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VIOLENCE IN COLOMBIA: CAUSES AND CONSEQUENCES

Final Report

FELIPE BARRERA OSORIO

Fedesarrollo

ANA MARÍA IBÁÑEZ

Universidad de los Andes

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Felipe Barrera

Fedesarrollo

Calle 78#9-91

Bogotá, Colombia

fbarrera@fedesarrollo.org.co

Ana María Ibáñez**

Universidad de los Andes

Carrera 1E No.18A-10

Bogotá, Colombia

aibanez@uniandes.edu.co

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** Ana María Ibáñez was research associate of Fedesarrollo when this research started.

INTRODUCTION

This report comprises two defined papers. In the first one, “Dynamics and causes of crime in Colombia”, a systematic review of different theories of causes of crime in Colombia is undertaken. Using a new dataset, and improved techniques than the ones of previous studies, we tested several hypothesis of the underlying causes of crime in the country. The research assistance of Carolina Latorre was very important in the making of this article. This paper is presented in Chapter One.

The second study, “Does Violence Reduce Investments in Education?: A Theoretical and Empirical Approach”, explores the relationship between decisions of education and violence. This area of research is under exploration, and it opens the door to new investigation, both in terms of theory and empirical evidence. Maria Virginia Jordan provided excellent research assistance in this paper, presented in Chapter Two.

CHAPTER ONE

Dynamics and causes of crime in Colombia¹

1. Introduction

The complexity of conflict and crime in Colombia is enormous. A fast review of some facts gives some of its dimension. The conflict has been in the country for many years; there are several authors involve in it; objectives of the main illicit groups (the guerrilla and the paramilitaries) are diverse and heterogeneous; crimes rates for some types of offences are abnormally high, for others are "normal" in comparison with similar countries. The objective of this article is to test some common, widely accepted hypotheses about crime and conflict in the nation.

The first step is to give a brief description of the *dynamics* of the conflict. The second step is to pose a model that can capture some of the *rationality* of the conflict and crime. The final step is to derive some *empirical regularities* of the conflict.

There are several studies on violence and crime in Colombia. These are grouped into two main categories. In one the historic view prevails and in the other there is an effort to measure and to test hypotheses. Usually, historians and other social scientists tend to describe, in a rich and general way, the facts and theories of the conflict and economists tend to reduce the conflict to variables that they can measure. This work will tend to incorporate the two tendencies. In the description of the dynamics, we will follow more the historical approach, keeping an eye on potential testable implications. In the general model, we apply rigorous economic methods. We will, however, try to link both of these approaches as the rationality today is driven by the dynamics of yesterday.

This work is centered on the recent period of the conflict, the period between 1990 and 2002. This choice of years limits the study in several ways, but it has two main benefits. First, the rationality of the conflict is more or less homogenous during this period of time. Second, we believe that the quality of the data is better for this period of time than for any prior years.

We see this article as a "meta" study of the causes of violence. Our contribution is threefold. First, we gather a dataset at municipal level that has some important

¹ Fabio Sanchez, to whom we are very grateful, provided some of the data used for the paper. Juan Camilo Chaparro, at Fedesarrollo, collected and assembled a municipal dataset for the "Income Mission", data that were used as well for this research. Maria Carolina Latorre provided exceptional research assistance.

improvements with respect to previous ones by including new variables not used before. Second, we estimate a theoretically well developed equation of crime, using a better battery of techniques than used in previous studies. Third, we try to be methodical in the estimation of several hypotheses of the causes of crime.

Our focus is going to be on "conflict" (the internal war between guerrilla, paramilitaries, militaries and, in the middle, civil population), based on the underlying assumption that conflict is a chief determinant of crime. In fact, some of the empirical hypotheses that we tested corroborate this view. Unfortunately this path of analysis leaves aside some of the important crimes in the country. For instance, "Family Violence" is one of the most committed crimes and, given the data at our disposal, we cannot investigate this phenomenon.

2. Dynamics

The literature on the dynamics of the conflict is extensive. We follow some of the ideas of an important study recently published by the UNDP, the "Informe Nacional de Desarrollo Humano 2003". It presents a global recount of the conflict in Colombia. Also, we base this part on works by Echandia (1997, 1999) and Rubio (2002).

We defined the "dynamic" of the conflict as the relationship across time between groups outside the legal framework and crimes. Several authors claim that the increment of crime in the country has several links with the conflict.² For this reason, we will make a brief recount of the main characteristics of the conflict.

Currently, the conflict in Colombia has five main authors: two important guerrilla groups, the FARC and the ELN, who have different beginnings; the paramilitaries, who came into existence as a response of landlords and drug dealers to the guerrilla activity; the government, especially the Military (Armed?) Forces; and the civil society who, for most of times, is in the middle of the conflict.

The FARC started as a peasant movement in favor of land reform. During the 70's, due to increasing inequality and lack of land reform, the movement started to grow, moving from the rural frontier to areas with large and unequal

² However, disagreement is not uncommon in the literature of the conflict in Colombia. For instance, two recent studies present completely opposite views of the relationship between guerrilla activity (conflict) with homicide rates:

"During the 90's the empirical evidence on the link between homicide and guerrilla activity is very weak" (Levitt and Rubio (1997)).

"There exist a high correlation between conflict in Colombia and evolution of homicide rate" (own translation) (Sánchez, Díaz and Formisano (2003)).

ownership of land. During the 80's, the movement expanded to the "Llanos Orientales" region, where it found a new financial source, the taxing of cocaine production. The FARC reached the Magdalena Medio, a region rich in cattle and gold mines that provided another two financial sources, as well. The "Bloque Sur" of the group moved to the Tolima and Huila region, with the objective of creating a corridor for drug traffic.

The escalation of the conflict between the guerrillas and the government, and the zonal concentration of this guerrilla were the main characteristic during the nineties. The escalation was the response to a frontal attack of the Army to the most important guerrilla camp in 1991. The concentration is based on two motives: localities that provide financial resources (drug production) and corridors through which the guerrilla can move fast and the drugs can be trafficked.

The motivation of the movement has changed dramatically through time. In the beginning, the idea of redistribution was the main motor for the movement. In following three decades, this objective changed dramatically. Currently the objective is mainly an economic one: secure sources of financial support by focalizing the action and gaining control of certain critical corridors.

The dynamics of the ELN are quite different. First, it started as an ideological movement for the people in the lowest part of the income distribution. Second, it started in zones where petroleum and coal were an important source of income. During the 80's, this guerrilla promoted the *de facto* local government, supporting peasant councils, within certain and determined parts of the country. During the nineties, the ELN concentrated its action to specific departments, and retreated from regions where they try to enter, mainly large-state ownership of land, at the hands of the paramilitaries.

The paramilitaries began in the mid eighties as a reaction to the guerrillas. On one hand the movement is comprised of owners of large areas of land who were taxed and kidnapped by guerrilla. On the other, the movement includes drug producers. The paramilitaries have both property resources and resources from drug business. They have been fighting, with relative success, the ELN. The relationship between the FARC and Paramilitaries changes according to the zone of influence. In areas of drug production, there has been some symbiosis in which the drug lord produces with the security of the guerrilla; in other areas there have been confrontations.

In conclusion, one can say that the main driving force of the conflict in the last decade has been drug traffic. The conflict is based on securing financial resources and controlling strategic geographical locations.

As it is clear from the recount, during the '80 the conflict changed dramatically with the appearance of high rents derived from drug trade. This fact changed the dynamics in several ways: first, new authors appear in the conflict; second, drug started to be an important source of the financial support for several groups; third, the drug trade, as an illicit activity, created its own dynamics by incremented crime and other illicit activities. The rationality of crime has changed as well during the last decades. Interestingly enough, nowadays the conflict can be explained by clear incentives of economic and territorial control.

Gaviria (2002) tackles one of the most important puzzles in the behavior of crime in Colombia: the homicide rate in Colombia has increased in a significant way since the beginning of the eighties, despite the fact that there have not been any significant changes in the "main" variables that explain crime. Gaviria forms the hypothesis that the chief factor that has caused the change in the crime equilibrium is the boom of drug activity in the country. He bases his hypothesis on two ideas. First, that crime, as a variable, has two equilibriums: one in which crime rates are low, the other in which crime rates are high. This last equilibrium emerge in a situation in which the rule of law is highly eroded, and different types of crimes live together reinforcing one and other, creating a high congestion in the judiciary system. The second idea of Gaviria invests drug traffic as the detonator that has changed the state of the world from the low crime rate equilibrium to the high one. Gaviria presents indirect evidence that is in line with his hypothesis.

Echandia (1997) maps the geographic change in the conflict. In essence, the zones that have been affected by the conflict are strategic zones such as corridors of easy movement of troops and drugs. Also, they are zones prone to the absence of the government . According to his maps, violence is extremely high in those zones with high presence of guerrilla and paramilitaries.

Sánchez et al. (2003) present an spatial estimation of crime in Colombia. Using spatial econometrics, they regress the rate of homicides, kidnappings, crimes against property and piracy against socioeconomic variables, the lag of the respective dependent variable and a variable of crime in the neighboring municipalities. They find that the contagious effect of crime in a neighboring municipality is the most important determinant of crime.

This study poses several unanswered questions. The geographical component of the study is the contagion of crime from neighboring municipalities and the authors find that for each crime in a municipality, four other crimes occur in the neighboring municipalities. However, given the literature on the dynamics of the conflict, the spatial component observed in the conflict is quite different. The corridors where most of the conflict occurs are well-delimited zones that leave outside parts of the country. The evidence is very clear: there is an enormous

amount of dispersion in violence rates across municipalities. We expect that municipalities within a corridor (or close to a corridor) will be affected by violence. In the building of the corridor the violent agent will go from one municipality to the next one within the corridor, and during that transit, it may encounter other authors, and as result cause more crime and violence.

Rubio (2002) tries to explain guerrilla presence by regressing indicators of their presence in municipalities against several variables. He finds that presence of guerrilla is prone in municipalities with energy production (oil, etc), with a young population, and with a more unequal distribution of income. He does not find a statistically significant relationship between poverty and guerrilla presence. Also, against all conventional and empirical knowledge, he does not find a relationship between guerrilla and the production of drugs.

Velez (2003) studies the dynamics of the presence of guerrilla in the territory. She finds that the FARC and ELN have expanded lately towards bigger municipalities, municipalities with difficult access, and richer municipalities.

3. Rationally of crime

a. A model

Becker (1968) led the path for the economic study of violence. In essence, the importance and innovation of Becker's model lies in a new way to think about crime: crime is a rational activity, in which individuals weight costs and benefits of being a criminal.

We argue that the model of Becker has important implications on today's crime in Colombia. Before crime was the product of inequality and poverty; currently, the quest for economic rents is the main determinant of the conflict, and as byproduct, of crime in general.

Some of the most relevant conclusions of Becker's model can be synthesized in one simple equation (Becker (1968), Ehrlich (1996) and Freeman (1999)). Let $c_{i,j}$ be an indicator (0 or 1) that a person i commits crime type j ; let w_i be the wage that person i can receive in a legal activity; let $h_{i,j}$ be the (monetary) return that person i will get for crime j if the crime is successful; let p_j be the punishment (measure in monetary terms) for crime j ; let $(1 - \rho)$ be the probability of capture if the person i commits a crime (and ρ the probability of no capture); finally, let $u_i(.)$ be the utility level of person i . The condition for person i to commit the crime j is as follows:

$$c_{i,j} = 1 \quad \text{if} \quad u_i(w_i) < \rho(u_i(h_{i,j})) + (1 - \rho)(u_i(p_j)) \quad (1)$$

In words, a person will commit crime j if the its expected payoff is larger than the payoff from legal activity.

Several implications can be draw from Equation (1). First, if the payoff of illicit activities increases, the individual probability of committing a crime increases as well. Second, if the penalty or the probability of getting arrested increases, the individual probability of committing a crime decreases. Third, if the payoff of legal activities (the opportunity cost) increases, the individual probability of committing a crime decreases.

There are several issues behind Equation (1) that are important to spell out. The form of the utility function captures different degrees of risk aversion. For individuals with higher risk aversion, Equation (1) is less likely to be true. Also, the utility function can capture other characteristics, like the “moral standards” of the individual.

The institutional framework is implicit in the probability of capture and the punishment for the crime. For instance, a very weak enforcement system will imply a low probability of detection and a weak judiciary system will imply a low punishment.

To get the aggregate supply function of crime from Equation (1) is quite difficult, as is the aggregation of any market. The total amount of crime j , $C_j = \sum_i c_{i,j}$, will depend on the characteristics of the individuals and on characteristics of the society. In short,

$$C_j = f(\rho, h_{1,j}, \dots, h_{n,j}, p_j, w_1, \dots, w_n; \Omega) \quad (2)$$

where n is the total number of individuals. The variable Ω represents a series of other factor affecting crime, e.g. other institutional factors like the “moral” values of society; interactions between crime j and crime k ; or risk aversion (more on this later on).

Under some assumptions, the amount of crime depends on an average return of illicit activities (\bar{h}_j) and some representative price for legal activities (\bar{w}):

$$C_j = f(\rho, \bar{h}_j, p_j, \bar{w}; \Omega) \quad (2a)$$

Empirically Equation (2a) can be estimated as:

$$C_j = \beta_0 + \beta_1 \rho + \beta_2 \bar{h}_j + \beta_3 p_j + \beta_4 \bar{w} + \beta_5 \Omega + \varepsilon \quad (3)$$

Following is a discussion of some of the results of the empirical estimations of Equation (3).

b. Review of econometric studies

During the 90's several economists in Colombia undertook an ample agenda of estimating some forms of Equation (3). The agenda began with the increase in the amount of data available. Montenegro and Posada (1994) regress homicide and robbery rates at the departmental level against the log of GDP per-capita, the change in the index of basic necessities, the increment of education covertures, infant mortality, the change in the urbanization index, GDP growth, and the ratio of people accused and the number of crimes committed. Their conclusions are diverse: first, poverty is not correlated with violence; second, growth is positively related with violence; and more importantly, a weak judiciary system is a determinant of crime.

Sarmiento (1999) uses municipal level data and finds that the Gini coefficient of income distribution is one of the most important factors in explaining homicides. Inequality, according to the author, explains an important part of violence. This paper gives one of the most important empirical supports to the theory of "objective causes" of violence, mainly poverty and inequality (see below for a description of objective causes).

Levitt and Rubio (1997) explored five hypotheses of crime in Colombia. These five hypotheses are as follows. First, drugs are one of the main determinant of crime. Second, weak judiciary system is positively correlated with crime. Third, guerrilla activity is positively correlated with crime. Fourth, poverty and income inequality are positively correlated with crime. Fifth, there is a higher propensity for violence among Colombians than for other nationalities. Among these five, Levitt and Rubio find that the first two are important in explaining crime; the third one is unclear and the last two are without support.

Sánchez and Núñez (2001) regress homicide rates against the Gini coefficient of income inequality, presence of guerrilla, a proxy for drug traffic, and political participation, among others. Using a decomposition technique in which the differences among municipal homicide quintals is explained, they find that guerrilla presence, drug traffic and judiciary weakness are the main explanations of crime. They find as well that inequality and poverty explain a minimal part of the difference in homicide rates.

Sánchez, Díaz and Formisano (2003) present the most serious econometric effort to analyze violence in the country. They take four types of crimes (homicide,⁹

kidnappings, robbery and piracy) and regress each one against a large array of variables using a spatial technique. Again, the conclusions are quite similar to those of Sánchez and Núñez (2001). However, they find that the spatial component and persistence of crime are also important determinants of crime. In particular, they find that contiguous municipalities and time persistence induces an increased dynamic in crime (for each homicide, four more are created in nearby municipalities).

Finally, Bourguignon, Núñez and Sanchez (2003) link violence with a specific part of the income distribution, mainly, the population below 80% of the mean income.

4. Estimation

a. Empirical strategy

We argue that Equation (3) is relevant in explaining some of the important implications from the literature of violence in the country. In the first place, the absence of the government in several places of the territory can be captured by the parameter ρ . One hypothesis is that crime is increasing with the probability of non-capture ($\partial C_j / \partial \rho_j > 0$).

Another parameter related with this issue is the relationship between punishment (p_j) and crime: in theory, crime decreases as the punishment increase. For this research, in order to test this hypothesis we investigated extensively the penal laws of the country, and the changes in the laws through time (presented in the next section). As presented above, one of the first econometric articles (Montenegro y Posada (1995)) found that the one of the most important variables explaining crime was the weakness of the legal system.

As argued in the previous section, the dynamics of the conflict have been changing in the last decade. Now, there is a clear incentive for the illegal groups to go where there are the sources of financing of their activities. This can be capture by the parameter \bar{h}_j .

Drugs enters the equation not only through \bar{h}_j , but also via the effect their effect on ρ . One of Gaviria's hypotheses is that drugs create congestion in the judiciary system. Also, drugs create a system of enforcement thorough violence: in order to keep the business, homicide and violence prevent denounces and betrayal.

An important discussion of the determinants of crime in Colombia has to do with the so called "objective causes" of violence. In short, the objective causes are the initial causes of violence in the country, mainly inequality and poverty.

Several authors, using data from the eighties and nineties, do not find any effect of variables measuring inequality and poverty on violence. Again, as argued before, probably in the dynamics of the conflict these variables have lost weight in explaining crime, and therefore, the result is not surprising if the data are quite recent.

In the model, the relationship between poverty and crime is capture by the variable \bar{w} . If the returns from legal activities are low, then the crime rate is high. The return from legal activities increase in wealth, and therefore, the higher the poverty the higher the crime rate. The relationship between inequality and crime can be argued along the same lines. Inequality is a relative measure of poverty. Therefore, violence increases with inequality.

The spatial component of the conflict can be capture by the set of variables Ω . As described above, Sanchez et al. (2003) did a spatial estimation. Their focus was, however, the contagiousness of crime from nearby neighborhoods. We believe that in fact the geographical component of crime is important, but in a different way.

The strategy is, therefore, to estimate a specification of Equation (3). However, there are important problems in this estimation that are worth spelling out. These issues can be split in two: first, causality problems and, second, measurement errors.

The potential of double causality in Equation (3) is enormous. Consider the following example: typically, empirical estimations take the income of the geographic region as the proxy for potential returns from crime. The theory predicts that a higher income implies a higher “potential” return from crime and therefore, more crime (e.g. a positive relationship). More crime can produce, however, lower income for several reasons: crime may lead to lower investment; crime may imply the destruction of capital; etc. Therefore, the sign of the relationship between crime and income, as a proxy of potential return from crime, can be positive or negative.

In more formal terms, $E(\varepsilon / \rho, \bar{h}_j, p_j, \bar{w}, \Omega) \neq 0$, and therefore, estimates of $\beta_0 \dots \beta_5$ will be inconsistent. This problem permeates almost all the variables in the estimation.

The probability of detention, $(1 - \rho)$, can be endogenous to crime: if crime increases, the authority can respond with more policemen in the street. Therefore, the causality can be both ways. Same reasoning applies to the severity of the punishment, p_j .

As discussed above, a higher payoff of crime (\bar{h}_j) can induce more crime (as the model predicts), but more crime may induce the destruction of capital or lower investment and therefore, lower the potential payoff.

Measurement errors are also important in the empirical research of crime. If a variable is measured with error, and the error is correlated with the dependent variable, then again the estimates of the parameters of Equation (3) will be biased. If the error is not correlated with any intrinsic characteristic, estimator of Equation (3) is consistent.

With respect to this problem the literature has identified measurement errors in the dependent and in the independent variables. Apparently homicides are measure with accuracy, but other types of crimes have more problems. For instance, it is possible that information from police sources may try to inflate certain types of crimes (robbery) in order to obtain more resources. In this case, and if one of the proxies of probability of detention in Equation (3) is the size of the police force, the estimate of β_1 will be inconsistent. With respect to measurement error in the independent variables, if the error is correlated with the dependent variable the estimates will be inconsistent.

Another related problem is the difficulty to find direct estimates of some of the variables of Equation (3), for instance, the payoffs for both illegal and legal activities. As discussed above, several researchers approximate payoff of illegal activities with income (GDP, GDP per capita, growth, etc). Also, it is common to measure the potential payoff of licit activities with employment rate or wages. As should be clear, these types of proxies (legal and illegal payoffs) are, however, correlated. More growth is accompanied with more employment or better wages.

The solution for both types of problems is instrumental variables. However, finding proper instrumental variables is quite difficult. Part of the contribution of this research is to use instrumental variables techniques to get consistent estimators of Equation (3).

As it is clear from the literature review, conclusions that hold across all studies are nonexistent. One potential explanation for this is the lack of serious effort to correct for endogeneity problems. The only study that uses techniques different than simple OLS and Probit regressions is Sanchez and Núñez (2001). They report a two stage least square estimation, without spelling out the instruments that they use. Sanchez et al. used a spatial estimation, which may correct for spatial correlation of errors.

b. The data: stylized facts

Dependent variables and measurement of crime

We have two sources of data on crime rates. First, information by the Departamento Nacional de Planeacion (DNP) gives the number of homicides, massacres, total number of victims of massacres, bank robbery, kidnappings, and terrorist attacks per municipality. The data are decomposed by the various groups (FARC, ELN, Paramilitaries, Others). Second, data from the Judiciary Police (SIJIN) reports the number of extortions, robberies, car robberies, house robberies, terrorist attacks, jail escapes, robberies of state property, and drug traffic at the departmental level.

Table 1 presents the basic crime data. We divide the presentation across three periods: between 1990 and 1993; between 1994 and 1997; and between 1998 and 2002. At the municipal level, homicides, massacres, and kidnapping are per 100,000 inhabitants. There is not a clear consistent temporal tendency among them. Whereas homicides and bank robberies are declining through time, massacres, kidnapping and terrorist attacks are increasing. In order to see the dispersion of crimes across municipalities, we calculate the coefficient of variance (from now on, c.v.), which is the standard error divided by the mean. Usually, if the c.v. is increasing the population is becoming more heterogeneous, e.g. there is more dispersion of crimes across municipalities. Dispersion is decreasing for all crimes, except for massacres, at the municipal level.

Table 1. Crimes

	1990-2002		1990-1993		1994-1997		1998-2002	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Municipal								
Homicide	64.33	1.69	72.49	1.76	61.64	1.82	59.95	1.53
Massacre	30.49	1.37	NA	NA	23.78	1.00	34.52	1.59
Kidnapping	8.84	2.68	NA	NA	5.48	2.65	10.86	2.69
Bank robbery	0.54	16.10	0.75	21.62	0.66	19.70	0.41	12.11
City attacks	1.15	4.89	0.63	6.82	1.11	4.83	1.29	4.55
Departmental								
Terrorist	3.87	1.56	2.11	1.38	3.98	1.24	5.52	2.07
Extortion	1.85	0.98	1.87	1.05	1.63	0.94	2.06	0.96
Robbery	51.77	1.36	96.89	1.07	39.82	1.33	25.23	1.63
Stolen cars	35.51	1.10	11.72	1.62	39.54	0.94	51.33	0.80
Robbery of residency	26.17	1.42	19.59	1.50	26.17	1.65	31.44	1.15
Drug crimes	444.88	1.76	313.07	1.51	414.95	1.60	574.26	2.08
Nation. econ. patrimony	3138.82	2.17	3038.50	1.95	3237.95	2.58	3139.76	2.02

With respect to the departmental data, all the crimes, except for robberies, are increasing through time and in general the c.v. is decreasing. It is important to point out that these tendencies can be the effect of more denounces or that the

authorities are becoming more effective. As stated above, these types of crime measurement are prone to measurement errors.

Independent variables

Table 2 presents basic data on the independent variables of Equation (3). With respect to the proxies of illicit income, we look at four variables: income of the municipality, expenditure of the municipality, transfers to the municipality, and tax on property, industry and commerce. In essence, the assumption is that the revenues of illicit activities are increasing in these variables, as argued by Bourgnioun et al. (2003).

Table 2. Independent variables

	1990-2002		1990-1993		1994-1997		1998-2002	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Expenditure p.c.*	143.06	1.65	40.96	1.98	106.13	1.71	226.32	1.45
Income p.c.*	142.22	1.73	41.52	2.16	101.10	1.86	230.61	1.41
Transfers p.c.*	111.31	1.60	32.78	2.04	79.51	1.70	179.89	1.31
Prop.tax p.c.*	8.15	0.82	2.82	0.91	6.42	0.80	12.24	0.83
Indust.tax p.c.*	4.32	0.34	1.50	0.32	3.16	0.35	6.82	0.33
NBI	47.96	2.09	49.49	2.17	49.21	2.17	45.74	1.95
Criminals apprehended**	188.03	1.70	144.19	1.54	161.18	1.85	244.59	1.70

*Thousand of \$

**Per 100.000 inha.

The Index of Unsatisfied Basic Necessities (NBI) captures poverty, and as argued above, it is a proxy for licit income. As the index increases, there are fewer opportunities for licit activities and therefore, we expect to observe a higher crime rate.

The probability of capture is measured by the number of criminals apprehended (per 100.000 inhabitants). As Table 2 shows, the number is increasing through time.

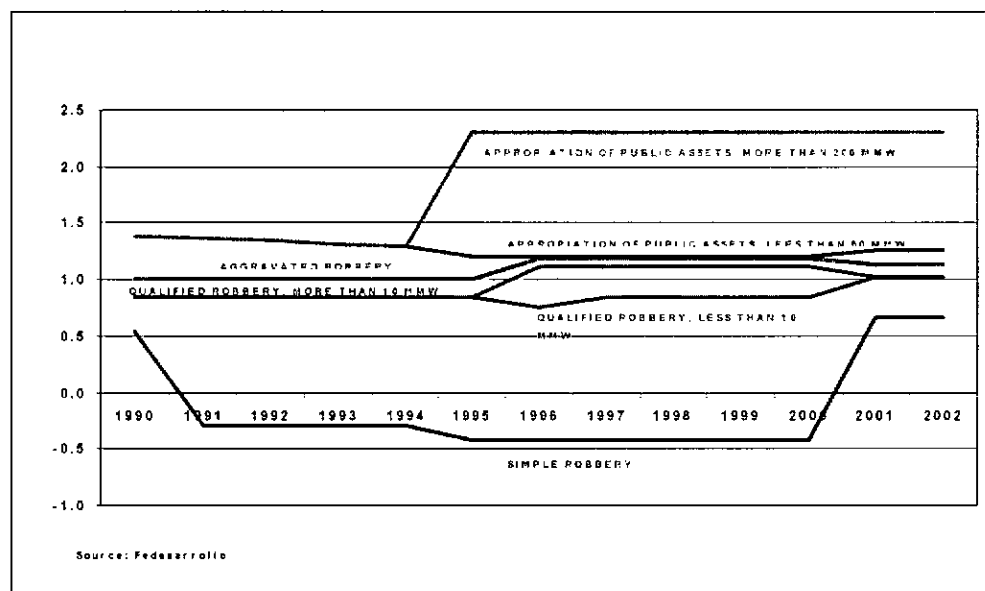
The cost of capture is of special interest in this paper. As the literature review shows, there is an apparent consensus that one of the major problems of crime in the country is the legal system. To test this hypothesis, we construct an index of legal punishment, by type of crime. Graphs 1 through 5 show the indices for several crimes. The description of the construction of the index is presented in the Appendix 1.

Each index comprises an array of characteristics of the code (mainly, the number of years of punishment, the fines, and aggravation or attenuation circumstances) of each crime, according to the several Penal Codes of the country for the period 1990-2002. Several intrinsic properties of the index are important. In the first

place, the level of the index is not relevant. The relevant aspects are the change and the direction of the index. Second, the punishment is higher if the value of the index is higher. Third, the relative position of the index of a particular crime is important.

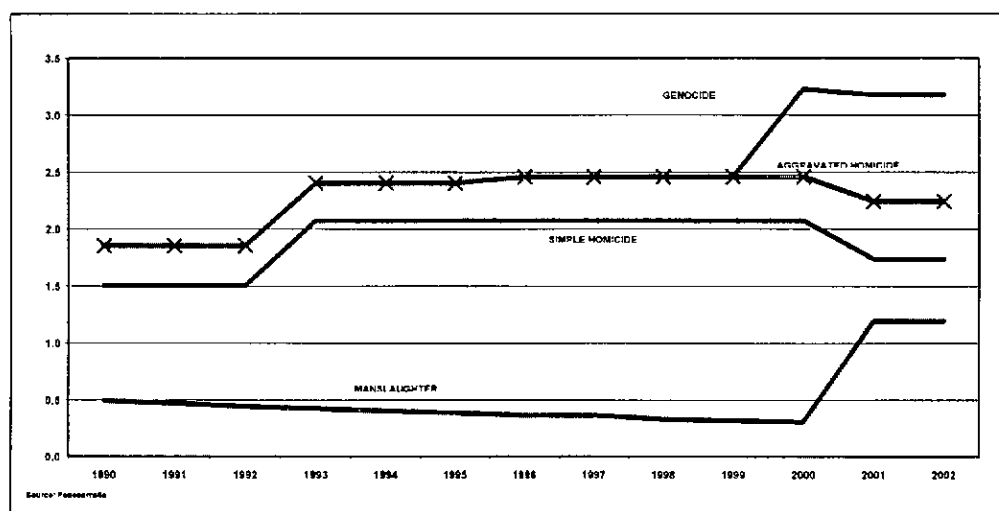
Graph 1 presents the indexes for robbery and appropriation of public assets. In general terms, there is a tendency for the hardening of the code for all crimes during the nineties (with the exception of simple robbery). It is interesting to observe that appropriation of public assets receives a harder punishment than any robbery, included aggravated robbery. Finally, there are two major reforms for the punishment of these crimes during the nineties: one in 1995 and the other in 2000.

Graph 1. Crimes Against Property



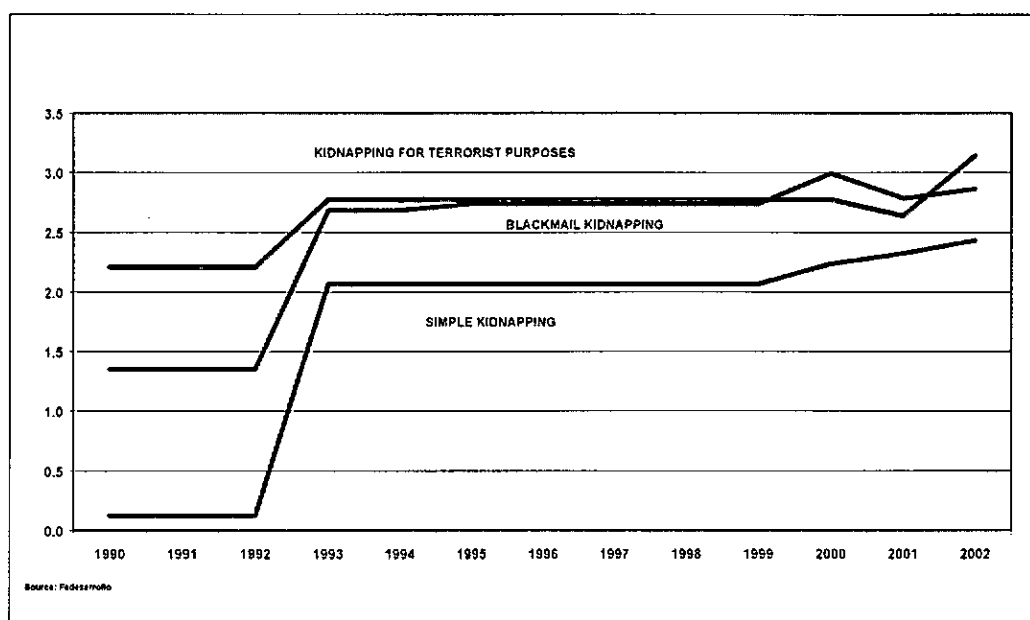
As Graph 2 shows, there is a tendency towards the hardening of the punishment for homicide and genocide. The decline in the punishment for manslaughter is caused by to a fine imposed in current pesos, a value that declines with inflation. There are two main years of reform, 1993 and 2000.

Graph 2. Crimes Against Life and Personal Integrity



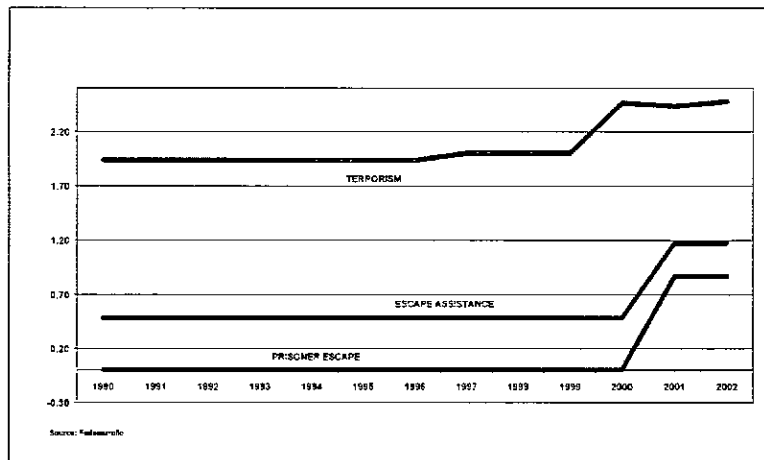
The punishment for kidnapping has gone through two major changes, both of them towards the toughening of the punishment (Graph 3). First, in 1993 the degree of punishment almost doubles with respect to the original level; second, since the 2000 the potential punishment has been increasing slightly.

Graph 3. Crimes Against Personal Freedom



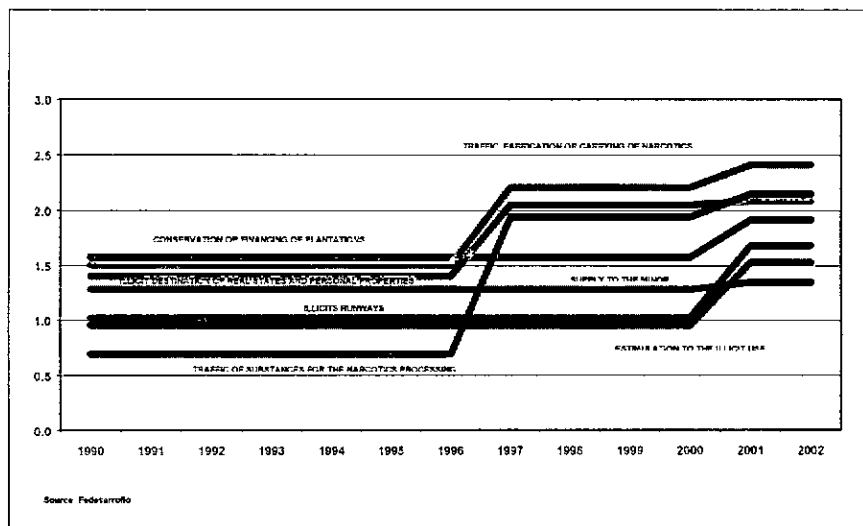
In terms of terrorism and prison escape (Graph 4), the penal code did not change until 2001, with the Law 599

Graph 4. Crimes Against Public Security and Prison Escape



Finally, punishments for drug related crimes were stable until 1997 (Graph 5). In that year the punishment increases especially for the crime related with the inputs of the drug manufacturing processes. Finally, the potential punishment for all of the drug related crimes increased in 2001 with the Law 599.

Graph 5. Drug Related Crimes



c. Hypothesis testing

Based on the literature review, we formed four hypotheses.

1. *There is a correlation between drug of crimes and other type of crimes.*

The most simple and direct way to test this hypothesis is the see the table of correlations for different crimes. Table 3 shows the pairwise correlations between drug crimes and others crimes, as well as between homicides and other crimes.

Drug crimes are statistically significantly correlated with all crimes except with car robberies. All crimes, with the exception of terrorist attacks, have a positive relationship with drug crimes. The degree of correlation has changed through time. All correlations are higher during the first half of the period under investigation (1990-1995) than in the second period. The only exception is homicide, which has declined not only in the actual number but also in its statistical significance. A potential explanation for these declines in the correlation between drug crimes and other crimes is that the major drug dealers (the heads of Medellin and Cali cartels) were free and in activity during the first half of the nineties. In contrast, during the second half of the decade the cartel of Medellin was dismantled and the main figures of the Cali cartel were in jail. Nonetheless, drug crime is still correlated with other types of crimes.

Table 3
Relationship between crimes:
Pairwise correlation

	Entire period		First half		Second half	
	Drug crimes	Homicide	Drug crimes	Homicide	Drug crimes	Homicide
Drug crimes	1		1		1	
Homicide	0.1413*	1	0.3321*	1	0.0699	1
Terrorist attack	-0.1000*	0.2174*	-0.0994	0.2364*	-0.1173*	0.2442*
Extortion	0.1537*	0.3391*	0.2440*	0.4457*	0.1328*	0.2489*
Robbery	0.0032	0.1574*	0.0186	0.2318*	0.0656	0.0628
Car robbery	0.5587*	0.3507*	0.6978*	0.4158*	0.5407*	0.3828*
Residential rob.	0.2104*	-0.0854*	0.3139*	0.0471	0.1690*	-0.2002*

*Coefficient significant at 10 percent

2. *Guerrilla activity causes paramilitary activity.*

A direct way to test causality is to use the Granger test of causality. In simple terms, the test explores if the past observations of a variable are important in explaining another one. In order to perform the test, the variable of attacks by one violent group is regressed against its own past values of attacks and the present and past values of the attacks of the other group. For example, if the past variables of paramilitaries are statistically significant in explaining the attacks by the FARC, then we can say that attacks by Paramilitaries Granger causes attacks by the FARC.

Table 4 presents the results. The first column shows the regression of attacks by paramilitaries against its own past and the attacks by the FARC (and past attacks of FARC). Lags 2 and 3 of FARC attacks are significant in explaining attacks by Paramilitaries. Lag 1 of attacks by paramilitaries is significant in explaining

present attacks. Running the Granger test, which is an F test, gives the value $F(4,11173)=7.44$, which indicates that the FARC attacks causes Paramilitary attacks.

The second column presents the other causality: attacks by paramilitaries causing FARC attacks. One interesting fact of the regression is the degree of persistence of FARC attacks, given by the positive and statistically significant coefficients of past attacks. The past Paramilitary attacks are also statistically significant in explaining FARC attacks. As a consequence, the hypothesis of this causality is supported ($F(4,1173)=14.395$).

The third column shows the results for causality between Paramilitaries and the ELN. In this case, none of the past attacks of ELN are statistically significant in explaining the attacks of Paramilitaries. The Granger test gives a value of 0.4, which indicates that the hypothesis of causality is rejected.

Table 4. Causality among illicit groups

Indep. var: attack of	Depend. var: attack of			
	Paramilitaries	Farc	Paramilitaries	Eln
Paramilitaries		-0.0441		0.1074
Paramilitaries(-1)	0.0780 *	1.2353 *	0.0797 *	0.1432
Paramilitaries(-2)	-0.0088	-0.2970 ***	-0.0077	-0.3765
Paramilitaries(-3)	-0.0049	0.2094	-0.0027	-0.1843
Farc	-0.0002			
Farc(-1)	0.0004	0.3890 *		
Farc(-2)	0.0010 ***	0.2812 *		
Farc(-3)	0.0031 *	0.0047		
Eln			0.0002	
Eln(-1)			-0.0001	0.4712 *
Eln(-2)			0.0004	0.0832 *
Eln(-3)			0.0000	0.1681 *
R2 adjusted	0.008	0.197	0.005	0.377
F stat	13.840	392.970	9.820	965.540

* Sign. at 99%

** Sign. at 85%

The last column presents the result of causality from paramilitaries to ELN. In this case as well, the persistence of ELN activity is clear (lag attacks are statistically significant). Past attacks of the Paramilitaries does not explain ELN

activities ($F(4,11173)=0.86107$)

In sum, there is evidence of a mutual causality between attacks of Paramilitaries and FARC. Contrary to previous research, we find that attacks of ELN and Paramilitaries are not connected, and they there is no Granger causality.

3. *Conflict (guerrilla and paramilitary activity) is correlated with other crimes (e.g. total homicides and drug traffic)*

As stated in the introduction, one underlying assumption is that the armed conflict is correlated with some types of crime. Conflict is modeled by the number of municipal attacks by the three main players, paramilitaries, FARC and ELN.

Table 5 presents the pairwise correlations between attacks by each armed group and different types of crime. For the entire period, the attacks by FARC and ELN are positively correlated, and statistically significant, with drug crimes, homicides, kidnappings, and bank robberies. The attacks by Paramilitaries are correlated with drug crimes and kidnappings. The Table indicates that the correlation is not stable through time. The correlation between FARC attacks and homicides and kidnappings is increasing in time.

Table 5. Pairwise correlation: conflict and crimes

Period:	Entire period			First half			Second half		
Attacks of:	FARC	ELN	Paramil.	FARC	ELN	Paramil.	FARC	ELN	Paramil.
Crimes:									
Drug	0.0996*	0.0558*	0.0447*	0.0955*	0.0363*	Low d.f.	0.0816*	0.0527*	0.0432*
Homicide	0.0632*	0.0336*	0.0046	0.0244*	0.0059	Low d.f.	0.1011*	0.0578*	0.0095
Massacres	-0.0679	-0.0719	0.0101	-0.1682	-0.3193	Low d.f.	-0.0659	-0.0714	0.0073
Kidnapping	0.1051*	0.1180*	0.0521*	0.0520*	0.0782*	Low d.f.	0.1035*	0.1189*	0.0509*
Bank rob.	0.2817*	0.2030*	0.0115	0.5624*	0.3199*	Low d.f.	0.2093*	0.1531*	0.0192

* Correlation significant at a 95% confidence

Low d.f: low level of observations

One interesting fact that appears from the correlations is the negative relationship between guerrilla attack and massacres. The relationship between paramilitaries and massacres is positive, but statistically not significant.

In sum, there is a clear correlation between conflict and crime in the country. It is important to keep in mind that the sources of variation of these data are both spatial and temporal. Municipalities with higher attacks by guerrilla are the ones that observe more crimes; years with more attacks also present higher crime rates. Still, the question of what causes what is not solved.

4. *Increment in punishment by penal laws did not reduced crime.*

To test hypothesis 4, we test for Granger Causality between the degree of punishment and the various types of crime.³ In this case we run a regression of each crime against its past values and against the present and past values of the punishment index. We test if the present and past values of the index explain the current levels of the crime. In theory as the index increases the level of crime decreases, if the penal law works in reducing crime.⁴

Table 6a presents the regression results. A common characteristic that emerges from the table is the persistence of crime across time. For all crimes, the coefficients on its own past values are positive and statistically significant, with the exception of homicides in which the second lag is negative.

Table 6a. Regression of Crimes against Legal Codes

Independent variables:	Dependent variable				
	Homicide	Kidnapping	Drugs crimes	Robbery	Attacks
Own Lag 1	1.0778 *	0.7431602 *	0.2548489 *	0.468842 *	0.315105 *
Own Lag 2	-0.131279 *	0.2448176 *	0.7748888 *	0.164793 *	0.507933 *
Index Legal Code	6.248967	28.64598	-59.70595	21.02048	2.659012
Index Legal Code Lag 1	-76.60724	-130.8582 *	413.397 *	-38.72403	-1.525906
Index Legal Code Lag 2	91.57847	-89.81168 *	-405.5904 *	-15.5063	-12.77278 *
Constant	-3.195998	543.5052 *	95.34062	47.26742	23.73964 *
R2 adjusted	0.9787	0.8225	0.7777	0.4799	0.5197
F statistic	3331.64	183.58	254.26	65.41	76.96

* Statistically significant at 95%

A second common characteristic is that the current value of the legal index does not affect any crime rate. Apparently for homicides, as well as for robberies, the legal code is totally ineffective, from a purely statistical viewpoint. Kidnappings are affected negatively by the past values of the legal code. The results for drugs crimes are difficult to interpret: while the first lag of the index is positive (the higher the punishment the higher the amount of crime), the second lag is negative. Given the size of the coefficients, the effects cancel each other out.

³ Echeverry and Partow (1998) regress a measure of probability of capture against crime. They find that the juridical system is quite ineffective: as the degree of the crime increases, the probability of conviction does not.

⁴ Clearly, this method is not complete because crimes depend of other variables as well. We will estimate complete models below.

Finally, for attacks (by guerrilla and paramilitaries), the past values of the legal code have some effect.

We also test for Granger causality between crimes and legal indices. Table 6b shows the results. With respect to terrorism, we find double causality (crime “changes” the legal code, the legal code affects crime). With respect to robbery, only causality from crime to the law is established. The law affects drug crimes; apparently drug crimes do not affect the severity of the law. In terms of kidnappings, we find double causality as well, but clearly the probability of causality of the crime towards the law is stronger in a statistical sense. Finally, for homicides, only causality from the crime to the law can be established.⁵

Table 6b. Granger Causality between Law and Crime

Terrorism	
Law changes crime	F stat
Crime changes law	12.49857 *
	8.319349 *
Robbery	
Law changes crime	F stat
Crime changes law	0.667247
	8.208441 *
Drug crime	
Law changes crime	F stat
Crime changes law	3.043543 *
	0.511039
Kidnapping	
Law changes crime	F stat
Crime changes law	6.485487 *
	1226.606 *
Homicide	
Law changes crime	F stat
Crime changes law	0.714841
	2.586912 *

*: Sign (95%)

In conclusion, for three types of crimes (terrorist attacks, kidnappings and drug crimes), the law has induced changes in the behavior of criminals. For robbery and homicide, the law is ineffective in reducing the number of these types of crimes from a purely statistical viewpoint.

⁵ However, as it is show below, once we control for other covariates, the law reduces homicide.

d. Model estimation

From the literature review, we can gather four general facts. First, *inequality and poverty do not cause violence*. This hypothesis is currently under heated debate. The majority of studies do not find a relationship between poverty and violence; a few of them find a relationship between inequality and crime. An explanation for the result is the limitation of the data. As explained before, at the beginning of the guerrilla groups were formed with the purpose of reducing inequality and poverty. Probably with good data of the sixties and seventies, it would be possible to find a relationship between poverty and violence. Currently, the guerrilla and paramilitary activity in the territory is based on another rationality: they are close to financial sources, in areas without the presence of State, and in strategic corridors.

Second, *crime occurs in zones where the presence of State is weak*. Fedesarrollo constructed a set of variables that allows for the direct testing of this hypothesis. Concretely, we measured the amount of municipal investment, which is a direct way to capture governmental investment. Third, *crime is higher in richer zones*. In terms of the model of Becker, a higher return of illicit activities will lead to higher crime rate. As argue by Bourguignon et al. (2003), the return of illegal activities can be modeled as an increasing function of municipal income where the crime is committed. Several proxies were tested in order to capture this effect. Finally, *crime is a decreasing function of the probability of capture*. Apparently, this is one of the most stable regularities in the empirical literature of crime in Colombia. In our analysis we test whether or not with our expanded dataset we reach the same conclusions.

We run Equation (3) at the municipal level for three different types of crimes, homicides, kidnappings and terrorist attacks.

Homicide

Table 7 shows the regression results for the rate of homicide per 100.000 inhabitants. The basic model includes municipal transfers (as proxy for potential illegal return), the index of basic unsatisfied necessities (proxy for legal return), number of criminals apprehended per 100.000 (proxy of probability of capture), the legal index of homicide (proxy of potential punishment), the municipal investment (proxy for governmental presence) and the level of drug activity.

The results of an OLS regression of the basic model are quite interesting. All of the expected signs are as expected, with the exception of the coefficient of the index of basic necessities, which is negative and significant. If the illicit return is higher, the crime activity is higher; if the probability of apprehension increases, the crime decreases; if drug activity increases, homicide crime increases; if the

legal index increases, the crime decreases; finally, if the presence of the State increases, crime decreases. The explanation of the total variation of the crime by the model is, however, quite low.

If the same model is estimated using fixed effects by municipality (column two), some of the results change. In concrete, the coefficient of drug activity becomes negative. A potential explanation for this is that drug activity is predominant in few municipalities of the country, and once we control for others characteristics of the municipality with the inclusion of fixed effects, the effect of drug activity vanishes.

Table 7

Determinants of Homicides

Dependent variable: Homicide per 100,000 inh.

	Basic Model	Fixed Eff.	Fixed Eff. Homi<mean	Fixed Eff. Homi>mean	IV	IV Homi<mean	IV Homi>mean
Municipal transfers	0.016	0.024 *	0.003	0.100 *	0.010	-0.009 *	0.078 *
Index of basis necessities	-0.282 *	-0.228	0.147 *	-0.395	-0.210 *	-0.050	0.120
Criminals apprehended	-0.038 *	-0.014 ***	0.002	-0.043 *	-0.161 *	-0.023 *	-0.128 *
Drug crime	0.025 *	-0.012 *	-0.001 *	-0.004	0.064 *	0.015 *	0.036 **
Penal index hom.	-191.939 *	-90.444 *	-45.101 *	-95.481	-104.010 *	-24.770 *	-139.052
Munic.investment	-7.030E-08 *	1.37E-08	-7.61E-09	-3.18E-08	-1.47E-07 *	-3.00E-08 *	-2.62E-07
Constant	535.14 *	303.80 *	125.91 *	395.66 *	317.84 *	84.91 *	453.94 *
Number of obs.	6395	6395	4174	2254	6323	4118	2238
F statistic	49.52	11.22	7.39	3.39			
R2 adjusted	0.04	0.67	0.55	0.75	0.04	0.06	0.02
Wald statistic					113.15	68.42	20.11

The results are more interesting when we separate the municipalities to those that have high homicide rates and those that have low homicide rates. Column three present the results for the low-homicide municipalities, and column four for those with high rates. The results are quite different for each group. For those municipals with low homicide rates, the index of basic necessities is positive and statistically significant and the law induces changes in the action of the criminals. For those municipalities in which the crime rate is high, the potential amount of illicit return (captured by municipal transfers) and the number of criminals apprehended are the most important determinant of the crime.

As argued in the previous section, problems of endogeneity can be severe in the estimation of Equation (3). In order to correct for these effects, we estimate the equation using three instruments: the distance of municipality to next main market (variable constructed by Fabio Sanchez); availability of water in the municipality; and a dummy indicator for the periods of district attorneys in the country. The rationality of using the first and second variable is that that variables are correlated with potential income from the illicit activities; the third one provides an instrument for changes in the legal codes and the war against drugs.

The results of the IV estimation are presented in column five. The model gives similar results as the previous ones, with the exception of the coefficient of drugs. Now, the coefficient is, as expected, positive and statistical significant. Still, the coefficient on the index of basic necessities is negative. However, when the same estimation is separated between municipalities with high and low criminal rates, the index loses significance in both regressions. Municipal transfers affect positively crimes only in municipalities with high homicide rates. Drug crimes impact positively homicide crimes in both types of municipalities. Finally, municipality investment reduces homicide crimes only in those places with low levels of homicide.

In conclusion, several main regularities emerge in the explanation of homicide rates. First, municipal transfers, as proxy for potential return of crime, explain homicides in those municipalities with high rates of homicide. The index of basic necessities does not yield stable results. At best, it explains crime in those municipalities with low level of homicides. Number of apprehended criminals and the penal index yields stable results: in general, an increment in those two variables reduces crime rates. However, the index works "better" for municipalities with low criminal rates and apprehension of criminals in those municipalities with high criminal rates. Finally, presence of the state works in reducing crime in those places where the crime rate is low.

Kidnapping

Several differences appear between determinants of kidnapping and homicide. In this case, we use income of the municipality as proxy for illicit return of crime. The basic model presents all the expected signs, with the exception of the legal index. As argued before, the probability of causality between the index and the crime is from the crime to index. In other words, the law is changed, as the crime is more prevalent, and that explains the positive sign on the coefficient (Table 8). With respect to the other main difference between this regression and the analogous one for homicides, the coefficient for the index of basic unsatisfied necessities is positive and statistically significant. Once the model is run using fixed effects by municipality, the only two variables that explain the rate of kidnappings are drug crimes and the legal index.

Table 8
Determinants of Kidnaping
Dependent variable: Kidnaping per 100,000 inh.

	Basic Model	Fixed Eff.	IV	IV Homi<mean	IV Homi>mean
Income of municipality	0.005 *	0.004	-0.007 *	-0.002 *	0.038 *
Index of basis necesities	0.090 *	0.030	0.140 *	0.005 **	0.266 *
Criminals apprehended	-0.005 *	0.002	-0.006 *	-0.001 *	-0.007
Drug crime	0.003 *	0.003 *	0.003 *	0.000 *	0.003 *
Penal index kidnaping	16.810 *	14.076 *	71.132 *	6.620 *	62.902 *
Munic.investment	-1.11E-08 *	-6.99E-09	-9.33E-09 ***	7.84E-10	-1.54E-07
Constant	-44.654 *	-35.801 *	-195.383 *	-16.937 *	-166.495 *
Number of obs.	4805	4805	4751	3654	1186
F statistic	27.69	10.89			
R2 adjusted	0.03	0.1984	0.0202	0.01	0.04
Wald statistic			155.5	63.21	50.88

As presented before, probably the results of the basic OLS model are biased due to endogeneity problems. The third column presents the IV estimation, using the same type of instruments as were used in the homicide regressions. All the variables keep the same signs, with the exception of the municipal income. However, once we split the sample into municipalities with high and low kidnap rates, the sign on the municipal income has the expected direction for municipalities with high kidnap rates. This result is analogous to the one found for homicide. Another main difference between municipalities with high and low kidnap rates is the asymmetry of the effect of criminals apprehended. It seems that this variable reduces crimes for those places in which crime is low (contrary to the effect in the homicide case).

As in the case of homicide, we see differences of behavior between municipalities with high and low crime rates. One striking difference between homicides and kidnappings is the effect of poverty in the determinant of the crimes. While the relationship between homicide and the index of basic necessities is instable, the relationship between the index and kidnappings is stable, positive and statistically significant.

Terrorist attacks

We add the attacks by paramilitaries, FARC and ELN, and run the model given by Equation (3). The results are presented in Table 9.

Table 9. Determinants of terrorist attacks
Dependent variable: attacks pre municipality

	Basic Model	IV	IV Attacks<mean	IV Attacks>mean
Property tax	1.07E-06 *	3.14E-07 *	5.65E-08 *	3.84E-07 *
Index of basis necessities	-0.004205	-0.018242 *	0.001115 *	-0.0696 *
Criminals apprehended	-0.002521 *	-0.001249 ***	-0.000341 *	0.000988
Drug crime	0.000274 *	0.000677 **	0.000128 *	-0.000821
Penal index terrorist	0.848947 *	0.206162	-0.025669	1.940723 ***
Munic.investment	-1.22E-07 *	-3.16E-08 *	1.71E-09	-3.74E-08 *
Constant	-0.187633	1.421577 *	0.138705 *	4.615077 **
Number of obs.	6416	6344	5303	1041
F statistic	949.42			
R2 adjusted	0.4701	0.3957	0.018	0.4472
Wald statistic		431.32	73.1	124.85

In this case, the proxy for illicit return is property tax. The basic model (OLS, first column) presents the same characteristics as the counterparts for homicide and kidnapping. As in the case of homicides the index of basic necessities has a negative coefficient, but it is statistical insignificant. The sign of the coefficient on property tax is positive and statistically significant. The IV estimation presents almost the same properties as the OLS.

For this case, the separation between municipalities with high and low crime rates, gives three main differences. First, drug crime affect positively terrorist attacks for municipalities with low crime rates. Second, the number of criminals apprehended reduces terrorist attacks in municipalities with low crime rates. Finally, presence of the State reduces crimes for those municipalities with high crime rates.

5. Conclusion

The conclusions from the existing empirical literature are disappointing and contradictory. While some authors find that one variable is an important determinant of crime and violence, others find the contrary. For this paper we tested some of the most controversial conclusions of the literature by using a new dataset and techniques.

Our findings are the following:

1. Drug crimes are critical determinants of all other types of crimes.
2. Guerrilla activity is correlated with drug crimes, kidnappings, homicides and bank robberies. Paramilitary activity is correlated with drug crimes and kidnappings. The correlation between FARC activity and kidnappings and homicides has been increasing in the last decade
3. Laws are ineffective for reducing homicide rates and robbery; they are effective in reducing kidnappings, terrorist attacks and drug crimes. Causality from crime to laws (increments in crimes inducing changes in law) is apparent in homicides and robbery; double causality is detected in kidnappings and terrorist attacks.
4. Regarding the determinants of crimes, there is variation across the type of crimes and across the type of municipality.
5. The return of illicit activities is a determinant of crimes for those municipalities with high crime rates.
6. Poverty determines homicides in municipalities with low crime rates; it determines kidnappings in all type of municipalities. For terrorist attacks (guerrilla and paramilitary attacks), poverty has asymmetric results.
7. The probability of capture is a quite stable and statistically significant determinant of the three types of crimes under investigation.
8. The presence of the State is an important and significant determinant of reducing terrorist attacks; it is not significant for kidnappings and it is significant for reducing homicide in municipalities with low levels of crime.

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Append 1. A Penal Law Index in Colombia, 1990-2002⁶

1. Introduction

One of the main characteristics of Colombia during the nineties is the increment in several types of crimes. Probably as result of this increment in violence, the country has been changing in a very rapid and drastic way its legislation concerning penal laws during the last 12 years. As a matter of fact, during this period there have been around five mayor laws reforming the legal parameters of punishment of several crimes.

Starting with the article of Becker (1968), economists has been thinking in crime as a rational activity in which people balance the expected benefit of committing the crime with the expected cost of it. The expected cost of crime includes two fundamental parameters, the probability of capture and the actual punishment. In order to explore the relationship between "punishment" and crime, we build an index of legal changes of the penal law during the nineties. The objective of this article is to present this "Penal Law Index" by type of crime.

One advance of this article with respect to others⁷ is the fact that we try to do a more clean measure of the changes in the Law. In order to do this, we interact with the expert in criminal law Diana Gonzales⁸. Thanks with this interaction we build a bridge between economist and lawyers, bridge that usually does not exist.

The article has three parts, including this one. In the second part, we present a review of the fundamental Laws concerning several types of crimes. In the third part we construct an index of the Laws by type crime, and we draw some conclusions based on the index.

A word of advise before presenting the Laws: we tried to choose general characteristics of the law that are somehow well specified in the codes. However, there are several cases in which interpretation, and particular circumstances, plays an important role and therefore the Law is not rigid and univocal as we are presenting it in this article. The Index has to be taken as an indicator of tendencies of the legal system in the country.

⁶ Carolina Latorre is coauthor of this part of the work.

⁷ For instance, Montenegro et. al. (2000) reviews some of the Penal Law.

⁸ In fact, Diana González has been judge and prosecutor at different times of her career.

2. Resume of law

We are going to divide the crimes in six types: crimes against property (mainly robbery and appropriation of public assets); crimes against life and personal integrity (homicide and the likes); crimes against public security (terrorist) and prison escape; crimes against personal freedom (kidnap); and drugs related crimes.

a. Crimes against property and public administration

With respect to crimes against property, we are going to focus in "hurto simple" (simple robbery), "hurto calificado" (qualified robbery) and "hurto agravado" (aggravated robbery). Table 1 presents, by year, the main Laws for this type of crimes. In terms of public administration, we are going to present the crime of appropriation of public assets.

Table 1. Crimes Against Property

		1980	1982	1991	1995	1996	1997	2001	
Simple Robbery	Law Punishment Minimal Punishment Maximal Punishment Attenuation	Decree 100 Prison 1 Year 6 Years -		Law 23 Arrest 6 Months 12 Months -		Law 228 Down ¹		Law 559 Prison 2 Years 6 Years Up ²	1. When there are not aggravation circumstances the penal action will be extinguished if the total damage is repaired 2. It goes from special contravention to crime
Qualified Robbery, less than 10 mmw	Law Punishment Minimal Punishment Maximal Punishment Attenuation	Decree 100 Prison 2 Years 8 Years -				Law 228 Down ¹	Repealed Law 228 Up ²	Law 559 Prison 3 Years 8 Years Up ³	1. It goes from crime to special contravention 2. It goes from special contravention to crime 3. The punishment increases with some aggravation circumstances
Qualified Robbery, more than 10 mmw	Law Punishment Minimal Punishment Maximal Punishment Attenuation	Decree 100 Prison 2 Years 8 Years -				Law 228 Prison 4 Years 10 Years -		Law 559 Prison 3 Years 8 Years Up ¹	1. The punishment increases with some aggravation circumstances
Aggravated Robbery	Law Punishment Minimal Punishment Maximal Punishment Attenuation	Decree 100 Prison 28 Months 12 Years -				Law 228 Prison 58 Months 15 Years Down ¹		Law 559 Prison 42 Months 12 Years Up ²	1. When there are not aggravation circumstances the penal action will be reduced if the total damage is repaired 2. The punishment increases with some aggravation circumstances
Appropriation of Public Assets, less than 50 mmw	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Decree 100 Prison 2 Years 10 Years - \$1,000 \$1,000,000	Decree 180 Prison 4 Years 15 Years - \$20,000 \$2,000,000		Law 190 Prison 54 Months 90 Months Up ¹ Amount Appropriated			Law 559 Prison 4 Years 10 Years - Amount Appropriated	1. The interdiction of rights and public functions is increased
Appropriation of Public Assets, more than 200 mmw	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Decree 100 Prison 2 Years 10 Years - \$1,000 \$1,000,000	Decree 180 Prison 4 Years 15 Years - \$20,000 \$2,000,000		Law 190 Prison 9 Years 270 Months Up ¹ Amount Appropriated			Law 559 Prison 54 Months 90 Months - Amount Appropriated	1. The interdiction of rights and public functions is increased

For simple robbery, the Decree 100 of 1980 imposed a minimal sentence of 1 year, and a maximal one of 6 years. It was defined as a crime, in contraposition of a contravention, and therefore was subject of prison. In 1991, with the Law 23, the simple robbery change of nature and become a contravention. Because of this,

it was subject of arrest, which is a lesser punishment as prison. Also, Law 23 reduced to minimal and maximal sentences to 6 and 12 months, respectively. The Law 228 of 1995 went further, and declares not penal sanction in cases of restitution of the full amount of the robbery in cases in which there were not causes of aggravation. With the Law 559 of 2000, the simple robbery became again a crime, with prison as punishment. Minimal and maximal sentences increase to 2 and 6 years.

Decree 100 of 1980 imposed prison of 2 to 8 years for qualified robbery, which is a robbery under special circumstances. For example, it is the robbery in which violence over individuals is exercised. Accordingly, the Law imposed a more severe punishment for this crime than for simple robbery (between 2 to 8 years of prison). In 2000, the Law 559 added aggravation causes and incremented to potential punishment to 3 and 8 years of prison (there are differences if the amount of the robbery is higher or lower than 10 minimum wages).

Aggravate robbery is a crime in which more circumstances are added to the robbery. The Decree 100 determined a range of potential jail between 2.3 and 12 years. In 1995, the Law 1995 prescribed the possibility of reducing the punishment to one half if there is complete restitution. In 2000, the Law 559 added more circumstances of aggravation.

The crime of appropriation of public asset has four mayor changes since the Decree 100 of 1980. According to that law, this crime had a fine (imposed in current pesos), prison between 2 to 10 years and lost of civil rights for 1 to 5 years. In 1982 (Law 180) the minimal and maximal punishment increases to 4 and 15 years, the fine increased as well and the years of privacy of public rights increment as well. In 1995 the Law 190 separated the punishment of the crime according to the amount stolen. If the amount did not pass the 50 minimum wages, the punishment was between 4.5 and 7.5 years. If it was higher than 200 minimum wages, the punishment oscillated between 9 and 22.5 years. Also, it increases previous number of years of lost of civil rights. With the Law 2000, the crime maintained the same parameters, except for the number of years of prison for crimes of less than 50 minimum wages. In this case, the punishment changed to 4 -10 years of prison.

b. Crimes against life and personal integrity

We review three types of crimes among this category: simple homicide, aggravate homicide and "homicidio culposo" (manslaughter), despite that in Table 2 we present several other crimes.

Table 2. Crimes Against Life and Personal Integrity

		1980	1993	1996	2000	2001	
Simple Homicide	Law	Decree 100	Law 40			Law 559	
	Punishment	Prison	Prison			Prison	
	Minimal Punishment	10 Years	25 Years			13 Years	
	Maximal Punishment	15 Years	40 Years			25 Years	
Aggravate Homicide	Attenuation	-	-			-	
	Law	Decree 100	Law 40	Decree 1901		Law 559	1. Some aggravation circumstances like terrorism goals are added
	Punishment	Prison	Prison			Prison	2. The granting of benefits to some criminals are excluded
	Minimal Punishment	16 Years	40 Years			25 Years	3. Some aggravation circumstances are added
Manslaughter	Maximal Punishment	30 Years	60 Years	Up ²		40 Years	
	Attenuation	-	Up ¹			Up ³	
	Law	Decree 100				Law 559	1. The having of guns and vehicles is forbidden
	Punishment	Prison				Prison	
Genocide	Minimal Punishment	2 Years				2 Years	
	Maximal Punishment	6 Years				6 Years	
	Attenuation	-				Up ¹	
	Minimal Fine	\$1.000				20 mmw	
Genocide	Maximal Fine	\$10.000				100 mmw	
	Law	Decree 100	Law 40	Decree 1901	Law 589	Law 559	1. Some aggravation circumstances are added
	Punishment	Prison	Prison		Prison	Prison	2. The granting of benefits to some criminals are excluded
	Minimal Punishment	16 Years	40 Years		45 Years	30 Years	3. Interdiction of rights and public functions from 5 to 10 years.
Genocide	Maximal Punishment	30 Years	60 Years		60 Years	40 Years	4. Interdiction of rights and public functions from 5 to 15 years.
	Attenuation	-	Up ¹	Up ²	Up ³	Up ⁴	
	Minimal Fine	-	-	-	500 mmw	2.000 mmw	
	Maximal Fine	-	-	-	2.000 mmw	10.000 mmw	

Simple homicide (literally defined as the killing of other person) was subject of prison between 10 and 15 years according by Decree 100 of 1980. In 1993, Law 40 changed the length of the punishment, increasing minimal and maximal number of years of prison to 25 and 40. In 2000 the Law 559 reduced the minimal and maximal sentences again to 13 and 25 years respectively.

Aggravate homicide was the killing of another person under aggravate circumstances (killing a relative, for instance). The contemplated prison for the crime was 16 to 30 years according to Decree 100. In 1993, the Law 40 introduce more circumstances of aggravation (mainly, terrorist) and incremented the potential punishment to 40 to 60 years of prison. In 1995, Decree 1901 excluded potential benefits of some individuals that commit the crime. According to Law 559, there is an inclusion of other circumstances of aggravate, and reduced the minimal and maximal punishment to 25 and 40 years of jail.

“Homicidio Culposo” (manslaughter) is a crime in which there is a fine, it is motive of prison and have some circumstances of aggravation (like been under influence of drugs). The Decree 100 established prison between 2 and 6 years for manslaughter. Curiously, the fine was established in current pesos of 1980 (between \$1.000 and \$10.000) The law was changed with the Law 559, in which some aggravation aspects were introduced and the fine was established in number of minimal wages.

Genocide (killing of 4 or more people) was “loosely” rule by Law 28 of 1959, in which the country was compromised to follow the international law. With the Law 589 the crime was established and defined at the light of the Colombian code. The law determined that the potential punishment ranged between 45 and 60 years; it implies a fine of between 500 and 2000 minimal wages; and it implies as well the loss of civil rights for a range of years between 5 and 10. With the Law 559, there is an increment in the loss of civil rights to 5 and 15 years; the number of years of prison reduced to 30 and 40, and the amount of the potential fine increased considerably.

c. Crimes against public security and prison escape

The crime of terrorism has observed five mayor reforms during the last twenty years. (Table 3) Decree 100 of 1980 imposed prison for this crime for a 10 to 20 years. In 1988 the Decree 180 imposed aggravation factors that increment the potential punishment to 15 to 25 years. Also, create a fine of 10 to 100 minimal wages. In 1997, the legislation includes international law for this crime (Decree 1269). In 2000, the Law 559 made three mayor changes: first, in aggravated circumstances, the punishment reduced to 12 and 20 years of prison; second, it incremented the fine; third, it reduce the maximal amount of prison under no-

aggravated circumstances to 15 years, leaving the minimal punishment intact.

Table 3. Crimes Against Public Security and Prison Escape

		1980	1988	1997	2001	2002	
Terrorism	Law		Decree 180	Decree 1269	Law 559	Law 733	1. International measures are adopted
	Punishment		Prison		Prison		
	Minimal Punishment		10 Years		10 Years		2. Some aggravation circumstances are added and the punishment and fines are incremented
	Maximal Punishment		20 Years		15 Years		
	Attenuation		-	Up ¹	Up ²	Up ³	3. The granting of benefits, amnesty and pardon for some criminals are excluded
	Minimal Fine		10 mmw		1.000 mmw		
	Maximal Fine		100 mmw		10.000 mmw		
Prisoner Escape	Law	Decree 100			Law 559		
	Punishment	Prison			Prison		
	Minimal Punishment	6 Months			3 Years		
	Maximal Punishment	2 Years			6 Years		
	Attenuation	-			-		
Escape Assistance	Law	Decree 100			Law 559		1. The interdiction of rights and public functions for the same time of the punishment is added and the punishment is increased if the criminal is sentenced for crimes against goods and persons protected by the International Humanitarian Right
	Punishment	Prison			Prison		
	Minimal Punishment	1Year			5 Years		
	Maximal Punishment	5 Years			8 Years		
	Attenuation	-			Up ¹		

In terms of escape from jail, two crimes are considered: the actual escape and the help on the action. The Decree 100 of 1980 considered escape a crime that imposes a punishment between 6 months and 2 years. The Law 599 increment the minimal and maximal punishment (to 3 and 6 years). In terms of helping the escape, the Decree 100 established a punishment ranging from 1 to 5 years. The Law 599 includes some circumstances of aggravation (interdiction of public functions) and increased the number of potential prison punishment to 5 and 8 years.

d. Crimes against personal freedom

There are three main types of kidnapping according to the Colombian Law: simple, for blackmail and for terrorist purposes (Table 4). The Decree 100 of 1980 asserted a punishment for simple kidnapping of 6 months to 3 years. In 1993 the Law 40 increased the potential punishment (6 to 25 years), and it imposed aggravate circumstances and fines. Also, potential these crimes were excluded from potential benefits of the general law (e.g. reduction in punishment for collaboration with justice) In 2001 the Law 599 increased the minimal punishment, but decreased the maximal (to 10 and 20 years respectively) Also it increased the fine. Finally, Law 733 excluded this crime from general benefits of the penal law (for example, the benefit of home arrest), and it increased the minimal punishment.

Table 4. Crimes Against Personal Freedom

		1980	1988	1993	1995	2001	2002	
Simple Kidnapping	Law	Decree 100		Law 40		Law 599	Law 733	1. Some sentence benefits, amnesties and pardons are abolished 2. Some benefits are excluded
	Punishment	Prison		Prison		Prison	Prison	
	Minimal Punishment	6 Months		6 Years		10 Years	12 Years	
	Maximal Punishment	3 Years		25 Years		20 Years	20 Years	
	Attenuation	-		Up ¹		-	Up ²	
Blackmail Kidnapping	Minimal Fine	-		100 mmw		600 mmw	600 mmw	1. Some sentence benefits, amnesties and pardons are abolished 2. Some of the benefits for effective collaboration were reduced 3. Benefits like reduction of punishment and house detention are excluded
	Maximal Fine	-		200 mmw		1.000 mmw	1.000 mmw	
	Law	Decree 100		Law 40	Law 1723	Law 599	Law 733	
	Punishment	Prison		Prison		Prison	Prison	
	Minimal Punishment	6 Years		25 Years		18 Years	20 Years	
Kidnapping for terrorist purposes	Maximal Punishment	15 Years		40 Years	Up ²	28 Years	28 Years	1. The punishment was modified when the purpose of the kidnapping were terrorism
	Attenuation	-		Up ¹		-	Up ³	
	Minimal Fine	-		100 mmw		2.000 mmw	2.000 mmw	
	Maximal Fine	-		500 mmw		4.000 mmw	4.000 mmw	
	Law		Decree 180	Law 40		Law 599	Law 733	
	Punishment		Prison	Prison		Prison	Prison	
	Minimal Punishment		15 Years	33 Years		26 Years	28 Years	
	Maximal Punishment		20 Years	60 Years		48 Years	40 Years	
	Attenuation		-	-		-	Up ¹	
	Minimal Fine		100 mmw	100 mmw		100 mmw	5.000 mmw	
	Maximal Fine		200 mmw	200 mmw		200 mmw	50.000 mmw	

Kidnapping for blackmail, according to Decree 100 of 1980, was subject of prison that ranged from 6 to 15 years. In 1993 the Law 40 increased minimal and maximal years of prison (25 and 40 years) and imposed a fine between 100 and 500 minimal wages. In 1995 the Law 1723 exclude some benefits of the law for this crime. In 2000 the Law 599 decreased the minimal and maximal punishment (to 18 to 28 years), but increased the fine to 2.000 and 4.000 minimum wages. Law 733 restrained the crime from potential benefits of collaboration and increased the number of potential punishment to 20 to 28 years.

Kidnapping for terrorist purposes was defined in 1988, with Decree 180. It established prison for this crime of 15 to 20 years and a fine between 100 and 200 minimal wages. In 1993 the Law 40 increased the punishment to 8 and 20 years. In 2002 (Law 733) increased again the punishment to 28-40 years, as well as the fine to 5.000 and 50.000 minimal wages.

e. Drug related crimes

We present three crimes concerning illicit drugs: conservation or financing of plantations; traffic, production or transport of drugs; and traffic of substances for the production of drugs. In Table 5 we present, however, four more crimes involving illicit drugs. An important characteristic of almost all penalties against drug crimes is that the quantity involved in the wrongdoing matters. Given that, we present the maximum punishment, which is increasing in the quantity.

Table 5. Drug related Crimes

		1986	1997	2001	
Conservation or Financing of Plantations	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 4 Years 12 Years - 10 mmw 400 mmw		Law 559 Prison 6 Years 12 Years - 200 mmw 1.500 mmw	
Traffic, Fabrication or Carrying of Narcotics	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 4 Years 12 Years - 10 mmw 100 mmw	Law 365 Prison 6 Years 20 Years - 100 mmw 50.000 mmw	Law 559 Prison 8 Years 20 Years - 1.000 mmw 50.000 mmw	
Illicit Destination of Real States and Personal Properties	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 3 Years 8 Years - 10 mmw 800 mmw	Law 365 Prison 4 Years 12 Years - 1.000 mmw 50.000 mmw	Law 559 Prison 6 Years 12 Years Down ¹ 1.000 mmw 50.000 mmw	1. There is no differentiation between the punishments or the fines according to the drug's amount
Stimulation to the Illicit Use	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 3 Years 8 Years - - -		Law 559 Prison 3 Years 8 Years - 100 mmw 1.000 mmw	
The Supply to the Minor	Law Punishment Minimal Punishment Maximal Punishment Attenuation	Law 30 Prison 6 Years 12 Years -		Law 559 Prison 6 Years 12 Years Up ¹	1. The minor's age is increased from 16 to 18 years
Traffic of Substances for the Narcotics Processing	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 2 Years 5 Years - - -	Law 365 Prison 3 Years 10 Years - 2.000 mmw 50.000 mmw	Law 559 Prison 6 Years 10 Years - 2.000 mmw 50.000 mmw	
Existence, Construction and Illicit Utilization of Runways	Law Punishment Minimal Punishment Maximal Punishment Attenuation Minimal Fine Maximal Fine	Law 30 Prison 3 Years 10 Years - - -		Law 559 Prison 4 Years 10 Years - 100 mmw 1.000 mmw	

With respect to conservation or financing of plantations, the Law 30 of 1986 determined a punishment of prison of 4 to 12 years, on top of a fine between 10 to 400 minimum wages. In 2000, the Law 599 increased both parameters: prison between 6 to 12 years and fines between 200 and 1500 minimum wages.

Traffic, production or transport of drugs is a crime that, according to the Law 30 of 1986, was subject of minimal prison of 4 years and maximal of 12. The fine oscillated between 10 and 100 salaries. In 1997 the Law 365 increased the potential number of years to 6 and 20 years, and the fine to 100-50000 minimum wages. With the Law 599 the minimal sentence increased to 8 years, and the lower bound of the fine to 1.000 minimum wages.

Crime relating the inputs for the production of drugs (traffic of substances for the production of drugs) was penalized with 2 to 5 years of prison according to Law 30 of 1986. Law 365 increased the number of years of prison to 3 and 10 and

imposed a fine between 2.000 and 50.000 minimum wages. In 2000 the Law 599 increased the minimal punishment (to 6 years), keeping the maximal number of years and the amount of the fine.

3. An index

In order to map the code into a numeric variable, we constructed the following index. We pick an array of characteristics of the code (mainly, the number of years of punishment, the fines, and aggravation or attenuation circumstances) and we form the measure

$$I_i = \sum_j \phi_j \ln(C_{i,j})$$

where, I_i denote the index for crime i , $C_{i,j}$ is the numeric value for characteristic j for crime i ; and ϕ_j an arbitrary weigh for each characteristic.⁹ The purpose of taking the logs was to escalate certain attributes, like fines, to a lower scale. In cases of years of prison and fines, the direct value was taken to do the calculation. In the case of attenuation or aggravation of the crime, the index starts with a value of one and goes down (attenuation) or up (aggravation) by 0.25 points.

Several intrinsic properties of the index are important. On the first place, the level of the index is not relevant. The relevant aspects are the change and the direction of the index. Second, the punishment is higher if the value of the index is higher. Third, the relative position of the index of a particular crime is important.

As an example of the description of the index, we are going to describe step by step the application of the index to the crime simple robbery. As Graph 1 shows (main text), the index for this crime decline in 1991 with respect to the value of 1990. In that a year two modification occurs: first, reduction in the number of years of punishment for the crime and the crime passed from a proper crime to contravention. The index continues stable until 1996, in which there is not penal sanction in cases of restitution of the full amount of the robbery, fact that represent a circumstance of attenuation, and therefore, the index reduces in that year. Finally, with the Law 599 that was implemented in 2001, the number of years of prison increases and the contravention was again declared as crime and as result, the index increases again.

⁹ We assume a heavier weight for potential years of prison and for attenuation or aggravation causes than for the fine.

It is important to stress that the actual number is not important. The important fact is the change in the index and the relative position of it with respect to the other crimes. For instances, as the Graph 1 shows, simple robbery receives the lesser punishment among three types of robbery (simple, qualified and aggravated) and two types of crimes of appropriation of public asset. All the indices are showed in Graph 1-5, main text.

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CHAPTER TWO

Does Violence Reduce Investments in Education?: A Theoretical and Empirical Approach

I. Introduction

Violence may erode investments in human capital. Societies in crime intense environments may experience contractions in supply and demand of education. Delinquent activities damage infrastructure and increase labor costs of education limiting, as a consequence supply of education. On the other hand, the income of households falls because crime destroys stocks of physical capital and deters investment. Moreover, families well being decline and returns to education may diminish. Investments in human capital, therefore, may diminish. Deterioration of human capital stocks caused by violence may impose large losses to society. Education promotes economic growth and help individuals overcome poverty. Recouping lags in investment may take decades.

This paper seeks to address two issues. First, the paper develops a formal dynamic model to link violence and education. Although some papers have estimated regressions to link educational outcomes and violence, no formal models have been developed yet. A theoretical model is crucial to understand the different channels through which violence affects education. Second, we estimate the impact of violence on school enrollment using a cross-sectional survey of Colombia. Estimations will provide evidence on the impact of violence on education and will contribute to assess the costs of violence.

We find violence indeed exerts a toll on education. School enrollment is less in Colombian municipalities with homicide rates above the national median. Moreover, the likelihood of school enrollment decreases as homicide rates raises for all group ages. The impact of homicide rates is larger than transferances from the national government to the local government earmarked for investment in education and health.

The paper is organized as follow. Section II reviews the human capital literature and describes some contributions of the economics literature to estimate the costs of violence. A dynamic model to understand investment in education in a violent environment is presented in Section III. Section IV describes the data used and discusses econometric results. Finally, Section V concludes.

II. Literature review

a. The influence of violence on education decisions.

When deciding investments on human capital, households compare benefits and costs to optimize their economic well-being (Becker, 1964). Benefits arise from private returns to education, mainly earnings on the labor market, and non-monetary benefits such as reductions in child mortality, improvements in birth control and a better health, among many others. On the other hand, monetary expenses and the opportunity costs from not engaging on earning activities are the main components of the costs of education.

After Becker's seminal contribution, the literature on human capital has developed prolifically. On the empirical context, three strands have emerged. The first strand examines family investments on human capital and its subsequent private returns based on earning functions and longitudinal surveys (for a detailed review see Schultz, 1988). The second strand utilizes educational production functions to identify the inputs that determine the quality of education (see Burtless, 1996; Angrist and Levy, 1999; Hanushek et al, 2001). Lastly, studies analyzing human capital in developing countries evaluate the socio-economic factors inducing school attendance (see Knaul and Parker, 1998; Ravallion and Wodon, 1998; Sosa and Marchionni, 1999).

Studies of educational achievement and school attendance have focused largely on individual and household influences. Yet lately geographical and context variables have emerged as important determinants as well (Long y Toma, 1988; Galenson, 1995; Ravallion and Woodon, 1998; Rephann, J.T, 2002). Geographical and context variables may indicate supply constraints, the costs of obtaining education as well as employment opportunities (Rephann, 2002) and, therefore, may shape human capital investments.

Violence and crime, two local-specific context variables, have been somehow ignored by the economic literature. However, a violent context can erode human capital investments by reducing households' utility, depressing private returns from education, limiting educational supply and decreasing household income. Moreover, countries facing long-standing civil wars may seriously experience deteriorations of human capital that may lead to lower economic growth and to perpetuation of poverty.

Violence can create a climate of anxiety that directly affects the utility and, therefore, the behavior of households. Crime obliges individuals to be constantly alert and adopt defensive strategies. Families living in violent areas overprotect their children and restrict their liberty to avoid victimization. Moreover, victims of crime and violence confront post-traumatic syndrome. A lower utility may

oblige households to redistribute spending in order to keep utility constant. Consumption in goods that provide immediate satisfaction may increase and spending in education, which profits are not foreseeable in the near future, may diminish.

Extreme violence, such as civil wars or terrorism, can destroy physical capital and deter investment. Examples of destruction of physical capital as a consequence of armed conflicts and terrorism abound. Guerrilla groups in Colombia damage oil pipelines, Al-Qaeda crashed airplanes in the financial center of the United States and ETA in Spain uses car bombs to destroy factories in the Vasque Region. Violence also creates uncertainty and deters investment. In the long run, destruction of physical assets and drop in investment impacts the income of households who in turn must reduce consumption. Gaviria (2000) finds in Colombia investments in education are cutback to compensate income shortages.

When violence deteriorates stocks of physical capital and human and physical capital are complements, private returns to education fall. Declines in capital stocks imply a slowdown in economic activities, a drop in demand for educated individuals and, as a result, private returns to education decrease. On the other hand, since investments in human capital diminish as a consequence of violence, the stock of educated individuals drops as well. If this drop exceeds reductions in the demand for educated individuals, returns to education increase.

Violence may also limit supply of education. Acute episodes of violence can cause destruction of physical infrastructure (e.g. schools, buses, libraries) that are crucial inputs to “produce” education. In addition, teachers may, on the one hand, elude posts in cities or towns with severe crime rates or, on the other hand, charge higher salaries to teach in violent neighborhoods (Grogger, 1997).

Despite the presumably large impact violence imposes on education, economic research on this topic is practically non-existent. A notable exception is the study by Grogger (1997) that examines violence inside school as determinants of educational outcomes and teacher salaries. On the other hand, sociologists and psychologist have analyzed the link between violence and educational outcomes in extent (see Simcha-Fagan and Schwartz, 1986; Lab and Whitehead, 1992; Bowen et al, 2002).

The economic literature has not developed yet theoretical models clarifying how violence affects households’ decision to invest on education. Moreover, empirical papers only concentrate on violence inside schools and do not examine the effect of city and country-wise violence. In addition, these papers rely on subjective empirical measures of crime and violence. The purpose of this paper is to fill

these gaps by developing a theoretical model linking investments in human capital and violence and by providing empirical evidence.

b. The costs of violence

Violence imposes social and economic costs to society. Costs of crime largely originate from reductions in economic activities, deviations of public and private funds from other purposes (e.g. education and health) to curtail violence and increments in welfare losses to households. The economic literature has concentrated mainly on estimating costs from slow down of economic activities as well as calculating public resources allotted to cut back crime.

Estimates of the costs of crime are mainly aggregated figures. Total economic losses to victims of crime, including medical costs and lost work time, during 1992 in the United States were measured in \$532 per crime and 17.6 billion for all reported crimes that year, this is equivalent to 0.3% of GDP (Klaus, 1994). Miller et al (1996) estimate losses from personal crime in the United States are \$105 billion and include from medical costs, lost earnings and public programs related to victim assistance. When pain, suffering and the reduced quality of life are incorporated, costs raise to an estimated \$450 billion annually. Londoño (1998) calculates human capital losses in Colombia originating from violence around 4% of GDP each year. Rubio (1997) approximates total household expenditures on protection and security amount to 1.4% of the Colombian GDP.

Welfare losses to households have been largely ignored despite the big burden they might be imposing. Families confront pecuniary and non-pecuniary costs from being victimized (Freeman, 1999). Victims of crime face monetary costs due to property losses, expenditures in medical and health care and legal costs associated with tort claims (Cohen et al., 1994). Non-pecuniary losses are presumably larger and stem from three sources. First, quality of life decreases because households have to cope with the reduced sense of personal and proprietary security (Fajnzylber, 1998). Second, households must reallocate budget in order to adopt preventive strategies, like hiring private guards and installing anti-theft devices. Third, households modify their behavior in order to prevent victimization. For example, students of night schools quit for security reasons (Cuéllar, 2000), people avoid road trips and do not go out at night (Gaviria y Vélez, 2001) and households have to seek refuge in other cities or countries (Kirchhoff and Ibáñez, 2001).

Estimates of non-pecuniary losses and evidence on behavioral responses are difficult to find. Levitt (1995) calculates the cost of pain, suffering and economic loss for the average crime around \$3.000. Ibáñez and Vélez (2003) find welfare losses from forced displacement in Colombia are 25 percent of the net present value of aggregated consumption of the average household. The propensity of

Colombian households to engage in anti-crime strategies is analyzed in Gaviria and Vélez (2001). Surveys applied to a representative sample of the Colombian urban population show more than 80 percent of respondents do not go out at night, 36 percent participate in neighborhood watching services, 21 percent hire private guards and 25 percent avoid road trips for fear crime.

But evidence about behavioral responses to crime is still insufficient. Does crime spur migration? Is crime a constraint to recreational activities? Episodes of crime induce adoption of anti-crime strategies? Does crime and violence deter investment on human capital? The purpose of this paper is to provide evidence on behavioral responses to violence and crime activities. Namely, the paper seeks to address whether violence in Colombia modifies investments in education. By providing empirical evidence about behavioral responses to crime, the paper contributes to understand the economic losses of violence.

III. Education and Violence: A Simple Dynamic Model

Violence influence decisions of education investments through several channels. The income of the family and the community fall affecting in turn the household's budget constraint; returns of education change due to violence; and violence impacts directly the well being of household. The purpose of this model¹⁰ is to show some of the potential links between violence and the decision of household's education, as well as to present a formal framework in which the relationship is explicitly modeled.

3.1 The model

a. Channels between violence and educational decisions

One critical assumption in the model is that violence (v_t), from the standpoint of view of the family, is given. The family "receives" certain amount of violence and makes decisions based on the observed level of violence. We consider three main channels of relationship between violence and education, channels that are going to be discussed in detail below. Violence directly affects the utility of the individual ($u(.)$); it lowers the income of the parents (y^p); and it modifies the returns to education (B).

Violence directly affects the utility of individuals

We assume that violence can reduce directly the well being of individuals. In mathematical terms this is represented by the following relationship:

¹⁰ The model builds upon the model of Barrera (2001) by including violence as a component that affects decisions of the individuals.

$$u(c_j, v_j) \text{ where } \partial u / \partial c > 0 \text{ and } \partial u / \partial v < 0 \text{ for } j = t \text{ and } t+1 \quad (1)$$

The utility of the individual increases with consumption (c) and decreases with violence.¹¹

Violence affects income of parents

The effect of violence over income is explained by two mechanisms. First, violence can directly destroy physical capacity. Second, violence creates uncertainty, and therefore, will lower investment. In synthesis, these two mechanisms translates in the following mathematical expression:

$$y^p = y^p(v_t) \text{ where } \partial y^p / \partial v < 0 \quad (2)$$

The expression indicates that the income of parents depends negatively on violence.

Violence affects returns to education

The effect of violence in the returns of education is twofold. As long as violence reduce the level of investment and the capacity of production, and assuming complementarities between deepening of physical capital and higher human capital, the returns of education diminishes with violence. However, violence may create a "stock effect" that induces increments in returns of education: if violence decreases education, let say at period t , in period $t+1$, given that the amount of human capital decreases with violence, the returns of education increase. The net effect of violence over returns to education is therefore ambiguous:

$$B = B(\eta, v) \text{ where } \partial B / \partial v > < 0 \quad (3)$$

The variable η captures "ability", a characteristic unobservable to the researcher.

In conclusion, Equations (1) to (3) show the key main channels of the effect of violence over education. Equation (1) presents the direct effect of violence over the well being of individuals; Equation (2) presents the effects of violence over the income of parents; and Equation (3) establishes that returns to education depend on the stock effect and reductions in demand for educated individuals.

¹¹ Properties of concavity are assumed in order to reach a unique maximum.

3.2 Household decision

Individuals make decisions in two periods. In the first one they decide the amount of consumption (c_t), the decision of whether to invest on education ($E, E = 0 \text{ or } E = 1$) and the quantity of the education (q_t)¹²; the individual receives income from the parents (y^p). In the second period, the individual (inelastically) works and decides the optimal amount of consumption (c_{t+1}).

The budget constrain of the individual for period t is $y^p(v_t) = c_t + p_t * E * q_t$ (where p_t is the price of education), whereas the constrain for period $t+1$ is $B(\eta, v_{t+1}) * E * q_t = c_{t+1}$. The first one states that individual consumes and attends to school payed by the parents. The second constrains establishes that the individual receives an income that is determined by the returns to education and consumes c_{t+1} .¹³

The solution of the problem is by backward induction. In any path of education ($E = 0 \text{ or } E = 1$) the individual choose optimally the consumption and the quantity of education. Given the optimal decision over these variables, the optimal E will be given by the path that yields the highest utility.

The problem of the agent when $E = 1$ is, therefore,

$$\max_{c_t, c_{t+1}, q_t} [u(c_t, v_t) + \lambda_t (y^p - c_t - p_t * E * q_t)] + \beta [u(c_{t+1}, v_{t+1}) + \lambda_{t+1} (B * E * q_t - c_{t+1})]$$

For positive values of q and c , the solution of this dynamic problem is given by the Euler Equation

$$(\partial u(c_t, v_t) / \partial c_t) * p_t = \beta (\partial u(c_{t+1}, v_{t+1}) / \partial c_{t+1}) * B(\eta, v_{t+1}) \quad (4)$$

and the two budget constrains. The Euler Equation states that the marginal cost of education in the first period has to be equal to the marginal benefit of it at the optimum.

Fom this equation, the optimal demand for c and q are derived. Specifically,

¹² In the original model, q represented "quality" of education. The two interpretations of the variable are consistent.

¹³ Implicitly we assume perfect foresight in that individuals knows, at t , the returns of education in $t+1$.

$$q_t^* = q(\beta, p_t, B(\eta, v_{t+1}), y^p(v_t), v_t, v_{t+1}) \quad (5)$$

Equation (5) gives the fundamental relationship between education and violence. In fact, using the Envelope Theorem, and assuming that $v_{t+1} = f(v_t)$ ¹⁴

$$\frac{\partial q_t^*}{\partial v_t} = \frac{\partial q}{\partial v_t} + \frac{\partial q}{\partial v_{t+1}} * \frac{\partial v_{t+1}}{\partial v_t} + \frac{\partial q}{\partial y^p} * \frac{\partial y^p}{\partial v_t} + \frac{\partial q}{\partial B} * \frac{\partial B}{\partial v_{t+1}} * \frac{\partial v_{t+1}}{\partial v_t} \quad (6)$$

Equation (6) can be positive or negative. On the one hand, the first three derivatives are negative: violence decreases utility ($\partial q / \partial v_t < 0$ and $\partial q / \partial v_{t+1} < 0$) and also decreases the income of the family ($\partial y^p / \partial v < 0$). On the other, violence can have a positive or negative effect over returns. If violence induces a negative effect over returns ($\partial B / \partial v < 0$), the sign is unequivocally negative. If violence has a positive effect over returns ($\partial B / \partial v > 0$), expression (6) can be positive.

Equation (4) does not provide, however, an equilibrium since the decision of $E = 0$ is an option. When $E = 0$, the problem of the individual is

$$\max_{c_t, c_{t+1}} [u(c_t, v_t) + \lambda_t (y^p - c_t)] + \beta [u(c_{t+1}, v_{t+1}) + \lambda_{t+1} (y - c_{t+1})]$$

where y is the income that the individual perceive in period $t+1$ if he does not have any education. The solution is given by the analogous to Equation (4):

$$\partial u(c_t, v_t) / \partial c_t = \beta \partial u(c_{t+1}, v_{t+1}) / \partial c_{t+1} \quad (7)$$

In order to find whether $E = 0$ or $E = 1$, we need to compare the utility realized in both paths of decisions of education. Therefore, $E = 1$ will be an optimal solution if

$$\sum_{j=t}^{t+1} u(c_j^*, v_j) \Big|_{E=1} > \sum_{j=t}^{t+1} u(c_j^{**}, v_j) \Big|_{E=0} \quad (8)$$

The “participation” equation (8) is critical, and it comprises the second relevant relationship between education and violence. First, violence affects both sides of the inequality via lowering utility. Second, violence affects the returns of education and therefore it makes more difficult (easier) to fulfill equation (8) if

¹⁴¹⁴ It is possible to find separately the effect of v_t and v_{t+1} over q^* . However, assuming that violence today is correlated with violence tomorrow simplifies the analysis and allow us to present in one equation the total effect of violence over education.

the effect is negative (positive). Finally, violence lower the income of parents, which in turn will induce a more binding budget constraint and a lower value of the left hand side of this equation.

IV. Empirical Estimations

4.1. The Data

The primary sources of data we used to analyze the impact of violence on education are the *Living Standards Measurement Survey* (LSMS-97) applied during 1997 in Colombia and the *Municipal Violence Data* (MVD). The LSMS-97 sample is representative of the Colombian Population and its eight regions. The sample contains information for 9,121 households and 38,518 individuals. The questionnaires that were administered to these households elicited information about socio-demographic characteristics of each household member, school attendance, health status and household spending. Information on household victimization during the last six months and access to public and social services was also collected.

The MVD was collected by the authors based on information from the Ministry of Defense, the Colombian Police and the Department of National Planning. The MVD contains yearly information at the municipal level¹⁵ for occurrence of violent events during the period 1993-2000. Violent events included in the MVD are homicides rates, terrorist attacks, massacres and kidnapping.

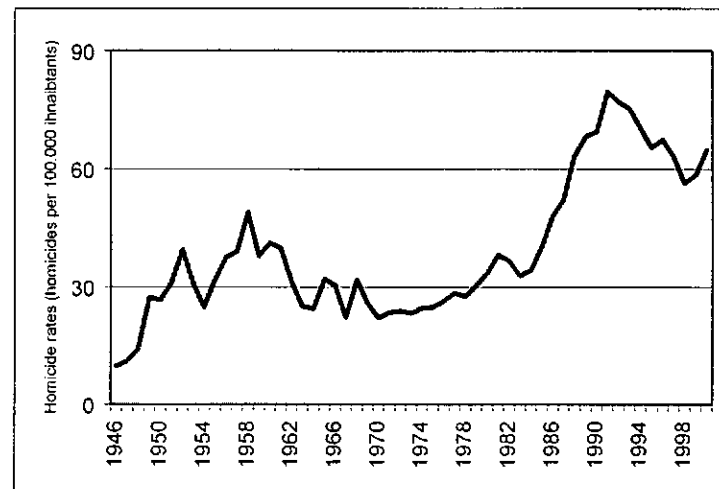
The origins of current violence in Colombia are diverse. During the last 40 years Colombia has faced a long-standing civil war. In addition, illegal drug-trafficking soared since the 1980s and, as a consequence, illegal activities and crime flourished. Lastly, the erosion of the Judicial System, provoked mainly by drug-trafficking, created favorable conditions for crime development (Montenegro and Posada, 2001).

Violence in Colombia is widespread. While urban areas are mostly affected by crime-related activities, the civil war takes place typically in the rural areas of the country. Figure 1 shows the trend of homicides rates from 1946 to 2000. During the sixties and most of the seventies, homicide rates did not exhibit major fluctuations and in the late seventies escalated dramatically tripling by 1990. Although violence covers most of the Colombian territory, homicide rates reached epidemic proportions in large cities (Gaviria and Vélez, 2001). In contrast, massacres, armed confrontations and forced displacement are predominant violent events in rural areas. Since 1995, near four percent of the

¹⁵ Municipalities are the smallest administrative unit in Colombia.

Colombian population (1'176,540 people) have fled their town to seek refuge from war.

Figure 1. Homicide rates in Colombia: 1960-2000



Source: Colombian National Police

What is the evolution of school enrollment in Colombia? During the period ranging from 1978 to 1995, school enrollment rates grew steadily in urban areas and registered significant gains in rural areas (see Table 1). Educational attainment increased by 2.7 years in urban areas and doubled in rural areas. As a result, the urban-rural gap narrowed significantly. Increases in school enrollment came along with less inequality (Vélez, 2002).

Table 1. School Enrollment: Urban and Rural Areas

	1978	1988	1995	1999
School enrollment - Urban areas				
Ages 7 to 11	91.8%	94.8%	96.5%	95.3%
Ages 12 to 17	76.9%	80.5%	84.4%	82.2%
Ages 18-22	31.2%	35.8%	41.0%	36.3%
School enrollment - Rural areas				
Ages 7 to 11	66.2%	85.4%	90.1%	90.5%
Ages 12 to 17	43.5%	57.2%	63.7%	66.0%
Ages 18-22	9.0%	14.6%	19.2%	20.6%

Source: World Bank (2002)

Evidence about the effect of widespread violence on school enrollment is ambiguous. Table 2 shows school enrollment rates for municipalities below and above the national median of homicides rates in 1997. When all the Colombian municipalities are included, divergences in school enrollment between violent and non-violent municipalities are not statistically significant. However, large cities exhibit two different behaviors in contrast from all Colombian municipalities and this might be driving the inconclusive results. First, violence in large cities is well above the national median. Second, investments to expand educational coverage were considerably greater in these cities. Therefore, large cities experienced unprecedented increments in homicide rates parallel to substantial expansions in access to education. If the four larger cities are dropped, school enrollments are higher in municipalities facing homicide rates below the national median. The difference is statistically significant and widens for older children and young adults.

Table 2. School Enrollment for Municipalities Below and Above the National Median of Homicide Rates

	Below the median	Above the median
School enrollment for total sample		
Ages 7-11	92.96	92.61
Ages 12-17	75.92	76.75
Ages 18-22	31.75	34.63
School enrollment for sample without four largest cities ¹		
Ages 7-11	92.96	90.37
Ages 12-17	75.92	72.64
Ages 18-22	31.75	27.27

Source: Authors calculations based on LSMS-97 and MVD

1. The four largest cities are Bogotá, Medellín, Barranquilla and Cali

The evidence about the impact of violence on education is mixed. However, it necessary to control for other municipal conditions as well as household and individual characteristics to uncover the determinants of school enrollment. The next section estimates probit models of school enrollment to identify such determinants and clarify whether violence affects school enrollment in Colombia.

4.3. The Determinants of School Enrollment

To examine the determinants of school enrollment, two groups of probit models were estimated. The first group estimates the probability of school enrollment depending only on household and individual variables. School enrollment is estimated for children between 7 and 11 years, 12 and 18 years as well as young adults between 18 and 22 years of age. The second group of regressions includes context and geographic variables as determinants of school enrollment.

Table 3 provides estimates of the probability of school enrollment when only household and individual influences are considered. Results are consistent with findings of similar papers. Male children are less likely to enroll in school. The probability of attending school is greater for children from male headed households with better educated or wealthier parents. School enrollment is less for children with working mothers. Lastly, residing in urban regions increases the likelihood of school attendance.

Table 4. Probability of School Enrollment - Household and Individual Characteristics

Variable	Ages 7-11		Ages 12-17		Ages 18-22	
	dF/dx	P> z	dF/dx	P> z	dF/dx	P> z
Male	-0.0255	0.00	-0.0304	0.00	-0.0274	0.00
Male household head	0.0058	0.00	0.0083	0.00	-0.0054	0.00
Years of schooling - More educated parent	0.0095	0.00	0.0304	0.00	0.0293	0.00
Yearly per capita aggregate consumption	0.0000	0.00	0.0000	0.00	0.0000	0.00
Working mother	-0.0235	0.00	-0.1481	0.00	-0.1572	0.00
Urban region	0.0159	0.00	0.1190	0.00	0.1079	0.00
Pseudo R-square		0.1458		0.1367		0.1216

Source: Authors calculations based on LSMS-97

Inclusion of homicide rates and other context specific do not alter results and provides interesting insights. Violence has indeed a negative impact on school enrollment for all age groups in particular for young adults. This may imply that reductions in utility, households' income and returns from education stemming from violence outweigh increments in private returns caused by shortages in supply of educated individuals.

All other context variables have a significant influence on school enrollments. Transfers from the National Government to Local Governments¹⁶ are effective to increase educational coverage. In stark contrast, the size of the educational staff in the municipalities exercises a perverse incentive on school enrollment¹⁷. As educational staff increases, the likelihood of enrollment diminishes. Distance to the state capital, which may reflect availability of school supply, decrease the probability of enrollment for children between 7 and 11 years of age, increase school enrollment for children between 12 and 17 years and has no effect for young adults.

The magnitudes of the marginal effects allow us to assess the impact of homicide rates on school enrollment. A one percent increase in homicide rates drops school enrollment in greater proportions than an expansion of one percent transfers of the National Government. It is worth asking whether controlling violence may contribute equally or more to school enrollment than transfers of the National Government earmarked for education and health. This might be particularly true in countries with acute episodes of violence.

Table 5. Probability of School Enrollment - Household, Individual and Municipal Characteristics

Variable	Ages 7-11		Ages 12-17		Ages 18-22	
	dF/dx	P> z	dF/dx	P> z	dF/dx	P> z
Male	-0.0210	0.00	-0.0313	0.00	-0.0320	0.00
Male household head	0.0099	0.00	0.0079	0.00	0.0148	0.00
Years of schooling - More educated parent	0.0077	0.00	0.0320	0.00	0.0331	0.00
Yearly per capita aggregate consumption	0.0000	0.00	0.0000	0.00	0.0000	0.00
Working mother	-0.0297	0.00	-0.1638	0.00	-0.1568	0.00
Urban region	0.0220	0.00	0.1416	0.00	0.1100	0.00
Homicide rates	-0.0002	0.00	-0.0001	0.00	-0.0003	0.00
Transfers from National Government p.c	0.0000	0.00	0.0001	0.00	-0.0001	0.00
Size of educational staff at the municipality	-0.0000	0.00	0.0000	0.00	0.0000	0.00
Distance to state capital	-0.0001	0.00	0.0000	0.00	0.0000	0.11
Pseudo R-square		0.1562		0.1482		0.1336

Source: Authors calculations based on LSMS-97

¹⁶ These transfers are earmarked for local spending on education and health.

¹⁷ Recently, the law allocating public spending to education was modified. Now, education spending depends on the number of children enrolled. The previous law had perverse incentives and teachers sought assignments in municipalities with low enrollment rates.

Violence in Colombia appears to erode investments in human capital. School enrollment is less frequent in municipalities with homicide rates below the national median. In addition, after controlling for individual, household and other context variables, violence influences negatively school enrollment. The costs of violence in this respect can be sizeable because deterioration of human capital is difficult to recoup in the long run.

Conclusions

Results of this paper show deterioration of human capital stocks is another economic cost of violence. As the theoretical model indicates, families reduce investments in education when confronted to violence because utility decreases, household income contracts and returns to education may shrink. But not only the “quantity” of education diminishes. Households may decide not to invest on education at all and the quality of education may also suffer due to destruction of infrastructure and a lower availability of teachers.

Estimations for Colombia reveal violence reduce investments in human capital. School enrollments in violent municipalities are small. And the likelihood of school enrollment for children between 7-11 years, 12-17 and young adults between 18-22 decreases as homicide rates increase. Violence, therefore, impinges not only monetary losses to households but modifies behavior in perverse ways. To recuperate declines in human capital investments as a result of crime may need decades.

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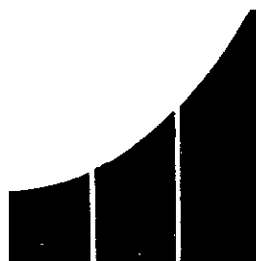
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