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WAR IS NOT HEALTHY.

POLITICAL VIOLENCE AND INFANT HEALTH OUTCOMES IN COLOMBIA

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ABSTRACT

PAHO (2008, 2003), WHO (2002) and National Governments in the Americas (2008) among other international institutions, have recently pointed that violence, at any level, has taken epidemic proportions.[2] The demographic effects of violence go beyond counting casualties. Yet, the very nature of hidden victims of violence makes it hard to measure. This document proposes a first approximation to measure the indirect effects of political violence in Colombia over a subpopulation that is not directly involved in the conflict, namely infants.

The document addresses this issue by investigating how violence affects infant health outcomes, measured by the probability of dying or being born with low weight, using DHS information for births during the 1990s in Colombia. Statistical problems are accounted by: (1) including municipality level variables such as economic performance and public investments on health, (2) covariates at the individual level on maternal information as well as prenatal and neonatal observed care and (3) exploiting the fact that DHS records fertility history of women, which allows to run a quasi-experimental design for brothers born to the same mother at the same municipality, but that differ on violence intensity.

The results show that as violence increases in 1%, the probability of death for baby boys increases in 0.4%, and more importantly when contrasting the results of the quasi-experimental design, births at violent municipalities have three times the probability of being born under weight than those births during pacific times.

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[2] See PAHO (2008) for a partial list of WHO and/or PAHO's publications in the topic.
National Governments of the Americas signed in 2008 a "Ministerial Declaration on the Prevention of Violence in the Americas" during the Yucatan (Mexico) Summit. March 1, 2008. (see http://www.paho.org/Spanish/D/DeclaracionMerida08.pdf, as downloaded in September-2008).

INTRODUCTION

The world report on violence and health (WHO, 2002) cites Africa and Latin America as the most violent regions in the world. The effects of such violence on their economies and populations have kept those regions from growing at a faster rate. Indeed, this report points out violence as a global public health problem, mainly for depleting young adults by large numbers. And more recently other institutions have supported this idea PAHO (2008, 2003), WHO (2008) and National Governments in the Americas (2008). However, other subtle and not so direct consequences of violence on human health have not been studied. This study will intend to solve the question of whether violence may affect human health or not, with particular interest on a group which definitely is not directly involved in the conflict, such is the case of infants.

Among the Americas, Colombia has been, by far, the most violent during the last two decades. The current civilian conflict has persisted for decades and involved several armed actors, generating many human losses.[3] In a country with a fairly homogeneous population, both in terms of religion and ethnicity, conflicts have erupted mainly as political confrontations, which have had important effects on daily life. The causes and some direct consequences of the conflict have been widely studied in Colombia, such as human lives lost in combat and the negative effects on economic performance (Ruiz and Rincon, 1996; Sanchez and Nunez, 2001; Montenegro and Posada, 2001; Rubio, 2002; Pshisva and Suarez, 2006).[4] An important issue bypassed by past studies is the effects of violence on health outcomes, such as infant mortality.

A first approach connecting violence and infant mortality was studied in Urdinola (2004). Using fixed effects estimations across 966 Colombian municipalities during the 1990s, this study finds that as homicide rates increased by 1 per thousand habitants the Infant Mortality Rate (IMR) increased by over 3 infant deaths per thousand in the same year, plus 1.5 additional deaths due to lagged effects. Those coefficients would translate in a reduction of about 3,150 infant deaths given a yearly average of 700,000 live births for the decade. However, there is not reliable data on other health outcomes, collected at the municipality level. Besides, several important confounders of infant health such as maternal education, households' characteristics, biological endowments, hygienic practices, maternal prenatal controls and health care practices are not captured by this approach.

[3] The current armed conflict has persisted for more than 40 years, and has ranked the country as the first one in number and rates of homicides in the Americas for the last 15 years.
[4] All of these papers include extensive reviews of the literature for the Colombian case.

For that reason, this study takes a step further and crosses individual data collected by the Demographic and Health Survey in 1995 and 2000, and municipality indicators on violence, economic performance and health investments. This information allows estimating the effect of violence on both infant mortality and health outcomes, for Colombian babies born between 1990 and 2000. In particular, this study presents estimates from both cross-sectional and "maternal" fixed effects, which consist in the contrast of health outcomes of brothers born to the same mother and at the same municipality, but at different periods being one more violent than the other. The latter corrects for several empirical problems that the traditional cross-sectional estimations impose. Those estimators suggest that as violence increases the probability of an infant dying increase, particularly affecting males. More importantly, the estimations suggest that violence has a negative effect on birth weight which is three times higher and significant during violent times.

These results reflect lower accessibility to medical services by pregnant women due to either the hostile environment or the destruction of health related infrastructure. The indirect consequences of these actions are for example reductions in access to health care by population, particularly affecting those with higher needs such as pregnant women and their children. These findings also suggest the need for reinforcing prenatal control for women and access to health inputs (i.e. vaccines) living in areas exposed to violence, where either health facilities are being destroyed or access to them is being reduced due to the conflict.

Research in this area is important in order to understand the full consequences of an intense and persistent civilian conflict and reveal hidden victims of war. The analysis may also provide insight into broader policy need, for instance by establishing which subpopulations are in greater need of support, or by suggesting which kinds of public health programs should be created or expanded to areas suffering from varying degrees of violence. This study is also relevant for other situations in which violent deaths have become a public health problem, depleting the young adult male population; such is the case of several Latin American or African countries.

The remainder of this paper is organized as follows: The next section includes a brief literature review on the Colombian conflict and the indirect consequences of violence on infant mortality. Section 3 presents a description of the data. Section 4 shows the empirical methodology and the last two sections present the findings and concluding remarks, respectively.

2. VIOLENCE AND HUMAN HEALTH: COLOMBIA IN CONTEXT

Colombia, the oldest democracy in Latin America, has had a steadily growing economy during the twentieth century despite three major civil conflicts. The first, known as the "One Thousand Days War" (1899-1902), resulted from confrontations between loyalists of the two main political parties--the Liberals and the Conservatives. Next came the seven-year period known as "La Violencia" (1946-53) marked by confrontations between liberal and conservative guerrillas primarily in rural areas. Finally, the current internal conflict began in the mid-1960s with the creation of socialist guerrillas in rural areas, and has been termed as the "Armed Internal Conflict" (1965-present).[5] In contrast to similar processes elsewhere in Latin America, the Colombian case escalated both in intensity and number of actors involved since the late 1970s, including the expansion of illicit, but very profitable, activities such as drug trafficking. This latter factor has deepened the conflict in Colombia. First, the war on drugs, which started in the late 1980s, contributed to the violent climate by provoking retaliatory responses, such as terrorist attacks. Secondly, the drug trade has corrupted government institutions and economically fueled outlaw armed groups, such as guerrillas and paramilitaries, all of which has added to the overall strife in Colombia.

Moreover, the expansionist movements of the main outlaw-armed groups in Colombia pose a counter-intuitive development of the conflict. High homicide rates are related to regional economies with the most accelerated economic growth, instead of the poorest municipalities. This is particularly true in isolated regions with sudden increases in income, such as those produced by the discovery and exploitation of emeralds, gold, petroleum oil, bananas and coca leaf plantations and cocaine processing (Montenegro and Posada, 2001). For instance, the largest and oldest guerrilla group in Colombia, FARC, during the 1990s set in areas that experienced economic booms mainly due to the exploration and transportation of petroleum oil, coal, or gold, production and transportation of bananas, and more recently coffee production zones (Rangel, 1999). The second largest guerrilla group, ELN, settles in municipalities where they can afford rents from the fiscal income, by threatening the local authorities or "electing" their majors, as well as in regions with high rents from petroleum oil exploitation (Penate, 1999). Paramilitary groups during the 1990s have followed two main expansionist strategies. On one hand, paramilitaries react to every political attempt that would empower guerrilla groups, such as peace negotiations initiated by the Colombian government with guerrillas (Romero, 2003). On the other hand, paramilitary groups

[5] At least four large guerrillas groups have been active in the last twenty years (M-19, FARC, EPL and ELN), as well as several paramilitary groups, and drug cartels.

fight against guerrillas for the control of very productive territories, such as illicit crops (Echandia, 1999). This weak relationship between poverty and violence eruptions allows for a cleaner research design for the question that this paper intends to solve.

2.1. Indirect Effects of the Conflict on Demographic Variables

The indirect effects of violence, such as the effect on infant health and mortality, are not so obvious. In addition, recent conflicts have erupted in places where both violence and mortality statistics suffer from several recording problems; as a consequence, little has been written on the topic. Indeed, the few studies linking violence and mortality have only presented the numbers on health outcomes, with no variables directly capturing the political turmoil.

World Health Organization,-WHO, (2002) reports the health outcomes in three countries under conflict. First, in Uganda during the mid-1980s measles, tetanus and diphtheria reached epidemic proportions. As a result, infant mortality rates more than doubled in the conflict areas. Second, in Zepa, a United Nations controlled area in Bosnia and Herzegovina, perinatal and childhood mortality rates doubled during the conflict. Lastly, in Sarajevo, the average birth weight fell by 20% in 1993 as a consequence of the doubling rates of premature births. Also, Ibrahim et al. (1996) believe that the increase in IMR in two Somali villages, during 1987-89, was due to the civilian conflict. However, the Cox model they use includes as explanatory variables baby/child's sex, household head's literacy, maternal occupation, and household size, which cannot fully reflect the political turmoil because of their limited focus. Finally, Camacho (2007) uses the birth weight of babies born, measured from vital records, in Colombia between 1998 and 2003 and crosses that information with the landmines explosions, per municipality. The argument is that explosions, even when they did not happen to the mother, create fear in the population and that reflects in higher stress levels for the mother, which end up having babies who weight less than average. Her results show significant effects when those explosions happened during the first quarter of the pregnancy, which translate in an average of 8.7 less grams on birth weight. This study only takes the 1998-2003 period because before that date births, from the vital registration system did not collect birth weight or any of the covariates used: mother and father's education and age, place of residency, place of delivery, marital status, parity and type of health insurance.

This present study, thus, will help solving the question on whether mortality and infant health are affected by violence. By using individual data which includes a wider control variables, than those offered by Camacho and a larger period (1990-2000). Moreover, the collection of data will

allow estimations on different anthropometric measures, such as birth weight, directly linked with better physical health not only at the first months of life, but also in latter years (Douglas et al, 2005, Cutfield et al., 2004; Lundgren, et al., 2004, Shi, et al., 2004).

2.2. Colombia's Infant Health in the Latin American Context

The IMR in Colombia for year 2000 was 30.6 per thousand live births.[6] Although this rate is high compared to developed countries such as the U.S. (6.9 per thousand) or Sweden (4 per thousand), in the Latin American context it is placed at a medium-low level next to Argentina, Panama, Costa Rica, Dominican Republic and Venezuela (Pan-American Health Organization-PAHO, 1999). The region overall has maintained a downward trend in the IMR since the 1960s. However, Latin America covers such a large and diverse region that, for comparison reasons, demographers have classified these countries according to their stage at the demographic transition. Colombia, along with ten other countries, is ranked as "transition in progress" with low overall mortality and moderate fertility levels (Chackiel and Plaut, 1996).

Following this distinction, some characteristics can be extracted from the PAHO compiled mortality statistics for Latin America countries from 1960 to 1995.[7] First, Colombia had the highest infant mortality rate of communicable diseases among the countries classified as "transition in progress" and those with similar socioeconomic characteristics. Second, Colombia next to Panama had the highest rates of perinatal illness during the 1960-95 period. Also, IMR by nutritional deficiencies were the highest until the early 1990s, when Colombia catches up with the rest of the countries. Third, from 1990 to 1996 Colombia held on average the largest proportion of babies born with low birth weight (14%) among all Latin American countries even larger than the proportions in the two least developed in the region: Bolivia and Haiti.[8] Finally, poor outcomes were also observed when analyzing morbidity rates. Colombia has continuously diminished the immunization rates, while kept high prevalence rates of communicable diseases such as poliomyelitis, neonatal and post neonatal tetanus, tuberculous-meningitis and diphtheria.

Finally, a brief cross-country exercise for the main IMR determinants from 1985 to 2000 for Colombia and countries that share very similar demographic and socio-economic conditions, but experienced low or no political violence incidence will test the idea of harmful effects of violence on infant survival. The selected countries are Argentina, Brazil, Chile, Colombia, Costa Rica,

[6] Author's estimation based on DHS-2000.
[7] See PAHO, 1999.
[8] It is also remarkable that Haiti holds the highest IMR in Latin America and Bolivia the highest in South America.

Dominican Republic, Mexico, Panama, Peru, Uruguay and Venezuela. The data includes: GDP per capita, proportion of illiterate women over age 15, accounting for women's education, infant's immunization rates (for DPT and measles, separately) and proportion of total population living in rural areas. The IMR is taken from the PAHO reports. The other variables are taken from the International Monetary Fund (IMF) dataset and PAHO.

I estimated fixed effects and ordinary least squared (OLS) models using the variables both in levels and in first differences. The results are very similar in both cases, and the fit has an explanatory power of 74% (adjusted R-squared). Following those estimators, I plot the observed and predicted IMR for Colombia in Figures 1a and 1b. We can see that if Colombia had socio-economically behaved as the rest of these Latin American countries, on average, by the end of the century the IMR would have been almost 5 deaths per thousand live births lower. With a current average of 700,000 live births per year during the years of analysis, that would imply 3,500 less infant deaths per year.

Although the channels through which the civil conflict may influence these outcomes are not known yet, one possibility may be the increase of internally displaced populations, which tend to have a higher risk of dying by communicable diseases and suffer from nutritional deficiencies (NRC, 2001). Another possibility is the constant attacks to electrical infrastructure and connecting roads which may reduce the quality of hygienic practices both in households and hospitals, as well as lower the possibilities of parents reaching health centers or medical services, and well as delay the transportation of food and the distribution of medicines. Also, there may be special conditions in Colombia, other than the increase of forced migrants that have led to the fact that it has the highest proportion of babies with low birth weight in the region. For instance, an increase in mothers' malnutrition due to the economic collapse in households, the excess mortality of young males, the typical breadwinners in Colombia, may also be conducive to low birth weight among Colombian babies.

3. DATA

The data combines several variables collected at the municipality level with the individual information captured by Demographic and Health Survey (DHS) in 1995 and 2000. The variables collected at the municipality level include: (1) population estimations by age and sex, calculated from the two latest available Colombian censuses, carried out in 1985 and 1993 by the national statistical office (DANE); (2) total number of homicides available by sex and big age groups and collected by DANE; and (3) public investments on health and health-related sectors and fiscal income that intend to capture the availability of the health and health related services provided in each municipality, as well as the economic performance. This information was taken from the fiscal yearly balance of each municipality, collected by *Contraloria General de la Republica*. More precisely, those public expenditures are the flow of investment in: infrastructure of clean water supplies (construction and maintenance), garbage collection and treatment, construction and improvement of slaughterhouses, construction and maintenance of hospitals and health care centers, acquisition of technical health devices, medical and laboratory equipment, promotional health campaigns, subsidies to high risk population (for the demand of health services), and operational expenditures of hospitals and health centers such as salary payments of medical doctors, nurses and the like. All these variables are expressed in constant Colombian pesos of year 1988.

The demographic and health survey is designed to capture information on health programs, contraceptive use, fertility, infant mortality, maternal mortality, nutritional status, AIDS prevalence, domestic violence, social security coverage and optometric conditions of the population. The survey covers a sub-sample of the Colombian population developed by PROFAMILIA –the DHS partner in Colombia-, stratified and multi-staged, targeting the non-institutional civilian population and with fractions of variable sampling. The DHS is directed to households and the other to individuals. The latest collects information of women ages 15 to 49 and their children no older than five years old (DHS-PROFAMILIA, 2000 and 2005).

This study kept all cases of women who had at least one single birth between 1990 and 2000, and whose births have reliable information on date of birth. Also, these mothers exclusively had single births and had at the most one infant death per year.[9] In particular, these records contain information on infant survival, and at which age the babies died (months in this case), and other health outcomes at birth, such as birth weight and birth length. More importantly, the survey

[9] "Single" births refer to one baby born per delivery. That is, I excluded all cases were twins or multiple births took place, as those babies usually are born pre-term and/or with lower weight than average.

includes several relevant variables in the determination of infants' health, such as: (1) household's socioeconomic conditions including urban/rural environment, access to public services such as electricity, clean water, and telephone, the availability of toilet facilities, possession of electro-domestics (TV and refrigerator)-all collapsed in a wealth index, age of household head, number of household members, partners age, occupational status and education levels of both the mother and her partner; (2) women's fertility conditions including parity and age at first birth; (3) women's anthropometric measures at the moment of survey such as weight and height which allows the construction of the Body Mass Index (BMI); (4) demographic characteristics such as women's age, relationship to the household head, civil status, whether the husband lives in the same house or not, migration status (which allows a decomposition of migrants between those who migrated to flee from violent conditions and those who migrated for economic reasons) as well as all their children's age, sex and whether or not they are alive; (5) information about health care practices and health status for the last four born babies including birth order, whether the delivery was attended by a medical doctor, nurse, midwife or traditional healer, the infants' weight and length at the moment of the survey, babies' social security coverage, number of months exclusively breastfed, received vaccinations (for BCG, DPT, polio, measles and hepatitis B), month at the first prenatal exams, and whether or not the baby had a diarrhea episode during the two weeks before the survey took place, and how it was treated (6) prenatal health care for the latest pregnancy such as number of days she was hospitalized while pregnant, number of prenatal controls and attended by whom, alcohol and tobacco consumption, whether she received medical attention due to complications or not, and if she was physically attacked while pregnant.

4. RESEARCH STRATEGY

As stated before, the peculiarities of the Colombian conflict during the 1990s poses a weak link between a confounding cause for both infant health and violence, such as dire poverty. Figure 2 plots the smoothed trend of the per capita fiscal incomes of the Colombian municipalities and their homicide rates, the relationship is clear. Using the available information at the municipality level for 966 municipalities in Colombia during the 1990s, we can see that as the yearly homicide rate increases, the yearly fiscal income increases too. This fact reinforces other authors' findings that violence appears in municipalities where sudden economic positive shocks appear (Rubio, 2002; Sanchez and Nunez, 2000; Penate, 1999; Rangel, 1999) and reduces the probability that both facts under study are caused by the same determinants.

Two estimation strategies are intended to capture the effect of violence on infant's survival and health outcomes. In order to keep a sample as constant as possible, these estimations will be tested only for babies born between 1990 and 2000, as important variables determining survival status and health outcomes were successfully collected for those births, as well as violence which is also measured for that period. The first approach is a logistic regression, where the dependent variable is whether an infant died or not, directly capturing the effect of violence on infant mortality following the model:

$$Health_{imt} = \theta v_{mt} + \alpha z_{mt} + \beta x_{imt} + \varepsilon_{imt} \qquad (1)$$

where *Health* is the health outcome under study for infant i who was born at time t in municipality m. In both cases a logistic regression is estimated as the dependent variable is dichotomous. For instance, *Health* equals 1 if an infant dies and 0 otherwise, or in the case of low birth weight *Health* will equal 1 if the baby was born under low birth weight (less than 2,500 grams) and 0 otherwise.

The main interest of this document is the estimation of θ, which is the parameter that measures the effect of violence (v) captured at the municipality level (m). In this particular case, it refers to total homicide rates. The control variables were described above and are represented in Equation (1) as z_m and x_i, depending on how such information was collected. The former variables (z_m) include controls collected at the municipality level (i.e. public investments in the health and health related sectors) and the latter include controls collected at the individual level (i.e. all DHS variables). The error term (ε_{itm}) captures the unobservable determinants and measurement errors.

Violence is measured as total homicide rates, male homicide rates and young males' homicide rates. Among the measurement of causes of dead homicide, and in general external causes of dead, keep the highest quality both in numbers as in cause of dead. Typically in Colombia and most countries for external causes of dead there is a precise legal process before burying the body, which involves both legal medicine and the legal system to check for the exact cause of dead. Therefore, homicide rates are considered in the literature as one of the best proxies for violence (see Fajnzylber et al., 1998). Indeed, when contrasting countries is easy to check that countries with high violence levels keep higher homicide rates or, as shown in Figure 3, the intensity of the political conflict is also depicted by homicide rates in Colombia.[10]

However, these cross-sectional estimates may pose several statistical problems. One of them is unobserved heterogeneity. In this particular study, some of these differences may be related either to reactions of households to the knowledge of health endowments of the baby, or to reactions to violence in the region. One way to reduce those problems is running logit random effects estimations. By doing so, the error term (ε_{itm}) now represents a combination of permanent and transitory processes, such that

$$\varepsilon_{imt} = \upsilon_{imt} + u_{itm}, \qquad (2)$$

where the first term represents the time-invariant unobserved heterogeneity (i.e. genetic predisposition) and the second term represents the time-varying stochastic error, or error due to factors inherent to the process other than measured or unobserved covariates. Both components are assumed to be normally distributed and more importantly independent and uncorrelated with the independent variables.

Another way to reduce such effects is to control for family variation, which can be captured as household and maternal fixed effects. For that purpose, I will use the DHS information which includes women's birth history. From that, I can compare the same health outcome for different babies born to the same mother, taking into account that one of them was born in an area of conflict, while the other was born in the same area but at a less violent time, always for non-migrant mothers. In this way, heterogeneity can be reduced by assuming similar genetic composition of the babies and then consider the effects of the conflict on a baby's health, using this "within-family" estimation.

[10] There are other measures of violence collected for this research, which include the summation of armed actions of illegal groups and armed actions perpetrated by outlaw armed groups. However, this information is only available since 1995 and the logit models keep iterating as the function is never concave or produce exaggerated large estimates with exaggerated standard errors which make no hypothesis testing possible.

5. EMPIRICAL FINDINGS

Table 1 shows the descriptive statistics of the data set, which corresponds to babies born to respondents (women in their reproductive years) up to five years before the survey date. Unusual observations in both violence (homicide rates higher than 800 per 100.000 habitants) and birth weight (below 1.000 grams or over 4.000 grams) have been dropped. The average weight at birth from 1990 to 2000 was 3,204.3 grams for Colombian babies, being 6.59% of the babies born with low weight, and the average length of babies was 49.81 centimeters. Only 3.48% of the babies born in the decade died before their first year of life, and on average died at 2.47 months. The average household had almost six family members; the household head was 31 years old and had a wealth index of -0.094, for an index that varies from -3.08 and .976 in Colombia.[11] The women included in the analysis had on average just above 6 years of education, were 27 years old, have had 2.74 children ever born in her life and gave birth to 1.76 children in the previous five years to the survey. During their pregnancy women on average attended to 5.5 prenatal visits and expend 10.6 months breastfeeding their infants. There are 61 different municipalities included in the survey for non-migrant mothers for which total homicide rate was on average 81.67 per 100.000 inhabitants, the male homicide rate is almost double that number with an average of 156.05 and the young male homicide rate was 269.63 per 100.000. All calculations here presented are made with total homicide rates, but the estimators are basically the same independently of whether violence is captured this way or with the other two homicide rates.

All regressions are estimated for babies born within five years previous the interview for both sexes and each sex separately, as it is a demographic fact that baby boys have higher mortality rates than baby girls. To avoid miss-specifications extreme observations in both violence (homicide rates over 800) and birth weight (below 1.000 grams or over 4.000 grams) have been dropped. Table 2 shows the results from a logistic random effects regression of homicide rates on infant deaths. The coefficients suggest the expected positive effect of homicide rates on the probability of an infant's death, although not statistically significant for both sexes and females. The statistically significant results for males suggest that the whole effect of violence is being absorbed by the weakest of the sexes. Also, the effect of violence lagged one year on infant's death was negative but statistically insignificant, it was only included to control for auto-regressive patterns in the series; lags of higher order do not hold such effect. I will now focus on

[11] The wealth index is built by DHS surveys in each country depending on the available household characteristics and tries to incorporate both structural (i.e. education) and current (i.e. assets) poverty.

the effect for males which is statistically significant. The coefficient of 0.004 translates into an increase of 0.48% in male infant mortality per increase of 1 per 100.000 in the total homicide rate in Colombia. This result is important if we consider that the average homicide rate during the decade for the municipalities included in the study was 81.67 per 100.000 inhabitants. Other specification models excluded some of the independent variables but still produced the same parameter for violence, which provides strong evidence of stability in the chosen model.

Table 3 shows the results with the same regression model, but the dependent variable is whether the baby is born under 2.500 grams or not (born with low birth weight). The results show a negative but insignificant parameter for all cases, which contrast with the results found by Camacho (2007), as this model suggests no effect of violence on birth weight. Yet, this discrepancy is not surprising as there are large differences on the statistical models, data sources and the definitions of both dependent and independent variables. But, more importantly, in this research strategy I have pointed out that there may be unobserved characteristics which cannot be controlled in this specification models, but are important to health outcomes.

In an attempt to control for them this study has proposed the following within family fixed effects exercise. For this exercise the number of observations reduces considerably. The descriptive statistics are presented in Table 4. It is important to notice that mother could have had more than two children in the previous five years of the survey, and that only have been selected those who *at least* had one birth in a violent era and one in a less violent time. In that way, there can be cases of one mother with three children of which two were born in pacific times and one in a more violent era. Thus, Table 4 represents the statistics based on the children and not on the mother in order to point out the differences, if any, in the observables. Almost all characteristics are on average similar with no statistically difference in means for babies born in either pacific or violent times, including weight and height at birth, except for levels of violence and fiscal income. Both of them are much higher for violent times, being this consistent with the literature describing the Colombian conflict, which erupts in zones with sudden economic positive shocks.

It is also important to notice that observed health care practices are on average the same for babies born in pacific times compared to babies born in violent times, except only for proportion of children who have been vaccinated at least with one doses of the triple viral vaccination, which is half in violent times and the difference is statistically significant. As all others health care practices are so similar, it may be pointing out the fact that mothers, on average, tend to behave similarly with their children unless extraordinary events happen, as violence eruption. This could be reflecting the fact that either women could not travel to health care facilities for the

vaccination or the vaccines did not arrive to the municipality, due to the very nature of the conflict.

As the number of observations is much lower, it is not possible to do the estimations on probability of dead, for not having enough observations of infant deaths which allow this comparison. Violent times have been defined as those with homicide rates above the median homicide rate. The estimations are here presented for the probability of being born with low weight one of the main predictors of good health on children. Table 5 shows the results for both sexes only as, again, there are not enough observations to do the exercise for each sex. The results are significant and very high as total homicide rate increases on the probability of being born with low weight, for children born in violent moments compared to their brothers born in the same municipality in more pacific moments during the 1990s. The parameters are much larger for this regression than for the random effects logit model and imply a difference of over 100% in the probability of being born under 2.500 grams as homicide rates increases 1%. The most important result is that the probability of a baby being born with low birth weight is three times higher and significant for children born in violent times, as opposed to insignificant effects for babies born in pacific times. These results reinforce the idea that violence is harmful to infants' health as birth weight definitely is highly correlated to infants' survival, as shown in the literature.[12]

[12] Indeed for this sample shows a correlation coefficient of 0.032 and a OLS significant coefficient of 0.139

4. CONCLUSIONS

Cross-sectional models using individual data suffer from several statistical problems. Although death occurs to all of us with a probability of 100%, nowadays it is a rare event to observe, particularly in sample populations. For instance, from the data gathered in Colombia in DHS-19955 and 2000 out of the selected 6,627 babies born between 1990 and 2000 only 3.48% of them died before their first birthday. This is less variability than one might wish for statistical purposes. Yet, the research strategy here designed tries to reduce both dimensionality of the problem as well as dealing with this.

The results from Logistic regression on a time series with random effects per mother and controlling by auto-regressive patterns in homicide rates suggest a higher probability of dying for babies born under violence. As violence increases the probability of dying for a baby increases too and it mainly affects baby males, which are born weaker than females. More importantly the quasi-experimental design using the women's fertility history allowed to construct a time series for brothers born to the same mother, who had never migrated, and who had at least one child in a pacific time and at least another in a more violent one (in the same municipality). The results on this design prove a three times higher probability of being born with low birth weight.

These harmful effects of violence reflect lower accessibility to medical services by pregnant women and their just born children, either by the hostile environment and/or the destruction of infrastructure, which in any case will reduce the probability of these women and their children having the needed medical attention. This, in turn, may be due to the hostile environment and/or the destruction of ~~health or health related~~ infrastructure, which in any case will reduce the probability of these women having prenatal controls or important health care practices to neonates, such as vaccination.

The policy implications of these findings go further the fact that violence is not healthy for babies. It is clear that after controlling for maternal specific conditions, municipality conditions, household characteristics and health practices; current violence have a negative effect on infants' health outcomes. Therefore, emphasizing the health supply services to neonates in violent areas will help reduce the harmful effects of violence on infant health. Moreover, the services should be directed to the weakest babies, that is those born preterm or below 2.500 grams at birth.

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TABLES

Table 1. Descriptive Statistics from Mothers who Gave Birth between 1990 and 2000.

Variable	Observations	Mean	Std. Dev.
Infant's Characteristics			
Weight at birth (gms.)	6,126	3,204.31	515.82
Height at birth (cms.)	2,446	49.81	3.24
Children's age of death (months)	213	2.47	2.98
Household's Characteristics			
Age of household head	662	31.18	6.99
Number of household members	9,057	5.85	2.62
Partner's age	7,157	32.73	8.26
Wealth Index	7,186	-0.09	1.04
Women's Characteristics			
Women's highest year of education	9,057	6.72	3.93
Age	9,057	27.80	6.56
Children ever born	9,057	2.74	1.92
Number of births in the past five years	9,057	1.60	0.76
Age at first birth	9,057	20.66	4.50
Weight (kgms.)	8,708	58.49	10.57
Height (cms.)	8,715	154.26	6.36
BMI	8,706	2465.19	497.08
Health Care Practices			
Number or prenatal visits	8,078	5.55	3.54
Number of days hospitalized while pregnant	15	3.34	4.38
Prenatal visits attended by doctor	8,086	0.83	0.38
Delivery attended by doctor	9,041	0.78	0.42
Baby has health card	8,835	0.92	0.27
Has ever been vaccinated	3,619	0.93	0.25
Has received BCG vaccination	8,826	0.92	0.27
Has received Polio vaccination	8,815	0.93	0.26
Has received DPT vaccination	8,790	0.91	0.28
Has received Measles vaccination	8,706	0.59	0.49
Has received Hepatitis vaccination	4,264	0.61	0.49
Has received Triple vaccination	4,264	0.39	0.49
Months of breast-feeding	8,623	10.58	8.73
Municipalities Characteristics			
Fiscal income per capita (hund of mill. of pesos 1998)	61	6.03	7.06
Public investments on health sector (hund of mill of pesos 1998)	61	2.27	2.94
Homicide Rate	61	81.67	93.98
Males' Homicide Rate	61	156.05	181.06
Yong Males' Homicide Rate (ages 15-44)	61	269.63	320.40

Table 2. Effect of Homicide Rates (per hundred thousand) on Infant Mortality, 1990-1999. Logistic Random Effects Regression. Dependent Variable: Infant is Dead=1

	Both	Males	Females
Homicide Rate	0,001	0,004	-0,004
	(0,002)	(0,002)*	'(0,003)
Lag of Homicide Rate	-0,001	-0,003	0,002
	(0,002)	(0,003)	(0,002)
Municipality Controls	Y	Y	Y
Household Controls	Y	Y	Y
Rural residency	Y	Y	Y
Mother's demographics	Y	Y	Y
Prenatal care	N	N	N
Delivery care	N	N	N
Observations	6,627	3,338	3,289
Number of case identification	5,028	2,902	2,864

Robust Standard Errors in parenthesis. ***Significant at 1%, **significant at 5%, *significant at 10%

Table 3. Effect of Homicide Rates (per hundred thousand) on Infant Mortality, 1990-1999. Logistic Random Effects Regression. Dependent Variable: Infant is Born with LBW=1

	Both	Males	Females
Homicide Rate	-0,002	-0,004	-0,001
	(0,002)	(0,003)	(0,002)
Lag of Homicide Rate	-0,000	0,001	-0,001
	(0,002)	(0,002)	(0,002)
Municipality Controls	Y	Y	Y
Household Controls	Y	Y	Y
Rural residency	Y	Y	Y
Mother's demographics	Y	Y	Y
Prenatal care	Y	Y	Y
Delivery care	Y	Y	Y
Observations	3,963	2,030	1,933
Number of case identification	3,626	1,929	1,850

Robust Standard Errors in parenthesis. ***Significant at 1%, **significant at 5%, *significant at 10%

Table 4. Descriptive Statistics from Mothers who Gave Birth between 1990 and 2000 at Violent and Non-Violent Times[+]

	Observations		Mean		Std. Dev.	
Variable	Violent Time	Non-Violent Time	Violent Time	Non-Violent Time	Violent Time	Non-Violent Time
Infant's Characteristics						
Weight at birth (gms.)	296	252	3,307.92	3,318.58	658.99	702.91
Height at birth (cms.)	119	107	49.69	49.88	4.12	3.44
Children's age of death (months)	19	17	2.67	3.01	2.79	3.34
Household's Characteristics						
Age of household head	19	21	31.81	32.55	7.00	7.06
Number of household members	467	457	6.41	6.28	2.65	2.67
Partner's age	419	413	32.54	32.56	7.15	7.05
Wealth Index	378	373	-0.30	-0.30	1.16	1.17
Women's Characteristics						
Women's highest year of education	467	457	6.16	6.03	3.90	3.88
Age	467	457	28.00	28.25	5.92	5.94
Children ever born	467	457	3.64	3.67	2.16	2.23
Number of births in the past five years	467	457	2.51	2.48	0.71	0.67
Age at first birth	467	457	20.15	20.29	4.05	4.13
Weight (kgms.)	453	442	58.29	57.86	10.83	10.23
Height (cms.)	453	444	153.64	153.65	6.00	6.03
BMI	453	442	2467.18	2449.63	421.52	399.24
Health Care Practices						
Number or prenatal visits	415*	291*	5.08	4.32	3.94	3.41
Prenatal visits attended by doctor	292	415	0.72	0.76	0.45	0.43
Delivery attended by doctor	467	457	0.69	0.65	0.46	0.48
Baby has health card	448	440	0.90	0.88	0.30	0.32
Has ever been vaccinated	192	217	0.91	0.91	0.28	0.29
Has received BCG vaccination	447	439	0.89	0.87	0.32	0.33
Has received Polio vaccination	435	447	0.90	0.89	0.30	0.31
Has received DPT vaccination	447	438	0.86	0.89	0.35	0.31
Has received Measles vaccination	442	432	0.57	0.61	0.49	0.49
Has received Hepatitis vaccination	208	237	0.57	0.52	0.50	0.50
Has received Triple vaccination	208*	237*	0.24	0.41	0.43	0.49
Months Breastfeeding	445	437	10.05	11.18	7.51	7.89
Municipalities Characteristics						
Fiscal income per capita (hund of mill. of pesos 1998)	467	457	6.48	5.87	8.47	8.65
Public investments on health sector (hund of mill of pesos 1998)	467	457	2.41	2.44	2.99	3.04
Homicide Rate	467*	457*	70.52	23.83	60.98	10.36
Males' Homicide Rate	467*	457*	133.86	44.33	119.70	19.91
Yong Males' Homicide Rate (ages 15-44)	467*	457*	231.30	75.70	215.91	36.19

*The difference in means is statistically significant from a t-test

[+]Violent times are defined as those with Total Homicide Rates above the median.

Table 5. Effect of Homicide Rates (per hundred thousand) on Low Birth Weight, 1990-2000. Maternal Fixed Logistic Regression.

Dependent Variable: Born with Low Birth Weight=1

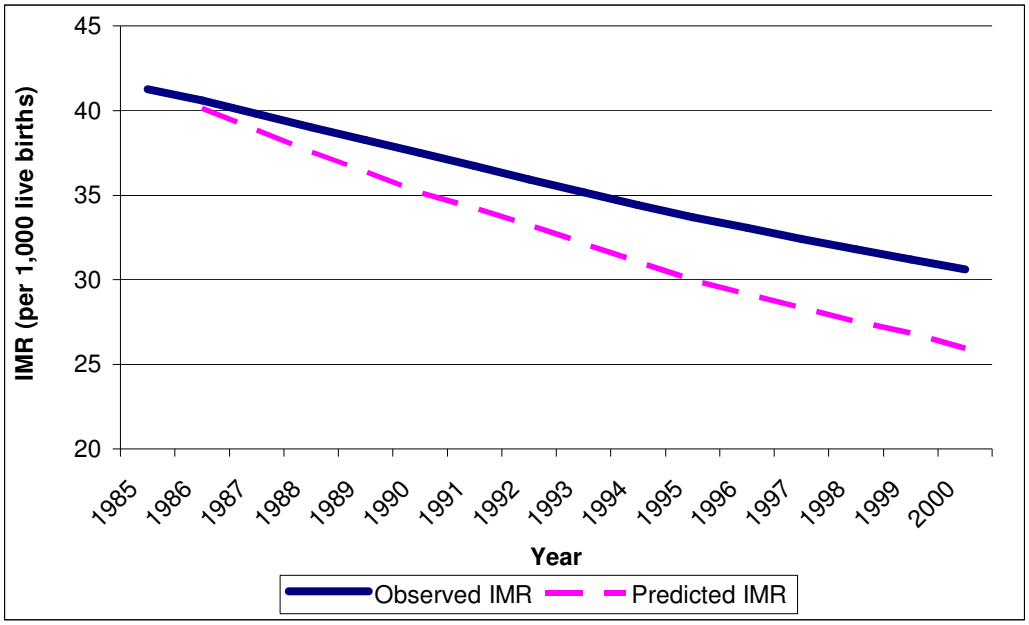
	Violent times	**Non-violent times**
Homicide Rate	1.105	0.029
	(0,295)***	(0,032)
Lag of Homicide Rate	-0.706	0.002
	(2.014)	(0,010)
Municipality Controls	Y	Y
Household Controls	Y	Y
Rural residency	Y	Y
Mother's demographics	Y	Y
Prenatal care	Y	Y
Delivery care	N	N
Observations	99	95

Robust Standard Errors in parenthesis. ***Significant at 1%, **significant at 5%, *significant at 10%

FIGURES

Figure 1a.Observed and Predicted Infant Mortality Rate (IMR) for Colombia, 1985-2000 from Cross-Country Regressions

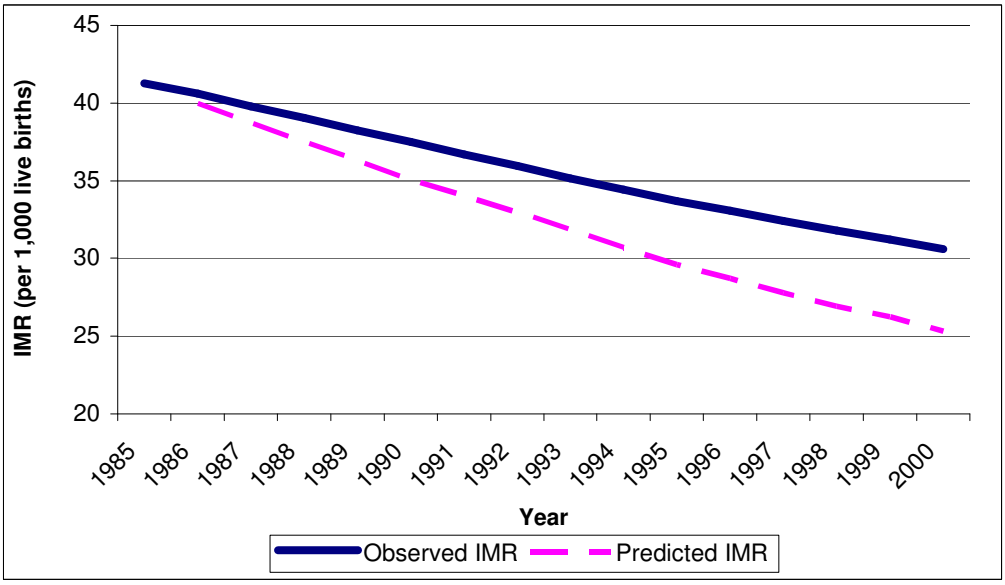
IMR=f(Female illiteracy, GDP, Immunization, Rural)



Source: Authors calculations

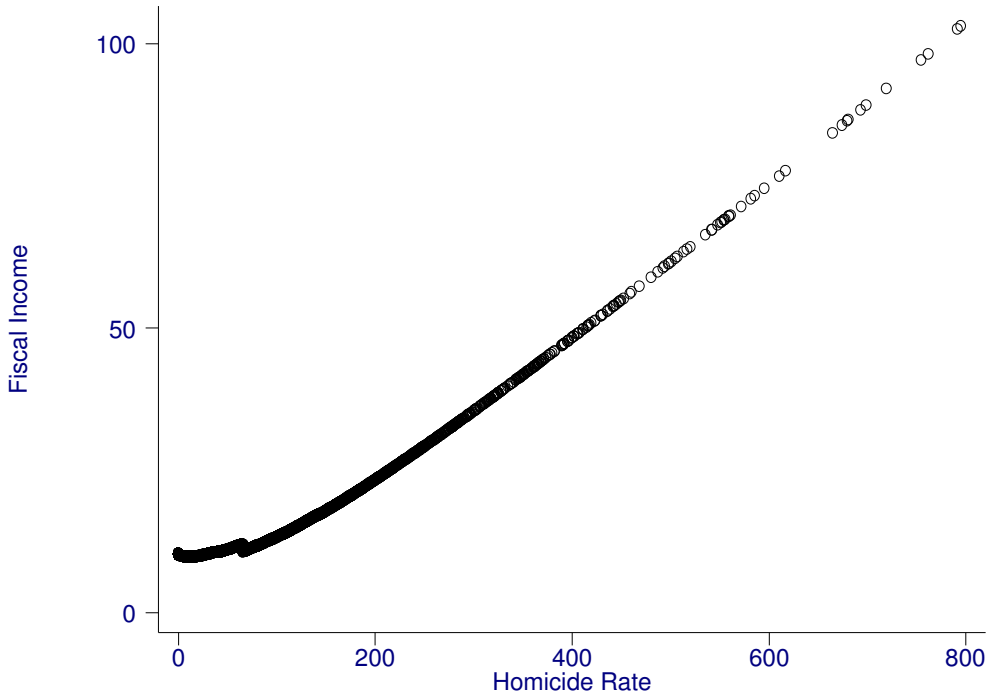
Figure 1b.Observed and Predicted Infant Mortality Rate (IMR) for Colombia, 1985-2000 from Cross-Country Regressions

IMR=f(Female illiteracy, GDP)



Source: Authors calculations

Figure 2. Relationship Between Fiscal Income Per Capita and Homicide Rates in Colombian Municipalities, 1990-2000



Source: Authors calculations

Figure 3. Homicide Rates (per 100,000) and Homicide Numbers in Colombia, 1946-2000