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## **DOES VIOLENCE REDUCE INVESTMENT IN EDUCATION?: A THEORETICAL AND EMPIRICAL APPROACH\***

**FELIPE BARRERA<sup>‡</sup>**  
**ANA MARÍA IBÁÑEZ<sup>\*\*</sup>**

### **ABSTRACT**

The paper develops a dynamic theoretical model and presents empirical evidence about the relationship between violence and education investments. 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. Three channels are identified. First, violence can affect directly the utility of households and, therefore, it may modify the consumption of education. Second, extreme violence can destroy physical capital and create uncertainty, which will lower investment and production. In the long run, destruction of physical assets and drop in investment impact the income of households who in turn must reduce consumption and cutback investments in education. Third, violence can modify the rates of return of education, and therefore, can change the investment on education. 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 rise for all group ages. The impact of homicide rates is larger than transferences from the national government to the local government earmarked for investment in education and health.

JEL classification: I21, D11, H56

Key words: Theory of Education, Violence, Colombia, Empirical estimation

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<sup>‡</sup> Felipe Barrera is research associate of Fedesarrollo. [fbarrera@fedesarrollo.org.co](mailto:fbarrera@fedesarrollo.org.co)

<sup>\*\*</sup> Ana María Ibáñez was research associate of Fedesarrollo when this research started. [aibanez@uniandes.edu.co](mailto:aibanez@uniandes.edu.co)

# ¿REDUCE LA VIOLENCIA LA INVERSIÓN EN EDUCACIÓN?: UNA APROXIMACIÓN EMPÍRICA Y TEÓRICA

## RESUMEN

Este artículo desarrolla un modelo teórico dinámico y presenta evidencia empírica acerca de la relación entre violencia y acumulación de capital humano. La literatura económica tiene artículos que estiman la relación entre violencia y educación, sin embargo, no se ha desarrollado un modelo formal en la literatura que identifique los canales por medio de los cuales la violencia incide en la educación. El artículo identifica tres de ellos. En primer lugar, la violencia afecta directamente las decisiones de inversión en educación al afectar la utilidad de los hogares. En segundo lugar, la violencia destruye directamente los medios de producción y genera incertidumbre, lo cual reduce la inversión y el ingreso de los hogares. Por ende, la inversión en educación de los hogares puede disminuir. Finalmente, la violencia afecta los retornos de la educación lo cual modifica, a su vez, el consumo en educación.

La evidencia encontrada muestra que la violencia induce a una reducción en la acumulación de capital humano. La asistencia educativa es menor en aquellos municipios Colombianos en los cuales la tasa de homicidios es mayor que la mediana nacional. La probabilidad de asistencia educativa en colegios decrece a medida que la tasa de homicidios aumenta para *todos* los grupos de edades. El impacto de la tasa de homicidios es mayor que el impacto de las transferencias para educación del Gobierno Nacional a los Gobiernos Locales.

Clasificación JEL: I21, D11, H56

Palabras clave: Teoría de la educación, violencia, Colombia, estimación empírica

## 1. 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 drop. 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 for 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 rise for all age groups. The impact of homicide rates is larger than transferences 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.

## **2. 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, 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 drops in investment impact 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 the 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 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 and 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.

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 model<sup>1</sup> 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**

We consider three main channels of relationship between violence and education. 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:

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

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<sup>1</sup> The model builds upon the model of Barrera (2001) by including violence as a component that affects decisions of the individuals.



The utility of the individual increases with consumption ( $c$ ) and decreases with violence.<sup>2</sup> 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. Violence may affect directly the utility function because it creates fear, or other “states”, that decreases the well being of individuals. As it is described on other papers, one of the objectives of violence is to create a state of fear in order to, for instance, assure the functioning of illegal business (Gambetta (1993))

### **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, lowers investment. In synthesis, these two mechanisms translate 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 can destroy directly the production activities of individuals. Terrorist attacks to towns are quite destructive of houses, shops, and infrastructure. Also, a town under the potential attack of illegal groups will see a reduction of investment, and therefore, lower production.

### **Violence affects returns to education**

The effect of violence in the returns of education is twofold. As long as violence reduces 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 diminish with violence. However, violence may create a “stock effect” that induces increments in returns of education: if violence decreases education, let say at period  $t$ , the returns of education

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<sup>2</sup> Properties of concavity are assumed in order to reach a unique maximum.

increase in period  $t+1$ . Thus, in  $t+1$ , investment in education increases. The net effect of violence over returns to education is therefore ambiguous:

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

The net effect over investment in education (the increment in  $t+1$  and the decline in  $t$ ) can be positive or negative.

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.

### *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 ( $E$ ,  $E = 0$  or  $E = 1$ ) and the quantity of the education ( $q_t$ ): The individual receives income from his parents ( $y^p$ ). In the second period, the individual (inelastically) works and decides the optimal amount of consumption ( $c_{t+1}$ ).

The budget constraint 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 constraint for period  $t+1$  is  $B(\eta, v_{t+1}) * E * q_t = c_{t+1}$ . The first one states that the individual consumes and attends to school payed by his parents. The second constraint establishes that

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<sup>3</sup> The variable  $\eta$  captures "ability", a characteristic unobservable to the researcher.

the individual receives an income that is determined by the returns to education and consumes  $c_{t+1}$ .<sup>4</sup>

Implicitly, we assume that the provider of education is the Government, and therefore,  $p_t$  does not reflect the enrollment fees, but other cost associated with education (books, uniforms, etc) In general, the price of education ( $p_t$ ), when it includes all the cost of education can increase with violence. Indeed, it is more costly for the Colombian Government to provide education in an area with acute violence. For instance, the implicit opportunity cost of teachers increases in these types of zones. Presumably, the higher cost would impact the price of providing education. We did not include this mechanism in the model because the majority of individuals in areas of acute violence attend public schools. For this reason, prices are given and the effect of violence does not translate onto educational prices. In a model of demand and supply, however, this effect may be important.

The solution of the problem is by backward induction. In any path of education ( $E = 0$  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<sup>5</sup>,

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

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

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<sup>4</sup> Implicitly we assume perfect foresight in that individuals knows, at  $t$ , the returns of education in  $t + 1$ .

<sup>5</sup> One assumption of the model is perfect foresight, and therefore, uncertainty is not explicitly model. However, this assumption can be easily incorporated with a maximization of the expected function, with violence following a stochastic process. However, results do not vary greatly.

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

and the two budget constraints. 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.

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

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

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

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

The last assumption simplifies the analysis and allows us to present in one equation the total effect of violence over education. Although it is possible to incorporate separately the effect of  $v_t$  and  $v_{t+1}$  over  $q^*$ , it does not add much to the analysis and complicates matters unnecessarily. Moreover, several articles present evidence about the positive correlation inter-temporal violence<sup>6</sup>.

Equation (6) can be positive or negative. On 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 hand, 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

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<sup>6</sup> For instance, Sánchez et. al. (2003) or Barrera(2004)

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

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 the effect is negative (positive). Finally, violence lowers 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.

It is important to stress several assumptions of the model. As stated above, the separation between public and private education is a critical one. In this model we assume that education is publicly provided, and therefore, individuals face “free” education. This assumption is not far-fetched for acute violence zones where public education is the norm.

Another important assumption is the lack of migration. Migration of individuals due to violence is an important phenomenon in Colombia (see Ibáñez and Velez (2003)). In the model, we do not incorporate this behavioral response to violence and this limits our results. Theoretically, it is possible that a family migrates from a rural area in which provision of services is limited to a city in which supply of education is higher.

## 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 level<sup>7</sup> 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).

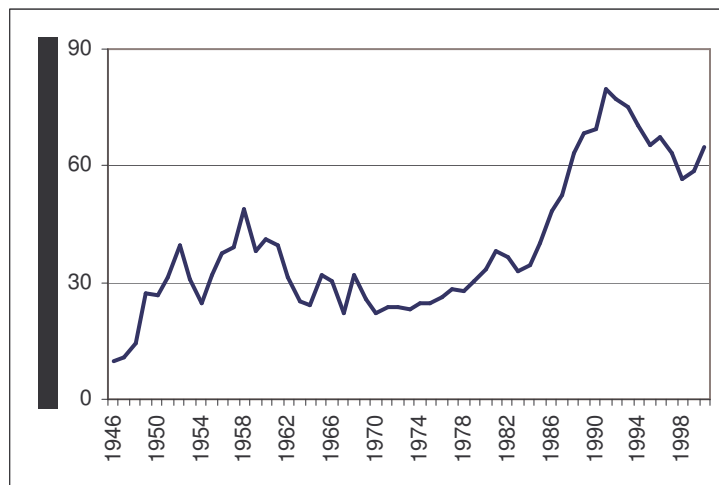
Violence in Colombia is widespread. While urban areas are mostly affected by crime-related activities, the civil war takes place typically in the rural areas of the country. Figure 1 shows the trend of homicides rates from 1946 to 2000. During the sixties and most of the seventies, homicide rates did not exhibit major fluctuations and in the late seventies escalated dramatically tripling by

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<sup>7</sup> Municipalities are the smallest administrative unit in Colombia.

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 Colombian population<sup>8</sup> 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).

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<sup>8</sup> This is approximately 1.3 million people.

**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 <sup>1</sup>		
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.

#### 4.2. 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	0.00	0.00
Working mother	-0.0235	0.00	-0.1481	0.00	-0.1572	0.00
Urban region	0.0159	0.00	0.119	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 variable does not alter results yet it 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 Governments<sup>9</sup> are effective to increase educational coverage. In stark contrast, the size of the educational staff in the municipalities exercises a perverse incentive on school enrollment<sup>10</sup>. 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 cutting bade violence may contribute equally or more to school enrollment that transfers of the National Government earmarked for education and health. This might be particularly true in countries with acute episodes of violence.

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<sup>9</sup> These transfers are earmarked for local spending on education and health.

<sup>10</sup> 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 seeked assignments in municipalities with low enrollment rates.

**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

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 require decades.

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