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MATH AND LANGUAGE AT WAR: THE EFFECT OF THE COLOMBIAN ARMED CONFLICT ON MATH AND LANGUAGE LEARNING

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ABSTRACT: *Armed conflict reduces human capital accumulation due to economic constraints on families, cuts in education spending, destruction of schools and by causing post-traumatic stress disorder in children. This paper estimates the effect of conflict on math and language learning by using the Colombia Saber (Knowledge) Tests score for 5th, 9th and 11th grades. Results suggest a small, but statistically significant impact for the 5th grade and 9th grade samples, at most of 6.5% of the test scores standard deviation; as net enrollment rates fall throughout secondary education, estimates are small or not significant for the 11th grade sample. Policy recommendations focus on providing families and children with better support networks, on fighting the growing extortions in poor neighborhoods and on special interventions in regions with the highest armed conflict levels.*

KEYWORDS: Civil War, Learning Attainment, Colombia, Standardized Tests.
JEL Classification: I21, O15.

INTRODUCTION

In many countries around the world, at least once a year, students are summoned to take tests that are a requisite to apply for college education or that are designed as an assessment of the education they receive. During a day or two, they answer questions on math, language and sciences. With the scores, educational institutions and governments assess the quality of the education they provide. Those very same tests are applied in countries that experience high levels of violence or civil war. This is the context where children's learning happens: learning in the midst of conflict. Taking the Colombian internal armed conflict as case study, it is this learning, measured as the scores in the Colombian government's standardized Saber Tests (Knowledge Tests) that is the focus of this paper. The goal is to estimate the effect of the Colombian armed conflict on the Saber test scores at 5th, 9th, and 11th grade.

On the macroeconomic level, previous research has found that after a civil war GDP per capita is lower and GDP growth is higher due to an increase in the investment rate when compared to pre war levels; the aftermath is also marked by higher inflation since governments needed to emit money to finance their military campaigns (Chen et. al, 2008). There is evidence that Sub-Sahara African countries tended to have a GDP growth 2.2 percentage points higher during the peace years (Collier, 1999). Civil war can even reduce the growth of neighboring countries to the level of those hosting the conflict (Murdoch and Sandler, 2002). Macroeconomic research on the impact of civil war still needs to sort out the existence of a peace dividend or of a "war hangover" as Collier (1999) pointed out.

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This paper is placed in the strand of economics literature exploring the microeconomic-level effects of civil warfare. Worse health and education indicators at the individual and household levels are the main outcomes of civil war. Certainly, the availability of household and individual level data (as pointed out by Blattman and Miguel, 2010) has opened the path for better understanding of how individuals and families cope with conflict-related consequences (Justino, 2009). About health impacts, genocide and crop failure in Rwanda reduced the height-for-age of children exposed to these shocks in utero (Akresh et. al., 2011). Likewise, children exposed to civil war in Burundi (Bundervoer et al., 2009) had a lower height-for-age. In regards to infant mortality, increases in homicides per 100,000 inhabitants translated into higher infant mortality rates in Colombia (Urdinola, 2004). Finally, in utero exposure to maternal stress due to violence is associated with early delivery (Smits et al.,2006), changes in gender ratios (born males to born females ratio) (Catalano et all, 2005) and, again in Colombia, with lower weight at birth and higher probability of miscarriage (Camacho, 2008).

The microeconomic exploration of the effects of civil war on education mainly deals with the effects on the schooling attained (measured by completed years of education). A shortcoming of this approach is that years of schooling are an input and not an outcome variable of the educational process. The present research aims at filling a gap in the literature by measuring the human capital effects of civil war using an outcome variable of the education process: cognitive achievement represented by scores in Colombian standardized tests at three different school grades (5th grade, 9th grade and 11th grade).

This research will use the number of extortions, terrorist attacks, kidnappings, mass murder victims and attacks against the police per year at the state level as the indicators of the armed conflict. The variables will be adjusted per 100,000 inhabitants to account for the heterogeneous population distribution in the country. The number of battle deaths is traditionally used as the variable measuring the intensity of a civil war. It is important to notice that open battles or battle engagements are a rare event in a guerrilla type of war, while terrorist attacks, ambushes, kidnappings and extortions tend to be more frequent. Also, it is not known, at least theoretically, which conflict intensity indicator households use to make decisions to cope with the negative externalities of the armed conflict. For all these reasons, several armed conflict indicators can lead to more representative results when considering that, in the midst of conflict, households make decisions.

The main contribution of this paper is the use of an outcome of education, represented by the test scores, as the measure of the human capital accumulation. Nonetheless, there is a caveat: the test scores may not be fully representative due to sample attrition. If all the children that are supposed to be enrolled at any chosen school grade take the test, the scores will give the complete picture of the cognitive achievement; nevertheless, when children drop out of school, the scores only give the information of those that do stay in school and, thus, the information is biased. Attrition can be more serious if conflict is the leading reason to drop out of school. The attrition is addressed in two different ways. First, estimations will use the scores from 3 grades with different net enrollment rates (5th grade, 9th grade and 11th grade). The enrollment for 5th grade is around 90%, while for 9th grade it goes down around 70% and, finally, it is around 50% for 11th grade.

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Second, the drop-outs are included in the regressions, by assigning them the average features and scores of the actual test takers.

The effects of conflict on learning are reduced: higher levels of conflict at birth may be more harmful for the learning achievement of the 5th grade students. Due to sample attrition or the reduction of the net enrollment rate throughout secondary education, the sample only shows a negative impact of conflict on learning up until 9th grade. The effect on the 11th grade scores appears very small or even positive. Adding up the exposure to conflict at birth and the exposure to conflict during the year of the test, higher levels of conflict lead to a reduction of language scores (5% of the standard deviation for 5th grade and 3% of the standard deviation for 9th grade) and of math scores (6.5% of the standard deviation for the 5th grade and 6% of the standard deviation for the 9th grade). Performance on the math tests seems to suffer more from higher levels of conflict. Robustness checks confirm the negative impact on the 9th grade scores and the unrepresentative results for the 11th grade scores; however, the inclusion of the dropouts eliminates any effect of the exposure to conflict at birth. The results call for policies aimed at promoting the completion of all primary and secondary years (like conditional cash transfer programs), as well as policies helping mothers and communities to support children to cope with the stress and trauma caused by violence.

Following this introduction, a literature review is presented. Then, a section discusses some background about the Colombian conflict, the educational system and the Saber Test. The data section addresses the selection of the conflict indicators and the processing and cleaning of the test scores samples. The empirical method section introduces the theoretical model and describes the identification strategy. Basically, the conflict indicator level is assigned according to the state of residence, the year of birth and the year of the test. The empirical method section also deals with the threats to this identification strategy. After discussing the results, the last section concludes and presents some policy recommendations.

LITERATURE REVIEW

During civil war, education and learning attainment deteriorate because families may withdraw children from school, children may not have access to the nutrition they need to succeed in school, or they just cannot get the education due to the destruction of facilities and killings of teachers. Lai and Thyne (2007) found that countries in civil war reduce educational expenditure even after the war is over and that there is a reduction in the balance of enrolled male to enrolled females. Akresh and de Walque (2008) argued that school age children exposed to genocide had fewer years of completed schooling. For Guatemala, Chamarbagwala and Moran (2011) concluded that rural Mayan males and females, born during the most violent years, had a lower probability of completing primary grades. In the case of Peru, Leon (2010) suggested that the younger children are exposed to violence, the higher the reductions in schooling attainment.

Psychology and psychiatry researchers have also explored how exposure to violence or war can affect the learning process. Food, water or shelter deprivation, and the loss of the family were related to the development of post-traumatic symptoms for children (Husain et al, 1998). Osofsky

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(1999) posits that school age children suffer from concentration issues (because of intrusive thoughts) and feelings of regret (as they can understand more about violence) and adolescents show higher levels of aggression, anxiety, behavioral and school problems and truancy. Good parenting, and specially mothering (Dybdahl, 2001), or the support of a significant adult, are the best strategies to foster children's learning in a violent environment. Nevertheless, parents with symptoms of post-traumatic disorder may be unable to offer support to their children (Curran and Miller, 2001).

This paper can be related to the work by Sharkey (2010), who estimated how homicides in students' neighborhood relate to their performance in vocabulary and reading tests, using neighborhood fixed effects regressions on data from Chicago. He argued that violence alters test performance through emotional and physiological responses to stress. He reported that experimental studies show that high levels of stress hormones impair cognitive performance and activities related to the declarative memory. His findings indicated that a homicide in the student's block within a week of the tests reduces the scores. He calls for a broader recognition of how violence can be an obstacle for human capital accumulation, whether or not students are directly exposed. If a negative neighborhood effect on cognitive development exists (a topic of extensive discussion, like in Burdwick-Will et. al, 2010), better and increased policing and the provision of safe community environments may result in cognitive development short term gains.

This paper is similar to the work by Sharkey (2010) since it also uses standardized test scores for students that are exogenously exposed to violence. Methodologically speaking, this research tries to follow closely the works by Leon (2010) and Chamarbagwala and Moran (2011). Following Leon (2010), this paper explores a long run effect by estimating of the impact of exposure to conflict at birth, while it explores the short run effect by estimating the impact of exposure to conflict during the year of the test. Contrary to Leon (2010), a linear state-specific trend is preferred over a cubic specific trend to avoid a drastic reduction in the data variability. Unlike Chamarbagwala and Moran (2011), no initial-level control variable is employed here since the effect of such a trended variable is expected to be absorbed by the linear state specific trend.

Another difference with these two works and the works previously done for Colombia (Urdinola, 2004; Camacho, 2008) is the use of 5 different armed conflict indicators. Leon (2010) and Chamarbagwala and Moran (2011) used human rights violations, but this variable may suffer from underreporting. It can be that citizens fear to report or that those who report are different in unobservables to those who do not report. In a extreme case, it can be that events go unreported because victims are dead. Urdinola (2004) used the number of homicides per 100,000 inhabitants at the municipal level. That variable may contain homicides not related to the armed conflict and does not account for the number of combatants killed as a result of attacks on the armed forces. Camacho (2008) used land mine explosions at the municipal level. Even though the mine explosions are random, their location is not and terrorist groups choose the location depending on the features of the places they want to target.

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COLOMBIAN BACKGROUND

The Colombian armed conflict[1]

Nahzri (1997) pointed at the land ownership concentration as the key factor to understand the roots and evolution of the Colombian conflict. There are two phases of the war system in Colombia (see Figure 1): the low intensity phase, from the 1960's up until 1982, and, then, a more intense phase begins as the war system breaks due to the money of drug dealing. After 1982, guerrilla groups became involved with the drug dealing and, as a response, right wing paramilitary forces were created. The armed groups gained sophistication and action capabilities because of the money collected by taxing the drug trafficking (Ortiz, 2002). The peak of violence coincided with another breaking point in the Colombian war system. President Andres Pastrana (1998-2002) offered a large demilitarized zone for peace talks. When the peace talks collapsed, the Colombian government asked for help from the US. The help materialized through the US-funded Plan Colombia, whose goals were to promote peace, increase security and end drug trafficking (Veillette, 2005). When in 2002, Alvaro Uribe was elected president, the state's military offensive took place. The Uribe government also pursued a more active social policy, increasing expenditure in areas like health and education (World Development Indicators, 2011), and extending the coverage of conditional cash transfer programs.

Not everything has gone well in this last phase of the conflict for the Colombian government. Since 2002, many allegations have been made about human right violations and the increased danger for some social groups, including public school teachers. As Noticolombia (2010) indicates, 927 teachers have been killed in Colombia (264 since 2002), more than 4,000 teachers have been threatened, 1,092 were forced to relocate, 70 looked for refuge in other countries and 60 disappeared. Moreover, the conflict seems to be mutating instead of reaching an end. Nowadays, the main priority for the government is to fight against the augmented and more powerful organized urban criminality.

Education system and the Saber Tests

Formal education in Colombia is divided into 3 levels after one year of pre-school education (Ministerio de Educacion, 2011): 5 years of primary education, 4 years of secondary education and 2 years of middle education. After completing these levels, students can apply for higher education, whether the 5 years of college education or the usually 2-3 years of vocational education. During the period of analysis, 2000-2010, the Colombian education system was subject to a policy of improving enrollment rates, quality and accountability, as well as increasing public expenditure. Indeed, the government had increased the education expenditure since 2002. Supporting the coverage expansion, the government implemented conditional cash transfer programs for families to keep their children in school.

The policies still seem to be insufficient. Data from the 2005 Colombian Census (the latest census available) (DANE, 2011) reveal that around 90% of children at age 10 are enrolled in any educational center, but the enrollment percentage drops to 56% when they are 17 years old. Children not enrolled in any educational institution mainly live in households with insufficient income and the share grows with age. Those who are not enrolled are mostly males regardless of

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age. The net enrollment rate in primary education has been around 90% and there were not substantial increases during the decade. The country did experience gains of 10 percentage points in net enrollment for secondary education and for middle education (Ministry of Education, 2011). Note, however, that only 40% of children achieve the milestone of completing their secondary education.

The Ministry of Education designs and applies the standardized tests, Pruebas Saber (Knowledge Tests), at the different levels of education. The goal of the Saber tests for 5th and 9th grades is to assess the quality of the education through the evaluation of the cognitive achievement of the students. By law, these tests are mandatory for all students enrolled in 5th and 9th grade and the government has to apply them every 3 years (Ministerio de Educacion - ICFES, 2011). As for the 11th grade, the Saber tests serve as a quality assessment and as a requisite in the application and admission for higher education (Ministerio de Educacion - ICFES, 2008).

Other tests, like the UNESCO PERCE-SERCE tests and the OECD PISA (Programme for International Student Assessment), have been applied to samples of Colombian students to measure their cognitive achievements and skills in language, math and sciences. Colombia has participated in the 2006 and 2009 OECD-PISA and, on average, only outperforms Brazil and Peru in both math and reading; more importantly, the country has improved the tests' means between 2006 and 2009. In the analysis of the 2006 tests, the Ibero American PISA Group indicates about Colombian students that: more than 50 % of students are below the basic level of scientific literacy; 72% of students cannot use basic formulae and procedures, and are not capable of direct reasoning and making literal interpretations of the results; finally, more than 50% of students cannot identify the main idea in a text (OECD-PISA, GIP 2010).

DATA SOURCES

Armed Conflict Indicators

Extortions, terrorist attacks, kidnappings, mass murder victims and terrorist attacks against the police were selected as the most representative measures of the Colombian armed conflict. Values were taken on a yearly basis at the state level from Revista Criminalidad (2008). The Colombian Police records the number of events for each of these variables at the level of its regional commands or special jurisdictions [2]. Legal definitions of each of the selected variables are taken from the Colombian National Police website (2011) and can be found in Table 1.

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Table 1 Legal Definitions of Selected Internal Armed Conflict Variables

Variable	Description
Extortion	When someone threatens to use force or harm another person unless a payment is made; threats can be made by members of the narco-terrorists groups, organized criminal gangs or common criminality to entrepreneurs, business people, government officers or citizens.
Terrorist attacks	Attacks carried out using explosive devices or any other form of destruction, bringing terror or uncertainty to the population and endangering lives, buildings, communication means and infrastructure.
Kidnappings	Seizing a person against her/his will in return of a ransom or for propaganda gains. The kidnapping can be simple, for less than three people kidnapped at the same time by the same criminal, or collective, for three or more people.
Mass murders	When 4 or more people are killed at the same time and place and by the same perpetrators. This variable does not include the military personnel killed in action or when a group of 4 or more criminals are killed during police or military operations.
Terrorist attacks against the police	Attacks against the police units and officers. These attacks can be ambushes, open combats, attacks against police stations or patrols or when the attacker retreats without engaging in combat.

Source: Colombian National Police Website, 2011.

The chosen indicators are not exempt from problems. Extortions suffer from underreporting because people being extorted may fear that reporting to the police can increase either their vulnerability or what they have to pay to criminals. Even though extortion can be more related to the common criminality, it is a perfect expression of the linkages between criminal activities and the internal armed conflict: common criminals may increase their own activities because the deterrence on them is reduced as the armed forces and the police fight the terrorist groups and the drug dealers. Mass murders, also known as massacres, were very common during the most violent years of the conflict. Usually, mass murders happened as a retaliation strategy of the drug-dealing gangs, but also as a part of the war between the right wing and the left wing narco-terrorists in order to bring terror to the population in conflict zones. As for kidnapping, civilians were kidnapped for a ransom, while politicians and members of the armed forces were kidnapped as a way to push society to demand peace talks.

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Some variables that can be relevant in the Colombian case are not going to be used in the empirical exercises. Total number of homicides is a very appealing measure; however, this variable includes killings that happen due to factors not related to the internal armed conflict. The second variable not chosen here is the amount of cocaine seized by the armed and police forces; this may draw some criticism because of the preeminent role drug trafficking has played in the Colombian conflict. Nevertheless, most of the seizing takes places in production or shipping areas, which are only part of the drug production, distribution and commercialization chain.

Table 2 exhibits the average values of the conflict indicators for the sample of the students taking the tests. For the 5th grade and 9th grade students taking the test in 2002-2003, 2005-2006, the average values are reported at the birth year (an assumed two years state average is taken as it is going to be explained) and at the test year (for the 2002-2003 and 2005-2006 a state level two years average was taken since no specific date of the test is provided). For the 11th grade students taking the tests from 2000 to 2007, the figures are also reported at the birth year and at the year of the test. Note that the closer the students were born to the years the conflict intensified (1994-2002), the higher the level of conflict experienced at birth; that is exactly why the 5th grade students tend to have higher averages of conflict indicators at birth than the 9th grade students (who are 4 years older).

Table 2. Average of conflict indicators (per 100,000 inhabitants) for 5th, 9th and 11th grades

PANEL A							
Conflict Indicator	Year	5th Grade			9th Grade		
		2002-2003	2005-2006	2009	2002-2003	2005-2006	2009
Extortion	Birth year	2.59	1.5	1.72	1.5	2.62	1.6
	Test year	5.99	4.11	3.19	5.71	4	3.09
Terrorist attacks	Birth year	2.97	3.27	4.39	1.51	2.28	3.54
	Test year	4.1	1.53	0.68	4.38	1.34	0.61
Kidnappings	Birth year	4.61	3.48	6.56	1.88	4.26	3.44
	Test year	6.92	1.73	0.49	7.83	1.61	0.45
Mass murder victims	Birth year	NA	1.25	1.75	NA	NA	1.19
	Test year	1.5	0.38	0.36	1.66	0.33	0.33
Attacks against the police	Birth year	1.09	0.74	0.92	0.09	0.8	0.65
	Test year	1.12	0.48	0.37	1.21	0.38	0.29

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PANEL B						
Conflict Indicator	Year	11th Grade				
		2000	2001	2002	2003	2004
Extortion	Birth year	0.97	0.98	1.1	1.3	1.59
	Test year	3.97	4.74	9.02	7.86	7.86
Terrorist attacks	Birth year	0.99	1.32	1.51	1.38	1.42
	Test year	5.36	4.01	5.47	3.86	2.15
Kidnappings	Birth year	0.49	0.63	0.64	0.67	1.02
	Test year	12.43	9.8	9.39	6.7	4.51
Mass murder victims	Birth year	NA	NA	NA	NA	NA
	Test year	4.62	3.21	2.05	1.65	0.82
Attacks against the police	Birth year	0.18	0.04	0.04	0.05	0.07
	Test year	1.36	0.98	1.08	1.22	0.56

Source: Colombian National Police, 2009.

Saber Tests Datasets

Of all the array of subjects in the tests, only the scores for math and language are going to be employed and discussed throughout this paper since these fields are also included in international based tests. For 5th and 9th grade, the datasets lack information on the student gender and family background related variables. The main drawback is that the year of birth is not reported; this poses a serious problem for the estimation of the effects of conflict at birth. To overcome this problem, it is going to be assumed that all the students in the 5th and 9th grades sample are of the expected ages (11 and 15 years old, respectively). Data from the 3 waves of the tests suggest that more students at 9th grade have been evaluated (see Table 3 for details). The increase in number of students taking the tests may be correlated with an increase in the enrollment and in the tests coverage.

Table 3 Statistics for 5th grade and 9th grade sample

Variable	5th Grade			9th Grade		
	2002-2003	2005-2006	2009	2002-2003	2005-2006	2009
Rural School	0.23	0.21	0.25	0.14	0.11	0.15
Private School	0.18	0.15	0.18	0.18	0.18	0.2
Observations	465706	521421	512137	242362	357632	401038

Source: Pruebas Saber, ICFES-Ministerio de Educacion nacional, 2010.

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No additional assumptions were needed for the 11th grade data since the files recorded the information about the year of birth, level of education of the parents (although the categories change for every wave and are not always recorded), the plans (if any) to go to college and all the detailed scores for the mandatory and the optional fields in the test. The 11th grade sample of test takers does not include all those graduating before 1990 and those with coding errors in the variables for age, birthyear and the identifying code of the school. Although the data is available from 2000 to 2009, only the years from 2000 to 2004 are considered for estimations since these provide the identification code for the schools. After all the cleaning process, it can be seen than more women than men take the 11th grade tests from 2000 to 2007. Finally, the percentage of father and mothers of the students with high school or more education also increases (see Table 4 for details).

Table 4 Statistics for the 11th grade sample

Variable	11th Grade				
	2000	2001	2002	2003	2004
Female	0.54	0.54	0.54	0.54	0.54
Age at test	18.66	18.43	18.6	18.32	18.15
Graduating at the test year	0.95	0.95	0.89	0.94	0.93
Mother with high school or more education	0.47	0.5	0.51	0.52	0.55
Mother with high school or more education	0.47	0.49	0.5	0.5	0.55
Number of siblings	2.94	NA	2.82	2.74	2.72
Observations	432488	398846	433673	424432	431322

Source: Pruebas Saber, ICFES-Ministerio de Educacion Nacional, 2010

The main statistics of the math and language scores for each of the selected grades are presented in Table 5. Some salient features about the scores are as follows. First, the scores variability (represented by the standard deviation) increases. Second, math and language average scores tend to go decline over time for the 5th and 9th grades sample, grades that may have a higher heterogeneity of students than the 11th grade. Third, the 11th grade math average seems to be stable, but the 11th grade language average actually improves. It may be entirely possible that only the relatively better students remain in school: their families can cope better with the economic constraints and the negative impacts of the internal armed conflict.

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Table 5 Math and Language scores mean and standard deviation for 5th, 9th and 11th grade samples

PANEL A							
Variable	Statistic	5th Grade			9th Grade		
		2002-2003	2005-2006	2009	2002-2003	2005-2006	2009
Math Score	Mean	294.88	290.22	284.31	296.97	295.27	290.49
	S.D.	72.79	58.83	73.07	71.57	47.97	75.49
Language Score	Mean	297.83	293.03	292.35	296.38	299.96	293.74
	S.D.	68.13	61.5	71.54	68.65	55.97	74.71
PANEL B							
Variable	Statistic	11th Grade					
		2000	2001	2002	2003	2004	
Math Score	Mean	42.99	41.15	42.68	41.77	41.04	
	S.D.	5.44	5.38	6.35	5.34	6.16	
Language Score	Mean	46.39	46.36	48.2	48.69	52.19	
	S.D.	6.4	6	6.76	7.8	8.33	

Source: Pruebas Saber, ICFES-Ministerio de Educacion Nacional, 2010.

EMPIRICAL METHOD

Theoretical Background

Cognitive achievement should be understood as the outcome of the learning at the level of the student. Education has many individual and social outcomes (UNESCO, 2008), but this paper focuses only on math and language learning. Most of the discussion on cognitive achievement is centered around the relevance of school inputs and family background; however, relevant for this paper is the use of the Saber Tests scores as a measure of the cognitive achievement in language and math, which is the best approximation for assessing learning. Other applied papers in the context of a developing country (like Behrman et al, 1997) have also used test scores as the cognitive achievement indicators.

Following Todd and Wolpin (2003), cognitive achievement can be described in the context of a production function (g). In such a function, the level of achievement at the entrance of first grade (A_1) depends on family inputs during the preschool time (F_0) and the child's endowment of ability(μ), or: $A_1 = g(F_0, \mu)$. Family inputs are defined by the family's permanent resources (W).

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The family's choices about where to live and to send offspring either to private or public education defines the level of school inputs (S) in the function. Families do not have complete information about the school inputs and, even with complete information, the inputs applied to each child may deviate from the school aggregate. For the beginning of the second year, the achievement production function is $A_2 = g(S_1, F_{1,} F_0, \mu)$. As children go through their education, the function will contain the history of family inputs, the school inputs and children's ability.

Civil conflict can affect the history of cognitive achievements in several ways. Armed conflict may reduce family resources through the destruction of family assets, drops of income due to decreased labor opportunities or due to the killing of household members. Because of economic effects, families are exposed to lower food intake during the time of conception and gestation of children, resulting in lower birthweight and learning difficulties during the school years. Armed conflict forces the most vulnerable families to relocate into places without access to proper sanitation services or housing; in these unhealthy new settings, the increased morbidity in children may harm their academic performance and achievement. Armed conflict possibly brings the destruction of school buildings and the killing or displacement of teachers, which altogether diminishes the quantity and the quality of the education that children can attain. Children could be forced to leave school for prolonged periods during war, decreasing the probability of future academic achievement. Direct and indirect exposure to violence and conflict may generate post-traumatic stress and learning disorders if children do not have adequate family and community support. With post-traumatic stress, the efficiency of the family and school inputs is reduced since children are not able to focus on learning and might experience behavioral or memory problems.

The variables being considered in this paper can affect children's learning through economic or psychological channels. Extortions work primarily through the economic channel. When a household is extorted, income is reduced and parents have less money available to spend on children's education. The risk of post-traumatic disorders due to extortion would only materialize if a household refuses to pay and criminals attack household members. Terrorist attacks have a negative consequence on learning causing post-traumatic disorders in children. Children can witness a terrorist attack or may suffer from the chaos and the forced changes in daily routines those attacks bring. Similarly, attacks against the police act through the psychological channel. The only way terrorist attacks may act through the economic channel is when terrorism leads to severe market disruptions or when the uncertainty created translates into reduced economic activity. Finally, exposure to mass murder victims has a psychological impact.

Identification Strategy

Based on the cognitive achievement production function, the net effect on the test scores of the economic and psychological channels will be estimated as follows:

$$Score_{ijt} = \alpha + \beta_1 Conflict_{jt} + \Pi_j StateTrend_t + X_i\gamma + \sigma_t + \eta_j + \varepsilon_{ijt} \qquad \text{Equation 1}$$

Where $Score_{ijt}$ is the score (either math or language) of student i born or residing in state j and taking the test in year t. $Conflict_{jt}$ is the value of the chosen violence indicator (extortion, terrorism, kidnapping, mass murder victims and terrorist attacks against the police) per 100,000

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inhabitants in state j during the test year t. σ_t is test year fixed effect. The test year fixed effects stand in the equation to take into account events during the year of the test that are not controlled with the selected variables and are common to all test takers regardless of the state they live. The $StateTrend_t$ variable is created in order to control for state specific linear trends; this linear trend aims at controlling for linear variations in economic development or conflict intensity in each state during the period of analysis. η_j represents the state fixed effects to control for state features, that affect both violence and learning outcomes, that are time invariant. Finally, X_i, contains the control variables: gender and parental education for the 11th grade sample estimations, and location of the school (rural or urban) and type of school (public or private) for the 5th grade and 9th grade samples. The coefficient of interest is the coefficient on the armed conflict indicator β_1.

Equation 1 estimates the effect of exposure to the armed conflict during the year of the test. It could be expected that increased armed conflict during the test year impairs the concentration and memory of students and generates additional stress during the test sessions[3]. It could also be expected that households may take some time to adjust to economic shocks due to the conflict; if so, student scores may be harmed by all the transitions happening at home. This is, nonetheless, only one side of the story.

The other side of the story acknowledges that exposure to conflict at birth may reduce the birthweight and may hinder child development. For instance, the gestation and development of children suffers from the increased stress hormones of mothers during pregnancy (like in Camacho, 2008); moreover, conflict early in life may force children permanently into trajectories of lower income and lower education (both in years and quality of education) due to changes in household resources and innate level of ability. If $Conflict_{jt}$ is the level of conflict in the state j during year of birth b and with year of birth fixed effects σ_t, the equation, Equation 2, for the effect of exposure to conflict at birth is:

$$Score_{ijt} = \alpha + \beta_1 Conflict_{jb} + \Pi_j StateTrend_t + X_i\gamma + \sigma_t + \eta_j + \varepsilon_{ijt}$$ Equation 2

Causality will exist as long as the state fixed effects remove all observed and unobserved features that are constant over time and common to all the individuals born and residing in each state. If there is any variable explaining armed conflict levels and the scores at the state level, and it stays constant during the period of analysis (like whether or not the state is a cocaine producing area, the presence of mineral rents that attract terrorist groups, or geography and infrastructure), the state level fix effects will cancel it out. Additionally, year fixed effects control for shocks that are common to all test takers whether during their birthyear or the year of the test. And state specific trends capture changes for each state through time. With all these fixed effects, the results will not be the effect of the armed conflict on learning attainment at a national level, but rather the average effect with respect to the state average and year average, after factoring out state trends. Causality will also imply that the error term is not correlated with the armed conflict levels. If states with higher conflict levels are also those with lower learning attainment (lower scores on the test), this assumption would be violated. The case of Colombia is quite unique since there is not a relationship between poverty and conflict: relatively wealthy states have the same, and even higher,

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levels of conflict than the poorest states. More interestingly, there is not a geographical pattern of how the conflict has spread through the territory. With all this, the estimates can be read as causal.

Threats to Identification

For the 5th grade and 9th grade scores, t takes values of 2002-2003, 2005-2006 and 2009, corresponding to the years when the tests were applied. The datasets do not provide the specific date of the test for each school, which makes the year identification difficult. To overcome this, the average level of conflict (for each of the 5 chosen indicators) at the state level was taken for the periods 2002-2003 and 2005-2006. Unfortunately, the yearly state variation is reduced by this averaging, but it is the only way to carry out the estimations. This procedure will bias down, towards zero, the possible impact of conflict on learning.

Another difficulty with the dataset for 5th grade and 9th grade is the lack of the test takers' birthdate. The year of birth was calculated by assuming that the students in the sample were of the expected age in each grade: 5th grade students are expected to be 11 years old and 9th grade students are expected to be 15 years old. For instance, 5th grade students taking the tests in 2002 are assumed to be born in 1991 and they are assumed to be born in 1992 if they took the test in 2003; for the level of conflict at birth, the state average between 1991 and 1992 is calculated. The Ministry of Education reports that from 2002 to 2008, the percentage of students who passed their grades went up from 82% to 90% (with the related drops in those who left school and in those who failed their grades). Moreover, the net enrollment rates are high for 5th grade (around 90%), but not that high for 9th grade (70%), as discussed before. The net enrollment rate is computed as the ratio of enrolled students at the expected age in a particular grade to the total population at the expected age.

None of the datasets report the state of birth of the test takers. If internal migration is high and it is mainly caused by conflict, assuming that students still live in the state of birth would bias downwards the estimations. This bias happens because students could be living, at the time of the test, in a safer state, rather than in a more violent state; if so, the sample is no longer representative since observations from more violent states at birth may be underrepresented. The 2005 Colombian census (DANE, 2011) reveals that around 90% of the students at the expected age for each of the grades still live in the same state (departamento) of birth. It seems that there is no direct relationship between conflict intensity and across state migration as the most violent states exhibit both high migration rates (Putumayo and Guaviare) and low migration rates (Antioquia, Santander, Valle). Most of internal migration happens within the state and that is why state level violence is more appropriate than municipal level violence.

Another threat deals with school mobility. The student is observed only at the moment of the test and nothing is known about his or her academic history. It is entirely possible that a student changes of school several times during primary and secondary education. This mobility can be important in explaining test scores. For instance, a student can move from a lower quality school to a higher quality school (or in the terms of the cognitive achievement model, a school with higher and better inputs) in which, despite the level of violence, the student is going to achieve higher test scores. The contrary is also true. Mobility can become even worse if parents decide to change schools as

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a way to protect their children from the direct threat of conflict. Data currently available do not allow for controlling school mobility.

Earlier, when describing Colombian education, a reduction in net enrollment rates from basic to middle education was mentioned. Those who dropped out of school may have done it for economic reasons and/or due to the civil conflict. The datasets only contain data about the students enrolled at the moment of the test and no information is available on the cognitive achievement of all those who dropped out of school. Nothing can be said about them[4]. A full understanding of how and why Colombian children drop out of school goes beyond the scope of this paper. Specifically for the years considered in this research, the unemployment rates around 10% and the increase in the self employment (employment without benefits), may signal that educational gains are slim regardless of the conflict level. Another issue to consider is that profits from criminal activities (like drug trafficking) may tempt some children to drop out of school. For the purposes of this paper, following Akresh et al (2009), the impacts of civil conflict on the Saber scores are conditional on being enrolled in school at the year of the test.

Even though Colombia suffers from a lot of underreporting of criminal activity due to the inefficiency of the judiciary system (Nazih, 1997), this is not a major source of concern for the estimation results. Certainly, victims do not report all extortion, but this is not the case for terrorist attacks, mass murders, kidnappings and attacks against the police, which are very difficult to hide from the authorities and the general media. A very valid point is about the endogeneity between policing and crime figures (like in Levitt, 1997). In Colombia, the rise in the armed conflict indicators is explained by the growing terrorist involvement in drug dealing and the demilitarized zone the government created for the failed peace talks. According to this timing of events, it is reasonable to expect that no endogeneity exists between policing and the conflict figures.

With all the turmoil the left wing and right wing narco-terrorists caused, individual criminals and other criminal organizations may take advantage of the reduced costs of carrying out their activities. As the number of criminals increases, the average police effort to chase each of them decreases. That a share of kidnappings, extortion, attacks against the police, mass murder victims and terrorist attacks come from other sources than the right wing or left wing terrorist groups cannot be ignored. Only extortions and kidnappings may suffer from this sort of pollution.

State level measures of conflict intensity are useful to incorporate most of the space-level variation of conflict throughout the country. Nevertheless, conflict is not homogeneous even at the state level and it is entirely possible that only some regions within the state receive the bulk of conflict, while others remain relatively peaceful. If so, this leads to issues of measurement error because the regressions cannot capture the different intensity at the state level. With measurement error, attenuation bias will take the estimates of the effects of exposure to conflict towards zero. Most likely the effect of conflict on learning (both at birth and the year of the test) is higher than what is estimated.

As it was discussed in the model of cognitive achievement, learning depends on school inputs and students' characteristics and innate levels of skills. The data available does not provide the

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variables to control for school-level inputs or student's features (like gender, in the case of the 5th and 9th grade estimations). Depending on their correlation with the chosen measures of civil war, the omitted variables can bias estimates of the impact of civil war upwards or downwards.

ESTIMATION RESULTS

This section presents the results of estimating Equation (1) and Equation (2). The effects of exposure to conflict at birth on language and math scores are discussed first and, afterwards, the estimates of exposure during the year of the test. This section closes with a discussion of robustness checks. The main results include different regression specifications: estimations without state nor year fixed effects and without state specific trends (Specification 1); estimations with only state and year fixed effects (Specification 2); estimations with state and year fixed effects and state specific trend (Specification 3); and estimations with school and year fixed effects and state specific trend (Specification 4). Errors are clustered at the state level (Specification 2, Specification 3 and Specification 4). Regressions for the 11th grade scores include gender and two indicator variables controlling for fathers and mothers having some or more than high school education. Given the information available in the datasets, no individual level controls are included in the regressions for 5th and 9th grades, but rather controls for the location of the school and the type of school are included. Conflict variables per 100,000 inhabitants per state per year are used. Additionally, assuming that all variables are criminal events and that those criminal events can be added up, some estimations include a variable called total conflict. Since aggregation can be an issue, a principal component factor analysis of total conflict is also employed.

Overall, regressions indicate the following. First, fixed effects, either at the state level or at the school level, matter. Second, the main difference between state level and school level fixed effects is that the latter results in more significant estimates; using the school fixed effects reduces the variability (which mainly happens at the state level) and gives smaller standard errors. Third, for 5th and 9th grades, exposure to conflict at birth is more deleterious on the scores than the exposure to conflict during the year of the test; besides, math scores are more sensitive to conflict than language scores. Fourth, due to reduced net enrollment rates, there seems not to be a relationship between the scores and conflict for the 11th grade sample. Fifth, when adding the exposure during the year of the test to the effects of the exposure at birth, higher levels of armed conflict lead to a 3-4 points drop in the math and language scores for 5th grade students, and a reduction of nearly 2-3 points for the 9th grade students. Sixth, 5th and 9th grade students attending rural and public schools received lower scores (almost 30 points lower) than the students attending urban and private schools. Seventh, the 11th grade students with parents with some or more than high school education achieved scores 3 points higher than those students whose parents have less than secondary education; gender difference is around 1 point in favor of males in the math scores.

Effect of Exposure to Armed Conflict at birth

The impact of exposure to armed conflict at birth on the 5th grade and 9th grade language and math scores are presented in Table 6 (5th grade) and Table 7 (9th grade). For the language scores, the point estimate for extortion is negative and significant, but larger for 5th grade than for 9th grade; any possible reduction can be caused by the attrition effect or by school desertion for

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secondary education. The estimate for the number of mass murder victims is of the correct sign in 5th grade, but it is not significant. It is noticeable that attacks against the police, an event that creates a lot of turmoil in any community, is significant and positive for the 5th graders' language scores; perhaps, the military and police response after an attack may increase the feeling of safety and reverse the initial negative effects of such an attack.

Table 6 Effect of exposure to conflict at birth on the 5th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	1.554	2.208	0.179	1.862	-2.404	-0.489	-2.494	-0.573
	(46.56)***	(64.46)***	(0.39)	(2.70)**	(2.60)**	(0.24)	(11.92)***	(2.31)**
Terrorism	-0.569	-0.553	-0.278	0.433	-0.124	-0.34	0.155	0.022
	(37.41)***	(35.42)***	(0.66)	(0.65)	(0.22)	(0.37)	(0.64)	(0.07)
Kidnapping	-0.533	-0.663	0.02	0.025	-0.008	-0.261	0.027	-0.279
	(56.59)***	(68.87)***	(0.23)	(0.16)	(0.05)	(0.71)	(0.40)	(3.73)***
Mass murder victims	-0.38	-1.015	-0.018	0.252	-1.23	-3.13	-1.568	-2.161
	(10.42)***	(27.69)***	(0.05)	(0.35)	(11.52)***	(27.84)***	(1.06)	(1.42)
Attacks against police	-0.808	-0.624	0.749	0.326	0.818	-0.394	1.134	-0.128
	(18.01)***	(13.58)***	(0.99)	(0.30)	(0.68)	(0.28)	(3.60)***	(0.39)
Total conflict					0.023	-0.119	0.005	-0.093
					(5.51)***	(27.30)***	(0.08)	(1.47)
Total conflict factorial					1.68	-1.685	0.071	-1.32
					(5.1)***	(27.30)***	(0.08)	(1.47)
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

Even though of negative sign, none of the estimates are significant for the 9th grade scores; again, the reduction in the heterogeneity of the sample, due to the attrition, may be behind this finding. Total conflict is only negatively significant, but marginal, for the 9th grade scores on language. Going to the math scores estimates, extortion and kidnapping have a significant and negative effect for the 5th grade scores. For the 9th grade scores, attacks against the police and the main factor

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from the principal component analysis have a negative and significant impact. As previously mentioned, attacks against the police could have a positive impact; here, in the case of the 9th grade scores, the same argument is valid for the negative impact: conflict intensifies with the augmented police and military activity after a previous attack on the troops.

Table 7 Effect of exposure to conflict at birth on the 9th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	1.118	-0.031	-2.681	-0.003	-1.978	-0.769	-1.13	0.285
	(26.15)***	(0.73)	(1.76)*	(0.01)	(1.32)	(0.38)	(3.68)***	(0.64)
Terrorism	-0.257	-0.512	0.521	-1.133	-0.179	0.175	-0.02	0.394
	(10.54)***	(21.33)***	(0.54)	(1.99)*	(0.39)	(0.20)	(0.08)	(1.07)
Kidnapping	-0.097	-0.365	0.795	-0.475	0.416	0.55	-0.223	-0.244
	(4.45)***	(17.07)***	(1.05)	(0.81)	(0.69)	(0.70)	(1.48)	(1.07)
Attacks against Police	1.402	0.011	3.02	-0.431	1.276	-1.16	-0.13	-2.984
	(16.70)***	(0.13)	(1.36)	(0.20)	(0.79)	(0.53)	(0.34)	(5.40)***
Total conflict					-0.014	0.084	-0.172	-0.13
					(0.01)	(0.26)	(2.21)**	(1.14)
Total conflict factorial					0.521	-0.128	-0.745	-1.733
					(0.37)	(0.07)	(1.77)	(2.81)***
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

Estimates of the exposure to conflict at birth for the 11th grade students' scores are in Table 8. On the language scores, extortion and kidnapping are negative and highly significant, but their point estimates are very small (less than one point). The relative reduction in point estimates, and even the sign switch (as in the case of terrorist attacks) can be fully explained by the reduction in heterogeneity in the sample as only 40% of the population supposed to be enrolled at 11th grade

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is actually enrolled.

Table 8 Effect of exposure to conflict at birth on the 11th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	0.405	0.547	-0.181	0.254	0.565	0.159	-0.018	-0.065
	(113.74)***	(156.49)***	(1.81)*	(2.87)***	(5.40)***	(2.99)***	(1.56)	(6.06)***
Terrorism	0.152	0.289	0.091	0.153	0.231	0.131	0.017	-0.048
	(60.72)***	(113.25)***	(1.11)	(1.87)*	(1.91)*	(2.00)*	(1.90)*	(5.44)***
Kidnapping	0.032	0.169	0.13	0.052	0.439	0.151	-0.052	-0.036
	(15.97)***	(93.93)***	(3.33)***	(0.92)	(3.79)***	(3.65)***	(4.52)***	(3.66)***
Attacks against Police	-0.041	0.282	0.226	0.222	-0.02	0.073	0.055	0.019
	(5.94)***	(36.57)***	(1.94)*	(2.05)**	(0.04)	(0.64)	(0.45)	(0.21)
Total Conflict					0.3	0.18	0.192	0.118
					(8.18)***	(7.56)***	(52.51)***	(35.13)***
Total conflict factorial					0.505	-0.002	0.967	0.283
					(1.50)	(0.03)	(9.49)***	(3.81)***
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

Effect of Exposure to Conflict during the Year of the Test

As it will be seen, these point estimates are smaller than those of the exposure to conflict at birth.

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Estimations for 5th grade (Table 9) and 9th grade scores (Table 10) suggest that extortion and terrorism are both significant and negative for the 5th grade language scores, while extortion is the only significant conflict indicator, but of positive sign, for the 9th grade language scores. This sign shift may be related to schooling desertion. Extortion may affect schooling by imposing an extra cost on households that, under the strain of conflict, may already be cutting down their expenditure on education; extortion can also lead to forced displacement, changing the access and the quality of the education available. Interestingly, the main factor of the principal component analysis has a negative and significant effect on language scores for both grades (around 1 point).

Table 9 Effect of exposure to conflict during the year of the test on the 5th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	0.046	0.351	-0.559	0.192	-0.431	1.596	-0.579	1.505
	(3.20)***	(23.80)***	(1.27)	(0.26)	(0.67)	(1.16)	(3.55)***	(7.85)***
Terrorism	-0.201	-0.085	-0.679	-1.3	-0.857	-1.019	-0.892	-1.1
	(15.57)***	(6.36)***	(2.04)**	(2.59)**	(1.66)	(1.84)*	(5.40)***	(5.95)***
Kidnapping	0.042	0.058	0.024	-0.613	-0.045	-1.238	0.024	-1.325
	(3.40)***	(4.62)***	(0.07)	(1.09)	(0.09)	(1.17)	(0.12)	(6.04)***
Mass murder victims	0.439	1.153	-0.47	-0.529	-0.497	-0.529	-0.334	-0.351
	(9.94)***	(25.42)***	(0.21)	(0.20)	(0.40)	(0.31)	(0.77)	(0.66)
Attacks against Police	-0.274	-0.003	-0.925	-1.905	-0.402	-0.741	-0.297	-0.384
	(10.12)***	(0.11)	(2.79)***	(4.33)***	(1.22)	(1.00)	(1.37)	(7.25)***
Total Conflict					-0.282	-0.18	-0.288	-0.224
					(1.16)	(0.76)	(4.16)***	(2.85)***
Total conflict factorial					-1.76	-4.845	-1.34	-4.819
					(1.55)	(1.31)	(2.71)**	(7.00)**
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

The results for the 5th and 9th grades math scores indicate that: terrorism and kidnapping have negative and significant coefficients; surprisingly, the coefficient on extortion is positive and

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relatively large and significant for both grades. The switched sign on extortion may be pointing at the environment of higher economic activity after 2000, with more money circulating, more profit from extortion for the criminals and, maybe, less impact on the households' budget. Specifically for 5th grade, attacks against the police reduce the math scores, but the point estimate is small; on the contrary, the main factor of the principal component analysis has a very large and negatively significant effect.

Table 10 Effect of exposure to conflict during the year of the test on the 9th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	0.316	0.193	-0.006	-0.003	1.722	1.951	0.898	1.028
	(17.67)***	(10.96)***	(0.01)	(0.01)	(1.90)*	(1.70)*	(5.86)***	(3.96)***
Terrorism	0.129	0.134	-0.537	-1.133	-0.216	-0.721	-0.065	-0.576
	(7.32)***	(7.77)***	(1.89)*	(1.99)*	(0.55)	(1.03)	(0.36)	(2.17)**
Kidnapping	0.058	0.148	-0.026	-0.475	-0.729	-1.581	-0.218	-0.948
	(3.76)***	(9.74)***	(0.07)	(0.81)	(1.06)	(1.59)	(1.32)	(3.57)***
Mass Murder victims	-0.268	0.814	-0.955	-0.431	-1.513	-1.265	-0.247	0.409
	(4.81)***	(14.87)***	(0.57)	(0.20)	(1.36)	(0.68)	(0.41)	(0.48)
Attacks against Police	0.241	0.275	-0.493	-1.324	-0.645	-0.206	-0.286	0.191
	(6.38)***	(7.40)***	(1.89)*	(3.58)***	(1.32)	(0.35)	(1.13)	(0.61)
Total Conflict					0.191	0.028	0.161	-0.008
					(1.02)	(0.10)	(2.21)**	(0.07)
Total conflict factorial					-3.257	-3.539	-1.1	-1.18
					(1.38)	(1.04)	(2.04)**	(1.46)
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

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Lastly, the effect of exposure during the year of the test on 11th grade language and math scores is evaluated. Table 11 shows how deleterious desertion, throughout high school, can be on biasing the sample and the results: point estimates of the significant coefficients on extortion, terrorism, kidnapping and attacks against the police (only for math scores) are positive. Only attacks against the police have a negative, but not large and not very significant effect, reducing the math scores.

Table 11 Effect of exposure to conflict during the year of the test on the 11th grade Language and Math Scores

Conflict Indicators	Specification 1		Specification 2		Specification 3		Specification 4	
	Language	Math	Language	Math	Language	Math	Language	Math
Extortion	0.051	0.017	-0.006	0.005	-0.008	0.001	0.006	0.013
	(85.05)***	(33.81)***	(1.45)	(1.13)	(1.29)	(0.34)	(3.26)***	(2.81)***
Terrorism	-0.012	0.001	-0.014	0.001	-0.014	-0.002	0.008	0.019
	(24.92)***	(1.56)	(2.10)**	(0.21)	(1.95)*	(0.85)	(4.17)***	(4.12)***
Kidnapping	-0.041	-0.008	-0.009	-0.004	-0.014	-0.007	0.007	0.004
	(87.74)***	(19.09)***	(1.88)*	(1.98)*	(2.31)**	(1.98)*	(4.28)***	(2.50)**
Mass Murder victims	-0.136	-0.008	-0.011	-0.007	-0.026	-0.016	0.001	-0.005
	(99.88)***	(7.29)***	(1.03)	(0.65)	(1.85)*	(1.65)	(0.28)	(2.00)**
Attacks against Police	-0.031	-0.007	-0.034	-0.007	-0.035	-0.004	-0.003	0.021
	(25.85)***	(6.62)***	(1.89)*	(1.06)	(1.65)	(1.20)	(0.90)	(3.91)***
Total Conflict					-0.005	-0.001	-0.001	0
					(2.27)**	(1.97)*	(1.87)*	(0.09)
Total conflict factorial					-0.104	-0.028	-0.036	-0.01
					(1.60)	(1.21)	(1.74)*	(0.97)
Clustered Errors	NO		State Level		State Level		School level	
Fixed effects	NO		State Level		State Level		School level	
Year of test fixed effects	NO		YES		YES		YES	
State specific linear trend	NO		NO		YES		YES	

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Conflict variables in per 100,000 inhabitants per state per year. Factor

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Eigenvalue 2.52; Proportion 0.47; KMO 0.70. Coefficients from separate regressions (controls for private and rural schools where appropriate).

Robustness checks

From the previous results, it was seen that the effect of the internal armed conflict gets smaller from 5th grade to 11th grade and that, even in some cases, the sign on the coefficients of conflict indicators switches from negative to positive. That extortions or kidnappings have a positive sign is not necessarily worrisome since more available income leads to potentially higher criminal gains by extorting and kidnapping. Nevertheless, positive sign on the coefficients for terrorist attacks, mass murder victims and attacks against the police may point to a different problem. School desertion biases the results by biasing the sample. According to auxiliary regressions (not reported here), desertion does seem to be sensitive to annual GDP growth. Poor households may not find it profitable to keep their children at school either because of high opportunity costs (foregone wages) or just because low gains from education. Gains from education could be low in a country with unemployment around 10%, high levels of self employment or employment without benefits and lack of upward social mobility. Therefore, children who remain in school are substantially different from those who drop out. Those staying in school may come from families that can cope better with economic shocks or that place a higher value on educational achievement.

Given the available data, it is not possible to know who the dropouts are. As a way to handle this attrition problem, the technique Bharadwaj et al. (2012) used for estimating the effect of early interventions on Chilean children with low birthweight is adapted for the purposes of this paper. Bharadwaj et al. had information on children at birth and their performance in language and math scores when they are at school. They could not observe the scores of children who died and they assigned to the dead children an artificial score ranging from the 55th percentile to the 80th percentile of the scores of those who did survive. Here, the procedure is adapted as follows: first the number of the dropouts is found and, second, the mean value of the test takers scores and most relevant variables are imputed to the dropouts.

The net enrollment rate can be defined as:

$$NetEnrollment_{jt} = \frac{DO_{jt}+TT_{jt}}{AgePopulation_{jt}} \text{ Equation 3}$$

Where, $NetEnrollment_{jt}$ is the net enrollment rate for grade j at the year of the test t; DO_{jt} is the variable for the dropouts (not observed in the Saber tests samples) or those who are not enrolled in grade j at the year of the test t; TT_{jt} stands for those who are observed, the test takers, and for whom scores are reported. Finally, $AgePopulation_{jt}$ is the reference age group or the total number of people aged 15 for 9th grade or aged 17 for 11th grade at the year of the test t , $j = 9th\ grade, 11th\ grade$ and t is the year of the test for 9th grade (2002-2003, 2005-2006 and 2009) and for 11th grade (from 2000 to 2004). Assuming that net enrollment rate stays constant throughout all grades of primary and secondary education, that is 90% for 9th and 11th grades during each year of the test, the number of dropouts can be found as:

$$NetEnrollment_{jt} = \frac{DO_{jt}+TT_{jt}}{AgePopulation_{jt}} = 0.9 \Rightarrow DO_{jt} = 0.9\left(AgePopulation_{jt}\right) - TT_{jt} \text{ Equation 4}$$

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For each of the mentioned years, the total age reference population was taken from the Colombian statistic bureau (DANE, 2011) population series. Acknowledging that sticking to the criteria of 15 years old for 9th grade and 17 years old for 11th grade may not be very representative for Colombia, a weighted age reference was computed as follows: 80% of the reference population of the expected age, 10% of the population one year younger and 10% of the population one year older. The samples of dropouts were constructed in such a way that they have on average the same values of the control variables used in the regressions with the real samples: same proportion of students attending private schools and of students attending rural schools (for the 9th grade sample) and the same proportion of female students and of students with mother and/or father with some or more than high school education (for the 11th grade sample). The dropouts were assigned the mean score in math and the mean score in language, as well as the 95%, 90%, 85% and 80% of those means. They were also given the same armed conflict indicators levels (by place of residence and year of birth and year of the test) as the real test takers.

The inclusion of the artificially created dropouts in the 9th grade and 11th grade sample leads to different results. Overall, it would seem that armed conflict is no longer deleterious for learning achievement if students stay in school until 11th grade. Negative effects of exposure to conflict at birth may disappear for students enrolled in 9th grade and 11th grade. The estimations do not indicate what should be the imputed scores to the dropouts in order to find a negative impact of armed conflict. Assuming very low scores would be indicative of extremely poor learning attainment, for which no negative impact of conflict would be needed. Finally, the coefficients on some of the conflict indicators remain positive even after including the artificially created dropouts.

Not reported here, the results for effects of exposure to armed conflict at birth on the 9th grade scores including the dropouts reveal that no variable is significant. For the 11th grade sample, exposure to conflict at birth would lead to positive and significant effects of extortion and kidnapping, but the point estimates are smaller than 0.5. It may be that the education system in Colombia, ensuring that parents keep their children in school, eliminates the negative impact of the armed conflict. Results are perhaps more interesting for the exposure to armed conflict during the year of the test. For the 9th grade sample including the dropouts , there is a reduction in the language scores (until using the 95% of the mean as the imputed scores for the dropouts) as consequence of higher number of mass murder victims, but the coefficient is significant only at 10% level. When the 9th grade dropouts are imputed only 80% of the scores in math, kidnappings, terrorist attacks and attacks against the police lead to a reduction of around 1 point; again, the coefficient is only significant at 10%. The final table shows the effects of exposure to conflict during the year of the tests for the 11th grade sample including dropouts. Kidnapping translates into very small and not very significant reduction in language scores for all the 5 specifications; the same is true for terrorist attacks. Math scores are negatively impacted by the number of mass murder victims throughout the 5 specifications; only when the imputed score is 80% of the mean to the dropouts, math scores are also negatively impacted by kidnappings, terrorist attacks and attacks against the police.

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Another robustness check is motivated by what previous works describe as the existence of non-linearities in understanding the effects of conflict and violence on school achievement. Sharkey (2010) found the impact of homicides in the neighborhood fades away as the time between the test day and the day of the killings gets longer. From the intervention perspective, Burdwick-Will, et al. (2010) indicate the possible existence of non-linear effects of violence on children. Is this the case for the Colombian armed conflict? Not reported here, Equation (2) was re-estimated with a squared term for each conflict indicator and without the state-specific trend, leaving only state and year of the test fixed effects. Although results should be taken with care and more theoretical discussion may be needed in order to draw an ultimate conclusion, it can be said that there are non-linear effects: extortion has negative and significant non-linear impact on the 5th and 9 grades language scores; terrorist attacks only have a negative non-linear effect on the performance of 5th grade language scores. For the math scores, only extortion and terrorist attacks have non-linear negative impact on the 5th grade students; 9th grade math scores are also negatively impacted by extortion, kidnapping and attacks against the police. The results of non-linear effects on 11th grade language and math scores remain insignificant.

The final robustness check deals with the timing of the exposure to conflict. Up until now, the contemporaneous exposure to conflict at birth and in the year of the test has been chosen as the timing for measuring the impact. Nonetheless, this approach has its weaknesses. For instance, exposure to conflict in utero can be more pervasive for the physical and cognitive development of the children (Camacho, 2008; Doyle et al., 2009). Following this line of thought, instead of the exposure to conflict at birth, the exposure to conflict during the gestation months is going to diminish the learning outcomes of children in the future. Additionally, the exposure to conflict in the year of the test might not be the right procedure because exams do not take place at the end of the year and, so, the conflict of that year has not been fully realized. It could be that conflict levels experienced in the year before the test are the ones that harm the performance of the students. Not reported here, but available upon request, regressions using the indicators of conflict in the year before the birth year and the year before the year of the test were estimated. The results (not reported here, but available upon request) indicate that only extortion has a negative impact on the math and language scores for 5th grade. In the case of 9th grade only mass murder victims reduce the scores on both math and language tests. No significant coefficient was found for the 11th grade regressions. These results highlight how the economic and the psychological channel can interact at different stages of the student's life to impair the learning outcomes: economic channel early in life (represented by extortions) and psychological channel later in life (represented by mass murder victims).

CONCLUSIONS

Previous research indicates that exposure to civil war and violence reduces the number of completed school years and test scores. This type of war imposes economic costs on families due to the destruction of assets or reduction of revenues. As a way to smooth consumption, households may take their children out of school either to reduce expenditure or to have them available for work. Governments may reduce their expenditure on education to make more funds available for the military effort. In the heat of the confrontation, schools are destroyed and teachers killed.

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Households may be forced to relocate and settle in places where education is insufficient or of a lower quality. Children, directly or indirectly exposed to violence, may suffer from post traumatic disorder, reducing their learning abilities; furthermore, their environment may not be learning-conducive due to the violence concerns at home and the economic constraints. Taken as a whole, these mechanisms create obstacles to the accumulation of human capital.

Using data collected by the Colombian Police, this paper estimates the effect of the Colombian armed conflict on math and language learning. Estimations are carried out via models in which the score in the Colombian Saber test is the dependent variable and one of the conflict indicators (Extortion, Kidnapping, Terrorist Attacks, Mass Murder Victims and Terrorist Attacks against the Police) is the main independent variable. The regressions also include state fixed effects and year of the test fixed effects, besides a state-specific linear trend. The identification strategy is based on the level of violence to which the student was exposed at the year of birth at the state of birth or at the year of the test in the state of residence.

The results indicate that the exposure to conflict at birth has a bigger impact on scores than the exposure to conflict at the year of the test. The reduction in the scores is bigger in point estimates for the 5th than for the 9th grade students. Due to attrition, as students drop out of school, the results are not conclusive for the 11th grade sample. In the cases of the 5th and 9th grades samples, the effects seem to be bigger for the math scores than for the language scores and the total effect (exposure at birth plus exposure at the year of the test) is a reduction about 3-4 points. The combined effect of the exposure at birth and the exposure during the year of the test produces a small reduction of language scores (5% SD for 5th grade and 3% SD for 9th grade) and of the math scores (6.5% SD for the 5th grade and 6% SD for the 9th grade). When tackling attrition by including artificially created dropouts, it seems that there is no effect of the exposure to conflict at birth, implying that the education system cancels out any pervasive effect of the violent conflict environment in which children grew up. This finding would also suggest that cash transfer programs, conditional on keeping children in school, may alleviate the effects of the armed conflict on the human capital accumulation. Overall, the variables leading these results are Extortion, Kidnapping and Terrorist attacks.

Small effects? On average. Some regions may deviate from the average and have suffered from high levels of conflict intertwined with poverty and forced displacement over long periods. These results may highlight the relevance of special interventions in these regions. Such interventions would need to target, in particular, children and mothers to help them overcome the trauma and stress generated by conflict. Furthermore, these regions need to be put back on the track of human capital accumulation with programs targeting adults who could not complete their schooling due to economic constraints and the burden of violence.

The results emphasize the importance of cash transfer programs conditional on keeping children in school (like Colombian' scheme of Familias en Accion). They also highlight the importance of fighting the crimes that have more negative incidence on the population because of the economic cost or post-traumatic stress disorders in children and adults. In particular for Colombia, as the recent developments indicate, authorities should focus their efforts on fighting all different types

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of extortions that are taking place in poor city areas. While fighting civil wars, government should also promote programs to offer support to families and communities, giving them the resources they need to help children to cope with the stress and trauma. Police forces should also help school administrators in providing the best climate for teaching and learning (as Osofsky, 2010, mentions) both inside the school and in the surrounding areas. Support networks can be built on the role of churches, community organizations and other grassroots groups (social and cultural groups) to provide a network of support for families and children, offering activities like mental counseling to mothers of children exposed to the violent conflict. Programs like Colombian Schools for Peace funded by the World Bank (2011) should be expanded in coverage and community involvement.

Future research in this area should address the dynamics of the attrition problem. The more is known about why students drop out of school after primary education, the better will be the assessment of the impacts of civil conflict on human capital accumulation. Solving the attrition problem would allow researchers to sort out the issue of the peace dividend or war hangover (Collier, 1999), at least, for the human capital accumulation process. Improvement in test scores due to lower violence, which could appear as a peace dividend, may ignore all those who dropped or are dropping out of school with a lower human capital. Education inequalities can be the worst war hangover during the expected years of peace. Data should allow the tracking of the same student throughout primary and secondary education to explore the evolution of the effect of conflict, controlling for individual level fixed effects.

End Notes

[1]: There has been a lot of controversy on how to classify the Colombian conflict. The Colombian Government has avoided calling it a civil war because it does not want the terrorist groups to claim the belligerent status. What happens in Colombia is, indeed, the fight between the State's armed forces against armed groups, in a type of guerrilla war (like the ones experienced in most of Latin America after the 1960's) and where the armed groups (right wing and left wing) use terrorist strategies. The issue of naming the Colombian conflict was solved in the first semester of 2011. In the process of passing a victims compensation law through congress, the government classified the conflict as an internal armed conflict (Law 1448 of 2011). According to the Human Rights Education Association (2010) an internal armed conflict is the conflict between two factions within one state. In international law, the 1977 Protocol II of the Geneva Convention defines this type of war as conflict of non international nature and aims at protecting the victims, while respecting the sovereign rights of national governments and delaying international intervention. When conflict or war are mentioned in this paper, it is meant the internal armed conflict and not civil war, according to the Protocol II of Geneva Convention and the Colombian laws.

[2]: For this paper, the figures of the major cities are going to be added to the states where they are located; for the public safety special regions, an educated guess was made with the information provided by army and police officers: for instance, if 10 extortion cases are reported for one of those regions and that region is formed by territory of 2 states (state X and state Y, for the purpose of illustration), following the army and police officers advice, it can be said that 80% of the cases correspond to state X and the remaining 20% to state Y.

[3]: The separate regressions for the identification of the effect of exposure at birth and the effect of exposure in the year of the test are preferred to one regression including the two effects.

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Basically, states that were very violent during the year of the birth of the test-takers are also the states that were very violent during the year of the test. Even though there is an overall decline in violence throughout the country, the ranking of violent states does not change over time. Using a single regression, including the two measures of exposure, will not allow for the separate identification.

[4]: A preliminary exploration of the mechanics of attrition was approached by using the state level net enrollment rates per year and the 11th Saber tests. Firstly, regressions on the net enrollment rates were run, with the state GDP growth and conflict indicators as independent variables (with year and state fixed effects). Not reported here, those regressions indicate that the effect of conflict is likely insignificant and only GDP growth may have a positive effect. Secondly, with the 11th grade datasets, the following proportions were constructed at the school level: females enrolled, students reporting that her family has a mortgage on their house, students living in a house owned by the family, students whose parents attained some or more than secondary education. Again, GDP growth and conflict indicators were chosen as independent variables. The school and test year fixed effects, and state specific trend regressions (not reported here) give a very diverse picture: conflict seems not to have an impact on the proportion of enrolled females; not highly significant (only at 10%), extortion and kidnapping reduce all proportions, while terrorism, mass murder victims and attacks against the police do not show a consistent pattern of effects on the proportions (regressions not reported here). The proportion tests may indicate that the armed conflict changes the composition of those staying until 11th grade, with respect to parental education and dwelling (economic issues), but varying the composition of those staying in school is not necessarily an explanation of why other dropped out of school. If these tests reveal something it is that economic factors are key in explaining why children leave school.

REFERENCES

Akresh, R. & de Walque, D., 2008. Armed Conflict and Schooling: Evidence from the 1994 Rwandan Genocide. World Bank Policy Research Working Paper Series.

Akresh, R., Verwimp, P. & Bundervoet, T., 2011. Civil War, Crop Failure, and Child Stunting in Rwanda. Economic Development and Cultural Change. 59 (4), 777-810.

Bharadwaj, P., Løken, K., Neilson, C. 2012. Early life health interventions and academic achievement. Discussion Series Paper. IZA DP No. 6864

Blattman, C. & Miguel, E., 2010. Civil War. Journal of Economic Literature. 48(1), 3-57.

Bundervoet, T., Verwimp, P. & Akresh, R., 2009. Health and Civil War in Rural Burundi. The Journal of Human Resources. 44(2), 536 - 567.

Burdick-Will, J., Ludwig, J., Raudenbush, S., 2010. Converging evidence for neighborhood effects on children's test scores: an experimental, quasi-experimental, and observational Comparison. In: Brookings Institution Project on Social Inequality and Educational Disadvantage: New Evidence on How Families, Neighborhoods and Labor Markets Affect Educational Opportunities for American Children. Electronic Version, 53 pages

Camacho, A., 2008. Stress and Birth Outcomes: Evidence from Terrorist Attacks in Colombia. Papers and Proceedings of the One Hundred Twentieth Annual Meeting of the American Economic Association (May, 2008). The American Economic Review. 98 (2), 511-515.

Catalano, R., Bruckner, T., Gould, J., Eskenazi, B., & Anderson, E., 2005. Sex ratios in California

ISSN 2055-608X(Print), ISSN 2055-6098(Online)

following the terrorist attacks of September 11. Human Reproduction. 20(5), 1221–1227.

Chamarbagwala, R., Moran, H., 2011. The human capital consequences of civil war: evidence from Guatemala. Journal of Development Economics 94, 41–61.

Collier, P., 1999. On the economic consequences of civil war, Oxford Economic Papers. 51 (1), 168– 183.

Curran, P., Miller, P.W., 2001. Psychiatric implications of chronic civilian strife or war: Northern Ireland. Advances in Psychiatric Treatment 7, 73-80.

Colombian National Police. "Glossary". Colombian National Police. 7 July 2011. <http://goo.gl/UA0x1>.

Colombian National Police. "Revista Criminalidad 50 años, 1958-2008". Colombian National Police. 7 July 2011. <http://goo.gl/ZDdWI>.

DANE. "Infrastructura Colombiana de Datos". DANE. 7 July 2011. <http://goo.gl/36lD7>

Doyle, O., Harmon, C.P., Heckman, J., Tremblay, R., 2009. Investing in early human development: Timing and economic efficiency, Economics & Human Biology. 7 (1), 1-6.

Dybdahl, R., 2001. Children and mothers in war: an outcome study of a psychosocial intervention program. Child Development. 72 (4), 1214–1230.

Human Rights Education Association. "Internal Conflict". HREA. 7 July 2011.< http://www.hrea.org/index.php?base_id=121>.

Husain, S. A., Nair, J., Holcomb, W., Reid, J., Vargas, V., Nair, S., 1998. Stress reactions of children and adolescents in war and siege conditions. American Journal of Psychiatry. 155 (12), 1718–1719.

ICFES. "Orientation guide 2008" (in Spanish). ICFES. 7 July 2011. <http://goo.gl/tBFLb>

ICFES. "Saber tests 5th and 9yh grade" (in Spanish). ICFES. 7 July 2011. <http://goo.gl/tBFLb>

International Committee of the Red Cross. "Protocol II". ICRC. 7 July 2011. <goo.gl/v3pPO>

Justino, P., 2009. Poverty and violent conflict: a micro-level perspective on the causes and duration of warfare. Journal of Peace Research. 46, 315 - 333.

Lai, B., Thyne, C., 2007. The effect of civil war on education, 1980—97. Journal of Peace Research. 44, 277–292.

León,G., 2010. Civil Conflict and Human Capital Accumulation: The Long Term Effects of Political Violence in Perú. University of California, Berkeley, Mimeo, 45pp.

Levitt, S. D., 1997, Using electoral cycles in police hiring to estimate the effect of police on crime. The American Economic Review. 87 (3), 270-290

Ministry of Defense. "Achievements of the Defense and Security Integral Policy for Prosperity" (In Spanish). Ministry of Defense. 7 July 2011. <goo.gl/BgqCc>.

Ministry of Education. "Levels of basic and middle education". Ministry of Education. 7 July 2011. <goo.gl/16gpQ>.

Murdoch, J. and Sandler, T., 2002. Civil wars and economic growth: a regional comparison. Defence and Peace Economics. 13 (6), 451 - 464.

Nazih, R., 1997, The political economy of violence: the war-system in Colombia, Journal of Interamerican Studies and World Affairs. 39 (2), 37-81.

Noticolombia, "1000 docentes asesinados en Colombia". Noticolombia. 7 July 2011. <goo.gl/FiCxL>.

OECD Programme for International Student Assessment (PISA). "What PISA produces". OCED.

ISSN 2055-608X(Print), ISSN 2055-6098(Online)

7 July 2011. <http://goo.gl/MMw7L>
OECD Programme for International Student Assessment (PISA). "Iberoamerica in PISA 2006. Regional Report". OCED. 7 July 2011. <http://goo.gl/ElvX0>
Ortiz, R. D., 2002, Insurgent strategies in the post–cold war: the case of the revolutionary armed forces of Colombia, Studies in Conflict & Terrorism. 25, 127–143.
Osofsky, J. D., 1999. The Impact of Violence on Children. The Future of Children. 9(3), 33-49.
Sharkey, P., 2010. The acute effect of local homicides on children's cognitive performance. PNAS. 107 (26), 11733-11738.
Smits, L., 2006. Lower birth weight of Dutch neonates who were in utero at the time of the 9/11 attacks. Journal of Psychosomatic Research. 61, 715–717.
Todd P., and Wolpin K. I., 2003. On the Specification and Estimation of the Production Function for Cognitive Achievement. The Economic Journal. 113 (485). F3-F33.
Urdinola, P., 2004. Could political violence affect infant mortality? The Colombian case. Coyuntura Social. 31, 63-79.
UNESCO, "Colombia Statistics". UNESCO Data Centre. 7 July 2011. <goo.gl/BU4M3>.
UNESCO, 2008, Los aprendizajes de los estudiantes de América Latina y el Caribe, UNESCO, Santiago (Chile)
Veillette, C. 2005. Plan Colombia: A Progress Report. Congressional Research Service Report for Congress, RL32774, 16 pp.
World Development Indicators. "Colombia indicators". World Bank-Data Bank. 7 July 2011. <goo.gl/gYizh>.
World Bank. "Colombia: Peace and Development Amid Conflict". World Bank. 7 July 2011. <http://goo.gl/KLDdU>

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