# Hit by El Niño: Households' responses and medium term effects on child outcomes in Ecuador

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Abstract

Approximately every 5-7 years, El Niño phenomenon hit the west coast in South America where it manifests in the form of extreme rainfall causing floods and landslides. This paper study how this disaster affected family responses (e.g. income and consumptions) and investments in children during the aftermath of the shock. Exposure to El Niño phenomenon is identified using two sources of variation: time and geographic variation in the exposure/intensity of the shock. Preliminary findings suggest that el Niño shock reduced household income especially in the rural areas, which also negatively affected household consumption. In addition, exposure to el Niño negatively impacted children food consumption and breastfeeding. Additionally, using a rich children dataset, I investigate the lasting effect of exposure to floods in utero and early in life on health and cognitive outcomes. Preliminary results suggest negative effects on cognitive test scores measured between 5 and 7 years after the disaster.

## 1. Introduction

Recent trends in global climate change suggest that extreme weather shocks may become frequent and their intensity more unpredictable (Lancet, 2003). Income losses, consumption fluctuations, and infectious diseases are among the costs of these weather shocks. These consequences can disrupt prenatal and early childhood development, which are sensitive periods in human development. In fact, there is a growing body of research arguing that adverse experiences *in utero* and during early childhood have lasting effects not only on later health outcomes, as argued by the fetal origins hypothesis, but also on human capital accumulation (Almond and Currie, 2011).

El Niño phenomenon is a climate event that causes several weather disasters ranging from extreme flooding and landslides on the western coast of South America to droughts in Indonesia. This paper analyses the effect of the 1997-98 el Niño phenomenon in Ecuador, the worst el Niño of the XX century on family and children wellbeing, by exploring a two-fold research question. First, this paper study how this disaster affected family responses (e.g. income and consumptions) and investments in children during the aftermath of the shock. Second, this paper investigates the lasting effect of exposure to floods in utero and early in life on children health and cognitive outcomes.

To explore the impact of el Niño on household responses and investments in children, this paper uses the Living Standard Measurement Studies (LSMS) surveys that have the advantage of having been collected two years before the shock (1995), during (1998) and one year after the disaster (1999). To identify the effects, this paper exploits two sources of variation: time (before

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and after the shook) and geographic variation in the exposure/intensity of el Niño. Specifically, this work uses data from Ecuador's weather stations to identify the total months of floods during el Niño at the village level. Results suggest that el Niño shock reduced household income especially in the rural areas, which also negatively affected household consumption. In addition, exposure to el Niño negatively impacted children food consumption and breastfeeding.

To investigate the lasting effect of el Niño on later children outcomes, this paper uses a dataset that collected children health and cognitive outcomes five and seven years after the disaster for a sample of around 7000 children. To identify the impact of El Niño phenomenon on children outcomes, this study uses two sources of variation. First, it exploits timing of birth variation since the sampled children were born between 1998 (during the shock) and 2002 (4 years later). Second, it relies on geographic variation in the exposure to the phenomenon since the sample includes villages in the coast and in the highlands. Findings suggest that children who were born during el Niño are shorter, tend to be more anemic and score lower in vocabulary tests five and seven years after the shock. Moreover, exposure to severe floods in utero is associated with a deficit in vocabulary performance five and seven years after the shock.

The contribution of this paper is twofold. First, the findings from this paper will contribute to enlarge the evidence about the lasting effects of early life adverse shocks on later child outcomes. Second, this study will enhance the understanding of households' responses to natural disasters by exploring heterogeneous responses according to families' characteristics. Additionally, this study will provide evidence on how investments in children respond to natural disasters, an issue that has been underexplored in the economic literature. However, this is extremely relevant since family investments are key inputs to the production of human capital. In the context of increasing climate volatility and uncertainty, the evidence from this paper stresses the importance of developing policies that improve coping mechanisms of more disadvantage households to ameliorate negative and lasting consequences on children.

## 2. Literature review

To understand the lasting consequences of extreme weather shocks on children's human capital, it is important to identify the effect of these shocks on family inputs such as income and consumption. Income loss is one of the most direct effects of natural disasters resulted from destruction of crops, livestock and infrastructure (Baez, de la Fuente and Santos, 2009). For instance, Baez and Santos (2008) found that two earthquakes that affected El Salvador in 2001 were correlated with a decline in the short-term income per capita of one third of pre-disaster mean. Anttila-Hughes and Hsiang (2012) studied the effects of typhoons in Philippines between 1950 and 2008 and found that at average exposure to the weather shock, average household income was reduced by 6.6% during the year after the shock.

Income reductions imply a tighter budget that could translate into consumption losses by affected households, whenever they lack coping strategies like formal or informal credit and insurance mechanisms (Baez, de la Fuente and Santos, 2009). Anttila-Hughes and Hsiang (2012) found that the average Filipino households failed to smooth consumption since total expenditures contractions followed the average income decline. Indeed, total expenditures decreased by 7.1% the year after the typhoons in Phillipines. Anttila-Hughes and Hsiang argue that the largest reductions in spending arise in categories related to human capital investments: food, medical care and education expenditures. Vicarelli (2010) explored the vulnerability of rural households in Mexico to droughts and extreme rainfall. She found that total consumption declined by 10% after extreme rainfall events and by 17% after droughts. Food consumption appears to be more susceptible to floods (-13%) than to droughts (-5%) with poor households being more vulnerable than high-income families. Kazyanga and Udry (2006) investigated whether household in Burkina Faso could smooth their consumption during the 1985 drought by using insurance mechanisms such as livestock, grain storage and inter-household transfers. Kazyanga and Udry found little evidence of consumption smoothing. However, they found that rich households were able to use self-insurance mechanism in the form of grain storage to partially smooth out consumption.

This paper enlarges this existing literature by exploring household income and consumption (total and food) responses to extreme weather shocks in the form of floods during El Niño weather shock during 1997-98 in Ecuador. Additionally, this paper studies how El Niño affected family investments in children, in the form of breastfeeding and food consumption. These investments are key inputs to the production of human capital, and how they are affected by extreme weather shocks have been underexplored in the economic literature.

Because households, especially those disadvantaged ones, fail to protect consumption on food, health and education, uninsured extreme weather shocks can have considerable and lasting effects on children's human capital (Baez, de la Fuente and Santos, 2009). Most of the research endeavors in developing countries have emphasized the effects of natural disasters on nutritional and health outcomes, while the evidence on cognitive and educational outcomes is still growing.

There is a consensus that exposure to natural disasters in utero and early in life increases malnutrition in the short term (see Baez, de la Fuente and Santos, 2009 for a review of evidence). Some studies have found full or partial recovery in terms of weight loss (Foster, 1995) but not in terms of height, especially among poor households (Del Ninno and Lundberg, 2005). Indeed, there is large evidence that demonstrates persistent effects of exposure to natural disasters during pregnancy and early years on stunting in late childhood and adolescence (Alderman et. al., 2006; Porter, 2008; Hodinott and Kinsey, 2001; Aguilar and Vicarelli, 2012).

The long-term effects of malnutrition in childhood can manifest in poor health outcomes during adolescent and adulthood (see Baez, de la Fuente and Santos, 2009; and Currie and Vogl, 2012). For instance, Almond et. al (2010) found that children who were in utero during the

Chinese famine were more likely to be disabled in adulthood. Decor and Porter (2010) estimated that children in utero or born just before the Ethiopian famine in 1984 are 3.9 cm shorter when they became young adults. Maccini and Yang (2009) studied the long-term effects of rainfall variation around the time of birth on later in life outcomes in Indonesia . The authors hypothesize that higher rainfall has a positive impact on harvests and therefore is associated with better nutrition in early years. They argue that their measure of rainfall shock captures more "typical" variation in contrast to extreme weather events like pandemics or droughts (and floods like in this paper). They found that higher rainfall at birth has a positive lasting effect on adult height and self-reported health status for women but not for men.

Regarding lasting effects of natural disasters on cognitive test scores, Shah and Millet-Steinberg (2012) provide evidence that exposure to droughts in utero reduced test scores among school age children in India, both in math and reading. Aguilar and Vicarelli (2012) studied the medium term effects of El Niño phenomenon in Mexico on children outcomes (four-five years after). They estimated that children exposed to the shock early in life scored 11-12 percent lower than same age children not exposed to the shock.

Furthermore, there is growing evidence of the persistent effects of exposure to natural disasters early in life and adult school attainment (see Baez, de la Fuente and Santos, 2009; and Currie and Vogl, 2012). For instance, Meng and Qian (2009) found that children exposed to the Chinese famine in utero had 0.58 fewer years of schooling. Similarly, in the case of the 1980 famine in Uganda, Umana-Aponte (2011) estimated that children in utero attained 0.36 fewer years of schooling. In the case of variation in rainfall around birth, Maccini and Yang (2009) found an increase of 0.1 years of schooling for women but not for men in Indonesia.

This paper enlarges the evidence in developing countries about lasting effects of extreme weather shocks in the form of floods on children outcomes. Also, it studies timing of exposure within utero and early in life periods. The next section explains the el Niño shock 1997-1998 and its intensity in Ecuador.

## 3. Background and data

### 3.1. El Niño 1997-1998 in Ecuador

El Niño is a recurrent climate event that causes several weather disasters: from heavy rainfall, severe flooding and landslides in the west coast of South America to extreme droughts in Indonesia. However, its cycle is irregular and varies in length from two to seven years (Kovats, S., et. al., 2003). This implies that the exact timing and intensity still remains uncertain.

El Niño event of 1997-98 in Ecuador was the greatest in magnitude compare to the 28 events in the 20$^{th}$ century (FAO, 2010). Precipitations were more then ten times above normal levels. Agriculture, roads and transportation were the economic sectors that felt the largest negative consequences (ECLAC, 1998). The most affected crops were rice, corn, sugar cane, coffee and cocoa (CAF, 2000). Floods caused damages to drinking water and sanitation systems and contamination of water, which increased the risk of infectious diseases. Indeed, malaria cases increased by 160% and dengue cases by 100% compare to 1996 (PAHO, 2000). Total economic and social costs added up to two billion dollars (around 15% of Ecuador's 1996 GDP).

### 3.2. Household data

To explore households' responses to El Niño, this study uses data from repeated cross-sections from Ecuador Living Standards Measurement Study (LSMS) household surveys for the years 1995, 1998, and 1999. These surveys are nationally representative and sample around 5000 households each year. The outcomes analyzed in this paper, as part of the responses to el Niño floods, correspond to household income, total and food consumption (proxy by expenditures) and women fertility. Additionally, this paper explores the effect of el Niño floods on investments in children in the form of food consumption and breastfeeding, information that is also gathered in this survey. The descriptive statistics for the sample of household in 1995 are displayed in table 1.

### 3.3. Child data

To analyze the medium term effects of El Nino on child outcomes, this paper uses data from a longitudinal survey that was designed to evaluate Ecuador cash transfer (CT) program. The first wave was collected in 2003-04 and it sampled 8000 children age 0-6 who were born in around 5000 families that were potentially eligible to receive the cash transfer. The sampled households reside in 6 different states: El Oro, Los Rios, and Esmeraldas, located in the coastal region, and Pichincha, Loja and Azuay located in the highlands. These states were selected because rolled out of the CT program had not started at that time (Paxson and Schady, 2010). A second wave was collected in 2005-06 with a 7% attrition rate.

It is important to note that this sample of families is not nationally representative of Ecuador because it is composed by households who were eligible to receive the cash transfer. Therefore, this sample corresponds to a disadvantage population. Also the families sampled are very young because the health component of the program required households to have no children above age 6.

The surveys gathered rich information on family's socio-demographic characteristics and they also collected health and cognitive outcomes. The health outcomes consider in this paper include height for age, and the likelihood of anemia. The cognitive outcome analyzed corresponds to the Peabody Picture Vocabulary Test (PPVT) since this test was administered in both rounds.

Because the PPVT was collected for children age 3 and above at the time of the survey, the sample used in this analysis include children born from 1997 to 2002[2]. Table 2 shows the descriptive statistics at baseline (2003-04) for the sample of children analyzed in this paper.

### 3.4. Rainfall data

To measure village's exposure to El Niño phenomenon, this study gathers rainfall data from 244 weather stations in Ecuador between 1971 and 2000. This rich dataset allow measuring excess of rainfall during El Nino 1997-1998 using the long-term mean precipitation (1971-2000) as reference.

Exposure to El Niño

A key component of this paper is the identification of village's exposure and intensity of el Niño flooding. El Niño 1997-1998 lasted approximately 19 months, from January 1997 to August 1998 (CAF, 2000; and, Ecuador meteorological department). Using monthly precipitation data for this period, I construct excess rainfall at each month and weather station as the deviations of the observed precipitation from the long –term mean (1971-2000) divided by the historical monthly standard deviation:

$$excess_{rain_{sd}} = \frac{P_{m,y,s} - \overline{P_{m,s}}}{\sigma_{m,s}} \qquad (1)$$

where $P_{m,y,s}$ is the precipitation observed for a given month *m* in year *y* at weather station *s*. $\overline{P_{m,s}}$ is the long term mean (1971-2000) for month *m* at location *s,* and $\sigma_{m,s}$ is the corresponding standard deviation. This index is known in the climatology literature as precipitation *anomalies*. According to climatologists, when analyzing extreme precipitation events, it helps to express the excess of rainfall in terms of standard deviations in order to provide more information about the magnitude of the anomalies after the influence of normal dispersion has been removed.

Next, the monthly excess of rainfall indicators are matched to the villages by using the closest weather station to the center of each village[3] (Maccini and Yang, 2009). At the village level (*v*), I calculate the exposure to El Niño as the numbers of months between January 1997

[2] Children born in 2003 and afterwards did not have PVPT measures in any survey wave
[3] The median distance to the center of a village is around 10 Km and the percentile 95 is 50 Km

and August 1998 where the observed excess of rainfall exceeded 1 historical standard deviation for each month:[4]

$$nino\_floods_v = \sum_{jan\ 97}^{aug\ 98} 1\{excess\_rain\_sd_{v,m} \geq 1\ sdev\} \qquad (2)$$

However, I show that the findings of this paper are robust to alternative measures of el niño shock such as using a 2 standard deviation cut-of or just summing up the anomalies (z-scores).

## 4. Identification strategy

Figure 1 shows the geographic variation in the intensity of El Niño shock among villages in Ecuador. As described in the reports about el Niño 97-98, the villages more affected by the floods were those located in the coastal regions while the ones situated in the highlands were less affected. This geographic variation resembles a natural experiment.

Exogeneity of the shock

In order to identify the effect of el Niño both on children and household outcomes, this paper uses a difference-in-differences approach. I exploit random variation in the intensity of the shock across villages. As shown in figure 1, the villages in the coast experienced a higher incidence of floods compared to those located in the highlands. To check in these cross-sectional variation in exposure/intensity to el Niño floods is correlated to some observable family characteristics across villages, table 3 shows the relation between total months of floods during el Niño (Jan 97-Aug 98) and households' characteristics using the LSMS 1995 survey data. With the exception of household size, exposure to el Niño is not statistically significantly associated to family socio-demographic characteristics. Although, in some of the variables tested the relationship is imprecisely estimated. Still, cross-sectional variation in exposure to el Niño may be correlated to unobservable characteristics like culture or attitudes. Consequently, the model specifications to be estimated control for socio-demographic variables as well as village fixed effects.

The main threat to the validity of this type of specification is that households may sort, migrate (Anttila-Hughes and Hsiang, 2012) for significant periods of time altering the household composition of the in the villages more affected by el Niño. Therefore, if some types of households migrate out of these villages, then the estimates of the effect of el Niño could be confounded with the effects of this sorting. To explore this concern, using the repeated cross-

[4] I will explore other alternatives to match the weather stations and the village like inverse distance weighting using ArcGis.

section of LSMS surveys before and after el Niño, I regress households' socio-demographic characteristics in 1995, 1998 and 1999 on the measure of exposure to el Niño floods as follows:

$$S_{h,v,t} = \alpha + \theta_{1998} year\_1998_{h,v,t} + \delta_{1998} year\_1998_{h,v,t} * nino\_floods_v + \theta_{1999} year\_1999_{h,v,t} + \delta_{1998} year\_1999_{h,v,t} * nino\_floods_v + \gamma_v + +\varepsilon_{h,v,t}$$

where *h* indexes household, *v* villages and *t* survey years. *S* captures the different socio-demographic characteristics: Household head age, gender, marital status and education and household size. The model includes survey year fixed effects and villages fixed effects (γ). The estimates of the δ's capture if average family characteristics during and after el Niño are different in the village more affected by el Niño compared to 1995 (the baseline category. Results are shown in table 4 and there is no evidence that potential sorting may contaminate the effects of el Niño on household's responses and children outcomes.

5. Households responses to El Niño

This section looks at the household responses to the El Niño in the aftermath of the shock. Even though the children data have family information, it cannot be used for this analysis because it was collected several years later. Therefore, this analysis uses the LSMS surveys that have the advantage that were collected two years before the shock (1995), during (1998) and one year after the disaster (1999). Two sources of variation are exploited to identify the effects of exposure to el Niño: time (before and after) and geographic variation:

$$m_{h,v,t} = \alpha + \theta_{1998} year\_1998_{h,v,t} + \delta_{1998} year\_1998_{h,v,t} * nino\_floods_v + \theta_{1999} year\_1999_{h,v,t} + \delta_{1998} year\_1999_{h,v,t} * nino\_floods_v + X_{h,v}\beta + \gamma_v + \varepsilon_{h,v,t}$$

where *h* indexes household, *v* villages and t survey years. *m* captures the different household responses such as household income, consumption, and fertility. The model includes survey year fixed effects and villages fixed effects ($\gamma_v$). Households' covariates (X) include age, gender, marital status and education of the household head, family size, number of members >=age 14, and trimester of survey. *nino_floods* indicates the total months of floods during el Niño for village *v*. Standard errors are clustered at the village level

$\delta_{1998}$ and $\delta_{1999}$ are the parameters of interest. They capture the effect of extreme floods during el Niño on 1998 and 1999 household outcomes. The comparison group is households in the same village during 1995 (before the shock).

5.1. Effects of el Niño 1997-98 on household income

Exposure to el Niño resulted in drops in household income. Table 5, column 1, suggests that household labor income fallen by 1.2% in 1998 and by 1.8% in 1999 for each additional month of floods during el Niño 1997-98. This implies that under the median exposure (5 months), median household labor income decreased by 5.8% in 1998 and by 8.8% in 1999.

Similarly, when looking at household total income (labor plus non labor income[5]), there is evidence that exposure to el Niño is associated with a reduction in household total income by 1.7% in 1998 and by 2.2% in 1999 for each additional month of severe floods in 1997-98. This suggests that at the median exposure, household total income dropped by 8.3% in 1998 and by 10.8% in 1999.

Table 6 shows the results broken by urban vs. rural households. The negative effects of exposure to el Niño on household income are stronger for rural households as expected since those families were the most affected by the floods given their dependence on agricultural activities. However, the differences in the income responses are not significantly different between urban and rural households (the p-value for responses in terms of total income in 1999 is borderline significant).

Alternative measure for the shock

In order to check that the results of the effects of el Niño floods on household responses are not driven by the way I construct the measure of exposure to the shock, table 7 present the results when using two alternative measures. The first alternative change the cut-off that defines a flood to two standard deviations above the historical mean (panel A). The second alternative, instead of defining an indicator for whether there was a flood, just sum up the z-scores of the excess of rainfall during el Niño (panel B). The estimates show the same patterns as the ones described above. Both household labor and total income declined in the aftermath of the shock for the villages more exposed to el Niño.

A placebo test

For the case of household income, I exploit the fact that there is an additional cross-section round from the LSMS with income information for 1994. The idea is that with two repeated cross-section data on income before the shock, I can check if exposure to el Niño floods is associated with a specific pattern in income changes prior to the shock that could be confounded with the effect of the shock afterwards[6]. To check this, I use the 1994 data as the comparison/baseline group and apply the observed exposure to the 1997-98 shock to the 1995 data to see if there is any effect of el Niño. The results suggest that changes in income between 1994 and 1995 are not different for household more affected by el Niño (Table 8).

[5] Non-labor income includes remittances, transfers, interest earned, and rents.
[6] This is similar to the identification assumption of traditional DID were treatment and comparison groups should follow the same trend before the shock. However, in my case the treatment variable is not dichotomous but continuous.

### 5.2. Effects of el Niño 1997-98 on household consumption

Household income responded negatively to el Niño shock. Now, I look if this translated in to a consumption drop (Table 9). Total household consumption corresponds to expenditures in food, education, durable goods, housing, electricity, clothing, transportation, etc[7].

Total household consumption declined by 1.1% in 1998 and by 2.1% in 1999 for each additional month of floods during el Niño. This implies that at the median exposure, household total expenditures declined by 5.75% in 1998 and by 10.69% in 1999. It seems that Ecuadorian households were not able to smooth their consumption in the aftermath of the natural disaster in 1997-98 since the declines in consumption mirror the negative effects on household income.

Food expenditures decreased in 1999 but not in 1998[8]. Food consumption decreased by 2.03% in 1999 for each additional month of floods during el Niño. At the median level of exposure to floods in 97-98, median household food expenditure decreased by 10.2% in 1999.

Table 10 presents the results of the effect of el Niño on consumption broken by urban vs. rural households. The point estimates of the effect of exposure to floods in 97-98 on household total and food consumption in 1999 are larger for rural households than for urban families although they are not significantly different (p-values are around 0.11 and 0.13).

Alternative measures for the shock

Table 11 explores if the results on household consumption are robust to alternative definitions of the shock. When exposure to floods during el Niño is measured using a 2 standard deviation threshold to define a flood or just merely sum the z-scores of the excess of rainfall, the estimates display the same pattern of negative effects on household consumption.

## 6. Effects of el Niño 1997-98 on investments in children

This section explores the effects of exposure to severe flooding on investments in children early in life. Two dimensions of investments are analyzed: food consumption and breastfeeding. In the LSMS surveys of 1995 and 1998, mothers reported children food consumption in terms of servings of meat, milk, eggs, fruit and vegetables and grains per week. The information is gathered for each child between age zero and four. Additionally, the survey asked mothers about duration of exclusive breastfeeding and total breastfeeding.

[7] According to Ecuador Bureau of Statistics, health expenditures were not included because the questions about it were not homogeneous across surveys.

[8] Since the proxy of consumption analyzed here corresponds to expenditures, they combine the quantity and price effect. Thus, finding no effect of the shock on food consumption in 1998 may not be the result of consumption smoothing. Because of the scarcity of some food items and increase in prices, quantities consumed in 1998 could have gone down but the overall effect of expenditure could be zero because it was offset by the increase in prices. This result will be further explored.

### 6.1. Children food consumption

Children consumption of meat, fruits and vegetables and grains declined during el Niño. Because the sample correspond to children instead of household, additional controls include child's age in months, and gender. Moreover, since the dependent variable is a count variable, food servings per week, I use a negative binominal count model instead of OLS. Table 12 shows the corresponding marginal effects of the interaction between the dummy for 1998 and the measure of el Niño floods (year 1995 is the baseline category). Results suggest that, in 1998, the average number of servings of meat per week declined by 0.14 for each additional month of floods during el Niño. Similarly, servings of fruit and vegetables decreased by 0.27 servings per week and those of grains fallen by 0.48 servings per week for each additional month of floods. When the results are broken by gender, the patterns are very similar (table 13)

### 6.2. Breastfeeding

To investigate the effects of exposure to floods on breastfeeding, I look at duration of both exclusive breastfeeding (not combined with formula or other sources of food) and breastfeeding in general. This information is asked in the three repeated cross-sections LSMS surveys in 1995, 1998 and 1999. The dependent variable is specified as months as well as a dummy variable if duration of exclusive breastfeeding is equal or more than three months (the median level) and if duration of overall breastfeeding is equal or more than 6 months (the median level). The sample used in these estimations correspond to children less than age 2 and the specifications also control for the fact that some children may still be breastfeeding by including a dummy variable for those cases.

Table 14 presents the effects of exposure to el Niño on breastfeeding. In terms of exclusive breastfeeding, results suggest that for each additional month of flooding exclusive breastfeeding declined by -0.07 months in 1998. This implies that at the median level of exposure, exclusive breastfeeding decreased by 0.4 months. The results follow the same pattern when exclusive breastfeeding is specified as a dummy variable for duration above three months[9]. Indeed, at the median level of exposure to el Niño, the probability of being breastfed by more than three months decreased by 0.09 percentage points. However, when duration of total breastfeeding is analyzed, there is no evidence of significant effects of exposure to el Niño.

Table 15 presents the results broken by gender. Evidence suggests that female children receive less exclusive breastfeeding than boys. These differences appear to be statistically significant.

[9] The sample is restricted to children older than three months.

7. Effects of el Niño on children medium term outcomes

To investigate the effect of severe floods during el Niño 1997-98 in Ecuador on children outcomes five and seven years after the shock, I exploit two sources of variation. First, cohort variation since the children data sampled kids that were alive (just born) during el Niño (born in 1997-98), that were in utero (born in 1999) and children who were born up to four years after the shock (born in 2002, the omitted group). Second, geographic variation since the children data contains information of families located in the coast and in the highlands (see in figure 2 the geographic variation in the children data). Therefore, to identify the impact of el Niño shock, the estimations use within variation over time in child outcomes for villages more affected by El Niño compare to others less affected. The model specification is the following[10]:

$$y_{i,v,t,w} = \alpha + \sum_{t=1998}^{2001} \{\theta_t cohort\_t_{i,v} + \delta_t cohort\_t_{i,v} * nino\_floods_v\} + X_{i,v,w}\beta + \gamma_v + \omega_w + \varepsilon_{i,v,t,w}$$

where *t* indexes cohort years, *v* villages, *i* children and w survey round (2003 and 2005). *Y* corresponds to health and cognitive outcomes. $\theta_t$ capture cohort fixed effects, $\gamma_v$ villages fixed effects and $\omega_w$ the survey wave fixed effects. $X_{i,v,w}$ include children and family socio-demographic characteristics: child's gender, age and birth order, mother's and father's education, father at home, mother language, number of children less than age 14 at home, and inflation at the state-year of birth. *nino_floods* indicates the total months of floods during el Niño for village *v*. Standard errors are cluster at the village level.

$\delta_t$ are the parameters of interest since they identify the impact of exposure to el Niño for children that were affected at different developmental periods (age 0-1, *in utero*, conceive after the disaster). The comparison cohort is the children born in 2002 since they were conceive years apart from the shock.

Exposure to severe floods, caused by el Niño 97-98, during early childhood and pregnancy have lasting effects on children's health and vocabulary five and seven years after the shock. Table 16 presents the results of the model presented above. The estimates in the first column suggest that, one month of floods during el Niño decreased the height for age of children born during the shock by 0.024 standard deviations. The median level of exposure to floods was 6 months. Thus, this suggests that, under the median exposure, median children height for age decreased by 0.15 standard deviations five and seven years after the shock for children born during el Niño.

Regarding the medium-term effects on likelihood of being anemic, I find that exposure to extreme floods for children born during el Niño (1997-1998) increase the probability of having

[10] Aguilar and Vicarelli (2011) estimate a similar model for weather shocks in Mexico their specification do not include village fixed effects and a different measure that capture village exposure to the shock.

anemia five and seven years later by 0.01 per month of floods exposure. This implies that under the median exposure (6 months), in the median village, the probability of being anemic five and seven years after el Niño raised by 0.07 percentage points for children born during the shock.

Regarding the impact of the shock on later cognitive development, column 3 shows the estimates for the Peabody Picture Vocabulary Test (PPVT). Exposure to severe floods in utero and early years affect later vocabulary performance. Under the median exposure, children who were born during el Niño scored 3.6 points less on the PPVT, which correspond to 24% of a standard deviation[11]. Similarly, under the median exposure, children who were in utero during el Niño (born in 1999) scored 2.5 point less on the PPVT, which correspond to 17% of a standard deviation. Note that for all three later outcomes, the estimates of the effect of el Niño 97-98 on children born two (in 200) and three (2001) years after the shock is not statistically different from zero as expected.

Table 17 Panel A presents the results broken by gender. The point estimates of the effects of el Niño floods are higher for girls born during el Niño when looking at the probability of having anemia and on vocabulary performance.  Whereas, the medium-term effects on vocabulary for children who were in utero during the shock are larger for boys. However, none of the estimates are statistically different across gender.

Table 17 Panel B shows the results broken by urban vs. rural areas. The point estimates for the likelihood of being anemic and for vocabulary performance are larger for children living in rural areas. However, these differences are not statistically different.

<u>Alternative measure for the shock</u>

In order to check that the results of the effects of el Niño floods are not driven by the way I construct the measure of exposure to the shock, table 18 present the results when using two alternative measures. The first alternative change the cut-off that defines a flood to two standard deviations above the historical mean (panel A). The second alternative, instead of defining an indicator for whether there was a flood, just sum up the z-scores of the excess of rainfall during el Niño (panel B). The estimates show the same patterns as the ones described above. There is evidence of medium term effects of el Niño on children's health outcomes (height and being anemic) and on vocabulary for children who were exposed during the first years of life to the shock, while in terms of vocabulary children in utero during el Niño also experienced a deficit.

[11] The PPVT is standardized to mean 100 and SD of 15 for the norming sample

## 8. Concluding remarks

To be added

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## Tables and figures

**Table 1**
**Ecuador's cash transfer evaluation survey - 2003/04**

| | Mean | SD | N |
|---|---|---|---|
| Family Characteristics | | | |
| If urban | 0.35 | 0.48 | 6856 |
| Father's years od education | 7.74 | 3.54 | 6231 |
| Mother's years of education | 7.71 | 3.47 | 6844 |
| Mother's age | 24.72 | 6.11 | 6850 |
| Father lives at home | 0.72 | 0.45 | 6749 |
| Children Characteristics | | | |
| If male | 0.51 | 0.50 | 6793 |
| Age in months | 40.02 | 15.41 | 6856 |
| If first born | 0.72 | 0.45 | 6749 |
| Height for age (z score) | -1.00 | 1.10 | 5960 |
| Standardized PPVT score | 86.12 | 17.15 | 3723 |
| If anemic | 0.58 | 0.49 | 6077 |

Source: Ecuador's cash transfer evaluation survey (2003-04)

**Table 2**
**Summary statistics - Ecuador Living Standard Measurement Survey - 1995**

| | Mean | SD | N |
|---|---|---|---|
| Household head Characteristics | | | |
| age | 45.48 | 15.44 | 5808 |
| If male | 0.82 | 0.39 | 5807 |
| Years of schooling | 6.82 | 4.85 | 5795 |
| Married or cohabiting | 0.76 | 0.43 | 5805 |
| If Salaried worker | 0.48 | 0.50 | 5082 |
| Household size | 4.64 | 2.35 | 5810 |
| Number of member age 14 or above | 2.97 | 1.56 | 5810 |
| Monthly total income (Ecu pesos 1995) | 967589.20 | 1725923.00 | 5700 |
| If urban | 0.56 | 0.50 | 5810 |

Source: Living Standard Measurement Study (LSMS) Survey 1995

**Table 3**
**Testing the exogeneity of el Niño 97-98 with LSMS data**

| Socio-demographics in 1995 | flood_shock_97-98 | S.E | N-Obs |
|---|---|---|---|
| Household head (HH) age | -0.071 | (0.092) | 5,808 |
| HH male | 0.002 | (0.002) | 5,807 |
| HH less than high school | 0.005 | (0.006) | 5,805 |
| HH married | -0.000 | (0.002) | 5,805 |
| Household size | 0.036* | (0.021) | 5,810 |
| ln household income | 0.015 | (0.025) | 5,629 |
| Urban | 0.004 | (0.015) | 5,810 |

Flood shock = number of months of floods during el niño 97-98

**Table 4**
**Balance check - is there any evidence of household sorting after el Niño?**

| | Household head (HH) age | HH male | HH married | Household size | HH less than high school |
|---|---|---|---|---|---|
| flood_shockX1998 | 0.092 | -0.002 | -0.001 | 0.002 | 0.001 |
| | (0.077) | (0.002) | (0.002) | (0.010) | (0.003) |
| flood_shockX1999 | 0.126 | -0.005* | -0.002 | 0.010 | 0.005 |
| | (0.104) | (0.003) | (0.002) | (0.012) | (0.004) |
| N | 17,425 | 17,424 | 17,421 | 17,427 | 17,422 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level. Includes village and year fixed effects. Baseline year is 1995

**Table 5**
**Effect of el Niño floods on household monthly income**

| | ln hh labor income | ln hh non labor income | ln hh total income |
|---|---|---|---|
| Nino_shockX1998 | -0.012* | -0.003 | -0.017** |
| | (0.006) | (0.022) | (0.008) |
| Nino_shockX1999 | -0.018*** | -0.019 | -0.022*** |
| | (0.006) | (0.024) | (0.007) |
| N | 16,283 | 8,595 | 17,079 |
| Effect at the median level of exposure (5 months) | | | |
| 1998 | -5.8% | | -8.3% |
| 1999 | -8.8% | | -10.8% |

Notes: * p<0.10 ,** p<0.05, *** p<0.01.Nino shock is the number of months of floods during el niño. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies

**Table 6**
**Effect of el Niño floods on household income – Urban vs. rural**

| | Urban | | | Rural | | |
|---|---|---|---|---|---|---|
| | ln hh labor income | ln hh non labor income | ln hh total income | ln hh labor income | ln hh non labor income | ln hh total income |
| Nino_shockX1998 | -0.005 | 0.003 | -0.010 | -0.021 | -0.015 | -0.027* |
| | (0.006) | (0.031) | (0.007) | (0.015) | (0.018) | (0.016) |
| Nino_shockX1999 | -0.011 | -0.001 | -0.011 | -0.033* | -0.058 | -0.042** |
| | (0.007) | (0.027) | (0.007) | (0.019) | (0.041) | (0.019) |
| N | 9,125 | 5,369 | 9,662 | 7,158 | 3,226 | 7,417 |
| P-value (urban=rural) | 0.3144 | | 0.307 | | | |
| | 0.2759 | | 0.1175 | | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01.Nino shock is the number of months of floods during el niño. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies

## Table 7
## Effect of el Niño floods on household monthly income – alternative measures of shock

| | Cut-off: 2 sdev | | | Sum of the z-scores during el niño | | |
|---|---|---|---|---|---|---|
| | ln hh labor income | ln hh non labor income | ln hh total income | ln hh labor income | ln hh non labor income | ln hh total income |
| ino_shockX1998 | -0.015** | 0.010 | -0.018* | -0.003* | -0.001 | -0.004** |
| | (0.007) | (0.028) | (0.009) | (0.002) | (0.006) | (0.002) |
| ino_shockX1999 | -0.019*** | -0.007 | -0.020*** | -0.005*** | -0.005 | -0.006*** |
| | (0.007) | (0.028) | (0.006) | (0.002) | (0.006) | (0.002) |
| | 16,283 | 8,595 | 17,079 | 16,283 | 8,595 | 17,079 |

tes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital tus and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies

## Table 8
## A placebo: use 1994 and 1995 data and " simulate" el niño on 1995

| | ln hh labor income | ln hh non labor income | ln hh total income |
|---|---|---|---|
| Nino_shockX1995 | -0.007 | 0.020 | -0.011 |
| | (0.007) | (0.024) | (0.009) |
| N | 9,458 | 3,824 | 9,891 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01.Nino shock is the number of months of floods during el niño. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies

**Table 9**
**Effect of el Niño: Does the income shock translate in to consumption?**

| | ln_total consumption (monthly) | ln_food consumption (monthly) |
|---|---|---|
| Nino_shockX1998 | -0.0115** | -0.0010 |
| | (0.0049) | (0.0032) |
| Nino_shockX1999 | -0.0214*** | -0.0203*** |
| | (0.0049) | (0.0055) |
| N | 17,318 | 17,152 |
| Effect at the median level of exposure (5 months) | | |
| 1998 | -5.75% | |
| 1999 | -10.69% | -10.17% |

Notes: * p<0.10 ,** p<0.05, *** p<0.01.Nino shock is the number of months of floods during el niño. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies

**Table 10**
**Effect of el Niño: Does the income shock translate in to consumption? urban vs. rural**

| | Urban | | Rural | |
|---|---|---|---|---|
| | ln_total consumption (monthly) | ln_food consumption (monthly) | ln_total consumption (monthly) | ln_food consumption (monthly) |
| Nino_shockX1998 | -0.0134*** | -0.0032 | -0.0020 | 0.0047 |
| | (-0.0046) | (-0.0033) | (0.0062) | (0.0051) |
| Nino_shockX1999 | -0.0124*** | -0.0151*** | -0.0313*** | -0.0330*** |
| | (-0.0045) | (-0.0056) | (0.0110) | (0.0105) |
| N | 9,754 | 9,636 | 7,564 | 7,516 |
| P-value (urban=rural) | 0.1328 | 0.1754 | | |
| | 0.1065 | 0.1356 | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

## Table 11
## Effect of el Niño on household consumption – alternative measures of shock

| | Cut-off: 2 sdev | | Sum of the z-scores during el niño | |
|---|---|---|---|---|
| | ln_total consumption (monthly) | ln_food consumption (monthly) | ln_total consumption (monthly) | ln_food consumption (monthly) |
| Nino_shockX1998 | -0.0169*** | -0.0014 | -0.0034*** | -0.0004 |
| | (0.0049) | (0.0037) | (0.0013) | (0.0008) |
| Nino_shockX1999 | -0.0226*** | -0.0191*** | -0.0057*** | -0.0054*** |
| | (0.0050) | (0.0057) | (0.0012) | (0.0013) |
| N | 17,318 | 17,152 | 17,318 | 17,152 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

## Table 12
## Effect of el Niño on children's food consumption

| # servings per week | Meat | Milk | Eggs | Fruits and Veg. | Grains and cereals |
|---|---|---|---|---|---|
| Nino_shockX1998 | -0.140*** | 0.008 | -0.004 | -0.272** | -0.484** |
| | (0.040) | (0.083) | (0.019) | (0.130) | (0.217) |
| N | 6,456 | 6,442 | 6,505 | 6,437 | 6,437 |
| Y median in 1995 | 4 | 7 | 2 | 9 | 5 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: child's gender, age in months, age in months sqr; age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

## Table 13
## Effect of el Niño on children's food consumption by gender

| | Male | | | | | female | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| # servings per week | Meat | Milk | Eggs | Fruits and Veg. | Grains and cereals | Meat | Milk | Eggs | Fruits and Veg. | Grains and cereals |
| Nino_shockX1998 | -0.086* | 0.018 | -0.019 | -0.277* | -0.377 | -0.213*** | 0.012 | 0.004 | -0.301* | -0.584*** |
| | (0.046) | (0.104) | (0.025) | (0.143) | (0.237) | (0.046) | (0.094) | (0.030) | (0.161) | (0.210) |
| N | 3,261 | 3,251 | 3,279 | 3,242 | 3,239 | 3,195 | 3,191 | 3,226 | 3,195 | 3,198 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: child's gender, age in months, age in months sqr; age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

**Table 14**
**Effect of el Niño on breastfeeding - Children less than age 2**

| | Exclusive BF (months) | Dummy for exc_bf> 3m | BF in months | Dummy for bf> 6m |
|---|---|---|---|---|
| Nino_shockX1998 | -0.074** | -0.017*** | 0.024 | 0.002 |
| | (0.034) | (0.006) | (0.044) | (0.005) |
| Nino_shockX1999 | 0.004 | 0.000 | 0.038 | 0.002 |
| | (0.041) | (0.008) | (0.047) | (0.006) |
| N | 3,967 | 3,536 | 3,967 | 3,069 |
| Effect at the mean exposure 1998 | -0.371 | -0.087 | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level. Dummy cut-offs correspond to the median levels in 1995. Controls: child's gender, age in months, age in months sqr; age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

**Table 15**
**Effect of el Niño on breastfeeding- Children less than age 2 - by gender**

| | Male | | | | Female | | | |
|---|---|---|---|---|---|---|---|---|
| | Exclusive BF (months) | Dummy for exc_bf> 3m | BF in months | Dummy for bf> 6m | Exclusive BF (months) | Dummy for exc_bf> 3m | BF in months | Dummy for bf> 6m |
| Nino_shockX1998 | -0.008 | -0.010 | -0.013 | -0.004 | -0.157*** | -0.027*** | 0.055 | 0.007 |
| | (0.041) | (0.008) | (0.060) | (0.006) | (0.052) | (0.009) | (0.064) | (0.007) |
| Nino_shockX1999 | 0.030 | -0.005 | 0.037 | -0.005 | -0.021 | 0.004 | 0.021 | 0.010 |
| | (0.062) | (0.013) | (0.050) | (0.008) | (0.055) | (0.011) | (0.077) | (0.010) |
| N | 2,062 | 1,827 | 2,063 | 1,591 | 1,905 | 1,709 | 1,904 | 1,478 |
| P-value (male=female) | 0.008 | 0.107 | | | | | | |
| | 0.489 | 0.568 | | | | | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level. Dummy cut-offs correspond to the median levels in 1995. Controls: child's gender, age in months, age in months sqr; age, gender, marital status and education of the household head, family size, number of members >=age 14, trimester of survey, years and village dummies.

**Table 16**
**Effect of el Niño floods on medium term children outcomes**

| | Height for age_z | If Anemic | PPVT |
|---|---|---|---|
| Cohort 97_98XNino_shock | -0.024** | 0.011* | -0.595** |
| | (0.010) | (0.006) | (0.261) |
| Cohort 99XNino_shock | -0.001 | 0.003 | -0.423** |
| | (0.008) | (0.004) | (0.177) |
| Cohort 2000 XNino_shock | -0.005 | 0.001 | -0.110 |
| | (0.006) | (0.004) | (0.130) |
| Cohort 2001 XNino_shock | 0.005 | -0.000 | -0.051 |
| | (0.008) | (0.004) | (0.119) |
| Number of observations | 10,455 | 9,829 | 8,223 |
| Y mean | -1.025 | 0.518 | 86.107 |
| Effect at the median level of exposure (6 months) | | | |
| Baby in el niño (Coh. 97-98) | -0.15 | 0.07 | -3.57 |
| In utero in el niño (Coh 99) | | | -2.54 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: Child's gender, age, and birth order; mother's and father's education, father at home, mother's language, number of children less than 14 at home  village and wave fixed effects.

## Table 17
## Effect of el Niño floods on medium term children outcomes – Heterogeneous effects

| | Urban | | | Rural | | |
|---|---|---|---|---|---|---|
| | Height for age_z | If Anemic | PPVT | Height for age_z | If Anemic | PPVT |
| Cohort 97_98XNino_shock | -0.029* | -0.002 | -0.399 | -0.029** | 0.016** | -0.886*** |
| | (0.017) | (0.010) | (0.438) | (0.014) | (0.007) | (0.306) |
| Cohort 99XNino_shock | 0.000 | -0.002 | -0.326 | -0.001 | 0.006 | -0.519* |
| | (0.015) | (0.008) | (0.209) | (0.009) | (0.005) | (0.268) |
| Cohort 2000 XNino_shock | -0.012 | -0.004 | -0.063 | -0.004 | 0.004 | -0.261 |
| | (0.012) | (0.006) | (0.202) | (0.009) | (0.004) | (0.169) |
| Cohort 2001 XNino_shock | -0.001 | -0.002 | -0.161 | 0.011 | 0.003 | -0.099 |
| | (0.018) | (0.006) | (0.170) | (0.009) | (0.004) | (0.160) |
| N | 3,635 | 3,325 | 2,767 | 6,820 | 6,504 | 5,456 |
| P-value (urban=rural) | 0.993 | 0.151 | 0.207 | | | |
| | | | 0.392 | | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: Child's gender, age, and birth order; mother's and father's education, father at home, mother's language, number of children less than 14 at home village and wave fixed effects.

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Height for age_z | If Anemic | PPVT | Height for age_z | If Anemic | PPVT |
| Cohort 97_98XNino_shock | -0.025 | 0.003 | -0.331 | -0.021 | 0.018** | -0.866** |
| | (0.017) | (0.010) | (0.356) | (0.014) | (0.008) | (0.346) |
| Cohort 99XNino_shock | -0.005 | 0.006 | -0.502** | 0.004 | 0.000 | -0.315 |
| | (0.012) | (0.005) | (0.227) | (0.012) | (0.005) | (0.192) |
| Cohort 2000 XNino_shock | -0.008 | 0.002 | -0.176 | 0.001 | 0.000 | -0.015 |
| | (0.011) | (0.005) | (0.172) | (0.010) | (0.004) | (0.150) |
| Cohort 2001 XNino_shock | -0.002 | 0.001 | -0.072 | 0.016 | -0.001 | 0.017 |
| | (0.011) | (0.005) | (0.151) | (0.012) | (0.005) | (0.174) |
| N | 5,327 | 5,047 | 4,213 | 5,128 | 4,782 | 4,010 |
| P-value (male=female) | 0.857 | 0.275 | 0.223 | | | |
| | | | 0.392 | | | |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: Child's gender, age, and birth order; mother's and father's education, father at home, mother's language, number of children less than 14 at home village and wave fixed effects.

## Table 18
## Effect of el Niño floods on medium term children outcomes. Robust to Alternative measures of the shock

| | Cut-off: 2 sdev | | | Sum of the z-scores during el niño | | |
|---|---|---|---|---|---|---|
| | Height for age_z | If Anemic | PPVT | Height for age_z | If Anemic | PPVT |
| Cohort 97_98XNino_shock | -0.028** | 0.017** | -0.565* | -0.007** | 0.004** | -0.150** |
| | (0.012) | (0.007) | (0.318) | (0.003) | (0.002) | (0.076) |
| Cohort 99XNino_shock | 0.007 | 0.006 | -0.649*** | 0.000 | 0.001 | -0.123** |
| | (0.010) | (0.005) | (0.210) | (0.002) | (0.001) | (0.051) |
| Cohort 2000 XNino_shock | -0.001 | 0.003 | -0.166 | -0.001 | 0.001 | -0.033 |
| | (0.008) | (0.004) | (0.166) | (0.002) | (0.001) | (0.040) |
| Cohort 2001 XNino_shock | 0.012 | 0.002 | -0.090 | 0.002 | 0.000 | -0.012 |
| | (0.010) | (0.004) | (0.152) | (0.002) | (0.001) | (0.034) |
| N | 10,455 | 9,829 | 8,223 | 10,455 | 9,829 | 8,223 |
| Effect at the median level of exposure | | | | | | |
| Baby in el niño (Coh. 97-98) | -0.056 | 0.033 | -1.129 | -0.063 | 0.035 | -1.272 |
| In utero in el niño (Coh 99) | | | -1.299 | | | -1.039 |

Notes: * p<0.10 ,** p<0.05, *** p<0.01. Robust standard errors in parentheses clustered at the village level.Controls: Child's gender, age, and birth order; mother's and father's education, father at home, mother's language, number of children less than 14 at home village and wave fixed effects.