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Armed Conflict Exposure, Human Capital Investments and Child Labor: Evidence from Colombia

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Abstract: This paper estimates the effect that exposure to armed conflict has on school drop-out and labor decisions of Colombian children between the ages of six and seventeen. We use a duration analysis methodology, complemented by biprobit estimations. Both approaches take into account the possible endogeneity of municipal conflict-related events through the use of instrumental variables. We find that conflict especially affects children older than eleven, inducing them to drop out of school and enter the labor market too early. We provide evidence that such effects may be generated through higher mortality risks, negative economic shocks and lesser school quality.

Keywords: Armed conflict, human capital, schooling, Colombia

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I. Introduction

There is no controversy regarding the importance of education for the economic wellbeing of individuals and nations.[1] Not surprisingly then, one of the main concerns in the education literature is the need to understand which factors might influence the quantity of education attained by students. The research on the subject is immense and often concentrates on how personal, family and school characteristics affect students' education attainment.[2]

Parallel to this literature, theoretical and empirical research on child labor in developing countries has expanded over the past years. According to statistics from the ILO (2006), one out of five children between the ages of five and seventeen years old work. Research suggests that many of these children are obliged to do so due to permanent lack of resources and transitory poverty shocks experienced by their families. Additionally, in many cases these working children drop out of school, thus possibly entering into what are known as poverty traps. [3]

This paper contributes to both literatures by studying the effect that exposure to armed conflict has on schooling investments and child labor decisions of households in Colombia. Harbom and

[1] At the national level, studies such as Barro (1991) and Mankiw et al. (1992) have shown the importance of education on economic growth rates. At the individual level, surveys by Glewee (2002) and Hoffman (2001) show how education can impact a worker's income, as well as other outcomes such as those related to health, fertility and agricultural innovation.

[2] For a comprehensive review on the subject with respect to developing countries, see Glewwe (2002) and Glewwe and Kremer (2006).

[3] For a recent review on the subject please refer to Edmonds and Pavnick (2005).

Wallensteen (2007) report that a total of 232 armed conflicts have transpired at 148 world locations since the end of the Second World War. Such a high incidence of violent conflicts implies that estimating the effect of conflict on students' schooling and labor status is crucial to determine the entirety of social costs that violence entails and implement proper policies for directly dealing with the problem.

Colombia provides a unique setting in which to study this relationship given that it has suffered (and continues to suffer) from one of the longest internal conflicts in the world. Guerrilla and paramilitary groups, active since the sixties, have committed all kind of violent attacks, affecting not only the state armed forces and national infrastructure, but also the civil population through homicides, kidnappings, population displacement and forced recruitment. All of these violent actions, directed against civilians, might certainly be expected to impact various households' decisions, among them, those related to human capital accumulation and child labor. Although this conflict has been evident throughout Colombia, it has varied in intensity across time and space, thus allowing us to identify its effect on particular variables of interest, likewise for different types of individuals.

The existent empirical evidence found in the literature on the effect of armed conflict on children's schooling is mixed. Earlier studies, which used macro-level data, found that armed conflicts had negligible impacts on the outcomes of interest, including education attainment and literacy rates (Miguel and Roland (2006) and Chen et al. (2007)). Conversely, studies using micro-level data, such as those by Barrera and Ibañez (2004), Shemyakina (2006), Dueñas and Sanchez (2007), Akresh and de Walque (2008) and Akbulut-Yuksel (2008), have consistently found that conflict has important and long-term negative effects on education outcomes. On the

other hand, the impact of armed conflict on child labor is completely understudied. To the best of our knowledge, no paper has yet theoretically or empirically researched this topic. The only possible exception is perhaps Estevan and Baland's theoretical paper (2007) where the relationship between life expectancy, schooling and child labor is analyzed.[4]

We believe this study contributes to the existent empirical literature in several respects. First, as mentioned earlier, we provide evidence concerning the impact violence has on child labor decisions, something that has not been studied before. Second, unlike earlier studies on education and armed conflict, we take into account the intertemporal nature of schooling drop-out decisions and, correspondingly, carry out a duration analysis approach. To estimate both effects, we combine two exceptional data sets. The first one provides detailed information on the education investment and child labor decisions of households; the second reports armed conflict in Colombia by event at the municipality level between 1990 and 2003. Using information regarding the latter, we are able to construct a measure of the intensity of armed conflict each child has been exposed to since they were six years of age. This allows us to discern variations in exposure to violence even between children living in the same municipality and household.

[4] Blattman and Annan (2007) study the long-term impact of child soldiering in Uganda and find negative effects on the level of education and the quality of jobs attained. Our research is different because we assess the impact civil conflict has on civilians as opposed to former rebel group members. Moreover, as the authors mention, their analysis, on the longer-term effects of war, uses a sample of males aged between 14 and 30; hence, it does not necessarily constitute a study of child labor.

Third, in our empirical analysis, we acknowledge the likely endogeneity between violence and school drop-out rates. This emerges directly from the participation of children in armed actions, and indirectly from the fact that being a school drop-out constitutes an expression of poverty and results in social exclusion, which, according to some studies in the literature, could lead to rebellion.[5] Regarding the former channel, estimates suggest that there are at least 300,000 children under 18 years of age directly involved in armed conflicts in countries such as Angola, Burma, the Democratic Republic of Congo, Lebanon, Liberia, Sierra Leone and Sri Lanka.[6] In Colombia, according to Human Rights Watch (HRW - 2004), at least one of every four irregular war combatants is under 18. Hence, it is expected that areas with higher drop-out rates will likely have higher rates of violent conflict if children join armed groups. To adequately control for both causes of endogeneity, we incorporate into our analysis an instrumental variables approach through a two step estimation procedure. The instrument used is a lagged government deterrence measure, with the key identifying assumption being that it should not directly influence current households' schooling decisions. More specifically, the instrument chosen is lagged homicide capture rates.

We find that violent attacks in Colombian municipalities where students reside increases the probability of school drop-out and child labor. This result is quite robust and significant using duration analysis estimation, either from a non-parametric or a parametric approach. Our estimates using the latter approach suggest that, on average, the conflict in Colombia has reduced

[5] See Collier (2004) for a review of this approach.

[6] A Newshour Extra special featuring Jim Leher and aimed at students: "Lesson: Children at war," PBS.

the average education of students residing in conflict areas by one year of education. Using the biprobit analysis, we again find that armed conflict exposure has a positive and significant effect on school drop-out rates and the extent of child labor. All the effects mentioned above differ according to the children's age. While there does not seem to be a significant effect on education investments or child labor decisions for younger children, violence does negatively affect the educational attainment of older individuals and increases the likelihood of their participation in the labor market. Specifically, for children older than twelve an increase in one standard deviation on the measure of lifetime exposure to armed conflict increases the joint probability of dropping out of school and participating in the labor market by 2.3%.

Finally, unlike previous studies, we also provide evidence of some of the possible channels through which violence may affect schooling and child labor outcomes. Our biprobit estimates suggest that, for students older than twelve, higher mortality risks, negative economic shocks and a reduction in school quality may all constitute driving mechanisms through which armed conflict reduces human capital investments and increases child labor.

Regarding these last results, our findings are related to two recent research topics. The first one concerns the effect of exogenous changes in life expectancy on educational investments which has been studied by Soares (2005), Estevan and Baland (2007), Lorentzen et al. (2005) and Jayachandran and Lleras-Muney (2008). In this regard, armed conflict and the premature deaths it causes is just another channel thorough which life expectancy may be altered. The second topic concerns the economic impact of conflict analyzed by authors such as Abadie and Gardeazabal (2003), Alesina et al. (1996) at the national level and Deininger and Okidi (1999) and Verwimp and Bundervoet (2008) at the household level. We argue that by generating negative economic

shocks to families, conflict could induce parents to send their children to the labor market as authors such as Skoufias and Parker (2006) and Duryea et al. (2007) demonstrated in other settings.

The remainder of the paper is organized as follows. Section 2 presents the existent literature on armed conflict and education investments. The empirical methodology and the data used in the paper are presented in section 3 and 4 respectively. The results are presented in section 5, while section 6 provides evidence concerning possible transmission channels. Section 7 concludes.

II. Related Literature

The theoretical literature on the possible effects of armed conflict on the education investment decisions of households is scarce to almost null.[7] The empirical evidence is somewhat larger. Some studies have used macroeconomic statistics or cross country data with mixed findings. For instance, Miguel and Roland (2006) using an IV methodology find no impact for U.S. bombings during the Vietnam War on Vietnamese literacy rates through 2002. Conversely, Chen et al. (2007), using cross country information and an event data methodology, observe that, as a consequence of war, countries experience a substantial drop in secondary school enrollment but no significant effect with respect to primary education.

[7] However, as previously mentioned, there exist several models, such as those employed by Soares (2005) and Estevan and Baland (2007), that link life expectancy with human capital investments. Given the higher mortality risks generated by armed conflict vis-à-vis civilian populations, such models could provide theoretical support for the relationship between violence and education.

Nonetheless, analyzing macro-level information could erroneously lead to the conclusion that there is no medium-term negative impact on education due to armed conflict. This is clearly shown for educational outcomes in a study conducted by Akresh and de Walque (2008) on Rwanda. Using two nationally representative cross-sectional household surveys, the authors initially show that average schooling outcomes in the country did improve after the 1994 genocide.[8] However, when they concentrate on the educational outcomes of school-age children directly exposed to the conflict, the situation is very different. Using a difference in difference approach, the authors find that, on average, exposed children achieved 0.5 years less of education than non-exposed ones, and are 15% less likely to complete fourth grade.

Similarly, using micro-level information from Tajikistan, Shemyakina (2006) evaluates the impact of conflict on educational investment. Using a linear probability model and a difference in difference specification, she finds that the probability of completing mandatory schooling was significantly reduced for women but not for men. Evidence for a developed country is found by Akbulut-Yuksel (2008). Following a methodology similar to Akresh and de Walque's (2008), she provides evidence that Germans that were school-aged during WWII achieved 0.3 fewer years of education as adults.

[8] Specifically, between 1992 and 2000, the fraction of people with no education in the country decreased from 30% to 24%, and the proportion of people with some primary school increased from 64% to 69%.

With respect to Colombia, two papers study the possible effects of violence on education investments. Barrera and Ibañez (2004) develop a theoretical model that identifies three different channels through which violence can affect investments in education. According to the authors, violence might directly affect a household's utility; it could induce negative economic shocks to the family due to the destruction of physical capital and the creation of uncertainty; finally it may also reduce education's rate of return. Using a probit model, the authors find a negative relationship between the probability of school enrollment and contemporaneous homicide rates. Dueñas and Sanchez (2007) estimate the effect of violence on school drop-out decisions for the poorest households in the eastern region of Colombia. Using information for approximately 300,000 children and youngsters, a duration model confirms that the activities of illegal armed groups increase the risk of dropout for all individuals, though with a much larger negative effect for the poorest of the poorest households. However, none of these studies are able to empirically identify any channel for the impact of violence on the school dropout rate.

We follow the last mentioned paper in the idea of using a dynamic behavior model that employs a duration analysis methodology. However, unlike Dueñas and Sanchez, we incorporate a nationally representative data set for Colombia. Additionally, and in contrast with the literature presented above, we are able to provide evidence regarding the additional effects of armed conflict on child labor, that, to the best of our knowledge, have not yet been examined in the literature. Finally, we also present evidence concerning three possible mechanisms through which conflict might reduce educational investments in Colombia and increase child labor.

III. Estimation Strategy

A. School Drop-out and Child Labor

Our primary interest in this paper is to determine how the presence of armed conflict in the municipality where a child resides affects her schooling attainment and labor decisions. As shown in the last section, with respect to the former variable, the most common strategies used in the literature are the estimation of linear probability, the employment of probit models, and a difference in difference approach. However, it should be noted that estimations of households' school drop-out decisions using these methodologies may not be entirely adequate. On the one hand, households' decisions regarding human capital accumulation are dynamic and hence any analysis should incorporate such feature in an explicit way. On the other hand, information regarding the level of schooling attained obtained from household surveys may be right censored, as some students enrolled at the time of the survey may drop out of school in the future.

A much richer methodology for studying the intertemporal decisions of human accumulation then is that of duration analysis.[9] Duration analysis can be directly applied to drop-out decisions by designating the dependent variable as the time elapsed until student *i* decides (or is compelled) to drop-out of school. Specifically, observing student *i* during period *t*, he or she may be attending school or may have already dropped-out. In either case, constructing the past history of student *i* is simple. In the former case, we have a censored observation; the construction of past schooling outcomes would be based on when the student entered the schooling system up until time *t*. In the latter case, whereby student *i* has already exited the schooling system without having graduated, we can construct the dependent variable up until the date when he or she reported dropping out of

[9] This methodology is commonly applied to questions such as those concerning unemployment spells (Bruce(1990)); teachers´ turnover [or 'the rate of turnover for teachers'] (Dolton and van der Klaau (1999)); or the time elapsed before fugitives are apprehended (Miles (2005)).

school. Once this student *i*'s past history of school attendance has been constructed, a duration analysis methodology can be applied. We follow Jenkins' (2004) discrete time estimation methodology and calculate the impact of armed conflict on the risk of dropping out of school. We use a nonparametric approach, one that utilizes the Kaplan-Meier estimator of the survival function, as well as a parametric approach with a normal and a logistic distribution.[10] The parametric model includes socioeconomic characteristics, a duration dependence variable and fixed effects for year and municipality.

In order to study the effect of armed conflict on child labor decisions, we complement the duration analysis methodology with a biprobit analysis. Specifically, our two independent variables will be if the child has dropped out of school and if she is engaged in labor activities. Naturally, by following this estimation strategy we are implicitly assuming that both decisions are correlated, an assumption that needs to be empirically tested. As in the case of schooling decisions, we believe that child labor decisions are influenced, not only by today's conflict related violence, but also by the intensity of violence the child has been exposed to throughout his or her life. In order to capture this lifetime effect, for each child *i* we construct a variable that captures the intensity of the violence to which she or he has been exposed since six years of age (the age at which he or she should have begun attending school) until 2003. That is, we construct an *accumulated* armed conflict measure that varies even across children coming from the same household. Using two stage biprobit models, we then separately estimate how this exposure

[10] Even though the logistic distribution is the standard in the literature for discrete duration analysis we included the IV linear probability model as robustness check.

affects children's drop-out behavior and labor participation between 6-11 and 12-17 years of age.[11]

B. Possible Armed Conflict Endogeneity

Finally, it should be noted that given the high participation of children in war, our empirical analysis takes into account the possible endogeneity of the armed conflict measures. As stated by Rubio (2001), Colombian municipalities with a relatively young population and high levels of inequality have a higher probability of suffering violent attacks. Moreover, as is well known, both guerrillas and paramilitary groups purposely recruit children and send them into combat. According to Human Rights Watch (2003), more than 11,000 children were fighting in Colombia's armed conflict at the time reported. If there exists any kind of pressure to leave school and join irregular forces, our variable of interest clearly runs the risk of being endogenous.

To adequately account for such endogeneity problems, a two stage estimation approach is undertaken in the duration analysis and the biprobit methodologies. Specifically, we use lagged rates of homicide captures at the state level, interacted with the respective municipal population (in order to obtain variation at this lower level of administrative government) as our instrument in the first stage.[12] This variable was chosen because, as expected, the possibility of irregular armed

[11] Although we explain the choice of age categories in more detail in the data section, we would note here that it reflects the structure of the child labor questions in the survey.

[12] The rate of homicide capture is simply the number of murderers apprehended by the police over the total number of homicides in a given year.

groups perpetrating attacks should diminish as the presence and effectiveness of law enforcement forces is stronger.

The identification assumption of this paper then is that this lagged government deterrence measure should not be directly related to current schooling investment or child labor decisions at the household level given a set of control variables. In principle, one could imagine that such an assumption would not hold if, for example, levels of deterrence are positively (negatively) correlated with investments in the education sector which might influence school drop-out and child labor decisions. We argue that this is not the case, given that deterrence decisions are under the central government control (the Ministry of Defense), while social investments in the municipality have been decentralized at the municipality level of government since 1991. Moreover, the resources used to finance educational investments are based on a pre-established formula that takes into account the number of students in the public education system as well as poverty and rurality measures. Hence, both types of spending in Colombia are carried out by different government branches and are not related. Additionally, the level of this deterrence measure is not easily observed by households given that it is at the state level; hence it is difficult to think of scenarios whereby they might influence their schooling and child labor decisions.[13]

IV. Data

A. Household Information

[13] It is worth noting that this two stage approach could also partially alleviate any concerns about omitted variable and measurement errors bias.

The child information used in this paper comes from the Encuesta de Calidad de Vida 2003 (ECV 2003). This is a national survey that follows the same methodology implemented in the World Bank's LSMS surveys; conducted by the Colombian Bureau of Statistics (Departamento Administrativo Nacional de Estadística, DANE). The survey's objective is to measure Colombian socioeconomic conditions, levels of poverty, and access to social programs. The 2003 survey interviewed 24,090 households between March and May 2003 in 128 municipalities. In order to evaluate the effect of violence on school drop-out decisions and child labor, we use information for individuals between six and seventeen years of age who, under the structure of the Colombian educational system, should be enrolled in school. In total, we have information for 20,642 children, coming from 11,142 households, who, after taking into account internal migration, have resided in 235 municipalities.[14]

Table 1 presents the school drop-out status and working status of the children in our sample. As observed, 12% dropped out of school, 39% are working and 7% are neither studying nor working. The Table divides this data further according to children's ages. Specifically, we divide them between those younger and older than twelve years of age. This dividing point was chosen due to the fact that the ECV 2003 has two distinct questions on labor force participation, depending on the age of the person. For younger children (aged 5-11), it asks whether the child carried out household chores or helped an adult in the household with his or her work. For older children (12 years of age or older), the survey asks the standard labor force participation

[14] Even though in 2003 the ECV was applied in only 128 municipalities, it contains detailed information on the migration of households; hence, we were able to establish households' respective histories of residence.

questions asked to adults. As expected, drop-out rates increase with age. While only 4% of children between six and eleven years of age have dropped out of school, the percentage increases to almost 20% for older children. The rates of child labor participation also differ according to age. Almost 58% of children reported having worked on household chores, or having helped an adult with his or her work. For children twelve or older, 8.62% of them reported having participated in the labor force. Finally, while the percentage of idle children younger than twelve is negligible, it increases to almost 13% for those over that age.

Table 2 presents the summary statistics of child and family characteristics that serve as controls in our estimations. It can be observed that the average age of the children is 11 years, and that 50% of them are male. The great majority is single and live in urban areas. As for family characteristics, we find that the average number of years of education of the household head is close to seven; 70% of them are male and their average age is 44 years. The survey also includes detailed information concerning each family's wealth as captured by the ownership of different types of assets, the quality of the house they live in, and its access to public services. With this information and using a principal component analysis, we construct a variable that captures a household's wealth. This variable has positive values ranging from zero to fifteen, with fifteen indicating the richest households. Finally, the survey includes information on household migration, inclusive of the exact moment it occurred and the location of origin. As shown in the Table, 20% of the children in the survey belong to a migrant household.

The ECV 2003 survey also includes a specific question concerning the precise moment each individual made the drop-out decision. This question allows us to construct the academic history of each student so as to carry out the duration analysis methodology described in section III. In

doing this, we expand the data-base so that for each individual there will be as many observations as her or his years of school attendance. Assuming that each child starts school at six years of age (as called for by Colombian law) we estimate his or her years of school attendance based on the last grade approved, together with his or her enrollment or drop-out information.[15] For each of these expanded observations, we create a drop-out dummy variable equal to zero if the individual was attending school a given year, and equal to one the year she or he decided to drop out. This is our dependent variable, and as in all duration analysis studies, it is right censored.[16] The expanded data set for the duration analysis methodology contains 120,330 observations and is matched with the respective individual and household characteristics that are assumed to be invariant over time. It should be kept in mind that the implicit assumption here is that individuals currently in school have never dropped out of the educational system.

[15] For instance, an individual that in 2003 was 15 years old, was still in school, and had just completed the ninth grade, would have ten observations starting with the year 1994. Similarly, a 12 year old individual that dropped out of school in 1999 and at that point had completed only 2 years of schooling would have an academic history consisting of only three observations, starting with 1997 and ending two years later.

[16] Even though the question was asked to every individual that reported being out of the educational system, 30 respondents did not answer it or did not remember their exact drop-out date. In order to lose as few observations as possible, we reckon the drop-out years of these individuals based on their age and their completed years of education. All regressions include a dummy variable indicating whether the year of drop-out was reckoned or not. The results are maintained when these individuals are not taken into account.

B. Armed Conflict and Municipal Information

The data at the municipal level is obtained from several public and academic sources.[17] As for the intensity of civil conflict, it should be mentioned that it is one of the longest ongoing domestic confrontations in the world, surpassed in length only by the Israeli-Palestinian and the Indian-Pakistani conflicts. The main irregular armed groups are two guerrilla organizations known as the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN)—both of which were founded on Communist ideas during the early sixties—and one rightwing paramilitary group known as the United Self-Defense Forces of Colombia (AUC), in existence for almost twenty five years, and which is now engaged in a peace process with the government. All three groups perpetrate attacks against the country's infrastructure and the civilian populations, kidnap individuals for both extortive and political reasons, engage in drug trafficking, and get involved in direct armed clashes with the Colombian regular army.[18]

Our measure of civil conflict in this paper is the total number of offensive actions (attacks against infrastructure and the civilian population, and clashes with governmental forces) undertaken by guerrillas, paramilitary groups and common criminals in each municipality and for each year. Map 1 shows the average number of attacks perpetrated by all armed groups within Colombia's borders between 1993 and 2008. The map shows Colombia's 1,101 municipalities, which, as can

[17] Our data was collected from Departamento Nacional de Planeación (DNP), Departamento Administrativo Nacional de Estadistica (DANE), Policía Nacional, Departamento Administrativo de Seguridad (DAS) and Centro de Estudios sobre Desarrollo Economico (CEDE), among others.

[18] For a detailed description of the Colombian conflict please refer to Echandía (2006) and Sanchez et al. (2005).

be observed, have all experienced different levels of armed conflict. The geographic variation of the conflict, across both space and time, allows us to identify its effect on both school drop–out decisions and child labor decisions.

Table 3 provides additional information regarding our conflict measure; it is revealed that between 1992 and 2003, the average municipal attack rate for the country reached 6.6 per 100,000 individuals. However, this rate varies significantly across time and municipalities, with an average standard deviation of 15 attacks. The same Table also provides descriptive statistics of the instrument used in our empirical estimations, homicide captures at the state level interacted with the respective municipal populations. As discussed, this government deterrence measure while explaining the presence of attacks should in principle have no relationship to schooling or labor decisions at the household level. As can be observed in Table 3 it exhibits substantial variation. Finally, this information is complemented with the per capita local tax revenue and poverty measures at the municipality level, whose mean and standard deviation are also presented in Table 2.

The combination of both data sets allows us to calculate for every youngster in the ECV 2003 survey the number of attacks he or she was exposed to in each school-age year (that is, when, ideally, she or he should be in school), and the deterrence actions implemented by the government in his or her municipality. These data features thus allow us to carry out both the duration analysis and the bi-probit methodologies so as to determine how armed conflict exposure affects the risk of dropping out of school and engaging in child labor.

V. The Impact of Armed Conflict on Human Capital Investments and Child Labor

School enrollment rates in Colombia have been continuously increasing over the last decade, in spite of the ongoing domestic conflict. Estimates from the Ministry of Education for the year 2005 indicate that primary gross enrollment rates were close to 110%, while secondary enrollment rates increased from 72% to 88% during the mentioned time period. Likewise, during the same period, drop-out rates decreased for every school grade. Figures from the Ministry of Education reveal that between 2000 and 2003, drop-out rates for preschool and primary education fell by two percentage points, while the reduction in secondary education was close to one percentage point. A first glance at these macro figures could erroneously lead one to conclude that the Colombian domestic conflict has not been harmful to schooling outcomes.

A closer look at the data, however, reveals a completely different story. Table 4 presents the unconditional mean for the drop-out rates for children residing in a municipality with either a low or a high intensity of armed conflict. Specifically, we divide municipalities into those with lower and those with higher average attack rates relative to the mean country level. As can be observed, there is a significant difference between the drop-out rates of children exposed to a low level of armed conflict relative to those exposed to a high one during their school years. The unconditional differences between the two groups are eight and eleven percent for each of the two age groups, respectively; both are significant at the one percent level.

A similar story is obtained when comparing the unconditional probability of children engaging in labor activities. The incidence of child labor for children aged 6-11 and 12-17 exposed to a lower than the mean level of armed conflict is 53% and 11%, respectively. These figures are significantly higher for those children exposed to a higher than the mean level of armed conflict. The difference between both groups—significant at the one percent level—is 13.3% and 4.7%,

respectively. Finally, Table 2 shows evidence in favor of the hypothesis that armed conflict affects the probability of children being idle. The difference between children that neither attend school nor work by the level of armed conflict to which they are exposed is three percentage points for children aged 6-11 and six percentage points for those aged 12-17..

The unconditional probabilities of children dropping out of school or engaging in child labor, presented in Table 4 evidence the substantial impact that armed conflict has on these related decisions. However, these estimates could suffer from several problems, such as omitted variable bias or endogeniety. The results of duration analysis and biprobit models directly address the above mentioned problems.

A. Duration Analysis: School Drop Out

In order to incorporate the dynamic effect of violence on school-related decisions, we use a duration analysis framework. Preliminary evidence concerning the impact of violence on school investment decisions using a non-parametric approach is presented in Graph 1. It depicts the Kaplan-Meier estimator, which calculates the survival function *S(t)* for school attendance, and displays the probability of remaining in school past time *t*. The graph divides all children according to whether or not they reside in a municipality with a higher than average level of armed attacks. As expected, for both groups, the probability of staying enrolled decreases over time. Nevertheless, the survival function decreases over time at a much higher rate for those children subjected to a higher intensity of conflict while attending school. A log rank test, with

the null hypothesis that the survival functions of the two groups are the same, is rejected with a Chi2 value of 297.92. [19]

The evidence presented in this graph, however, also suffers from possible omitted variable bias, just as with Table 4. The previous literature has established the importance individual and family characteristics play in determining human capital investments. To account for these characteristics Table 5 presents the results of the estimation of a discrete time duration model. In the first five models we assume that the errors are normally distributed and hence could also be interpreted as a linear probability model applied to each school-age year of the individuals. Alternatively, Models (6) through (9) take the approach suggested by Jenkins (2004) and assume a logistic distribution of the errors.

Models (1) and (6) in Table 5 present the effect of armed conflict controlling for the traditional socioeconomic indicators as well as year and municipality of last residence fixed effects. As can be observed, all the controls used in the estimations have the expected signs. In Colombia, boys have a significantly higher probability of dropping out of school than girls. Similarly, children belonging to poorer households, who are over-age, or who reside in a household where the head has a low level of education have higher drop-out risks. Likewise, children that have migrated at some point in their lives are at a significantly higher risk of dropping out of school than those

[19] Cleves et al. (2004) point out that these tests compare the overall survival functions across groups, but do not test their equality at a specific time point.

who have always resided in the same place.[20] Finally, children living in municipalities with lower levels of land inequality and higher levels of per capita local taxes (a measure of local wealth) exhibit a lower drop-out risk.

These two models suggest that, after controlling for personal and family characteristics armed conflict has a positive but small effect on the drop-out risk of Colombian students. However, this estimate ignores possible simultaneity problems between attacks and students' drop-out decisions. In order to take into account such problems, we implement an instrumental variables approach for Models (2)-(5) and a two step estimation procedure for Models (7)-(9), using homicide capture rates as instrument. The lower panels of all these Models in Table 5 present the first-stage results of this estimation strategy. Our instrumental variable is highly correlated with the armed conflict measure, as can be observed in the t-statistics and F test. Specifically, the sign for lagged homicide captures is negative, which implies that higher presence of government forces and stricter law enforcement curb the violent actions of the irregular armed groups.[21]

[20] This finding is particularly relevant given that Colombia has the second highest number of displaced population of any country, which suggests that specific policies should be implemented with respect to these children.

[21] Related to the robustness and exogeneity of the instrument used several other specifications were carried out. Results are always maintained if we use two-year average capture rate or if we use an additional instrument (antinarcotics operations at the municipality level). For this last specification the Sargan tests always indicate that, inasmuch as one of the instruments is exogenous, we cannot reject the hypothesis that the other one is also exogenous under any standard confidence level. However, using the two instruments the resulting F-test was lower

Finally, for the IV linear probability model an endogeneity test in which the null hypothesis states that the armed conflict measure is exogenous is clearly rejected at a 1% confidence level.

The preliminary evidence previously presented is corroborated by our parametric discrete time duration analysis. For all specifications, which gradually incorporate control variables, the coefficient of interest implies that students living in a municipality with higher rates of conflict related violence will be at greater risk of exiting the educational system. Model (2) in Table 5 only includes as controls the instrumented armed conflict measure to which each child is exposed, the duration dependence variable, and the time and municipality fixed effects.[22, 23] All other Models gradually incorporate additional control variables related to the main characteristics of the children, households and municipalities. As can be observed, for all of them, the value and significance level of our coefficient of interest is significant and has the expected sign, reassuring us as to its robustness.

(close to 5). To avoid a weak instrument problem we decided to report the results using only homicide capture as our instrument. The results from all these specifications are available upon request.

[22] As mentioned before, the municipalities that are taken into account for the fixed effects in the drop-out decision are the ones in which the child resides now. Previous versions used the municipality of origin and results are maintained. They are available upon request.

[23] For the logistic distribution the estimation having as only control the armed conflict measure never converged and hence is not reported.

This duration analysis approach may exhibit two shortcomings. The first one is related to the assumptions taken when constructing the data set. As previously explained, due to data restrictions, we should assume that if we observe a child in school at the time the survey was taken he or she has never previously dropped out of school. Similarly, we also assume that they entered the educational system at age 6, as per the law, even if, in fact, we have no way of ascertaining if they actually did. To account for these possible measurement errors, we construct an over-age variable, which estimates the difference between the age of each child and what her or his school grade should be accordingly.[24] The second problem is related to migration. As previously stated, nearly 20% of the children were migrants. The ECV 2003 survey provides us with sufficient information, not only to determine the exact moment in time when each child migrated, but also the specific municipality he or she used to live in. The armed conflict measure takes this into account.[25] However, if there are unobserved differences between migrant and non-migrant children, we need to control for them. To address these two problems, we included as controls an over-age variable and a migrant dummy as control variables. As can be observed, the main results do not change, suggesting that the possible related bias created was minor.

[24] For example, a ten year old girl should, in principle, be attending fifth grade if she entered school at six, has not repeated any grade and did not drop out for any period of time. If she is indeed attending that school grade, her over-age variable will be zero. If she or he is one grade above or below it, his or her over-age variable will be -1 or 1, respectively.

[25] That is, we assign the specific number of attacks that occurred in the municipality where each child lived in each year. For example, if a child lived in municipality A from 6 to 10 years of age and in B since she was 11, the armed conflict measure for each year will correspond to municipality A until he or she became 10, and to municipality B from that point forward.

The coefficients in the regressions allow us to appraise the effect of violence on schooling investment decisions. Using the results from Model (5) in Table 5, we estimate the survivor function *S(t)* for each student in his or her academic history. Specifically, if we denote λ(s) as the probability of exiting the schooling system during period *s*, then the survivor probability for the entire academic history of the respective child will be given by: $S(t) = \prod_{s=1}^{t} [1 - \lambda(s)]$. Using this probability, it is possible to estimate the expected average education attained by each child in our sample. Furthermore, we can also estimate the counterfactual average education attainment if no armed conflict were to take place.

As shown in Table 6, the coefficients obtained suggest that the civil conflict in Colombia has reduced the average education of students residing in areas experiencing conflict by one year. Even though the effect is similar for all children irrespective of their gender or level of household wealth, it greatly differs according to the age of the child in question. We estimate that if there had been no violence in Colombia, the average educational attainment of children between six and eleven years of age residing in areas experiencing conflict would have been 0.4 years larger. Similarly, for children between twelve and seventeen years of age, the presence of armed conflict has reduced their educational attainment by 1.4 years. This effect is significant, and amounts to 10% and 22% of the average education attained by these children respectively.[26]

[26] It is worth noting that Akresh and de Walque (2008) estimate that boys and girls exposed to the Rwandan genocide completed 0.5 and 0.3 less years of education, respectively. However, the average education in this country is much lower.

B. Biprobit Analysis: School Drop-Out and Child Labor

Given that the ECV 2003 survey only reports information concerning the past week's working activities', we are unable to undertake a duration analysis for labor decisions, as we did for education. Instead, we decided to use a biprobit estimation methodology, which allows determing the impact of armed conflict on both school drop-out decisions and labor decisions. However, in order to capture the long-term effect that violence may have over the course of a child's time in school, we use an *accumulated* average conflict each child has been exposed to throughout her academic life as explained in Section III. This measure allows us to continue controlling for fixed effects at the municipality level, and hence for all unobservable but constant characteristics related to the place in which each child resides.[27]

The biprobit estimates of the impact of armed conflict on school drop-out and child labor decisions are presented in Tables 7 and 8 for children younger and older than twelve years of age in 2003, respectively. All of the models report bootstrap standard errors (in brackets) at the municipality level to account for the first stage in the estimation strategy. The first model in both tables includes the usual personal and family characteristics as control variables. Additionally, it also includes our measure of the average rate of armed attacks each child was exposed to since the age of six. For both age groups, we observe that, the older they are and the poorer their family is, the more children tend to work. Similarly, boys have a higher probability than girls of engaging in work activities. According to the marginal effects, it is estimated that a boy between

[27] Note that the measure of conflict here is therefore different from that in the duration analysis approach.

12 and 17 years of age has an almost 2% higher probability than a girl of dropping out of school and working. This might explain the higher educational achievements of Colombian girls, and is consistent with previous studies on Colombia (Attanasio et al. 2006). The effect of gender with respect to younger children is not significant at any standard level, however. Finally, it is important to note that the value of the rho coefficient and its standard error suggest that, the biprobit approach is indeed the appropriate methodology to carry out for children between 12 and 17 years of age. Moreover, its sign suggest that school dropout and child labor decisions are positively correlated. The same is not true for younger children, suggesting that for this age group, the bivariate probit estimation was not necessary, and that separate probit regressions would yield very similar results.

Looking at the coefficient of interest in the first model, we find that the average exposure to violence during the period of schooling has no significant or even a marginal negative effect on the probability that a child will start to work or drop out of school. However, as the endogeneity test suggests, we need an instrumental variable approach. Using the same deterrence measure used in the duration analysis, we instrument armed conflict exposure with average homicide capture exposure over the course of a child's lifetime. Models (2) through (4) in both Tables 7 and 8 include the instrumented armed conflict measure, with the control variables being added gradually. They are all estimated under a two stage procedure. The Tables' lower panels present the coefficient of interest at this first stage. As expected, the instrument is again significant and highly correlated with the armed conflict measure.

For all models, we find that for children between five and eleven years of age, armed conflict has no impact on work decisions. However, as suggested by the duration analysis methodology it

does impact in a negative manner the drop-out decision. For children twelve and older, armed conflict exposure increases the probability of both entering the labor market and dropping out of school. In the latter case, as we gradually add the control variables, we see that the bias due to omitted variables proves significant, especially for the individual characteristics of each child. When the household characteristics are included the coefficients of interest are reduced to a much lesser degree. Specifically, when all of the controls are used, the marginal effect suggests that an increase by one standard deviation of the armed conflict exposure measure increases the joint probability of work and drop-out by 2.11% for children in this age group. This is clearly a non-negligible effect. For instance, being a migrant child increases this joint probability by nearly 0.1%.

As a robustness check we also present in Table 9 the results from an ivprobit estimation in which we assume that the drop-out and labor decisions are taken independently. As can be observed, the main results are maintained. From the biprobit rho estimate, for children between 6 and 11 years of age this is the appropriate specification. For older children however the data suggest that both decisions are taken simultaneously and hence the results presented in Table 8 are the most appropriate ones.

VI. Likely Pathways from Conflict to School Drop-out and Child Labor

Theoretically, there are several factors that could be driving the above results. Civil conflicts may increase the drop-out risk of students and their probability of engaging in labor activities through a reduction in returns to schooling, through negative economic shocks affecting the family, the destruction of fiscal capital such as schools or roads, the migration of teachers, a reduction in life expectancy or simply due to the fear parents may have of sending their children to school.

Understanding the pathways through which armed conflict influences schooling investment and child labor decisions is necessary in order to design proper policy responses. In this section, we investigate three possible channels in connection with three distinct literatures: the first establishes the negative consequences of violence with respect to economic conditions; the second links economic shocks to children's labor participation; and the third connects life expectancy with human capital accumulation.

Previous studies such as those by Abadie and Gardeazabal (2003) and Alesina et al. (1996) have established the negative consequences armed or civil conflicts may have on the economies of affected regions. Similarly, Deininger and Okidi (1999) and Verwimp and Bundervoet (2008) prove that civil conflict has negative effects on households' consumption growth. By the same token, Colombian households residing in municipalities experiencing high levels of violence could experience negative economic shocks, which could in turn force some children to work and leave school. Even though no previous study has directly evaluated the effect of violence or internal conflicts on the probability of children engaging in work, there is a vast literature relating economic shocks with children's employment and schooling. With respect to Mexico, Skoufias and Parker (2006) found that the unemployment of household heads induces greater labor force participation among girls. With respect to Brazil, Duryea et al. (2007) found that negative economic shocks reduce school enrollment and increase children's participation in the labor force. Similarly, Jacoby and Skoufias (1997) and Beegle et al. (2006) find that, within a credit constraint framework, income fluctuations affect school attendance (in the case of Indonesia) and labor supply (in the case of Tanzania) with respect to youths.

A second possible transmission channel, tested in this paper, corresponds to a somewhat more recent literature, one that studies the relationship between life expectancy and human capital accumulation decisions. The literature suggests that lower life expectancy translates into smaller returns on educational investments, which in turn induces a trade-off for parents, between an investment in their children's education and engaging them in child labor. Soares (2005) and Estevan and Baland (2007) develop theoretical models that suggest a positive relationship between life expectancy and schooling. They demonstrate that a higher mortality among youths induces inefficiently high levels of child labor. Empirical studies such as those by Lorentzen et al. (2005) and Jayachandran and Lleras-Muney (2008) find that increases in life expectancy are associated with higher human capital investments. Armed conflict and the premature deaths it causes is just one more channel thorough which life expectancy is altered.

Finally, it is reasonable to assume that armed conflict will not only change the expected returns on education through life expectancy but also in terms of the quality of education that children living in conflict areas receive. For instance, Hanushek et al. (2008) show that drop-out decisions are related to school quality, in the sense that students attending low-quality schools are less likely to remain in school compared to those attending high-quality ones. Even though there is no study in the literature directly linking school quality with armed conflict, it is reasonable to believe that the number and quality of teachers, the related infrastructure, and even the attendance rate in conflict areas will be lower. For instance, as previously mentioned, Akbulut-Yuksel (2008) shows that during the Second World War, the number of schools and teachers in Germany were affected by the conflict. Hence, it could also be the case that armed conflict in Colombia reduces the quality of education imparted in schools, which in turn reduces the returns on education. This will increase the drop-out rate and induce children to enter the labor market.

The empirical strategy we implement to determine the channels from armed conflict to drop-out decisions and child labor is depicted in Diagram 1. To test these three channels, we use an ivprobit and a two-stage bivariate probit regression for children younger and older than twelve respectively, where the dependent variables reflect whether or not a child works and whether or not he or she dropped out of school. We then study how the instrumented armed conflict measure affects these three possible channels, and how they in turn affect school drop-out and child labor decisions. Results from these specifications are presented in Tables 10 and 11 for both age groups of children.

Specifically, we use the growth in the commerce and industry tax at the municipal level during a child's time in school to capture the economic shocks stemming from conflict in the municipality where the child lives. As can be observed in Models (1) in both Tables, economic activity in the municipality is negatively influenced by exogenous variations in armed conflict. Moreover, the higher the growth in economic activity (measured by changes in industry and commerce tax revenues), the lower the probability that any child will drop out of school and, for children twelve or older, the lower the probability they will enter the labor force. Similarly, the lower panel of Model (2) in Table 11 shows that armed conflict increases homicides in the municipality where a child lives; correspondingly, it will also decrease the life expectancies of its inhabitants. Additionally, the instrumented higher homicides increase the likelihood that a child will drop out of school and enter the labor force if she is older than eleven. Finally, as can be observed in Model (3), the effect of armed conflict on the quality of education as measured by a standardized high school graduation exam (ICFES) turns out to be negative and significant. More importantly,

it appears that a lower level of school quality will induce a child to leave school and start working when they are older than eleven.

Given the importance of understanding the magnitude of these transmission channels, the marginal effect for each was estimated.[28] Of all three possible channels, we find that the strongest effect for children older than twelve comes from the decrease in life expectancy, and, correspondingly, the returns on education. It is estimated that an increase by one standard deviation on homicides will increase the probability of a child engaging in work activities and dropping out of school by almost 9%. The effects of a change by one standard deviation in the economic activity and the quality of education channels are nearly 6% and 3%, respectively.

For the first two possible channels (economic shock and life expectancy), the policy implications are clear. Estevan and Baland (2007) prove that even though higher mortality rates among young adults induces a trade-off between education and child labor, conditional cash transfers could, in principle, restore child labor to its efficient level. Similarly, the studies relating child labor to economic shocks suggest that mechanisms aimed at helping to smooth households' income could, in principle, reduce child labor and increase school attendance. The absence of a complete insurance market in Colombia for deaths or economic shocks appears to be a driving mechanism. Hence, with respect to both the economic shock channel and the changes in expected returns on

[28] These were estimated using the mfx command in stata. As in the previous section, we calculate the joint marginal effect of both dropping out of school and participating in child labor.

education channel, conditional cash transfers could be a useful policy tool for reducing drop-out rates in conflict areas.[29]

VII. Conclusions

This paper studies the effect that armed conflict exposure might have on households' schooling investment and child labor decisions in Colombia. Estimating such an effect is imperative, given the high incidence of armed conflicts in developing countries, the importance that education has for the wellbeing of individuals, and the possible poverty traps child labor can generate among less wealthy children. Additionally, as the real costs that violence entails in the development of nations becomes rightly assessed, policymakers might better implement the appropriate measures to offset its negative effects.

Even though previous studies have dealt with this question before, this study complements the existing literature in several respects. As mentioned, we provide the first evidence regarding the effect of conflict on child labor. Moreover, we take into consideration the intertemporal characteristic of schooling investment decisions, and hence take a duration analysis approach. In addition, we correct for possible endogeneity problems related to armed conflict. Finally we provide evidence regarding the possible channels through which conflict influences child labor and drop-out decisions. We find that using both a non-parametric and a parametric duration

[29] Another alternative explanation for the increase in child labor and reduction in educational investments could be that children in Colombia are leaving school in order to work in the illicit drugs business, for instance, as coca growers. However, as previously stated, evidence from Angrist and Kuegler (2008) does not support this story.

methodology, violent attacks significantly increase the risk of school drop-out for children between the ages of six and seventeen. Biprobit estimates suggest that armed conflict influences the schooling and labor decisions of children twelve and older, individuals for whom a trade-off between engaging in child labor and continued schooling emerges. We find no effect for children younger than the age of 11. Finally, we are able to identify at least three channels through which this effect takes place—these are negative economic shocks, lower life expectancies, and lower school quality.

These results provide strong evidence regarding the major impact armed conflicts around the world may have on economic development through a decrease in human capital accumulation and the deepening of poverty traps for younger generations. The policy recommendations stemming from this paper are clear. Countries suffering civil conflict should design measures to reduce the school drop-out and child labor rate, particularly in the most affected areas. Particular attention should be given those children older than eleven years of age.

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TABLES

Table 1: School Drop-out and Working Status of Children

	% of Children	N° of Observations
Drop-out of School	**12.14%**	**20,642**
6-11 Years Old	4.81%	10,631
12-17 Years Old	19.93%	10,011
Working	**33.91%**	**20,642**
6-11 Years Old (Household Chores)	57.73%	10,631
12-17 Years Old (Labor Market)	8.62%	10,011
Not Studying - Not working	**7.06%**	**20,642**
6-11 Years Old	1.82%	10,631
12-17 Years Old	12.64%	10,011

Source: ECV 2003

Table 2: Descriptive Statistics

Characteristics	Observations	Mean	St. Dev.	Maximum	Minimun
Age	20,642	11.36	3.43	17.00	6.00
Male[+]	20,642	0.50	-	-	-
Single[+]	20,642	0.99	-	-	-
Over-aged	20,259	-0.06	1.55	9.00	-7.00
Urban[+]	20,642	0.73	-	-	-
Head of Household's Education	20,642	6.76	4.66	31.00	0.00
Head of Household's Age	20,642	44.10	11.95	97.00	11.00
Head of Household's Gender[+]	20,642	0.71	-	-	-
Household Income	20,642	8.74	4.37	15.97	0.00
Wealth Index	20,642	8.42	3.35	15.36	0.63
Number of children in household	20,642	3.22	1.82	16.00	0.00
Hacinamiento[+]	20,642	0.48	-	-	-
Migrants[+]	20,642	0.20	-	-	-
Municipal per capita Taxes	20,642	-2.64	1.24	-0.54	-7.83
Unsatisfied Basic Needs Index (Poverty Rate)	20,642	26.37	20.75	100.02	2.36

Source: ECV 2003, Departamento Nacional de Planeación (DNP) and CEDE.

[+] Denotes dummy variable

Table 3: Descriptive Statistics

Year	Municipalities	Attacks Rate		Antinarcotics Operations Rate		Homicide Capture Rate (State Level)	
		Mean	*Std. Dev*	*Mean*	*Std. Dev*	*Mean*	*Std. Dev*
1992	1,075	6.53	13.83	2.20	7.23	0.30	0.40
1993	1,075	3.06	9.04	1.21	4.82	0.25	0.20
1994	1,075	5.03	11.69	1.29	5.99	0.24	0.15
1995	1,075	2.91	7.61	1.35	5.14	0.25	0.19
1996	1,075	3.30	8.93	1.05	4.12	0.26	0.21
1997	1,075	4.47	9.93	0.73	3.65	0.25	0.25
1998	1,075	4.79	10.92	0.47	2.30	0.32	0.43
1999	1,075	6.01	13.31	0.64	4.98	0.32	0.32
2000	1,075	7.80	16.84	0.41	2.22	0.41	0.73
2001	1,075	8.16	19.64	0.34	1.91	0.39	0.61
2002	1,075	12.27	23.91	0.34	1.63	0.38	0.48
2003	1,075	16.58	35.04	0.08	0.75	0.29	0.19

Source: Departamento Nacional de Planeación (DNP), Policía Nacional, Departamento Administrativo de Seguridad (DAS) and CEDE.

Table 4: School Drop-out and Working Status of Children According Exposure to Armed Conflict

	Low Armed Conflict Exposure	High Armed Conflict Exposure	Difference
Drop-out of School			
6-11 Years Old	0.017	0.104	-0.087***
	(.002)	(.005)	(.004)
12-17 Years Old	0.165	0.275	-0.11***
	(.004)	(.008)	(.009)
Working			
6-11 Years Old (Household Chores)	0.530	0.663	-0.133***
	(.006)	(.008)	(.01)
12-17 Years Old (Labor Market)	0.071	0.119	-0.047***
	(.003)	(.006)	(.006)
Not Studying - Not working			
6-11 Years Old	0.007	0.038	-0.031***
	(.001)	(.003)	(.003)
12-17 Years Old	0.107	0.168	-0.061***
	(.004)	(.007)	(.007)

Source: ECV 2003, Departamento Nacional de Planeación (DNP) and CEDE.

Table 5

Duration Analysis: Dependent Variable is Drop-out of School status for Children Aged 6-17

COEFFICIENT	*Normal Hazard Function*					*Logistic Hazard Function*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dropout	Dropout	Dropout	Dropout	Dropout	Dropout	Dropout	Dropout	Dropout
Attacks (in log)	0.002**	0.021***	0.019***	0.019***	0.028***	-0.023	0.523***	0.480***	0.261*
	[2.47]	[4.78]	[4.58]	[4.56]	[3.76]	[0.65]	[6.96]	[6.26]	[1.79]
Age	-0.001**		-0.001	0	0	-0.348***	-0.392***	-0.321***	-0.331***
	[2.10]		[1.63]	[0.96]	[0.87]	[7.98]	[9.23]	[7.48]	[7.70]
Male	0.002***		0.002*	0.002**	0.002**	0.234***	0.155***	0.204***	0.199***
	[2.84]		[1.76]	[2.08]	[2.07]	[4.30]	[2.96]	[3.84]	[3.73]
Single	-0.073***		-0.076***	-0.073***	-0.073***	-1.469***	-1.585***	-1.376***	-1.366***
	[9.11]		[9.03]	[8.85]	[8.78]	[12.19]	[14.64]	[12.07]	[11.95]
Urban	-0.007***		-0.016***	-0.007**	-0.007**	-0.054	-0.943***	-0.056	-0.061
	[4.42]		[6.20]	[2.24]	[2.21]	[0.55]	[11.18]	[0.55]	[0.60]
Overage	0.009***		0.011***	0.009***	0.009***	0.781***	0.899***	0.750***	0.760***
	[16.32]		[5.60]	[5.68]	[5.78]	[17.29]	[20.39]	[16.82]	[17.00]
Migration	0.003**		0.002**	0.003**	0.003**	0.147**	0.297***	0.409***	0.418***
	[2.33]		[2.08]	[2.23]	[2.30]	[2.17]	[4.47]	[6.00]	[6.10]
Head Education	-0.000***			-0.000***	-0.000***	-0.100***		-0.098***	-0.098***
	[3.94]			[2.90]	[2.90]	[10.04]		[10.10]	[10.16]
Head Age	-0.000**			-0.000**	-0.000**	-0.009***		-0.009***	-0.010***
	[2.39]			[2.22]	[2.20]	[3.71]		[3.78]	[3.94]
Head Gender	0.001			0.001	0.001	-0.076		-0.092	-0.095
	[0.83]			[0.71]	[0.65]	[1.25]		[1.55]	[1.59]
Log (Home per capita income)	-0.000**			0	0	-0.018***		-0.015**	-0.016***
	[2.09]			[1.52]	[1.52]	[2.89]		[2.54]	[2.58]
Wealth	-0.003***			-0.003***	-0.003***	-0.230***		-0.241***	-0.240***
	[10.04]			[4.69]	[4.70]	[13.02]		[13.76]	[13.67]
Number of children	0.001***			0.001***	0.001***	0.057***		0.045***	0.046***
	[4.24]			[4.75]	[4.75]	[3.58]		[2.91]	[2.93]
Overcrowding	0.002			0.002	0.002	-0.319*		-0.398**	-0.383**
	[0.78]			[0.78]	[0.82]	[1.90]		[2.43]	[2.33]
Log (Municipal Taxes)	0				-0.006	-0.383***			-0.323***
	[0.23]				[1.62]	[4.16]			[5.59]
Poverty Rate	-0.001***				0.001	0.039**			0.018**
	[2.96]				[1.47]	[2.33]			[2.16]
Duration Dependence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments First Stage									
Homicide Captures		-0.323**	-0.321**	-0.321**	-0.214**		-0.321**	-0.321**	-0.214**
		[0.087]	[0.087]	[0.087]	[0.068]		[0.087]	[0.087]	[0.068]
F -test		13.860	13.640	13.640	9.940				
Endogeneity Test (p-value)		0.015	0.021	0.019	0.004				
Observations	120,315	118,913	118,898	118,898	118,898	119,525	118,123	118,108	118,108

All regressions include controls for duration dependence and possible frailty, or unobserved heterogeneity, at the municipality level. A dummy for missing information on the exact date of dropout is also included.

Clustered standard errors at the municipality level are reported in brackets for models (1)-(5). (*** p<0.01, ** p<0.05, * p<0.1, + one tail significance).

Table 6

Predicted Impact of Armed Conflict on Human Capital Accumulation

Category	Number of Children	Predicted Average Schooling with Violence	Predicted Average Schooling without Violence	Average Difference
All Children	18,890	4.736	5.600	-0.864
		(0.014)	(0.018)	(0.005)
Children Aged 6-11	9,943	3.471	3.840	-0.370
		(0.012)	(0.015)	(0.003)
Children Aged 12-17	8,947	6.141	7.555	-1.413
		(0.015)	(0.020)	(0.007)

Standard errors in parenthesis

Authors' calculations based on Model 5 of table 5.

Table 7

Two Stage Biprobit Model: Dependent Variables are Work and School Drop-out Status for children aged 6-11

COEFFICIENT	(1)		(2)		(3)		(4)	
	Work	Dropout	Work	Dropout	Work	Dropout	Work	Dropout
Attacks (in log)	0.003	-0.065	0.193	1.484**	-0.034	1.269***	-0.087	1.218***
	[0.056]	[0.154]	[0.268]	[0.643]	[0.198]	[0.473]	[0.204]	[0.461]
Age	0.107***	0.088**			0.096***	0.089**	0.108***	0.122***
	[0.006]	[0.042]			[0.007]	[0.038]	[0.007]	[0.046]
Male	-0.077**	-0.061			-0.084***	-0.065	-0.079**	-0.054
	[0.032]	[0.059]			[0.031]	[0.054]	[0.032]	[0.057]
Urban	0.008	0.042			-0.220***	-0.339*	-0.006	0.063
	[0.068]	[0.225]			[0.057]	[0.194]	[0.064]	[0.221]
Overage	-0.046***	-0.011			-0.017	0.037	-0.045***	-0.045
	[0.017]	[0.037]			[0.016]	[0.037]	[0.017]	[0.042]
Migration	-0.021	0.405***			-0.027	0.376***	-0.032	0.423***
	[0.062]	[0.142]			[0.066]	[0.122]	[0.065]	[0.135]
Head gender	-0.033	-0.226***					-0.035	-0.230***
	[0.031]	[0.064]					[0.031]	[0.064]
Head Education	-0.006	-0.035***					-0.012**	-0.046***
	[0.004]	[0.011]					[0.006]	[0.013]
Head Age	-0.005*	-0.007**					-0.005*	-0.007**
	[0.003]	[0.003]					[0.003]	[0.003]
Log (Home per capita income)	-0.001	-0.018***					0.001	-0.018***
	[0.004]	[0.007]					[0.003]	[0.007]
Wealth	-0.063***	-0.122***					-0.056***	-0.109***
	[0.012]	[0.027]					[0.010]	[0.026]
Number of children	-0.021**	0.036					-0.01	0.046
	[0.010]	[0.029]					[0.010]	[0.032]
Overcrowding	-0.250***	-0.332					-0.181**	-0.263
	[0.092]	[0.454]					[0.085]	[0.462]
Municipality Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments First Stage								
Homicide Captures			-0.094***		-0.114***		-0.114***	
			[0.018]		[0.016]		[0.016]	
Rho	-0.032		0.031		-0.007		-0.029	
	[0.030]		[0.035]		[0.028]		[0.032]	
Observations	10,070		10,076		10,070		10,070	

Bootstrap standard errors at the municipality level are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1, + one tail significance).

Table 8

Two Stage Biprobit Model: Dependent Variables are Work and School Drop-out Status for children aged 12-17

COEFFICIENT	(1)		(2)		(3)		(4)	
	Work	Dropout	Work	Dropout	Work	Dropout	Work	Dropout
Attacks (in log)	-0.141*	-0.182*	1.701***	2.017***	1.469***	1.734***	1.426***	1.683***
	[0.081]	[0.103]	[0.181]	[0.195]	[0.322]	[0.241]	[0.335]	[0.233]
Age	0.257***	0.318***			0.259***	0.305***	0.285***	0.351***
	[0.015]	[0.022]			[0.011]	[0.012]	[0.012]	[0.013]
Male	0.550***	0.090***			0.554***	0.092***	0.568***	0.104***
	[0.089]	[0.032]			[0.044]	[0.027]	[0.046]	[0.031]
Urban	0.031	-0.091			-0.356***	-0.574***	0.033	-0.082
	[0.104]	[0.085]			[0.076]	[0.058]	[0.075]	[0.051]
Single	0.017	-1.218***			-0.158	-1.466***	0.004	-1.292***
	[0.155]	[0.125]			[0.159]	[0.153]	[0.175]	[0.153]
Overage	0.081***	0.059***			0.083***	0.078***	0.039**	0.01
	[0.013]	[0.014]			[0.017]	[0.011]	[0.017]	[0.011]
Migration	0.222***	0.184***			0.215***	0.162***	0.237***	0.204***
	[0.077]	[0.055]			[0.048]	[0.045]	[0.051]	[0.047]
Head gender	0.061	0.015					0.048	0.001
	[0.047]	[0.037]					[0.058]	[0.038]
Head Education	-0.019**	-0.033***					-0.026***	-0.039***
	[0.008]	[0.005]					[0.009]	[0.006]
Head Age							-0.006**	-0.006***
							[0.003]	[0.002]
Log (Home per capita income)	0.002	-0.008*					0.005	-0.005
	[0.004]	[0.004]					[0.004]	[0.005]
Wealth	-0.109***	-0.139***					-0.105***	-0.136***
	[0.022]	[0.014]					[0.016]	[0.014]
Number of children	-0.002	0.015					0.01	0.027***
	[0.019]	[0.012]					[0.015]	[0.010]
Overcrowding	-0.08	-0.252**					-0.039	-0.208*
	[0.124]	[0.113]					[0.109]	[0.107]
Municipality Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments First Stage								
Homicide Captures			-0.079***		-0.088***		-0.089***	
			[0.013]		[0.014]		[0.015]	
Rho	0.754***		0.803***		0.764***		0.748***	
	[0.043]		[0.013]		[0.018]		[0.019]	
Observations	9,668		9,677		9,668		9,668	

Bootstrap standard errors at the municipality level are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1).

Table 9

IV Probit Model: Dependent Variables are Work and School Drop-out Status

COEFFICIENT	Children Aged 6-11		Children Aged 12-17	
	Work	Dropout	Work	Dropout
Attacks (in log)	-0.22	1.251***	1.840***	2.114***
	[0.208]	[0.345]	[0.461]	[0.405]
Municipality Fixed Effects	Yes	Yes	Yes	Yes
Instruments First Stage				
Homicide Captures	-0.125***	-0.168***	-0.058***	-0.057***
	[0.024]	[0.029]	[0.016]	[0.015]
Observations	8,438	6,133	9,281	9653

Clustered standard errors at the municipality level are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1). All controls from the last models in Tables 7 and 8 are also included.

Table 10

IV-Probit Model

Possible Transmission Channels: Dependent Variables are Work and School Drop-out Status for children aged 6-11

COEFFICIENT	(1)		(2)		(3)	
	Work	Dropout	Work	Dropout	Work	Dropout
Industry and Commerce Tax Growth Rate	8.88	-149.064***				
	[25.410]	[46.190]				
Homicide Rate			-0.004	0.031***		
			[0.010]	[0.012]		
Relative ICFES score					2.066	-33.157***
					[5.719]	[11.345]
Instruments First Stage						
Instrumented Armed Attacks	-0.008***	-0.009***	22.209**	36.334***	-0.036***	-0.038***
	[0.001]	[0.001]	[11.044]	[12.826]	[0.002]	[0.003]
Observations	10,050	8,233	10,050	8,233	10,067	7,607

All regressions include municipal fixed effects and the control variables from the last model of Table 7.

Clustered standard errors at the municipality level are reported in brackets. (*** p<0.01, ** p<0.05, * p<0.1).

Table 11

Two Stage Biprobit Model

Possible Transmission Channels: Dependent Variables are Work and School Drop-out Status for children aged 12-17

COEFFICIENT	(1)		(2)		(3)	
	Work	Dropout	Work	Dropout	Work	Dropout
Industry and Commerce Tax Growth Rate	-309.969***	-363.509***				
	[72.090]	[50.868]				
Homicide Rate			0.053***	0.062***		
			[0.012]	[0.009]		
Relative ICFES score					-27.823***	-32.629***
					[6.471]	[4.566]
Instruments First Stage						
Instrumented Armed Attacks	-0.005***		26.988***		-0.051***	
	[0.001]		[9.667]		[0.004]	
Rho	0.75		0.75		0.75	
	[0.019]		[0.019]		[0.019]	
Observations	9,668		9,668		9,668	

All regressions include municipal fixed effects and the control variables from the last model of Table 8.

Bootstrap standard errors at the municipality level are reported in brackets. (*** p<0.01, ** p<0.05, * p<0.1 significance).

Graph 1

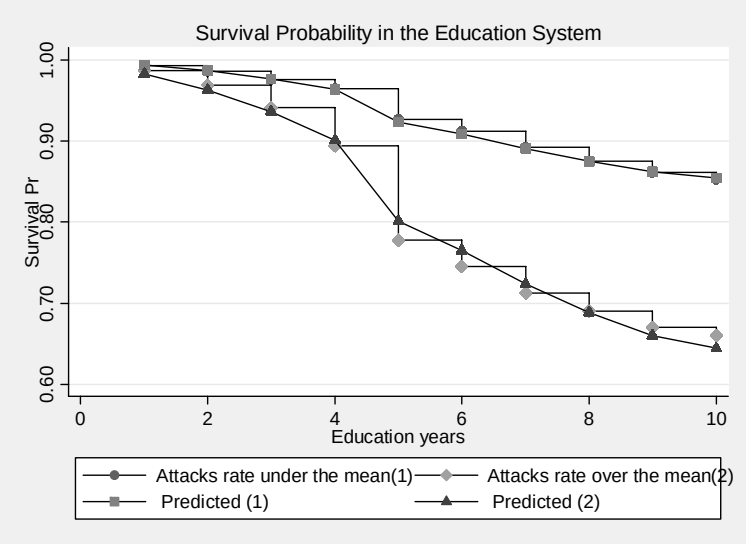
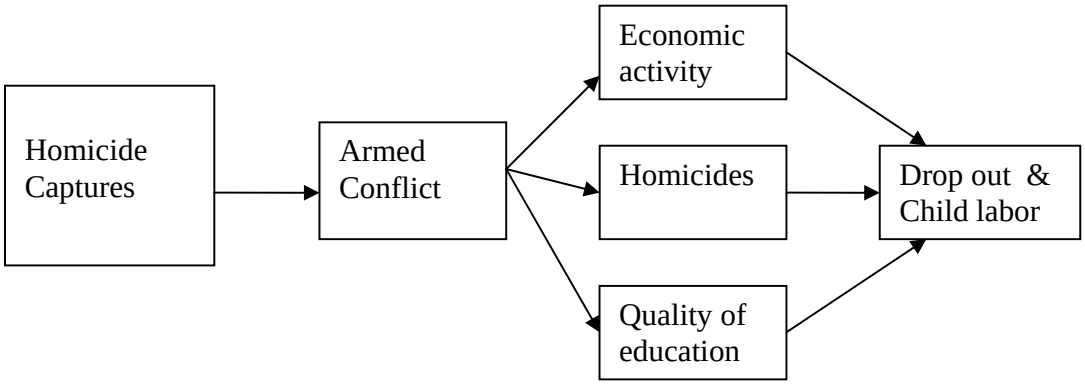
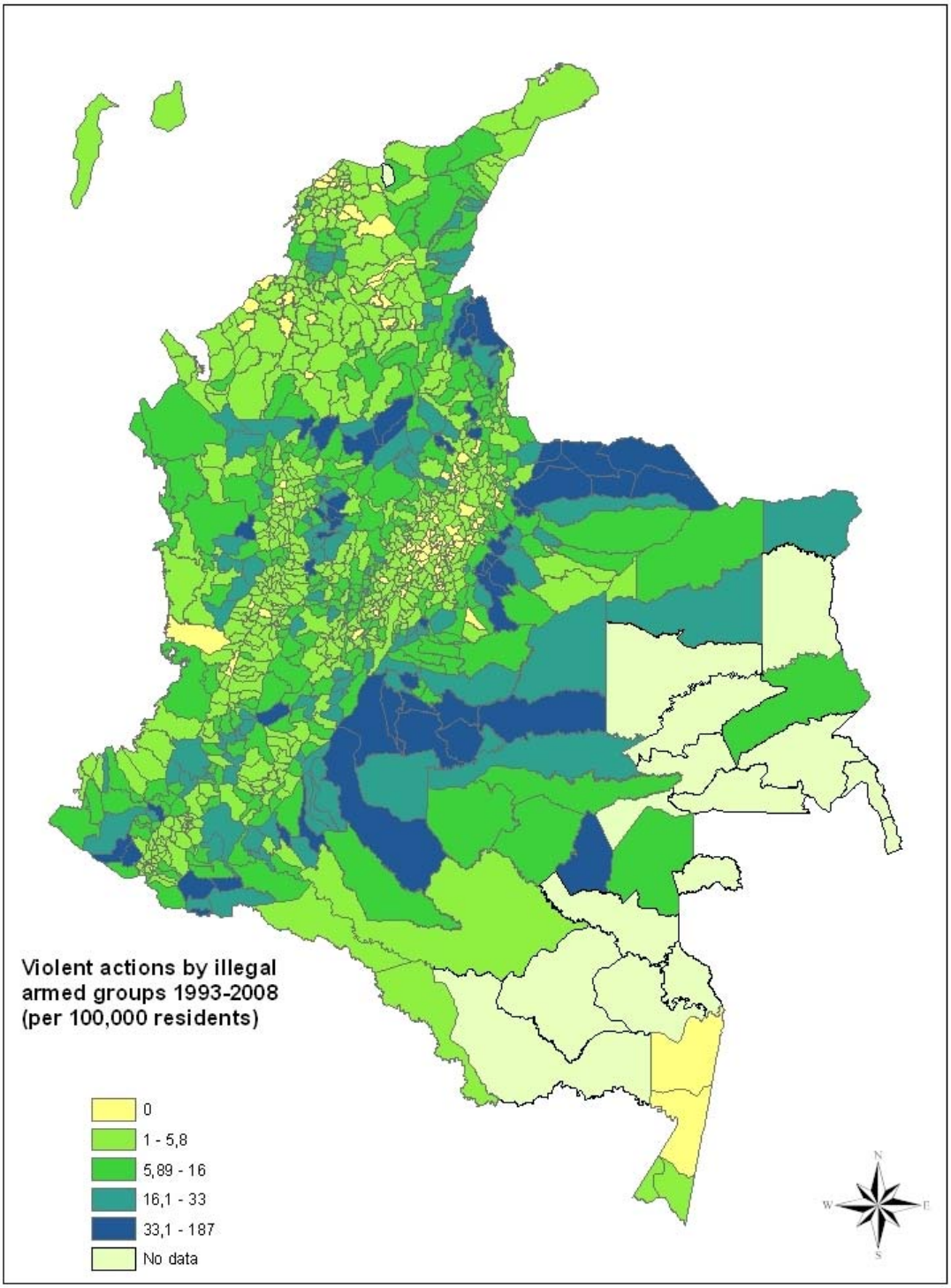


Diagram 1. Pathways from armed conflict to school drop-out and child labor




Violent actions by illegal armed groups 1993-2008 (per 100,000 residents)
0
1 - 5,8
5,89 - 16
16,1 - 33
33,1 - 187
No data
N
W
E
S