8\beta}$. Under gang competition and collusion, deadweight loss is $\frac{2\alpha_d^2}{9\beta}$ and $\frac{9\alpha_d^2}{32\beta}$ respectively. It is well known that double-marginalization can be eliminated using non-linear pricing, however the literature has identified a number of reasons why non-linear pricing may be difficult in practice. The gang could theoretically charge a single annual fixed fee equal to the downstream firm's profit, $\frac{\alpha_d^2}{4\beta}$, rather then charge extortion in each territory, however this is not seen in practice.

D Additional Figures and Tables

Figure A-1
Example Routes, Deliveries, & Extortion Payments on a Single Day

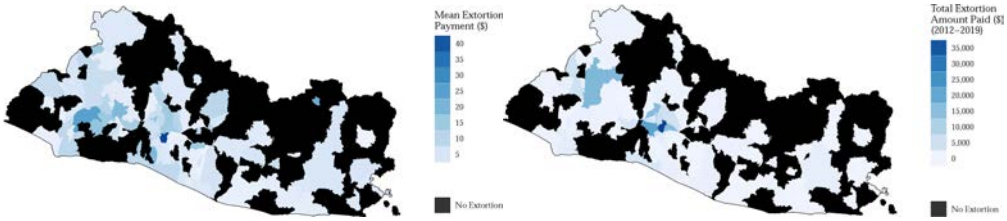
Notes: Map shows example of all truck routes, deliveries to retailers, and extortion payments to gangs on a single day in December, 2016.

Table A-1
Relationship between Extortion & Delivery Values

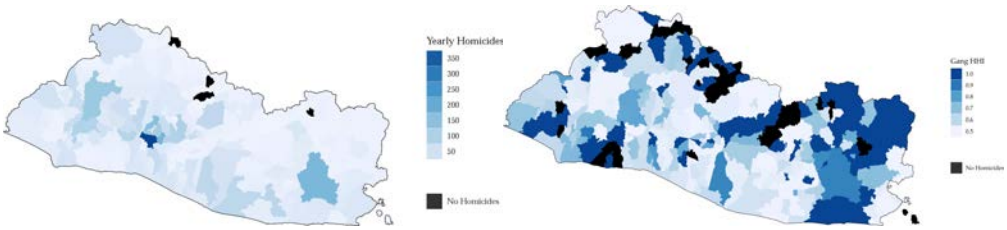
	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)
log(Value of Delivery)	0.040**	0.023**	0.014*	0.022***
	(0.017)	(0.011)	(0.008)	(0.006)
Municipality FEs	No	Yes	Yes	Yes
Route FEs	No	No	Yes	Yes
Retailer FEs	No	No	No	Yes
Outcome Mean	1.66	1.66	1.66	1.65
Adjusted R2	0.0013	0.1889	0.3630	0.5444
Observations	62,798	62,787	62,783	59,965
Clusters	119	119	115	113

Notes: The unit of observation is a delivery on a route. Standard errors clustered at the route level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A-2
Extortion, Homicides, and Gang Competition Across Municipalities



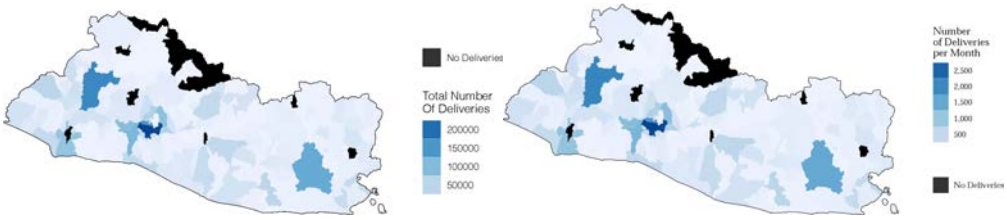
a. Average Extortion Payment b. Total Extortion



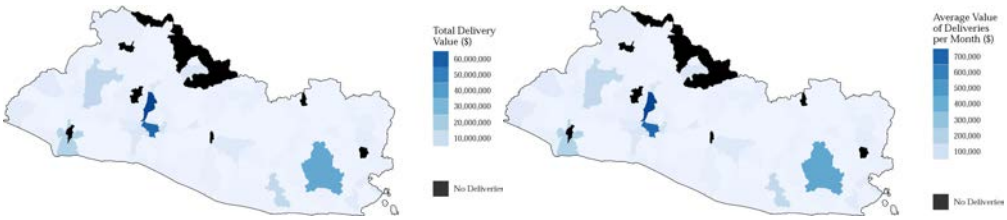
c. Yearly Homicides d. Gang HHI

Notes: Gang HHI defined using MS-13 and Barrio-18 homicides.

Figure A-3
Delivery Frequencies and Values Across Municipalities



a. Number of Deliveries b. Deliveries Per Month



c. Total Delivery Value d. Monthly Delivery Value

Notes: Data is from 2012-2019.

Table A-2
Falsification Test Examining Effect of Non-Aggression Pact on Cost
in Municipalities with Gang Competition

	log(Cost)	log(Cost)	log(Cost)
$NonAggr_t \times Comp_d$	0.026	0.020	0.010
	(0.021)	(0.017)	(0.011)
Municipality FEs	Yes	Yes	Yes
Retailer FEs	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes
Product FEs	No	No	Yes
Covariates	No	Yes	Yes
Outcome Mean	1.24	1.24	1.24
Adjusted R2	0.636	0.636	0.833
Observations	10,241,127	10,241,127	10,240,911

Notes: The unit of observation is a delivery. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Cost is defined as the amount paid by the distributor to source the delivered products. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-3
Effect of Non-Aggression Pact on Crime
in Municipalities with Gang Competition

	Gang Homicides		Theft		Robbery		Domestic Violence	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$NonAggr_t \times Comp_d$	-0.339^{**}	-0.293^{**}	-0.159	-0.150	-0.026	-0.122	0.150	0.313
	(0.142)	(0.124)	(0.375)	(0.289)	(0.277)	(0.251)	(0.639)	(0.577)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes	No	Yes
Outcome Mean	0.86	0.86	0.38	0.38	0.28	0.28	0.17	0.17
Observations	3,872	3,872	3,534	3,534	3,441	3,441	3,472	3,472

Notes: Results from Poisson regressions. The unit of observation is a municipality-month. Gang homicides includes the sample of homicides in which MS-13 or Barrio 18 was a perpetrator or victim. The sample period is 6/2015 to 1/2018. Controls include nightlights, population density, and census municipality characteristics interacted with year. Municipalities in which the outcome is zero for all periods are dropped. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-4
Effect of Non-Aggression Pact on Homicides
Alternative Periods for Defining Competition

	HHI Defined 1–4 Years Prior		HHI Defined 1–6 Years Prior	
	(1)	(2)	(3)	(4)
$\text{NonAggr}_t \times \text{Comp}_d$	-0.315^{**}	-0.233^{*}	-0.311^{**}	-0.254^{*}
	(0.149)	(0.132)	(0.148)	(0.130)
Municipality FEs	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes
Outcome Mean	0.94	0.94	0.89	0.89
Observations	3,391	3,391	3,679	3,679

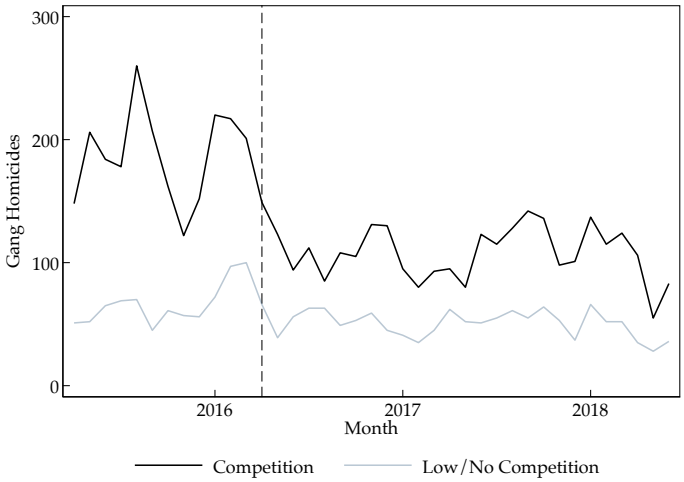
Notes: Results from Poisson regressions. The unit of observation is a municipality-month. Outcome is number of homicides in which MS-13 or Barrio 18 was a perpetrator or victim. The first two columns define the gang HHI measure using homicides over 4/1/2012 to 4/1/2015 while the last two columns use 4/1/2010 to 4/1/2015. Controls include nightlights, population density, and census municipality characteristics interacted with year. Municipalities in which the outcome is zero for all periods are dropped. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-5
Effect of Non-Aggression Pact on Extensive Margin of Extortion

	Panel A: Outcome: Has Extortion					
	(1)	(2)	(3)	(4)	(5)	(6)
$NonAggr_t \times Comp_d$	0.019	0.018	0.018	0.017	0.016	0.031
	(0.018)	(0.030)	(0.018)	(0.018)	(0.018)	(0.025)
Municipality FEs	Yes	Yes	Yes	Yes	No	No
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Route FEs	No	Yes	No	Yes	No	No
Municipality-Route FEs	No	No	No	No	Yes	Yes
Route-$NonAggr_t$ FEs	No	No	No	No	No	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
Outcome Mean	0.18	0.18	0.18	0.18	0.18	0.18
Observations	12,847	12,847	12,847	12,847	12,847	12,847
	Panel B: Outcome: Number of Extortion Payments					
	(1)	(2)	(3)	(4)	(5)	(6)
$NonAggr_t \times Comp_d$	0.772***	0.254	0.636***	0.322*	0.228	0.376
	(0.255)	(0.170)	(0.231)	(0.175)	(0.145)	(0.238)
Municipality FEs	Yes	Yes	Yes	Yes	No	No
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Route FEs	No	Yes	No	Yes	No	No
Municipality-Route FEs	No	No	No	No	Yes	Yes
Route-$NonAggr_t$ FEs	No	No	No	No	No	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
Outcome Mean	1.17	1.17	1.17	1.17	1.17	1.17
Observations	12,818	12,847	12,818	12,847	12,528	12,528

Notes: The unit of observation is a route-municipality-month. The outcome variable in Panel A is an indicator variable equal to one if a route-municipality-month paid any extortion, and zero otherwise. The outcome variable in Panel B is the number of extortion payments made in a route-municipality-month. Results are estimated using Poisson regressions. Covariates include nightlights, population density, and census municipality characteristics interacted with year. All regressions control for the total number of deliveries and the total value delivered by the distributor firm in a given route-municipality-month. The sample period is 6/2015 to 1/2018. The sample is a balanced panel comprised of all municipality-routes ever visited by the firm during the sample period. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A-4
Gang Homicides by Competition Prior to Non-Aggression Pact



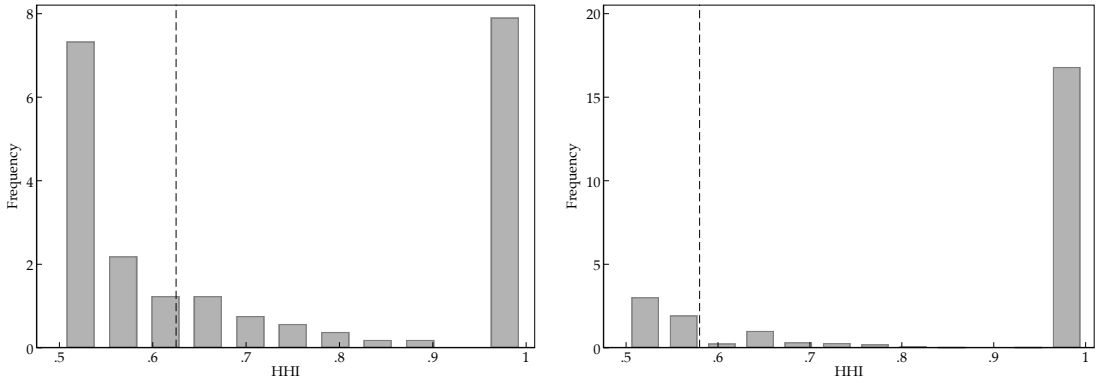
Notes: Charts show homicides in which gangs were victims or perpetrators in municipalities with gang competition and without gang competition as defined by the homicide Herfindahl–Hirschman Index. Vertical line shows start of non-aggression pact (April 2016).

Table A-6
Effect of Non-Aggression Pact on Extortion
Aggregated Effect

	Outcome: log(Total Extortion+1)					
	(1)	(2)	(3)	(4)	(5)	(6)
$NonAggr_t \times Comp_d$	0.105*	0.101*	0.103***	0.099***	0.097***	0.090*
	(0.054)	(0.053)	(0.034)	(0.034)	(0.034)	(0.052)
Municipality FEs	Yes	Yes	Yes	Yes	No	No
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Route FEs	No	Yes	No	Yes	No	No
Municipality-Route FEs	No	No	No	No	Yes	Yes
Route-$NonAggr_t$ FEs	No	No	No	No	No	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
Outcome Mean	0.58	0.58	0.58	0.58	0.58	0.58
Adjusted R2	0.318	0.382	0.639	0.663	0.709	0.722
Observations	12,847	12,847	12,847	12,847	12,847	12,847

Notes: The unit of observation is a route-municipality-month. The outcome variable in the top panel is the total amount of extortion paid in a route-municipality-month in dollars. The outcome variable is the log of the total amount of extortion paid in a route-municipality-month in dollars plus one. All regressions control for the total number of deliveries and the total value delivered by the distributor firm in a given route-municipality-month. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. The sample is a balanced panel comprised of all municipality-routes ever visited by the firm during the sample period. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

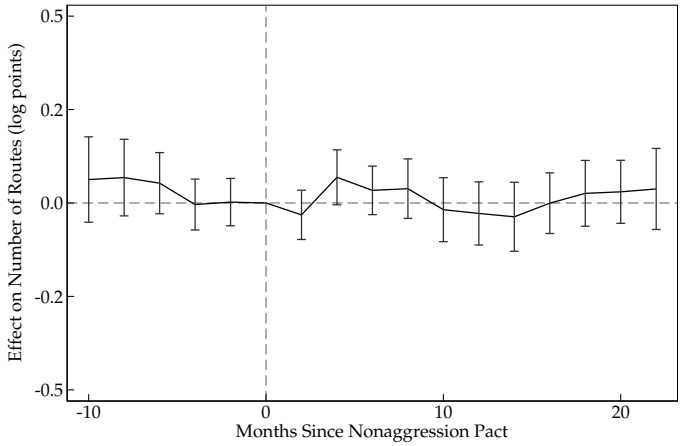
Figure A-5
Histogram of Homicide HHI prior to Non-Aggression Pact



a. Municipality level b. Canton level

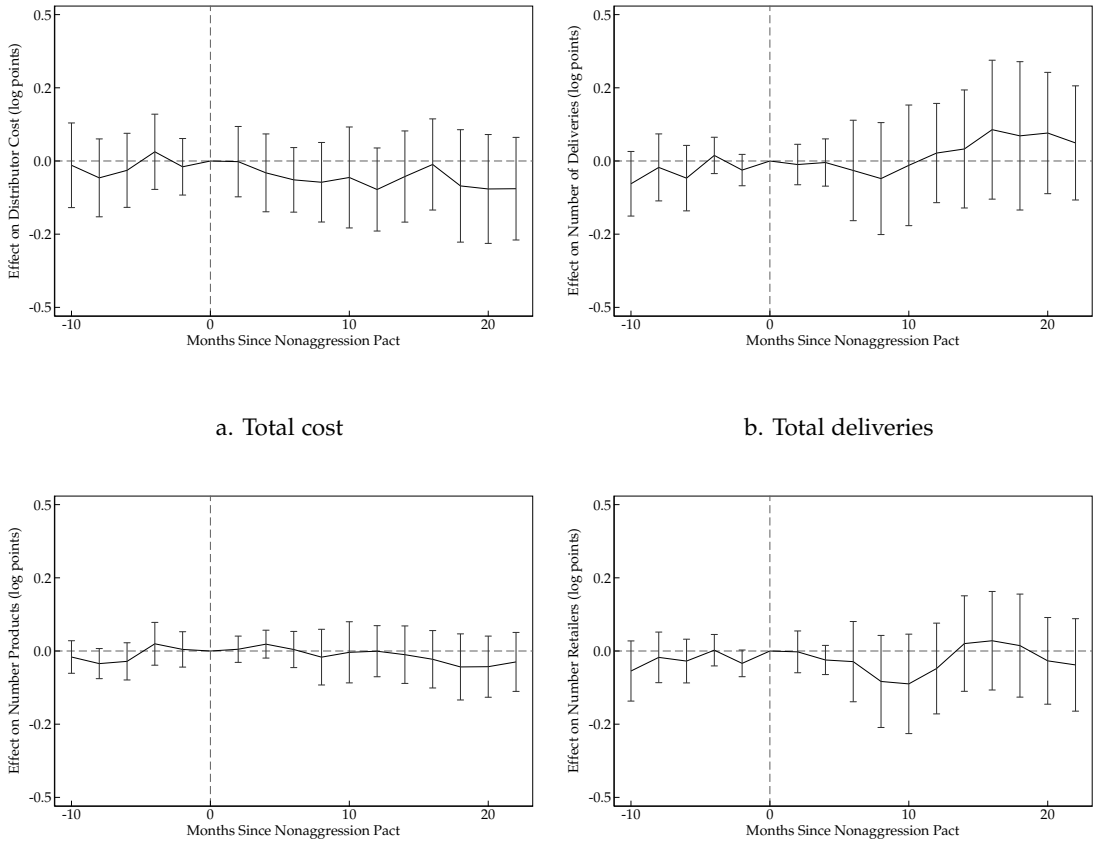
Notes: Vertical line shows preferred cutoff for defining areas with competition.

Figure A-6
Impact of Non-Aggression Pact on Number of Delivery Routes



Notes: Vertical line shows start of non-aggression pact (April 2016). Shows bimonthly point estimates from a Poisson regression using the difference-in-difference specification with number of routes in a municipality-month as the outcome. Specification includes month fixed effects and municipality fixed effects. The period prior to the start of the non-aggression pact is omitted. Error bars indicate 95% confidence intervals using standard errors clustered at the municipality level.

Figure A-7
Impact of Non-Aggression Pact on Sales



a. Total cost

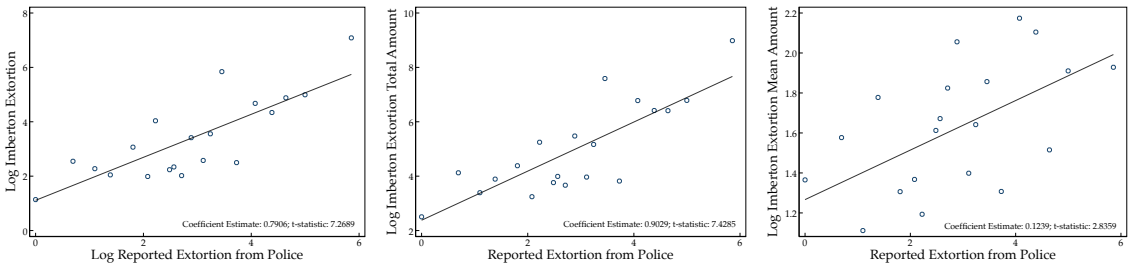
b. Total deliveries

c. Unique products

d. Unique retailers

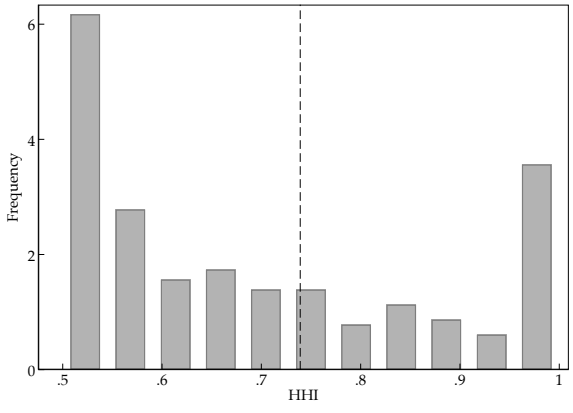
Notes: Vertical line shows start of non-aggression pact (April 2016). Panel a. and b. show bimonthly point estimates from the difference-in-difference specification with log total cost and log total trips by municipality-route-month as the outcome. Panel c. and d. show the results with the number of products and number of retailers by municipality-route-month as the outcome. Specification includes month fixed effects and municipality-route fixed effects. The period prior to the start of the non-aggression pact is omitted. Estimates from OLS regression for cost and deliveries and Poisson regression for count outcomes. Error bars indicate 95% confidence intervals using standard errors clustered at the municipality level.

Figure A-8
Municipality Level Correlation between Extortion Reported by
Delivery Firm and Extortion Reported to Police



a. Frequency b. Total Amount c. Mean Amount

Figure A-9
Histogram of Inmate HHI prior to Non-Aggression Pact



Notes: Vertical line shows top quartile, the baseline cutoff used for defining areas with competition with the homicide HHI.

Figure A-10
Municipality Level Correlation between Homicide HHI and Inmate HHI

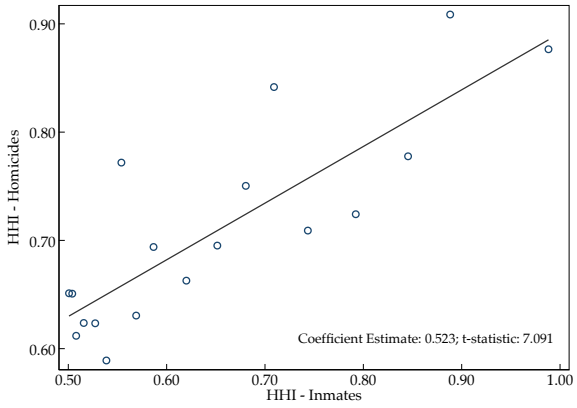
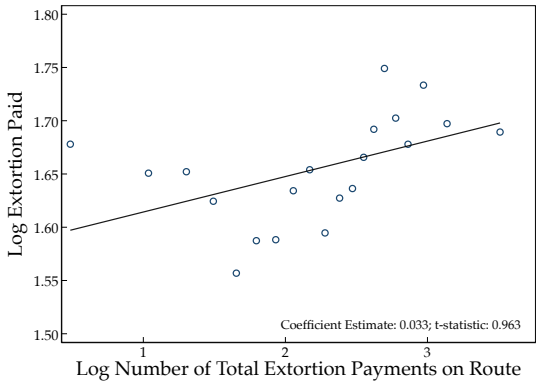
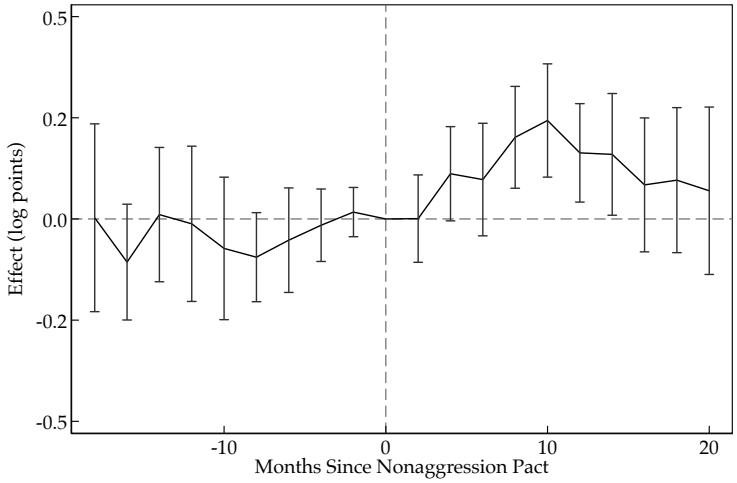


Figure A-11
Relationship Between Extortion Rates and Number of Extortion Payments



Notes: The figure presents binscatters between the log of the extortion amount paid by the firm upon delivery and the log number of extortion payments made on a route on the same day. The unit of observation is an extortion payment-delivery pair. The regressions include route fixed effects. The bottom-right of each figure presents the estimated coefficient and t-statistic. Standard errors are clustered at the delivery route level.

Figure A-12
Impact of Non-Aggression Pact on Extortion
Alternative Sample



Notes: Figure uses the same specification as Figure 6 but uses a longer sample. In particular, we use data for the period September 2014 to May 2015. Note that in June 2015, the distributor changed how extortion was recorded and started validating extortion payments. As in Figure 6, specification includes month fixed effects, municipality fixed effects, and covariates. The omitted period is the period prior to the start of the non-aggression pact between MS-13 and Barrio 18. Error bars indicate 95% confidence intervals using standard errors clustered at the municipality level.

Table A-7
Effect of Non-Aggression Pact on Criminal Cases Related to
Deprivation of Liberty and Kidnapping

	Combined		Kidnapping		Deprivation of liberty	
	Cases	Cases	Cases	Cases	Cases	Cases
$\text{NonAggr}_t \times \text{Comp}_d$	0.112*	0.086	1.492*	2.009*	0.098	0.073
	(0.065)	(0.064)	(0.827)	(1.186)	(0.062)	(0.062)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes
Outcome Mean	1.51	1.51	0.01	0.01	1.50	1.50
Observations	4,526	4,526	621	621	4,526	4,526
Clusters	146	146	27	27	146	146

Notes: Results from Poisson regressions in which the outcome is the number of criminal cases commenced in a municipality-month. The counts only include consummated crimes, not conspiracy to or attempted crimes. Covariates include nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-8
Effect of Non-Aggression Pact on Price Discrimination by Gangs

	log(Extortion)	log(Extortion)	log(Extortion)
$NonAggr_t \times Comp_d$	0.090	0.124	0.304***
	(0.103)	(0.088)	(0.088)
$NonAggr_t \times Comp_d \times Value_r$	0.125**	0.129**	0.129***
	(0.058)	(0.054)	(0.036)
Municipality FEs	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes
Route FEs	No	No	Yes
Covariates	No	Yes	Yes
Outcome Mean	1.59	1.59	1.59
Adjusted R2	0.283	0.290	0.380
Observations	36,810	36,810	36,807

Notes: The unit of observation is an extortion payment. $Value_r$ is the value of deliveries for retailer r in \$1,000s. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-9
Effect of Non-Aggression Pact on Time between Extortion Payments

	Delivery Time	Delivery Time	Delivery Time
$NonAggr_t \times Comp_d$	6.868	7.816**	7.444***
	(4.891)	(3.661)	(2.717)
Municipality FEs	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes
Route FEs	No	No	Yes
Covariates	No	Yes	Yes
Outcome Mean	59.91	59.91	59.91
Adjusted R2	0.108	0.111	0.122
Observations	7,785	7,785	7,781

Notes: The unit of observation is an extortion payment. The dependent variable is the time between extortion payments in minutes as recorded by the wholesaler. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-10
Effect of Non-Aggression Pact on Extortion
Alternative Specifications

	Municipalities without Homicides Homicides in Control		Control for Policing Initiative (PESS)	
	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)
$NonAggr_t \times Comp_d$	0.208***	0.180***	0.204***	0.169**
	(0.043)	(0.062)	(0.048)	(0.064)
$PESS_{dt}$			−0.023	−0.065**
			(0.034)	(0.031)
Municipality FEs	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes
Outcome Mean	1.58	1.58	1.60	1.60
Adjusted R2	0.212	0.214	0.188	0.191
Observations	15,740	15,740	15,001	15,001

Notes: The unit of observation is an extortion payment. First two columns include municipalities without gang homicides in the control group (municipalities without competition). Second two columns include an indicator for the start of the increase in enforcement in a municipality due to PESS (Plan Secure El Salvador). Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-11
Effect of Non-Aggression Pact on Extortion
in Municipalities with Gang Competition
Specifications with Alternative Cutoffs for Defining Competition

	50^{th} Percentile		60^{th} Percentile		70^{th} Percentile		80^{th} Percentile	
	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)	log(Extortion)
$NonAggr_t \times Comp_d$	0.191***	0.171***	0.199***	0.192***	0.209***	0.192***	0.231***	0.237***
	(0.053)	(0.063)	(0.050)	(0.067)	(0.048)	(0.065)	(0.037)	(0.053)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes	No	Yes
Outcome Mean	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Adjusted R2	0.188	0.190	0.188	0.191	0.188	0.191	0.188	0.191
Observations	15,001	15,001	15,001	15,001	15,001	15,001	15,001	15,001

Notes: The unit of observation is an extortion payment. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-12
Effect of Non-Aggression Pact on Extortion in Municipalities with Gang Competition
Alternative Specification with Continuous Measure of Competition

	log(Extortion)	log(Extortion)	log(Extortion)
$NonAggr_t \times HHI_d$	-1.033^{***}	-0.969^{**}	-0.605^{**}
	(0.261)	(0.369)	(0.282)
Municipality FEs	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes
Covariates	No	Yes	Yes
Route FEs	No	No	Yes
Outcome Mean	1.60	1.60	1.60
Adjusted R2	0.188	0.191	0.271
Observations	15,001	15,001	15,001

Notes: The unit of observation is an extortion payment. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-13
Effect of Non-Aggression Pact on Development and Population

	Nightlights	log(Nightlights)	Pop Density	log(Pop Density)
$NonAggr_t \times Comp_d$	0.003	-0.030	-0.048	-0.003
	(0.053)	(0.020)	(0.101)	(0.007)
Municipality FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes
Outcome Mean	1.32	-0.41	6.21	1.08
Adjusted R2	0.99	0.99	1.00	1.00
Observations	740	740	740	740
Clusters	148	148	148	148

Notes: The unit of observation is a municipality-year. Covariates include census municipality characteristics interacted with year. The sample period is 2014 to 2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-14
Effect of Non-Aggression Pact on Household Income and Expenditure

	Household Income	Income Per Capita	Household Expenditure	Expenditure Per Capita
$NonAggr_t \times Comp_d$	4.337	3.408	1.075	0.366
	(9.190)	(3.169)	(5.683)	(1.719)
Municipality FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes
Outcome Mean	514.77	159.98	349.28	109.27
Adjusted R2	0.06	0.06	0.13	0.12
Observations	88,255	88,255	88,255	88,255
Clusters	136	136	136	136

Notes: The unit of observation is a household-municipality-year. Covariates include census municipality characteristics interacted with year. The sample period is 2014 to 2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-15
Effect of Extortion on Distribution Margin by Distance to Nearest Sale
Instrumental Variable Difference-in-Difference Model

	Reduced-Form		First-Stage	IVDD	
	Distributor Margin	log(Margin)	Extortion	Distributor Margin	log(Margin)
Panel A. Sale within 1km					
$NonAggr_t \times Comp_d$	0.639**	0.130**	2.998***		
	(0.237)	(0.055)	(0.780)		
Extortion				0.213***	0.045***
				(0.067)	(0.012)
Outcome Mean	3.81	0.99	8.21	3.81	0.99
Adjusted R2	0.465	0.444	0.589		
F-Stat				65.8	60.0
Observations	40,945	40,447	40,945	40,945	40,447
Panel B. Sale within 5km					
$NonAggr_t \times Comp_d$	0.237	0.051	1.488***		
	(0.277)	(0.061)	(0.390)		
Extortion				0.160***	0.034***
				(0.059)	(0.011)
Outcome Mean	3.76	0.99	8.63	3.76	0.99
Adjusted R2	0.492	0.439	0.284		
F-Stat				42.1	41.8
Observations	144,683	143,194	144,683	144,683	143,194

Notes: Distributor margin is defined as the difference between wholesale price and manufacturer price. All specifications include municipality fixed effects, month fixed effects, retailer fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-16
Effect of Extortion on Distribution Margin
Instrumental Variable Difference-in-Difference Model
Controlling for Homicides

	Reduced-Form		First-Stage	IVDD	
	Distributor Margin	log(Margin)	Extortion	Distributor Margin	log(Margin)
Panel A. Nearest Sale					
$NonAggr_t \times Comp_d$	1.371*	0.118**	1.640**		
	(0.718)	(0.055)	(0.629)		
Extortion				0.836***	0.072***
				(0.245)	(0.023)
Outcome Mean	4.17	1.03	7.41	4.17	1.03
Adjusted R2	0.566	0.443	0.464		
F-Stat				22.5	22.5
Observations	34,963	34,571	34,963	34,963	34,571
Panel B. Sale within 1km					
$NonAggr_t \times Comp_d$	0.661***	0.131**	3.227***		
	(0.239)	(0.057)	(0.791)		
Extortion				0.205**	0.042*
				(0.089)	(0.022)
Outcome Mean	3.81	0.99	8.21	3.81	0.99
Adjusted R2	0.465	0.444	0.590		
F-Stat				16.6	15.9
Observations	40,945	40,447	40,945	40,945	40,447
Panel C. Sale within 5km					
$NonAggr_t \times Comp_d$	0.248	0.053	1.518***		
	(0.280)	(0.062)	(0.406)		
Extortion				0.163	0.035
				(0.186)	(0.041)
Outcome Mean	3.76	0.99	8.63	3.76	0.99
Adjusted R2	0.492	0.440	0.284		
F-Stat				14.0	14.2
Observations	144,683	143,194	144,683	144,683	143,194

Notes: Distributor margin is defined as the difference between wholesale price and manufacturer price. All specifications include municipality fixed effects, month fixed effects, retailer fixed effects, and controls for homicides, nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-17
Effect of Non-Aggression Pact on Distributor Pharmaceutical Margins

	log(Margin)	log(Margin)	log(Amount)	log(Amount)
$NonAggr_t \times Comp_d$	0.090	0.106	0.112	0.133
	(0.138)	(0.078)	(0.140)	(0.080)
Municipality FEs	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes
Retailer FEs	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes
Outcome Mean	1.60	1.60	3.47	3.47
Adjusted R2	0.419	0.421	0.473	0.474
Observations	629,112	629,112	639,151	639,151

Notes: Distributor margin is defined as the difference between wholesale price and manufacturer price. All specifications include municipality fixed effects, month fixed effects, retailer fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-18
Effect of Non-Aggression Pact on Consumer Prices at Pharmacies
By Drug Categories

	Diabetes Drugs		Hypertension Drugs		Coronary Drugs	
	log(Price)	log(Price)	log(Price)	log(Price)	log(Price)	log(Price)
$NonAggr_t \times Comp_d$	0.055**	0.057**	0.122**	0.108*	0.079**	0.074***
	(0.023)	(0.022)	(0.058)	(0.058)	(0.033)	(0.026)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Retailer FEs	No	Yes	No	Yes	No	Yes
Drug FEs	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Outcome Mean	-1.10	-1.10	-0.38	-0.38	-0.87	-0.87
Adjusted R2	0.877	0.882	0.778	0.807	0.770	0.791
Observations	56,820	56,820	23,169	23,163	53,863	53,861

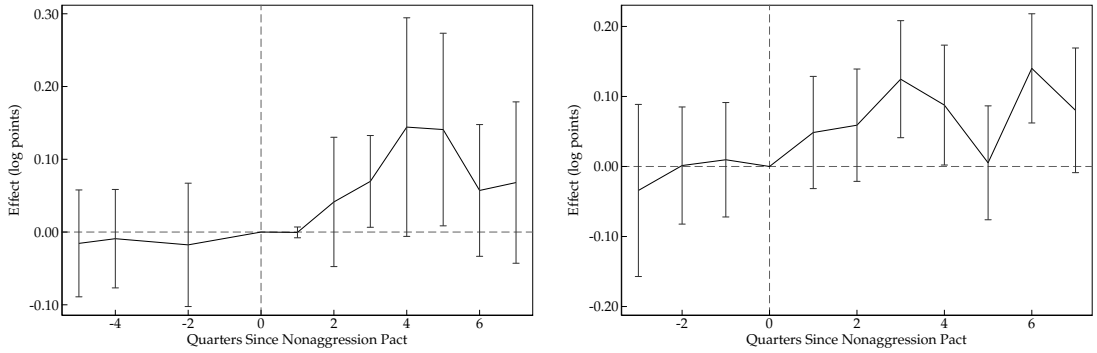
Notes: The unit of observation is a drug-pharmacy-month. For the period prior to January 2016, data is at the semi-annual level and the unit of observation is a drug-pharmacy-semi-year. The outcome is the price per unit (pill, milliliter, or gram depending on the product). Specifications include controls for nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-19
Effect of Non-Aggression Pact on Hospital Visits
Additional Diagnosis Categories

	Diabetes Diagnosis		Hypertension Diagnosis		Coronary Diagnosis	
	Visits	Visits	Visits	Visits	Visits	Visits
$\text{NonAggr}_t \times \text{Comp}_d$	0.117***	0.122***	0.030	0.018	0.077	0.092
	(0.032)	(0.030)	(0.057)	(0.054)	(0.074)	(0.065)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	No	Yes
Outcome Mean	1.72	1.72	4.69	4.69	1.34	1.34
Observations	4,588	4,588	4,588	4,588	4,557	4,557
Clusters	148	148	148	148	147	147

Notes: Results from Poisson regressions in which the outcome is the number of visits in a municipality-month. Covariates include nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A-13
Effect of Non-Aggression Pact on Drug Prices and Associated Visits
Dynamic Effects



a. Drug Prices

b. Hospital Visits

Notes: Shows point estimates for each period using the difference-in-difference model. Figure a. shows the effect on pharmaceutical prices. Figure b. shows the effect on hospital visits for chronic conditions affected by drug adherence. The omitted period is the quarter prior to the start of the non-aggression pact between MS-13 and Barrio 18. Standard errors are clustered at the municipality level. All specifications include municipality fixed effects, month fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year. Error bars indicate 95% confidence intervals using standard errors clustered at the municipality level.

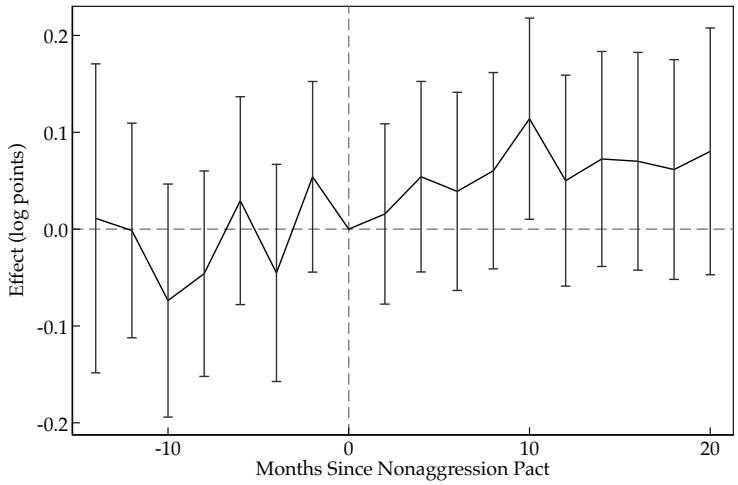
Table A-20
Effect of Non-Aggression Pact on the Number of Pharmacies in Municipalities with Gang Competition

	Total Number of Pharmacies	Number of Pharmacies that purchase from Distributor
$\text{NonAggr}_t \times \text{Comp}_d$	0.005	−0.024
	(0.012)	(0.038)
Municipality FEs	Yes	Yes
Year FEs	Yes	Yes
Covariates	Yes	Yes
Outcome Mean	13.81	6.62
Observations	3,540	2,201

Notes: Results from Poisson regressions where the unit of observation is a municipality-month. In first column, the outcome is the number of pharmacies that are operating in a municipality-month obtained from pharmacy registration data. In the second column, the outcome is the number of pharmacies in a municipality-month in the distributor sales data. All specifications control for nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E Canton Level Analysis of Non-Aggression Pact

Figure A-14
Impact of Non-Aggression Pact on Extortion
using Gang Competition Defined at Canton Level



Notes: Vertical line shows start of non-aggression pact (April 2016). Figure shows bimonthly point estimates using the difference-in-difference specification with log extortion amounts as the outcome using the treatment indicator defined at the canton level. Specification includes month fixed effects, municipality fixed effects, and covariates as in the baseline specification (2). The omitted period is the period prior to the start of the non-aggression pact between MS-13 and Barrio 18. Error bars indicate 95% confidence intervals using standard errors clustered at the canton level.

Table A-21
Effect of Non-Aggression Pact on Extortion
using Gang Competition Defined at Canton Level

	Outcome: log(Extortion)			
	(1)	(2)	(3)	(4)
$NonAggr_t \times Comp_d$	0.175**	0.154***	0.116	0.096*
	(0.076)	(0.051)	(0.079)	(0.051)
Canton FEs	Yes	Yes	Yes	Yes
Month-Year FEs	Yes	Yes	Yes	Yes
Route FEs	No	Yes	No	Yes
Covariates	No	No	Yes	Yes
Outcome Mean	1.68	1.68	1.68	1.68
Adjusted R2	0.193	0.315	0.223	0.333
Observations	13,486	13,484	13,486	13,484

Notes: The unit of observation is an extortion payment. Covariates include nightlights, population density, and census municipality characteristics interacted with year. The sample period is 6/2015 to 1/2018. Standard errors clustered at the municipality level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A-22
Effect of Extortion on Distribution Margin
Instrumental Variable Difference-in-Difference Model
using Gang Competition Defined at Canton Level

	Reduced-Form		First-Stage	IVDD	
	Distributor Margin	log(Margin)	Extortion	Distributor Margin	log(Margin)
			Nearest Sale		
$NonAggr_t \times Comp_d$	1.394*	0.154***	1.892***		
	(0.757)	(0.042)	(0.330)		
Extortion				0.737***	0.082***
				(0.189)	(0.020)
Outcome Mean	4.40	1.06	7.81	4.40	1.06
Adjusted R2	0.570	0.451	0.474		
F-Stat				31.1	31.1
Observations	27,750	27,750	27,750	27,750	27,750
			Sale within 1km		
$NonAggr_t \times Comp_d$	0.589***	0.076**	2.313***		
	(0.126)	(0.028)	(0.677)		
Extortion				0.255***	0.033***
				(0.073)	(0.011)
Outcome Mean	4.01	1.02	8.66	4.01	1.02
Adjusted R2	0.459	0.452	0.582		
F-Stat				57.3	57.3
Observations	37,753	37,753	37,753	37,753	37,753
			Sale within 5km		
$NonAggr_t \times Comp_d$	0.358**	0.064**	1.603***		
	(0.143)	(0.028)	(0.419)		
Extortion				0.224***	0.040***
				(0.053)	(0.009)
Outcome Mean	3.89	1.01	8.88	3.89	1.01
Adjusted R2	0.489	0.438	0.302		
F-Stat				56.8	56.8
Observations	136,333	136,333	136,333	136,333	136,333

Notes: Distributor margin is defined as the difference between wholesale price and manufacturer price. All specifications include municipality fixed effects, month fixed effects, retailer fixed effects, and controls for nightlights, population density, and census municipality characteristics interacted with year. Standard errors clustered at the route level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.