IS MURDER BAD FOR BUSINESS? EVIDENCE FROM COLOMBIA

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I. Introduction

VIOLENCE remains a development challenge today. Every year, approximately 11% of global GDP is spent on addressing and containing violence (Institute for Economics and Peace, 2013). More than 65% of these resources are spent in developing countries. Despite this investment, the poorest countries and regions often are the most violent, based on their homicide rates.1 Violent crime not only imposes direct costs on society through mortality, but also induces indirect economic costs by distorting workers’ and firms’ decisions. These distortions are reflected in market prices and market size. This paper explores the effects of violent crime on market prices and market size. For this purpose, I matched unique plant-level and rich consumer pricing data with homicide rates in Colombia. Except for the elasticities of aggregate production in relation to violent crime, these effects have not been previously identified.2 I also present a theoretical model, which, when combined with the empirical estimates, helps to explain the mechanisms driving the effects of violence on local markets. 

Based on firm data availability, I use Colombian annual data from 1995 to 2010 and focus on examining the effects of violent crime in urbanized areas to conduct my empirical analysis. Colombia offers an ideal setting to identify the effects of violent crime in local economic activity. In the early 1990s, it was the second-most violent country in the world. This violent period in the early 1990s was followed by a remarkable improvement in security conditions. The entire period of analysis is thus marked by substantial variation in violence over time and among municipalities across the country. This variation is ideal for identification purposes. Moreover, as a developing country, Colombia offers unique panel data on firms’ behavior and consumer prices.3 Consequently, the results of this study are useful for understanding the effects of violent crime in other developing countries with limited access to high-quality data.

To estimate the causal effects of violent crime, I use the large reductions in violence caused by increased security expenditures of the Democratic Security program under Alvaro Uribe’s presidential administration. High spending on security led to decreased violence in municipalities that voted for Uribe in the 2002 presidential election, when he was elected for the first time, as he was looking for reelection in 2006 (when he was reelected). According to most historical accounts, Uribe’s electoral platform prioritized improving security conditions in Colombia (BBC, 2004; Buitrago, 2006; Pachón, 2009). To do so, Uribe increased spending on military infrastructure, personnel, and intelligence (Presidencia, 2003; Ministerio de Defensa, 2009, 2010).

There is a strong temporal correlation between the beginning of the Uribe administration and an improvement in security conditions in Colombia. According to the Colombian Observatory of Human Rights, between 2002 and 2010, homicide rates fell by 48%, from 65.74 to 33.97 homicides per 100,000 inhabitants. Figures from the U.S. State Department show a similar trend, suggesting reductions of 83% in kidnappings and 76% in terrorist attacks between 2002 and 2010. Consequently, the variation I exploit comes from the fact that municipalities that voted for Uribe received more support to reduce violence relative to nonsupporters (as Uribe was looking for reelection) and thus show proportionally higher reductions in violence.

I find large effects of violent crime on a series of market prices, including wages, output, and input prices. I find that firms that face high violent crime have low output prices, low wages, and low input costs. My estimates suggest that when homicide rates increase by 1%, output prices fall by 1.14%, wages decrease by 1.10%, and input prices decrease by 0.44%. As firm output prices fall more proportionally to the prices of inputs and labor, firms reduce their average production and sometimes exit the market. Overall, when

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1 According to the Global Study on Homicide from the United Nations Office of Drugs and Crime, during 2012, South Africa and Central America had the highest homicide rates on record, averaging more than 25 victims per 100,000 inhabitants, followed by South America, Central Africa, and the Caribbean, averaging between 16 and 23 homicides per 100,000 inhabitants.

2 The only exceptions are Camacho and Rodriguez (2013), who study the effects of conflict on the probability of firm exit, and Rosenthal and Ross (2010), who study the effects of violent crime on firm location decisions. See online appendix III for a literature review of studies on the effects of violence on economic outcomes.

3 The firm data have been used previously by Kugler and Verhoogen (2012) to study the effects of firm size on output prices and by Fieler, Eslava, and Xu (2014) to develop a model of international trade with heterogeneous firms and endogenous quality choices.
violence increases by 1%, firm aggregate production falls by 0.39%.

Low output prices also are reflected in low living costs for workers in the local population. This finding is consistent with the behavior of food prices: when homicide rates increase by 1%, retail food prices decrease by 0.73%. However, workers’ low wages mean higher wage reductions than the reductions in their cost of living. Thus, real income decreases in areas with more violence. Consequently, areas with higher violent crime are also poorer, a condition that may fuel further social unrest and violence.

I combine my empirical estimates with a theoretical framework to understand the mechanisms through which violence affects local markets. The model presents an economy divided into municipalities that experience different levels of violence. In the model, violence reduces workers’ utility because it acts as a local disamenity (e.g., by increasing the probability of being harmed and the stress of living in dangerous environments). Violence also affects firms’ cost structure.

The model and the observed negative effects of violence on output prices suggest that firms’ marginal and fixed costs are reduced when violence increases. This may be explained by depreciating land values as found in large by previous studies. In addition, the observed negative effects of violence on firms’ output prices and production suggest that in the output market, the negative demand shock (from workers out-migration) outweighs the supply boost experienced by firms (due to lower costs).

The model also predicts that higher violence reduces labor supply through workers’ out-migration (which should increase wages) and the negative demand shock on firms (which should decrease wages if firms demand fewer workers). Hence, the observed negative effects of violence on wages suggest that in the labor market, the demand shock outweighs the supply shock.

I address several concerns related to the validity of my identification strategy. Because the estimates include fixed effects by firm (or municipality) and year, the identification is not threatened by static differences between areas or by aggregate time trends. The exclusion restriction is violated only if, during the years in which the Democratic Security program was implemented, the municipalities that supported Uribe also experienced changes in other variables that are not controlled for. I address these concerns in several ways. First, I show that the results are robust to the inclusion of controls for transfers from the central to municipal governments (as a total and by type). Second, I show that there is no correlation between my instrument and nonsecurity public income or expenditures from local governments (as a total and by type). Third, I show that my estimates change only marginally when I include controls for all other types of countrywide public expenditures (excluded in fiscal transfers from the central to municipal governments and in municipal fiscal accounts). These expenditures include all other countrywide public programs implemented during Uribe’s tenure.

I also test for the possibility that other differential time trends across municipalities that supported and did not support Uribe may explain my results. I rule out biases due to preexisting differences in economic conditions between Uribe’s supporters and nonsupporters; that pro-Uribre municipalities or firms may have been favored by financial or public institutions disproportionately, relative to other areas; or that preexisting differences in violence levels, geographic characteristics, institutional quality, or law enforcement between Uribe’s supporters and nonsupporters drive the variation in my instrument.

The closest group of papers to this investigation examine the relationship between firms and civil conflict, such as the effects of civil conflict on stock market returns (Abadie & Gardeazabal, 2008; Guidolin and La Ferrara, 2010), exporting performance (Ksoll, Macchiavello, & Moret, 2010), firm exit (Camacho & Rodriguez, 2013; Collier & Duponchel, 2010), and firm productivity (Klapper, Richmond, & Tran, 2013). They consistently find negative effects of civil conflict on firm performance. This paper contributes to this literature by using rich data to uncover the effects of violent crime (and not conflict) on output prices, input prices, food prices, wages, firm average production, and firm exit. It also combines the empirical evidence with a theoretical model to understand the mechanisms of these effects and identify the effects of violent crime on workers’ real income and firm aggregate production.

II. Model Setup

The purpose of the model is to provide a link between the estimated (observable) effects of violence and its consequences on a firm’s cost structure and aggregate production. The model combines simple components from previous multiregional models by Redding (2012) with labor supply models by Roback (1982) and Rosen (1979) and extends them to include violence. The model describes an economy divided into municipalities with different levels of violence. Violence is assumed to be exogenous for modeling purposes, but the empirical section accounts for this issue. Each municipality comprises workers and firms.

A. Workers’ Problem

Each worker has 1 unit of labor that is supplied inelastically with 0 disutility. Workers face different levels of violence depending on their locations, and violence acts as a municipal disamenity and reduces utility.

4 See appendix III for a detailed list of the point estimates of the studies that identify the effects of violent crime on land values.

5 For a more recent application, see Serrato and Zidar (2016).

6 Inelastically supplied labor is a common assumption in studies of local labor markets. See Rosen (1979), Roback (1982), and Moretti (2011).
Workers also are imperfectly mobile across locations. Following Redding (2012), restrictions on mobility are introduced assuming that workers have idiosyncratic preferences for each location \((x_{im})\) drawn from a known distribution. Idiosyncratic preferences also can be understood as idiosyncratic mobility costs for each location, which are independently drawn across workers and locations. This assumption is necessary to guarantee different welfare levels across locations.

In sum, each worker \(i\) located in municipality \(m\) maximizes utility over a composite variety of goods \((C_{im})\), given wages \((w_m)\), a goods price index \((P_m)\), violence \((v_m)\), and an exogenous idiosyncratic mobility cost \((x_{im})\). Specifically, the worker solves the following problem for each municipality:

\[
\max_{C_{im} > 0} \left[ \frac{1}{v_m} \right]^{1-\beta} x_{im}
\]

s.t. \(P_mC_{im} = w_m, \quad (1)\)

where the composite good is defined as the aggregate sum of an individual’s consumption across all varieties produced in each municipality.\(^7\) Given the set of optimal utilities that individual \(i\) can have across all municipalities, he or she chooses the region that offers the highest utility. I denote the corresponding indirect utility function by

\[
V(P_m, w_m, v_m, x_{im}) = \left[ \frac{(w_m)}{P_m} \right]^{\beta} \left[ \frac{1}{v_m} \right]^{1-\beta} x_{im}. \quad (3)
\]

Violence therefore reduces not only workers’ indirect utility directly through \(v_m\) but also indirectly through changes in market prices \((w_m, P_m)\). In addition, by inducing workers’ out-migration, violence reduces the supply of workers in each municipality \((L'(v_m) < 0)\).

B. Firms’ Problem

Each firm \(j\) acts as a monopolistic competitor, producing a unique and differentiated product.\(^8\) Firms are immobile across locations (they are created and die in the same municipality) and face different violence intensity \((v_m)\) depending on the municipality in which they are located.\(^9\) They produce outputs using only labor.\(^10\)

Violence also affects firms’ marginal and fixed costs of operation. In practice, violence may increase firms’ marginal and fixed costs through higher security expenditures. However, violence also may reduce these costs by depreciating land values. Hence, I do not assume the direction of the effects of violence on firms’ costs, but rather use the model to derive conditions that allow empirical testing of the sign of these effects.

Following Redding (2012), to produce a variety, a firm must incur a fixed cost of \(F\) units of labor and a variable cost \(MC\), which are both functions of violence. Naturally, the effects of violence on fixed costs should occur over the long term. Hence, the amount of labor \((l_m(j))\) required to produce \(y_m(j)\) units of variety \(j\) in municipality \(m\) is given by

\[
l_m(j) = F(v_m) + MC(v_m)y_m(j). \quad (4)
\]

Profit maximization implies that equilibrium prices are a constant markup over marginal costs, such that the prices offered by firm \(j\) at municipality \(m\) are given by

\[
P_m(j) = \left[ \frac{\epsilon}{\epsilon - 1} \right] MC(v_m), \quad (5)
\]

where \(\epsilon\) denotes the elasticity of demand.

**Lemma 1.** Given \(P > 0\) and a constant elasticity of demand \(\epsilon\), a marginal change in violence affects prices and marginal cost in the same direction:

\[
\frac{\partial P_m(j)}{\partial v_m} = \left[ \frac{\epsilon}{\epsilon - 1} \right] \frac{\partial MC}{\partial v_m}.
\]

Lemma 1 suggests that by estimating the observable changes of output prices on violence, we will be able to infer the direction in which violence affects firms’ marginal cost.

Replacing the constant markup condition, equation (5), in the free-entry condition \((\Pi^* = 0)\) yields the equilibrium output

\[
y_m^*(j) = \left[ \frac{F(v_m)}{MC(v_m)} \right] (\epsilon - 1). \quad (6)
\]

**Lemma 2.** If the marginal effect of violence on firms’ marginal cost and equilibrium output is positive (negative), then

\(^7\)This implies that the composite good can be expressed as

\[
C_{im} = \left[ \int c_{im}'' dj \right]^{1/\beta}, \quad (2)
\]

where \(j\) denotes the number of firms offering their products in municipality \(m\).

\(^8\)This assumption allows testing of whether violence affects extensive (firm exit) and intensive (average production) margins of production. If firms are assumed to act as price takers, then violence affects only the extensive margin of production (firm exit).

\(^9\)This assumption follows the behavior observed in Colombian data, where firms’ mobility between municipalities occurs for only 2% of the sample. However, the results of the model hold if there are some restrictions on the mobility of firms, which in practice is always the case, given that firms invest in infrastructure in each location.

\(^10\)This assumption is imposed for simplicity. A more complicated version, in which firms produce using labor and other firms’ outputs as their inputs of production, yields similar results.
the marginal effect of violence on firms’ fixed cost will also be positive (negative).

Lemma 2 follows directly from equation (6) and the quotient rule for derivatives.

Given equation (6), the labor market clearing condition \( L(v_{m}) = N_{m}^{∗} \times l_{m}^{∗} \) implies that the total number of firms in each municipality \( (N_{m}) \) is proportional to the endogenous supply of workers. Violence thereby also affects the extensive margin of production:

\[
N_{m}^{∗} = \frac{L(v_{m})}{F(v_{m})} \left[ \frac{1}{\epsilon} \right]. \tag{7}
\]

Consequently, given the estimated (observable) effects of violence on output prices, output production, and number of firms, we may able to infer the direction in which violence affects firms’ cost structure.

C. Incidence of Violence on Welfare and Production

The effects of violence on workers’ welfare can be approximated by its effects on their indirect utility of consumption. The changes in indirect utility capture the direct disutility effects of violence and the indirect effects through price changes. In addition, the effects of violence on firms can be approximated as the sum of its effects on firms’ extensive and extensive margins of production.

**Proposition 1.** Given equation (3), the effects of violence on the utility of consumption of worker i at municipality m can be expressed as

\[
\frac{dV_{im}}{dv_{m}} = \frac{\partial V_{im}}{\partial P_{m}} \frac{\partial P_{m}}{\partial v_{m}} + \frac{\partial V_{im}}{\partial w_{m}} \frac{\partial w_{m}}{\partial v_{m}} + \frac{\partial V_{im}}{\partial v_{m}}. \tag{8}
\]

Moreover, given equations (6) and (7), the total effects of violence on firms’ production can be approximated in each municipality by

\[
\epsilon_{y_{m}} = \frac{dlog(Y_{m})}{dlog(v_{m})} = \frac{dlog(\bar{y}_{m})}{dlog(v_{m})} + \frac{dlog(N_{m})}{dlog(v_{m})}.
\]

where \( Y_{m} = N_{m}\bar{y}_{m} \) denotes the aggregate production in municipality m at period t, given the total number of firms \( (N_{m}) \) and the average production per firm \( (\bar{y}_{m}) \).

Consequently, the local-market effects of violence on individuals and firms are captured by the effects on market prices (i.e., output prices and wages) and market size (i.e., firm exit and production). In the next sections, I identify these effects and combine the empirical estimates with the results of lemmas 1 and 2 to identify the direction in which violence affects firms’ cost structure.

The directions in which violence affects firm exit and production indicate the relative strengths of changes in product supply from firms and product demand from workers in the output market, whereas the direction in which violence affects wages indicates the relative strengths of supply and demand changes in the labor market.

III. Data

A. Data on Violent Crime

Data on violent crime by municipality are available from the Colombian Vice Presidency’s Observatory of Human Rights. I use homicide rates per 100,000 inhabitants as measures of violence, because they are available for the whole period of study and for all municipalities in the country.

Figure 1 (right panel) presents the time evolution of intentional homicide rates for the period of interest. It shows that violent crime fell dramatically after 2002 with the election of Álvaro Uribe as president. Figure 2 presents the geographic distribution of intentional homicide rates for 2002 and 2011, the years before and after the sharp decline in violent crime. The figure suggests that the violent crime reduction occurred throughout most of the country. The figure also shows a strong geographic variation in homicide rates during the period of analysis.

Due to firm data availability, this paper’s main estimates use data from only 317 municipalities of Colombia. These municipalities have a lower share of rural population and higher economic prosperity and population, are less oriented toward agriculture-related economic activities, and have more governmental presence relative to the municipalities excluded from the manufacturing sample (see table II.2 in appendix II for a detailed comparison between groups). These municipalities also have lower civil conflict intensity but more violent crime. In fact, the correlation between homicide rates and civil conflict–related measures in the municipalities where the manufacturing survey is available is not statistically significant (see table II.3 in appendix II).

Consequently, this paper focuses on examining the effects of violent crime, but not on civil conflict, as the Colombian civil conflict mostly took place in rural rural areas with low governmental presence and low economic growth.11

B. Data on Market Prices and Size

My main source of information on market prices and size is the Encuesta Anual Manufacturera (Annual Manufacturing Survey), collected by the Departamento Nacional de Estadística (DANE), the Colombian statistical agency. The data set is a census of all manufacturing plants with ten or more workers or with a total output value larger than 65 million in 1992 Colombian pesos (approximately USD$95,000). Plants included in the survey are followed

11 See Lozano-Gracia et al. (2010), Dube and Vargas (2013), and Camacho and Rodriguez (2013) for details.
until they go out of business. This data set contains unbalanced panel data for approximately 16,776 plants in 317 municipalities between 1995 and 2010, which amounts to 124,247 observations.

In addition to standard plant information, the census includes physical quantities and prices of each output and input used or produced by each plant. In this paper, firms’ prices are defined as the plant-product-year observation, estimated by dividing the total value of sales or expenditures by physical quantities (see appendix II for details). Appendix II (table II.1) presents the descriptive statistics of the survey for 1995 and 2010. I use these data to estimate the effects of homicide rates on output prices, wages, production, and the firm exit decision.
IV. Identification Strategy

To identify the effects of violent crime, I exploit the municipal and annual variation in homicide rates between 1995 and 2010. Figure 1 (left panel) presents the municipal and annual variation in homicide rates between different levels of violent crime. In this setting, whereas low-production areas tend to be more violent, high-production areas tend to be less violent (Collier and Hoeffler, 2004), implies that high-production areas tend to be less violent. Time endogeneity, however, may still occur.

The identification of \( \gamma_1 \) is challenging, given the endogeneity concerns between homicide rates and market outcomes, even after controlling for firm or municipality fixed effects. Specifically, firm or municipality fixed effects solve only issues of cross-section endogeneity that correspond to static differences between areas with high and low levels of violent crime. Time endogeneity, however, may still occur. For example, time endogeneity may occur in two different directions in firm production. First, when production is high, economic conditions may improve and thus decrease poverty and violent crime. Time endogeneity concerns between homicide rates and market outcomes. In this setting, \( \gamma_1 \) is upward biased. In contrast, as Dube and Vargas (2013) have suggested, a rise in contestable income via an increase in production also may increase violent crime by raising gains from income appropriation. This so-called greed or rapacity channel suggests that violent crime may be equally significant in areas with high and low production. In this situation, \( \gamma_1 \) is biased toward 0.

To address endogeneity concerns, I use a panel-instrumental variable methodology. Firm or municipality fixed effects solve the cross-section endogeneity problems, and the instrument for homicide rates addresses the time endogeneity concerns between homicide rates and market outcomes. In sum, I estimate the following specification,

\[
\log(y_{jmt}) = \gamma_1 \log(v_{mt}) + k_j + g_t + \epsilon_{jmt},
\]

(10)

where \( y_{jmt} \) represents market prices or size observed for firm \( j \), at year \( t \), and located in municipality \( m \); \( v_{mt} \) are homicide rates; \( \epsilon_{jmt} \) is the error term; and \( k_j \) and \( g_t \) are fixed effects by firm (or municipality) and year. For the estimates of the effects of homicide rates on the firm exit decision, the model includes fixed effects only at the municipal and year levels.

The identification strategy is valid so long as the exclusion restriction (i.e., \( \text{corr}(DS_{jmt}, \epsilon_{jmt}|X_{mt}, k_j, g_t) = 0 \) and the relevance assumption are satisfied. The identification strategy is valid so long as the exclusion restriction (i.e., \( \text{corr}(DS_{jmt}, \epsilon_{jmt}|X_{mt}, k_j, g_t) = 0 \) and the relevance assumption are satisfied. 13

A. Instrumenting for Homicide Rate

As shown in figure I.1 of appendix I, since the middle of the twentieth century, violence in Colombia has systematically increased, driven mainly by the creation and growth of illegal armed groups. In 1964, adherents of a Cuban-style revolution founded the Ejercito de Liberacion Nacional (ELN, National Liberation Army). In 1966, a second left-wing group, the Fuerzas Armadas Revolucionarias de Colombia (FARC, Revolutionary Armed Forces of Colombia), was founded as a union of all remaining communist guerrillas. Initially, both groups claimed to defend the interests of the rural poor, aiming to overthrow the government and install a Marxist regime. In time, however, both groups became primarily economically motivated (Dube & Vargas, 2013). In the late 1980s in areas where the state was unable to provide security, landowners and drug traffickers responded to the left-wing guerrillas’ actions with their own paramilitary and antiinsurgency efforts. In 1997, the paramilitary forces coalesced into the Autodefensas Unidas de Colombia (AUC, United Self-Defense Organization of Colombia).

In 1998, former president Andrés Pastrana initiated unsuccessful peace negotiations, with FARC. During these negotiations, there was a strong perception that the government conceded too many benefits to FARC without getting anything in return (Fergusson et al., 2016). In fact, violence persisted, and FARC, AUC, and ELN increased their territory (Buitrago, 2006; Pachón, 2009). In this climate, Álvaro Uribe, a right-wing member of the Liberal Party, whose electoral platform focused on improving security conditions and cracking down on illegal armed groups, was elected president in 2002 with 53.04% of the votes. Uribe declared that Colombia’s main concern was to reduce violence: “Of course we need to eliminate social injustice in Colombia but what is first? Peace. Without peace, there is no investment. Without investment, there are no fiscal resources for the government to invest in the welfare of the people” BBC (2004).

13 The relevance assumption, as defined by Imbens and Angrist (1994), Abadie (2003), and Angrist, Imbens, and Rubin (1996), requires a strong correlation between violent crime and the instrument.

14 The Colombian government demilitarized 42,000 square kilometers for FARC, but there was no cease-fire by FARC during this period.
According to Uribe’s plan published in 2003, the Democratic Security program would gradually restore police presence in all municipalities; dismantle terrorist organizations; reduce kidnappings, extortion, and homicides; prevent forced displacement; and fight the illegal drug trade (Presidency, 2003). Uribe intended to achieve these goals by increasing spending on military infrastructure, personnel, and intelligence. In 2002, he declared a war tax of 1.2% on the assets of wealthy individuals and corporations to collect additional funds for his security program. In 2004, Uribe successfully sought a constitutional amendment that allowed him to run for a second term as president and was reelected in 2006 with 62% of the votes.

I exploit the fact that areas that consistently supported Uribe received more support to reduce violence relative to areas that did not support him as he was looking for reelection, and hence, these areas should show proportionally higher reductions in violence. Specifically, my instrument for homicide rates is constructed as

\[ DS_{mt} = \text{Share Uribe 1st} \times I[\text{year} \geq 2002], \tag{13} \]

where \( DS_{mt} \) stands for “Democratic Security” and \( \text{Share Uribe 1st}_{mt} \) represents the share of total votes for Uribe in the first presidential election at municipality \( m \). The share of votes in each municipality in each election is publicly available and obtained from the Registraduría Nacional del Estado Civil.

### B. Effectiveness of Democratic Security

Figures 3 and 4 present evidence of the correlation between homicide rates and the instrument \( DS_{mt} \). Figure 3 presents the mean values of homicide rates for four groups of municipalities: those in which Uribe won both elections (always won), lost both elections (always lost), won the first but lost the second election (won 1–lost 2), and lost the first but won the second election (lost 1–won 2). The figure shows that although violence decreased in all municipalities, higher reductions occurred in places that supported Uribe consistently. Furthermore, municipalities where Uribe always lost showed smaller changes in homicide rates. This finding is consistent with the idea that areas that supported Uribe received more support to improve security conditions.

Figure 4 presents a fitted linear regression of the mean change in homicide rates between (a) 1995 and 2001 (before Uribe’s tenure) and (b) 2002 and 2010 (during Uribe’s tenure), against the share of votes that Uribe received in the first presidential elections. The figure suggests that municipalities with higher support for Uribe had higher reductions in homicide rates between 2002 and 2010. It also suggests that no systematic reductions in homicide rates occurred prior to his election.

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15 The Dirección de Impuestos y Aduanas Nacionales (DIAN), the official institution for tax collection, reports that in 2002, approximately COLS$2.5 billion in taxes was collected, surpassing original expectations.

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16 To carry out the analysis, I use data on the Colombian civil conflict obtained from the Centro de Memoria Histórica (CMH). Currently, this is the best source of data on civil conflict as it combines information from nongovernmental organizations and governmental records with testimonies from the victims of the civil conflict.
(before Uribe’s tenure) was unrelated to the support that Uribe received during the 2002 presidential election.\footnote{I also correct for biases due to multiple testing using Bonferroni’s correction (see table VI.6 in appendix VI).}

An additional concern related to the validity of my empirical strategy is that I use the same instrumental variable to study the effects of violent crime on multiple outcomes, which could be correlated in time or have common unobserved components. Consequently, as one outcome is directly affected by violent crime, it may have an impact on others indirectly, and through these dynamics, the instrument may become endogenous.\footnote{This issue is defined by Conley, Hansen, and Rossi (2012) as cases when the instrument is plausible only exogenously and corresponds to situations when there are prior beliefs that the instrument has a nearly 0 (but not 0) correlation with the outcome variable after controlling for the endogenous regressor.}

Input prices, for example, could be directly affected by violent crime, and in time, their changes will indirectly affect output prices, which could
entail a violation of the exclusion restriction. In an effort to account for these concerns, I center my analysis in the effects of a contemporaneous violent crime shock on firm outcomes and restrict my analysis to the short term, which should minimize endogeneity issues related to the dynamic effects between outcome variables.\textsuperscript{19}

\textsuperscript{19}In fact, the analysis of the effects of violent crime on firm outcomes in the long term is an interesting extension of this research project, which

If municipal expenditures, countrywide public expenditures (other than Democratic Security), and national transfers from central to municipal governments did not change disproportionately in municipalities that systematically supported Uribe relative to nonsupporting areas, how did homicide rates decrease during his tenure? Changes in security may be pursued by relaxing the exclusion restriction using the methodology proposed by Conley et al. (2012).
Table 1.—Effects of Violence on the Intensive and Extensive Margin of Production

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<th>OLS (1)</th>
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<th>2SLS (6)</th>
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<td>Civil conflict controls</td>
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Dependent Variable: Log (Real Production)

Dependent Variable: Log (Number of Firms)

Table 2.—Effects of Violence on Output and Input Prices

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<th></th>
<th>OLS (1)</th>
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<th>2SLS (4)</th>
<th>2SLS (5)</th>
<th>2SLS (6)</th>
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<td></td>
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</tr>
<tr>
<td>Log (Homicide Rate)</td>
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<td>-0.15**</td>
<td>-1.19***</td>
<td>-1.14***</td>
<td>-1.14***</td>
<td>-0.16***</td>
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<td></td>
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<tr>
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<td>-1.15***</td>
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<td>-1.13***</td>
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<tr>
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Dependent Variable: Log (Real Production)

Dependent Variable: Log (Real Production)

Table 3.—Effects of Violence on Nominal Wages

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>OLS (2)</th>
<th>2SLS (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log (Homicide Rate)</td>
<td>-0.28***</td>
<td>-0.16***</td>
<td>-0.15***</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.03)</td>
<td>(0.03)</td>
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<tr>
<td>First stage</td>
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<td></td>
</tr>
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<td>DS</td>
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<td>-1.81***</td>
<td>-1.85***</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>F-statistic (excluded instrument)</td>
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<td>44.80</td>
<td>42.27</td>
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<td>Population</td>
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</tr>
<tr>
<td>Observations</td>
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</table>

Dependent Variable: Log (Nominal Wages)

Dependent Variable: Log (Nominal Wages)
and defense expenditures, which are not part of the municipal fiscal accounts, countrywide public program accounts, or the fiscal transfers from central governments to municipalities may explain the decrease. In appendix IV, I describe in detail the way in which security expenditures are allocated in Colombia.

V. Effects of Violent Crime on Local Prices and Market Size

A. Effects on the Intensive and Extensive Margin of Production

Table 1 presents the estimates of equations (11) and (12) using the logarithm of real production as the dependent variable. All the regressions in the table include year fixed effects and controls for population. Columns 1 to 5 include firm and columns 6 to 10 municipality fixed effects. Additional controls include interactions of year fixed effects and sector GDP shares for agriculture, services, and industry; 1995 night light density; 1995 number of financial institutions; 1995 number of public institutions; and 1994 homicide rates. It also includes controls for the number of loans approved for firms, the volume of those loans, and municipal tax collection from firms.

The results of the OLS estimates suggest that the effects of homicide rates on real production are biased toward 0, in line with the rapacity channel discussed in section IV. The 2SLS estimates suggest negative effects of violence on firms’ production. When endogeneity is addressed, the coefficients increase in absolute value. My preferred estimates, presented in column 6, suggest that when homicide rates increase by 10%, firms’ production declines by 2%.

To estimate the effects of homicide rates on the total number of firms, I aggregate the firm data by municipality. As shown in table 1, the estimates are also consistent with endogeneity between firm exit and violence driven by the rapacity channel. They suggest that when homicide rates increase by 10%, the total number of firms in a given municipality declines by 1.9%. It is important to mention here that because only formal firms are observed in the sample, firms may exit to the informal sector. Consequently, the estimates measure only firms’ exit from the formal sector.

Following equation (9), the aggregate production-violence elasticity corresponds to the sum of the elasticities of the number of firms and firms’ production with respect to homicide rates. Table 1 identifies the values for these elasticities. They suggest that when violence increases 1%, aggregate production falls by 0.39%.21 Using a back-of-the-envelope calculation, this implies that the 48% decline in Colombia’s homicide rates from 1995 to 2010 increased aggregate production at least by 19.6% during these years.22

B. Effects on Output Prices

Table 2 presents the estimates of equations (11) and (12), taking the logarithm of firms’ output prices as the dependent variable. All regressions in the table include year, firm, product fixed effects, and controls for population. Product fixed effects correspond to the four-digit classification of the International Standard Industry Classification, which account for 113 four-digit codes. Additional controls include interactions of year fixed effects and sector GDP shares for agriculture, services, and industry; 1995 night light density; 1995 number of financial institutions; 1995 number of public institutions; and 1994 homicide rates. It also includes controls for the number of loans approved for firms, the volume of those loans, and municipal tax collection from firms.

The estimates suggest a negative and sizable effect of homicide rates on firms’ output prices. As for the case of market size, the effects of violence on firms’ prices grow in absolute value when correcting for endogeneity. Column 5 presents my preferred estimates, which suggest that when homicide rates increase by 1%, real output prices decrease by 1.14%.

In practice, input-output linkages could cause firms to face lower input prices when violence is higher. To check if this occurs, I estimate the same specification using the logarithm of input prices as the dependent variable. Table 2 presents the results, which show similar behavior. Column 10 suggests that when homicide rates increase by 1%, the input prices faced by firms decrease by 0.44%. Firms thus decrease output prices disproportionately more than the reductions in input prices that they face.

The behavior of local retail food prices shows a similar pattern. In appendix V, I estimate equations (11) and (12) using data on retail food prices as the independent variable.23 Column 7 in table in the appendix presents my preferred estimates and includes municipality, year, product, and controls by municipality (there are 500 product types in the sample). The estimates suggest that when homicide rates increase by 1%, real food prices decrease by 0.73%.

In sum, evidence suggests that living costs are lower in high-violence areas, given that food prices and nondurables have a high share in the Colombian CPI. In particular, according to the Departamento Administrativo Nacional de Estadística, the Colombian statistical agency, food consumption and nondurable good purchases represent approximately

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20 Real production is estimated as the value of all products made by the firm during the year, valued at factory gate prices without taxes. The annual producer price index produced by the Colombian Statistics Department is used to obtain real values.

21 My estimates are a lower bound of the effects of violent crime on aggregate production because \( E(\log(y_{jm}) \leq \log(E(y_{jm})) \). I report the elasticity using firm-level data, which enables controlling for firm time-invariant characteristics.

22 According to the World Bank’s World Development Indicators, between 1995 and 2010, Colombia’s GDP jumped from $92.51 to $297 billion.

23 The data cover average annual retail prices of the 500 most-consumed food products (according to sales) within 53 municipalities located in 20 departments, from 1996 to 2010.
70% of the CPI. Moreover, evidence of the effects of violence on other types of durable prices such as housing shows similar behavior (see appendix III for an exhaustive list of studies that estimate the effects of violent crime on housing prices).

C. Effects on Wages

This section estimates the wage-violence elasticity, which corresponds to running a hedonic wage equation in the spirit of Rosen (1986). As Kniesner, Viscusi, and Ziliak (2010) and Lavetti (2012) noted, the estimation of a hedonic equation on wages should ideally include information by individual and by firm.24 Despite the richness of the data used in this paper, information on both firms’ and workers’ characteristics is unavailable. I therefore include only fixed effects by firm. Although most estimates in the literature use workers’ heterogeneity, recent studies have called attention to the relevance of firms’ heterogeneity in explaining wage variation (Card, Heining, & Kline, 2013).25

Table 3 reports the estimates of equations (11) and (12) using the logarithm of nominal average wages as the dependent variable. All regressions in the table include year and firm fixed effects. Economic controls include interactions of year fixed effects and sector GDP shares for agriculture, services, and industry and for 1995 night light density. Additional controls include the interaction of year fixed effects and 1995 number of financial institutions, 1995 number of public institutions, and 1994 homicide rates. It also includes controls for the number of loans approved for firms, the volume of those loans, and municipal tax collection from firms.

I find evidence of strong negative effects of violence on wages. As for the previous cases, the elasticity of violence on wages grows in absolute value when corrections for endogeneity are introduced. The estimates in column 6 suggest that when homicide rates increase by 1%, nominal wages decrease by 1.10%.

Despite being a rich data set, the manufacturing census contains information on formal businesses only (i.e., firms that comply with government regulations and fees and hence are part of the formal labor market). Considering that between 1995 and 2010, informality accounted for approximately 60% of the total workforce (Mondragón-Vélez, Peña, & Wills, 2010), it may be argued that the wage effects that have been identified using the manufacturing survey are not representative of the whole Colombian labor market.

The only time-varying information available on labor informality in Colombia comes from Colombian household surveys (a representative sample of the Colombian labor market). I use these surveys, between 2000 and 2010, to test the robustness of the effects of violent crime on wages. Appendix VI (table VI.5) presents the results, which are consistent with previous findings and suggest a negative effect of homicide rates on nominal wages.

VI. Effects of Violent Crime on Local Markets

Combining the empirical results of section V with the results of the theoretical model clarifies the underlying mechanisms that drive the observable effects of violence on firms’ behavior. Given the negative effect of violence on output prices, lemmas 1 and 2 suggest that higher levels of violence also reduce firms’ fixed and marginal costs. This effect may be explained by depreciating land values, as found by Thaler (1978), Hellman and Naroff (1979), Lynch and Rasmussen (2001), Bowes and Ihlanfeldt (2001), Gibbons (2004), and Linden and Rockoff (2008).26

For the output market, the observed negative effects of violence on firms’ output prices and production suggest that demand reduction caused by workers’ out-migration is stronger than the supply boost caused by lower input prices. In addition, the model predicts that higher violence induces workers’ out-migration. The observed negative effects of violence on wage compensation suggest that in the labor market, firms’ demand for labor shrinks (due to lower production in the output market) more proportionally than workers’ supply of labor does.

It is also worth considering what could be the effects of violence on real income based on the elasticities identified so far. Let $PI$ represent the aggregate price index. A simple accounting exercise of the effects of violence on real income is then given by

$$\frac{\partial \ln(w/PI)}{\partial \ln(v)} = \frac{\partial \ln(w)}{\partial \ln(v)} - \frac{\partial \ln(PI)}{\partial \ln(v)}. \quad (14)$$

An approximation of the effects of violence on the price index ($PI$) can be obtained by using the estimated elasticities of the effects of homicide rates on goods prices (−1.14), food prices (−0.73), the average elasticity found in the literature for housing rents (−1.32),27 and their corresponding weights in the Colombian CPI.28 Replacing these values in equation (14), I find that when homicide rates increase by 10%,

24 Some studies also include fixed effects for matching effects between firms and workers, which solves the endogeneity caused by endogenous switching. This is relevant only when there is an idiosyncratic productivity component associated with potential job matching in the theoretical model, which is not the case in this paper.

25 Frías, Kaplan, and Verhoogen (2012), for instance, suggest that two-thirds of wage variation can be explained by firm heterogeneity, and Abowd, Creecy, and Kramarz (2002) show that workers’ and firms’ heterogeneity have equal importance in explaining wage variation. Estimates by Lavetti (2012) show that a wage’s hedonic equation that includes only firms’ heterogeneity can explain as much as 66% of the wage variation. See tables 6, 7, and 10 of Lavetti (2012).

26 See appendix III for a detailed list of the point estimates of these studies.

27 I cannot estimate this elasticity, as no data are available. A review of all papers is included in appendix III.

28 According to the Colombian Statistics Department, their weights in the CPI are 43%, 25%, and 32%, respectively.
real income drops by 0.07%. Consequently, higher homicide rates increase poverty.

VII. Conclusion

This paper studies the effects of violent crime on local markets. I find that firms that face higher violent crime lower their output prices and wages. They also face lower input costs. Firm output prices fall more, however, proportionally to the prices of inputs and labor, which ultimately drives firms to reduce average production, and some firms exit the market. Overall, when violence increases by 1%, aggregate production (including the reduction in the extensive and the intensive margin of production) falls by 0.39%.

Firms’ reduction of output prices is reflected in low living costs for the local population. This finding is consistent with low food prices in areas with high levels of violent crime. Yet because workers face low wages and their wage reduction is higher than the reduction in their cost of living, real income is lower in areas with more violence. High-violence areas are therefore also poorer than low-violence areas, which may fuel further social unrest and violence.

By combining the estimated elasticities with the theoretical model, I examine the underlying mechanisms that drive the observable effects of violence on firms’ behavior. I find that high levels of violence reduce firms’ fixed and marginal costs. These cost reductions are reflected in lower output prices that, when combined with workers’ out-migration and declining demand, explain the reductions in the extensive and intensive margins of production.

In sum, I find that reductions in violent crime have large economic returns. A back-of-the-envelope calculation suggests that the 48% decline in homicide rates between 1995 and 2010 in Colombia increased aggregate production by 19.6%. My estimates, however, are a lower bound of the total social costs of violent crime. Specifically, my estimates do not measure the costs of violent crime on mortality (see Soares, 2006, for a measurement of these effects).

Although this paper uses unique and rich data on firms, some data limitations should be mentioned. My estimates deal mainly with the effects of violent crime on the 317 most populated Colombian cities in which most economic activity occurs. No data are available to assess the effects of violent crime on rural areas, which restricts the analysis of the general equilibrium effects of violent crime in Colombia. In addition, there are no data on the extent to which violence increases informality, because there are no data for the size of this sector. This constraint is especially relevant for developing countries, for which the size of the informal sector is significant.

Next steps in this research agenda include identifying the effects of violence on the informal sector and rural areas, for which only limited information about developing countries exists. Fruitful insights also may also be gained by testing the results of this paper on a developed country.

REFERENCES


