CHILD LABOR, RAINFALL SHOCKS, AND FINANCIAL INCLUSION: EVIDENCE FROM RURAL COLOMBIA

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Abstract. This paper examines the effect of rainfall shocks on the allocation of time among child labor activities (the intensive margin) and the participation in education and labor activities (the extensive margin) by confronting households with an intertemporal trade-off between increased current household income (child labor) and higher potential future earnings (schooling). Specifically, I show the extent to which these income shocks lead households to increase their child labor supply and whether household financial inclusion mitigates or exacerbates the effects of these shocks, using data from a panel household survey in rural Colombia. The main findings are that rainfall shocks induce households to choose immediate benefits instead of long-run benefits by increasing the probability of child labor and reducing the probability of attending school. Moreover, formal loans reinforce the effect of rainfall shocks on the probability that a child works, whereas crop insurance and agricultural loans allow households to deal with this trade-off optimally by reducing the probability.

JEL Codes: D13, Q54, J13, J22, O16

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1. Introduction

As a result of climate change, extreme weather events are likely to increase their occurrence (Seneviratne et al., 2012). Developing countries are especially vulnerable to the effects of extreme weather events.[1] In rural areas, climate change directly affects the health and well-being of households that depend on natural resources for their basic subsistence (Hunter, 2007). These households usually rely on climate-sensitive resources such as local water supplies and agricultural land; and climate-sensitive activities such as growing crops and raising livestock (Shackleton and Shackleton, 2004). Climate change can decrease the availability or quality of these local natural resources, restricting rural households' options that depend on natural resources for consumption or trade.

Furthermore, according to the Climate Vulnerability Index, some of the most vulnerable countries to climate change also display all sorts of barriers to access and usage of financial services such as formal insurance or credit. More specifically, the most vulnerable population to climate change does not have access to formal insurance to cope with risky scenarios (Moore et al., 2019), such as droughts, floods, or temperature anomalies. Consequently, households might resort to informal risk coping mechanisms, such as child labor, to smooth their consumption, perpetuating the cycle of poverty onto the next generations by forcing families to decrease their investment in children's human capital (Ferreira and Schady, 2009; Skoufias, 2003). Thus, if households use child labor as a buffer against these shocks, higher household financial inclusion might help mitigate these shocks' effects through formal credit or insurance access.

In line with this, the use of insurance is a necessary practice because it allows the people to mitigate shocks related to uncertainty about the income, improves the capacity to evaluate and deal with risks, smooths consumption cycles in the presence of adverse shocks, protects savings, avoids over-borrowing and deviating income to attend emergencies and allows to invest (Goodwin, 1993; Iturrioz, 2009; Mahul and Stutley, 2010).

This paper examines the effect of rainfall shocks on household investment decisions through the channels of the allocation of time among child labor activities (the intensive margin) and the participation in education and labor activities (the extensive margin). Specifically, using data from a panel household survey in rural Colombia, I investigate the extent to which these transitory shocks lead households to increase their child labor supply and whether

[1]For example, according to the University of Notre Dame Global Adaptation Index (ND Gain), which shows a country's current vulnerability to climate disruptions, the majority of developing countries have the highest vulnerability indexes, like Somalia or Niger with a 0.67 (the index ranges from 0 to 1) for 2017. In addition, Kompas et al. (2018) these authors show that developing countries have the largest long-run impacts of climate change scenarios on the World GDP.For example, suppose the temperature raises 1°C. In that case, it is estimated that Colombia would lose 1.104% annually in terms of GDP, which is above the median of the group (-0.77%).

household financial inclusion mitigates this. Also, I explore the mechanisms through which weather shocks affect the household decision of child labor supply.

Using two out of three rounds of a household longitudinal survey for rural Colombia (ELCA), combined with a data set of station-level meteorological data from the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), I exploit exogenous variation in rainfall shocks to examine the relationship between weather variability and child labor.[2] To state that weather shocks are a source of exogenous variation, I have to rely on the assumption that household and children's characteristics are not related to the shock's timing and occurrence. Also, weather shocks have to be considered random concerning household labor practices. Moreover, to see whether this shock is an accurate measure of an actual shock, I use it to predict self-reported shocks by the households and see how much it predicts what the household reports.

Rainfall is the most important dimension of weather variation in Colombia. Moreover, because of its position on both the Caribbean and Pacific oceans, Colombia is highly prone to extreme weather caused by the El Niño-La Niña-Southern Oscillation (ENSO) climate patterns, which implies that precipitation records vary widely over time and space, with some periods characterized by heavy rainfall and others by intense droughts (Carrillo et al., 2017). As a result, Colombia experiences a high incidence of extreme weather events and is extremely vulnerable to the effects of climate change. For example, according to the Global Climate Risk Index 2012, in 2010, Colombia was the third most affected country from weather-related losses.

So far, the economic literature has examined quite a few studies on how extreme weather events influence economic outcomes (Dell et al., 2014) and, more specifically, human capital. This literature identifies a significant impact on human capital through different channels: higher temperatures are associated with a decrease of the yearly income (De Laubier-Longuet Marx et al., 2019); both female and male wages are positively related to rainfall shocks (Mahajan, 2017); the occurrence of floods is strongly associated with worsening food security and child stunting (Dornan et al., 2014); higher early-life rainfall has statistically significant causal effects on anthropometric measures (Maccini and Yang, 2009; Tiwari et al., 2013; Mattisson, 2018; Thai and Falaris, 2014). On the side of schooling and child labor, the literature has found similar results to the extent that weather events have a negative effect on schooling and a positive effect on child labor (Jensen, 2000; Björkman-Nyqvist, 2013; Colmer, 2013; Randell and Gray, 2016; Thai and Falaris, 2014; Marchetta et al., 2018; Maccini and Yang, 2009). This literature mainly focuses on Africa and Asia, and the evidence for the relationship for Upper Middle-Income countries, like Colombia, remains scant.

[2]The main reasons behind using this survey instead of the Demographic and Health Survey (DHS) are that the ELCA allows for household-level analysis, and the ELCA has information related to the use of formal and informal financial services.

In addition, the majority of the literature studies the role of financial inclusion as a direct effect, but not much as a mediation channel. Therefore, I intend to examine how, in particular, small farmers' households in Colombia react to these shocks in terms of child labor and investigate the mechanisms through which these results sustain.

The effects of financial services on child labor have been previously uncovered. When credit and insurance markets work poorly or do not exist, children act as an insurance asset to smooth household consumption in the presence of uncertainty in the future (Cain, 1982; Robinson, 1986; Pörtner, 2001; Grootaert and Kanbur, 1995; Dillon, 2013; Jensen, 2000; Guarcello et al., 2010; Jacoby and Skoufias, 1997; Bandara et al., 2015; Beegle et al., 2006). Also, imperfections in the credit (financial) market show two main opposing effects of household access to credit (Wydick, 1999). The first one is where child labor is used as a substitute for hired labor in a family enterprise in the presence of labor-capital binding constraints. Therefore, if a household has access to credit, these constraints are relaxed, allowing the family to replace child labor with hired labor (Dumas, 2013; Edmonds, 2006; Ranjan, 2001; Ersado, 2005; Becchetti and Conzo, 2014). The other effect is that as the family business becomes more capitalized, the marginal product of family labor increases, increasing the opportunity cost of schooling. Suppose this second effect dominates the first effect. In that case, theoretically, investment in schooling should decrease as credit constraints are relaxed for the family business (Casabonne, 2006; Chua, 2010; Hazarika and Sarangi, 2008; Islam and Choe, 2013; Lakdawala, 2018; Menon, 2010). However, this literature has not focused on financial inclusion as a mediation channel in order to see whether access to formal financial services mitigates the effects of weather shocks on child labor. I find that access to insurance and formal savings does not mitigate weather shocks and, in this particular scenario, increased access to formal loans before the shock has an adverse effect on child labor.

The rest of the paper is organized as follows. Section 2 provides a theoretical framework and section 3 summarizes the data sources. Section 4 describes the identification strategy to estimate the effect of rainfall shocks on child labor and section 5 reports the main findings and section 6 reports some robustness checks. Section 7 investigates the potential mechanisms behind the main results and section 8 concludes.

2. Hypothesis and Mechanisms

In the presence of weather shocks, rural households that mainly depend on agricultural production for their living may lose part of the production (e.g., a flood that leads to crop failure), representing an income shock to the household. If households want to succeed in smoothing their consumption profile, but lack insurance or are credit constrained, they are

forced to resort to other mechanisms to cope with weather shocks, such as child labor (Beegle et al., 2006).

The way this works is that when hit by a weather shock, households tend to increase their use of child labor, typically by having children complement adult labor in household activities such as gathering firewood and water (Basu and Van, 1998; Beegle et al., 2006). At the same time, what could also happen is a decrease in school attendance. Therefore, households are forced to reallocate the time children spend on studying, leisure, and working. Depending on the magnitude of the shock, households may be forced to take children out of school to dedicate their time exclusively to work or modify their leisure time.

At the household level, child labor comes from an intertemporal trade-off between immediate benefits (increased current household income) and long-run benefits (higher potential future earnings). These immediate benefits interfere with the accumulation of the child's human capital, implying potential long-run costs (Akabayashi and Psacharopoulos, 1999). By entering the job market at an early age, an individual can make an immediate contribution to the household income and perhaps gain labor market experience. However, this increment to household earnings potentially carries a long-term cost to the extent that the time children spend working could be used instead in activities that build up their long-run human capital (Dehejia and Gatti, 2005). The nature of this cost depends on the alternatives to child labor, such as schooling or time spent playing (which also contributes to cognitive development).

An important mediation channel that allows households to deal with this trade-off optimally is the access to credit and insurance, meaning households can borrow against future income and/or have protection against potential losses to smooth income (weather) shocks without resort to child labor (Bandara et al., 2015). Thus, when faced with a transitory weather shock, households would use insurance or credit to offset the shock.

However, there could be unexpected effects of access to credit in this context, as mentioned before, because as a family farm (or business) becomes more capitalized, the marginal product of family labor increases because it allows to have better access to complementary input (physical capital) and intermediates (e.g., fertilized), increasing the opportunity cost of schooling (Wydick, 1999). This means that when households have access to credit for the family farm, this increases child productivity, raising the returns to child labor. This occurs because children play an important role in the family farm's initial growth because as the farm grows, children provide the additional labor required at times when the returns are not high enough to hire an adult employee. Therefore, in the presence of a weather shock, the farm that does not have returns high enough to hire an adult employee may need to resort to child labor hand to cope with increase (or decreased) crop productivity.

There could be another explanation for the unintended effects of already existing credits before the occurrence of the rainfall shock. For example, Duygan-Bump and Grant (2009) show that delays in payments are the result of adverse events that affect a household, such as bad health or unemployment. Since a rainfall shock works as an income shock, households might have more pressure to make the credit payments on time. Therefore, to find additional income resources to pay on time, households resort to child labor working as a perverse effect. However, if the household received the credit after the shock, it can relieve some pressures by increasing the capital after the shock.

It is also important the type of credit requested by the household because if the household receives an agricultural loan, this capital can contribute to replacing child labor, either allowing the acquisition of adult labor or increasing the productivity of the farm and thus reducing the number of hours a child would have to work.

Besides, other characteristics related to the child and the household may mitigate or exacerbate this phenomenon, such as gender, age, participation in government programs, and receiving aid. Gender roles and age often dictate occupations and tasks undertaken by boys and girls, the conditions and hours of work, and educational opportunities (International Labour Office (ILO), 2017). In fact, Patrinos and Psacharopoulos (1995) has pointed out that boys are more likely to work. However, according to Zapata et al. (2011) girls are more likely to work in less visible and, therefore, under-reported forms of child labor such as household chores like cleaning, cooking, childcare, collecting water, and firewood. In addition, age plays a key role in terms of labor. Younger children can be less likely to work because they are not as useful for certain activities that older children can do with greater precision and fluency (Dammert, 2010).

Besides, if the household benefits from a conditional cash transfer program known as (Familias en Acción), children might be less prone to engage in labor activities in the presence of weather shocks. Here, the government provides educational subsidies conditional on regular school attendance. Thus, it motivates parents to support their children to continue with their education. However, However, these types of programs could not affect child labor but a positive and significant impact on school attendance because households prefer to combine school and labor, considering that the transfers are too small to provide an incentive to forgo the labor income (Cardoso et al., 2004).

Lastly, the literature has found evidence regarding financial assistance and its impact on child labor. For example, cash transfers affect reducing children's participation in work (Datt and Uhe, 2019) and hours worked (De Hoop and Rosati, 2014). Also, international remittances sent by migrant workers to their families reduce the labor supply of children in developing countries (Ebeke, 2012; Cuadros-Menaca and Gaduh, 2020). In addition to this, the survey provides information on whether the household received any assistance due to

the occurrence of a natural disaster. This help does not necessarily have to come from the government; it can also come from NGOs, family, friends, among others. On this account, when the household receives this type of help, it directly targets the need encountered by the shock; therefore, it helps to mitigate all the effects resulting from the shock, at least partially.

To sum up, what can be expected is that a rainfall shock acts as an income shock on the household, generating an increase in child labor and a reduction in school attendance. Additionally, the mediation channel related to financial inclusion can present ambiguous effects. However, households that receive another type of assistance (e.g., aid for natural disasters) can mitigate the effects of the rainfall shock.

3. Data

This paper uses two different data sources: the household panel survey (ELCA) and weather station data.

3.1. **Household panel survey (ELCA).**

The first data set is the Colombian Longitudinal Survey (ELCA) that contains geocoded information on households, children, and land use for three rounds: 2010, 2013, and 2016. Literature has defined child labor for children to be aged between 5 and 17. However, 99.3% of the data for children between 10 and 17 years old in the first round is missing. Thus, I will focus only on the second and third round[3].

For child labor on the intensive margin, I will be using the total number of hours working in economic activities and chores last week for each child; it may be difficult to differentiate working from doing chores related to agricultural activities in the household[4]. For the extensive margin, I will check whether a child does any type of work in the past week, whether a child does any household chores or attends school.

In order to examine the household financial inclusion mediation channel, there is information on whether someone in the household has a bank account, any type of insurance, or a loan with a formal institution, the date and type of the loan, and whether the household is up to date with the loan payments. In addition, this survey has some other relevant variables such as age, gender, household size, age of the household head, level of education attained by the parents, parent's employment, amount of land available for cultivation by the household, and participation in governmental programs.

[3]For the third round, the survey does not include information about child labor for some 5-year-old children. Moreover, all results remain robust if I restrict the sample to children between 6 and 17 years old in the two rounds.

[4]It is important to keep in mind that the question on household chores is only done to children between 5 and 13 years old for the second round, and 6 and 16 years old for the third round, thus it is important to remember this when seeing the results for this outcome

The sample included 2,911 rural households in 2013 and 2,354 in 2016. The sample is probabilistic, stratified, multistage, and cluster, selecting municipalities based on demographic and socioeconomic characteristics. The rural sample is representative of small farmers in four rural micro-regions. However, with some differences in their economic model: Mid-Atlantic, Coffee Region, Cundiboyacense and Center-East [5]. Additionally, Figure 1, Panel (a) shows the surveyed municipalities in the ELCA.

3.2. **Weather station data.** Rainfall and temperature data come from IDEAM, which has geocoded monthly data by weather station for the last 30 years. As input for the rainfall shock, I consider the monthly precipitation data of each weather station. Moreover, I use each household's nearest weather station to construct the rainfall shock at the household level. Following the shock definition of Colmer (2013); Kazianga and Udry (2006); Jensen (2000), I define the rainfall shock as a dummy variable that takes value one if the household experienced rainfall one standard deviation above the average rainfall of the last 30 years for the municipality three months before the survey.[6] Also, I extend it to one and six months before the survey. The importance of considering those months is because once the child is taken out of school, there is a cost in terms of paperwork to enroll her again. Therefore there could be a persistent effect of taking out children from school.

Also, to check whether this measure of rainfall shock is accurate, I perform some robustness checks by changing the definition of rainfall shock to the following ones. In the literature, Burke, Hsiang, and Miguel (2015); Skjeflo (2015) define rainfall shocks above or below some specific percentiles of the sample of rainfall. Therefore, above the 80th percentile is a weak shock, above the 85th percentile is a moderate shock, and above the 90th percentile is a severe shock. Also, Dell, Jones, and Olken (2014); Marchetta, Sahn, and Tiberti (2018) define shocks as the deviation of the long-run mean. Finally, Dell, Jones, and Olken (2014); Brando and Santos (2015); Deschênes and Greenstone (2011) define the shock as the number of days or months exposed to the shock.

3.3. **Descriptive Statistics.** The second round of ELCA sampled 5,735 children between 5 and 17 years old in 2,911 households between March 2013 and September 2013. The third round sampled 4,587 children between ages 5 and 17 in 2,441 households between March 2016 and September 2016. Thus, the total number of children surveyed, ages 5 and 17, is 10,322, and the total number of households is 5,352.

Table 1 shows the summary statistics of the main variables for the second round. Overall, 69% of children between 5 and 17 years old helped with chores around the house, and on

[5]For more information about how ELCA municipalities differ from the rest of Colombia's municipalities see Appendix, Table **??**. This Table is constructed using an annual panel of Colombian municipalities, constructed by the Center for the Study of Economic Development from Universidad de los Andes.

[6]A drought shock is defined in the same way but only taking into account one standard deviation below the average rainfall. See Table A.1 to see these results

average, children spent 2.7 hours in a week doing household chores. On the other hand, only 14% of the children worked in the past week to the survey, and on average, children spent less than half-hour working. Additionally, 92% of children attended school. Also, in this sample, 48% of children are female, and the average age of a child is 11.17 years.

Table 1, also, shows summary statistics for household characteristics. Here, on average, children live in a household where the number of people living in the household is 5.78 people. The average age of the household head is 46.54. Only 19% of the children within the sample live in a household that with a female household head, and only 20% of the children live in a household where the household head achieved high school education or more. 85% of the children live in a household that has children older than 10. It is important to mention that each child lives in a household with one piece of land (1.4) on average. Around 35% of the households have formal loans and only 34% have any type of insurance. Around 21% of households save money and only 3% do it formally. Only 0.2% of households have any type of agricultural insurance (crop or animal insurance). Finally, the average distance to the nearest weather station is 6.01 km. Figure 2 shows the distribution of the distance of the households to the nearest weather station.

Table 2 presents the percentage of households that were experienced a rainfall shock three months before the survey. Also, it shows the exposure (in months) to a rainfall shock in the last 3 and 6 months. The upper part of the table shows summary statistics on self-reported shocks by the household, such as crop failure, animal death or disease, job loss of the household head or any household member, and floods in the last three years.

Table 3 shows the percentage of children that never lived in a household that received a weather shock (88.05%), the children that lived at least once in a household that received a weather shock (11.83%), and the children that were treated twice by the weather shock (0.12%). Moreover, Figure 1, Panel (b) shows the percentage of children treated by a rainfall shock in each municipality. Darker colors indicate a higher percentage of treated children.

4. Empirical Strategy and Specification

As mentioned before, this paper uses rainfall shocks as a source of exogenous variation. As mentioned before, this paper uses rainfall shocks as a source of exogenous variation. Therefore, the first specification is being used to answer the question of whether weather shocks can predict what the household self-reports. Then I examine the effect of rainfall shocks on child labor, household chores, and school attendance.

First, it is important to check how good is the shock measure based on Colmer (2013); Kazianga and Udry (2006); Jensen (2000). This concern can be examined using this measure to predict the self-reported shock $SRshock$ and check if it has a good fit.

$$SRshock_{jmt} = \alpha_0 + \alpha_1 Shock_{jt} + \alpha_j + \alpha_m + \alpha_{dt} + \varepsilon_{jmt} \tag{4.1}$$

Second, it is important to examine the effect of rainfall shocks on whether the child worked, did any household chore in the past week, or attended school. The basic specification is:

$$y_{ijmt} = \alpha_0 + \alpha_1 Shock_{jt} + \alpha_j + \alpha_m + \alpha_{dt} + \varepsilon_{ijmt} \tag{4.2}$$

where: subscripts index individuals (i), households (j), municipality (m) and survey rounds (t = 2, 3); y is an indicator of whether the child participates in the labor market (or hours spent working), helps with household chores or attends school; $Shock$ is the measure of weather shock (an indicator of precipitation deviation from the mean by household), and X contains a set of controls including individual and household characteristics. Controls include household head's schooling, household head's age and age squared, gender, household size, household benefits from governmental programs; the household is engaged in at least one agricultural activity, the distance to the nearest weather station, presence of children over ten years old in the household, the child's age, and child's gender. Also, α_j, α_m and α_{dt} are household, municipality, and department-time fixed effects respectively [7]. Errors are clustered at the household (treatment) level to control for the possible correlation of another type of shocks within the household among years.

As discussed in Section 2, I expect that these type of weather shocks lead to an increase in child labor if there is a lack of access to formal financial services, i.e., I expect $\alpha_1 > 0$, where α_1 measures the effect in percentage points of the presence of a rainfall shock on the probability that a child works (or attends school) against those children that did not live in a household that had a rainfall shock. The main outcome is the number of hours the child spent working the past week, α_1 measures the effect in hours of the occurrence of a rainfall shock on the number of hours a child spends working against those children that did not live in a household that had a rainfall shock.

To investigate the role of household financial inclusion as a buffer against rainfall shocks, I examine whether the effect of the shocks varies with households' financial inclusion. In particular, I want to estimate the following specification:

$$y_{ijmt} = \alpha_0 + \alpha_1 Shock_{jt} + \alpha_2 Shock_{jt} \times FI_{jt} + \alpha_3 FI_{jt} + \alpha_4 X_{ijt} + \alpha_j + \alpha_m + \alpha_{dt} + \varepsilon_{ijmt} \tag{4.3}$$

where financial inclusion is measured by access to formal credit, bank account, insurance, crop insurance, and the timing of acquiring formal loans. The effect of interest is α_2, which captures the differential impact of a shock among households with different access to credit, bank account, and insurance. I expect insurance and credit holdings to mitigate the effect of shocks, i.e., $\alpha_2 < 0$ for child labor.

[7]The reason behind including household and municipality fixed effects at the same time is because some households migrate to different municipalities. 72 households moved to a different municipality out of 3,247, meaning 2.22% of households moved between rounds.

Moreover, I explore gender, age group, receiving natural disaster aid, and benefiting from Familias en Acción heterogeneous effects with the following specification[8]:

$$y_{ijmt} = \alpha_0 + \alpha_1 Shock_{jt} + \alpha_2 Shock_{jt} \times HE_{ijt} + \alpha_3 HE_{ijt} + \alpha_j + \alpha_m + \alpha_{dt} + \varepsilon_{ijmt} \tag{4.4}$$

where HE_i can be $Gender_i$, the age group Age_{it}, $NDAid_{jt}$ or $FamiliasAccion_{jt}$. These specifications are useful to check whether households allocate time differently for girls and boys because boys might be more prone to join the labor force while girls might be more prone to stay at home and do chores such as take care of other children, do laundry, cook, collect firewood and fetch water, etc. Also, empirical evidence has shown that older children might be more prone to work when they live in households with smaller children (Patrinos and Psacharopoulos, 1997).

Besides, households benefiting from Familias en Acción and receiving aid due to a natural disaster might help households to smooth their consumption through time due to the income shock they had to experience, helping households not to face the inter-temporal trade-off between increasing current household income and reducing future potential earning through the accumulation of the children's human capital (Akabayashi and Psacharopoulos, 1999).

5. Results

I begin by investigating whether rainfall shocks are a good measure of a shock by checking if this measure predicts the self-reported shock as presented in equation (4.1). To do this, I use a linear probability model to regress self-reported shocks against the weather shock using municipality and department-year fixed-effects in the first column and adding household fixed-effects in the second column. The results are presented in Table 4. This table shows that the effect of the rainfall shock on the self-reported flood shock (columns 1 and 2) is statistically significant, and the rainfall shock increases 9.9 percentage points the probability that the household reports a flood in the past three years. The R-squared for this specification (column 2) is slightly larger than for some of the remaining self-reported shocks presented in the table.

Table 5 presents the results for equation (4.2). All specifications control for age of the child, gender, education level and age of the household head, household size, whether the household has children older than 10, whether the household belongs to Familias en Acción, the distance of the household to the nearest weather station. Columns 1, 4, and 7 only include municipality and department-year fixed-effects. Columns 2, 5, and 8 add household fixed effects. Finally, Columns 3, 6, and 9 add controls.

[8]Note that the results coming from this exercise are suggestive about potential mechanisms, but not necessarily causal, so they have to be interpreted with caution.

This specification shows that the probability of a child that works increases 6.4 percentage points when the household the child lives in has been exposed to a rainfall shock. Moreover, it shows that the probability of a child that does any type of chore increases 10.2 percentage points when the household has been exposed to a rainfall shock. Finally, the occurrence of this shock reduces by 3.6 percentage points the probability that a child attends school compared to children who did not live in a household exposed to a rainfall shock. In fact, around 72% of children who do not attend school, worked, or did chores in the past week, could suggest that children who drop out from school are allocating their time to household chores and/or working.

Table A.4 presents the results for the intensive margin. The occurrence of this type of shock does not have a statistically significant effect on the number of hours a child works. Moreover, the rainfall shock does not have any statistically significant effect on the number of hours a child spends on chores compared to those not exposed to this shock.

Something that might explain why there is an effect on the extensive margin but not on the intensive margin is that many (7.4% of the sample) children report to work but do not report how many hours they work. Another possible explanation behind these results is related to the time frame of the question because it asks how many hours the child spent working in the past week, and maybe a better measure could be for the month or the past three months.

Jointly with the other results presented above, this suggests that when a rainfall shock occurs, rural households that mainly depend on agricultural production for their living and want to smooth their consumption are forced to resort to informal mechanisms to cope with it, such as child labor (Beegle et al., 2006) by increasing the child labor supply (on the extensive margin). However, this competes with the time children spent at school. Therefore, some households might be forced to take children out of school to increase the current household income at the expense of future potential earnings through the child's education.

6. Robustness checks

In this section, I perform a series of robustness exercises to see if the results presented in the previous section hold up. Among the exercises I do is the selection of covariates using machine learning. Additionally, I change the definition of the shock and look at the effects of the rainfall intensity. Lastly, I use the distance from the households to their closest weather station to see what happens when I cut the sample by keeping the households that are closer to their station using two cutoff points. Table 6 shows the results for the following exercises.

For the definition of the shock, first, I choose to use the methodology of Burke, Hsiang, and Miguel (2015); Skjeflo (2015), which is to classify a rainfall shock above a certain percentile

of the entire sample of rainfall used in the previous definition of the shock. Therefore, a weak rainfall shock occurs when the precipitation falls above the 80^{th} percentile, a moderate shock is above the 85^{th} percentile, and a severe shock is above the 90^{th} percentile. Table 6 (Columns 1-3) shows that weak and moderate shocks affect child labor. However, in Panel B, severe and moderate shocks have a statistically significant effect on household chores, but not the weak shock. When a weak rainfall shock occurs, the probability that a child has to work is 4.5 percentage points higher. However, when a severe rainfall shock occurs, the child's probability of doing any household chore increases to 9.8 percentage points, similar to the past section results. Finally, only the weak shock affects school attendance, meaning that a weak shock reduces by 3 pp the probability that a child attends school.

To check how the intensity of the shock affects these outcomes, I use the deviation from the long-run mean used by Dell et al. (2014); Marchetta et al. (2018). Column 6 shows that this measure of intensity does not reveal any type of effect on any of the main outcomes. Moreover, using the definition of a z-score[9], Column 7 shows no effect on any of the main outcomes. Finally, Column 8 in Panel B shows that a 100% change in the rainfall generated a 1.1 pp change in the probability that a child did any household chore in the past week.

Also, Column 9 shows the results for selecting the covariates using Lasso by Belloni et al. (2014). This column shows that the effect of rainfall shocks on child labor and household chores outcomes remains practically the same, as well as their statistical significance when using machine learning selected controls.

Finally, Columns 10 and 11 show the results of restricting the distance from the households to the nearest weather station. Column 10 shows the results for households below the 95th percentile, and Column 11 shows the results below the 99th percentile. These columns show that restricting the sample to the households within a certain distance to the nearest station does not affect the result entirely, showing that the point estimates maintain the same magnitude and statistical significance as in the main table.

As an additional robustness exercise, on the Appendix is Figure A.1, this figure presents the results of the main specification in equation 4.2, but excludes one municipality at a time in each regression in order to see if the results hold or they change for a specific municipality. These figures show that the results hold when excluding the majority of the municipalities, and a single municipality does not sustain our results.

7. Heterogeneous effects

In this part, I investigate multiple alternative interpretations for the past results. First, I check household financial inclusion, then I check other relevant channels (e.g., gender and age), and finally, I delve into formal credits. Table 7 presents the results, Columns 1-5

[9]A z-score or standard score is a measure of how many standard deviations below or above the population mean a raw score is.

show the results for financial inclusion variables, Columns 6-10 show the results for relevant characteristics of the formal loans, and Columns 11-14 show other relevant information.

First, Columns 1-5 show the results for financial inclusion. Particularly, the fact that financial inclusion partially offsets the effect of a shock on child labor is only consistent with access to insurance, particularly agricultural insurance (see Panel A, Column 5). Households use their insurance in times of need instead of using child labor. However, there is no statistically significant effect on household chores o schooling. This result partially resembles the one found by Beegle et al. (2006) using a panel household survey in a rural region of Tanzania; their results suggest that insurance or access to credit might reduce the extent of child labor.

Also, I examine the effect of rainfall shocks on child labor outcomes and see the mediation channel of household savings, formal credit, insurance, and agricultural insurance tenure. Contrary to what has been found by Chiapa et al. (2016) regarding offering savings accounts to poor women in Nepal and a consequent increase in the level of schooling of daughters, and the results of Bandara et al. (2015) using a panel survey in Tanzania that showed that having a bank account reduces both male child labor and household work hours of a girl child, Panel A, B, and C show that a having a savings account in a formal institution does not mitigate the income shock due to higher than usual rainfall. A possible explanation behind this result is that the survey does not measure if the household head actively uses the account or how much money they have in the account, which could shed some light on whether using a savings account (self-insure) helps mitigating or not an income shock.

The literature has found that access to credit can either mitigate or reinforce the effects of transitory income shocks on child labor (Beegle et al., 2006). However, in other cases, such as the case of rural Bangladesh, Islam and Choe (2013) show evidence that children who are taken out from school are more likely to work in household enterprises that are set up with credit than in other types of work. These results are in line with the following where Column 1 presents the results for formal loans suggesting that formal credit has a harmful effect on school attendance (Panel C) when a rainfall shock occurs, meaning that a child that lives in a household that has a formal credit reduces by 6.3 percentage points the probability of attending school over children that lived in households with no formal credits. Nonetheless, it shows no statistically significant results for child labor or household chores.

These results suggest that when a household has a credit with a formal institution before the shock and then an income shock occurs, households may have a higher pressure to make the payments on time (Duygan-Bump and Grant, 2009). Thus households cannot afford the cost of sending children to school because although education is free, other related costs (such as physical access, school uniforms, even the cost of not working) cannot be afforded by the households due to this additional pressure. This can result in a persistent effect, since,

although, children stopped attending school to help with the household income temporarily, the cost of completing the paperwork to go back to school after the shock may be higher. Therefore these children may not work and not attend school at the same time.

To further explain this, I study the effects of certain characteristics of the formal loans, such as the moment the household acquired the credit and if the household is up to date with the payment of the credit installments (see Columns 6-10). Panel A shows that households that acquired the loan with a formal institution before the shock are more likely to have children who worked the past week and being up to date with the installments of a credit acquired before the shock also increases the probability that a child worked in the past week, and the magnitude of this effect is larger than just having a loan before the shock. Thus, these households resort to child labor to have immediate benefits by increasing current household income and paying the credit. However, acquiring a formal loan after the occurrence of the shock has no effect.

When the credit is agricultural, the results suggest that households with a greater number of agricultural credits relative to the total number of formal credits reduce the probability that a child works. This result suggests that households use this type of credit to replace child labor. This goes in line with what was mentioned in section 2, which explains that households that received agricultural loans use the capital to replace child labor, either by allowing the acquisition of adult labor or increasing the productivity of the farm and thus reducing the number of hours a child would have to work.

Insurance does not appear to mitigate the effect of rainfall shocks (these results are not statistically significant). This may be explained by the fact that the variable of insurance encompasses a wide range of insurances, including car insurance, life insurance, death insurance, health insurance, and agricultural insurance. All these insurances might not help mitigate income shocks due to any agricultural loss. However, just as an anecdotal result, agricultural insurance -in column (5)- is used by some families to mitigate the effects of the rainfall shocks on income, helping reduce child labor.[10]

This evidence suggests that neither credit nor insurance have an impact on mitigating the effects of the rainfall shock on the probability of a child working in the past week. In fact, it may have a perverse effect in some cases. Nonetheless, the fact that the household has any type of formal debt reduces the probability of school attendance upon a shock, this may relate to the fact that households have more pressure to make the credit installments on time, and sending children to school is costly.

[10]It is important to keep in mind that only 11 households have any type of agricultural insurance, which accounts for approximately 23 children in the sample. This shows the small take-up of agricultural insurance in rural areas, which represents that a large percentage of the population does not have a formal mechanism to help them deal with losses related to their work.

Other relevant characteristics, such as gender, shows that being a girl reduces the probability of working in the past week by 5.2 percentage points in the presence of a rainfall shock (see Panel A, Column 12), suggesting that households, in general, choose to allocate time differently for girls and boys, because boys might be more prone to join the labor force. Although this goes in line with what the International Labour Office (ILO) (2017) has found and other authors have reviewed, such as Grootaert and Kanbur (1995), there is no evidence that girls might be more prone to attend school or stay at home and do chores such as take care of other children, do laundry, cook, collect firewood and fetch water when a rainfall shock occurs (see Panel B and C, Column 12).

As reviewed by Grootaert and Kanbur (1995), participation rates of children in economic activities increase with age and tend to be higher for boys in the case of wage-work or work in the household enterprise or farm. Column 11 of Panel A reports the estimates of regressing child labor outcomes on rainfall shocks for the different samples of children, from ages of 5 to 9 and ages from 10 to 17. The probability of a child working increases 10.8 percentage points for children between the ages of 10 and 17 against children between 5 and 9, and this result is statistically significant. However, these results are not statistically significant for household chores or school attendance (see Panel B and C, Column 11). This suggests that older children (between the ages of 10 and 17) are the ones that are being used as a coping mechanism against rainfall shocks instead of small children, suggesting that the productivity of older children is higher than small children, which relates to what Dammert (2010) finds that there is no substitution within the household of younger for older siblings in the labor market and domestic work.

Moreover, there is statistically significant evidence suggesting that children that live in a household that received any type of aid due to natural disasters in the past 12 months are less likely to join the labor force (by 18.2 percentage points) than those who live in a household that did not receive such type of aid (see Panel A, Column 13). This means that this type of aid helps households smooth their consumption profile without resorting as much to child labor. There is no statistically significant effect on household chores or school attendance (see Panel B and C, Column 13). On this account, when the household receives this type of help, it directly targets the need encountered by the shock; therefore, it helps to mitigate all the effects resulting from the shock, at least partially.

Finally, households that benefited from the conditional cash transfer program do not display a reduction in the probability of a child working in the past week or attending school as a consequence of the weather shock (see Panel A and C, Column 14), which suggests that the transfer isn't big enough to provide an incentive to give up that extra labor income coming from child labor. However, it shows an effect on reducing the probability of doing household chores in the past week (see Panel B, Column 14).

8. Concluding Remarks

This paper examines the link between rainfall shocks, household financial inclusion, child labor (and other related activities, such as household chores and school attendance) in Colombia's rural context. First, the evidence presented previously suggests that a rainfall shock increases in 6.4 percentage points the probability that a child works, increases the probability that a child participates in household chores, and decreases the probability that a child attends school. These results are statistically significant, and suggest that children are being used as a coping mechanism against income shocks that affect the household's agricultural activities. In fact, when a rainfall shock occurs, children tend to increase their labor supply (on the extensive margin), competing with their time spent at school. Therefore, some households may be forced to take children out of school to increase the current household income at the expense of future potential earnings through the child's education.

Nonetheless, households with insurance cannot offset this shock. Also, access to formal credit negatively affects school attendance, unless it is an agricultural loan. This evidence demonstrates the importance of working towards policies that reduce access constraints to agricultural credit in rural areas. In addition, households with loans acquired prior to the shock increase child labor. This could be because households may have a higher pressure to make the payments on time. Thus, households resort to child labor to have immediate benefits by increasing current household income and repaying the credit, showing the importance of offering loan restructuring more often and easily, particularly in rural areas which are subject to more weather-related income shocks.

Considering the effects that climate change currently has, and will continue to have, on the frequency and intensity of extreme weather events and its effects on human capital formation, it is essential to emphasize the importance of promoting financial inclusion in rural Colombia as a public policy. It is important to promote access to agricultural insurance and credit for small producers and, above all, to allow the most vulnerable households to have access to the restructuring of debt in the case of adverse events to alleviate pressures on household consumption. Rural financial inclusion will help people mitigate uncertainty-related shocks, improve the capacity to smooth consumption, protect their savings and avoid informal financial mechanisms such as moneylenders or resort to child labor. Finally, it is important to promote rural financial education to spread the awareness of having and actively using financial services such as bank accounts and insurance.

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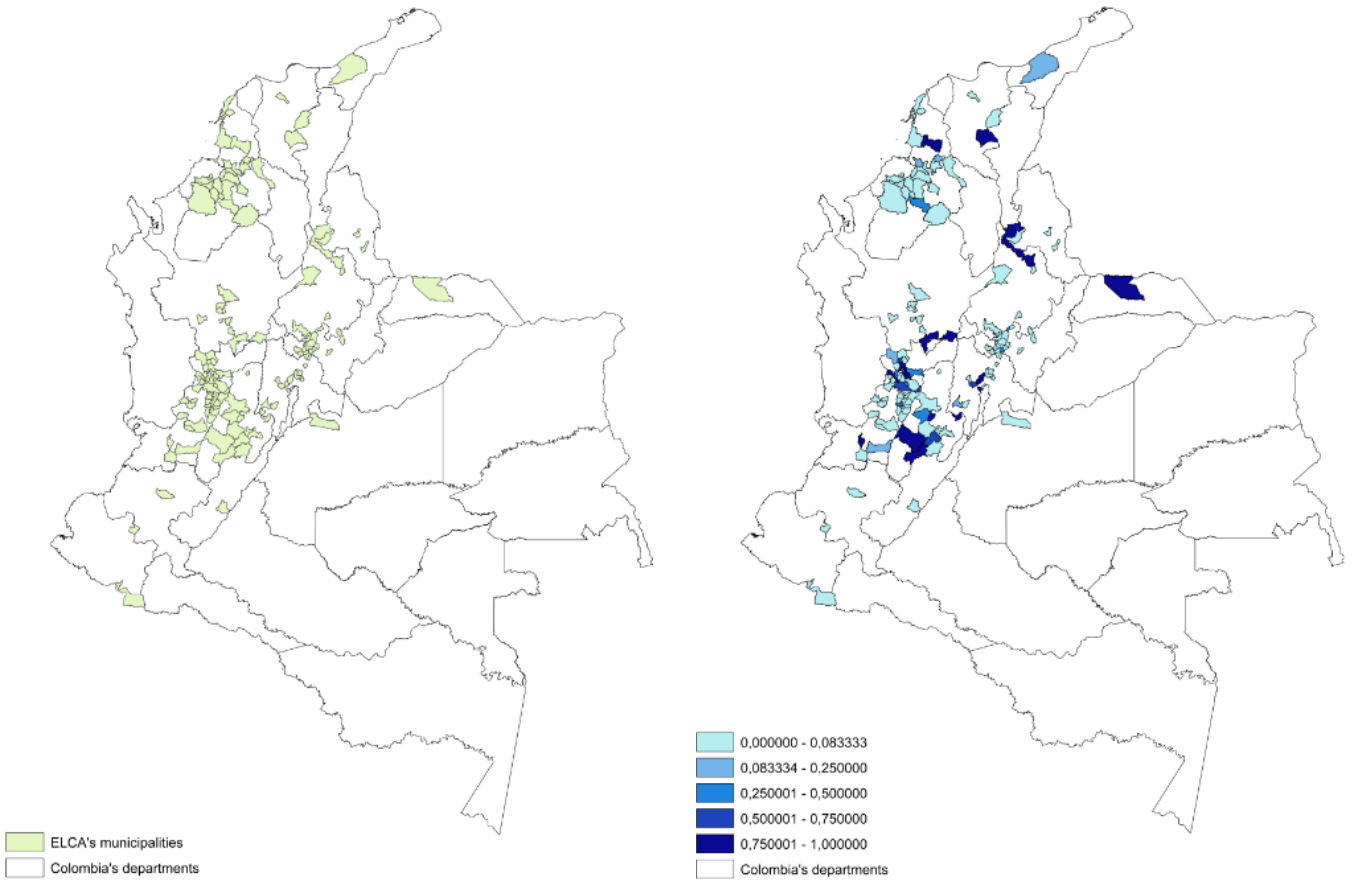
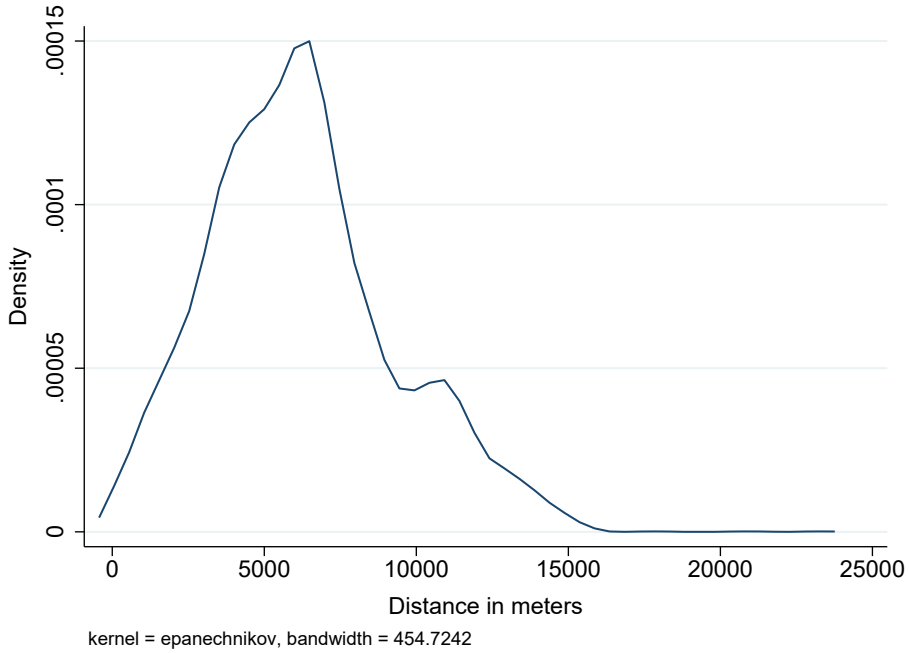
FIGURE 1. ELCA Municipalities



A. ELCA Municipalities **B.** Percentage of children treated

Notes: Figure A presents the map of the municipalities surveyed in the longitudinal survey (ELCA). Figure B shows the map of intensity with which the municipalities are treated. That is, the darker the municipality's color, the greater the percentage of children exposed to a rainfall shock in the municipality.

FIGURE 2. Distance from the household to the nearest weather station



Notes: This figure presents the distribution of distance of the households to the nearest weather station.

TABLE 1. Summary statistics

	(1) Mean	(2) Standard deviation	(3) Min	(4) Max	(5) Obs
Children characteristics					
Child Labor	0.14	0.34	0.00	1.00	5675
Hours working	0.35	2.19	0.00	50.00	5172
Child Chores	0.69	0.46	0.00	1.00	3896
Hours doing chores	2.71	4.19	0.00	48.00	3783
School attendance	0.92	0.27	0.00	1.00	5704
Female	0.48	0.50	0.00	1.00	5735
Age	11.17	3.70	5.00	17.00	5735
Age group	0.65	0.48	0.00	1.00	5735
Household characteristics					
Number of people within the household	5.78	2.14	2.00	18.00	5735
Female head of household	0.19	0.40	0.00	1.00	5735
Age of head of household	46.54	11.27	19.00	87.00	5735
Age squared of head of household	2293.34	1127.82	361.00	7569.00	5735
High school education achieved by HH	0.20	0.40	0.00	1.00	5729
Children older than 10	0.85	0.36	0.00	1.00	5735
Agricultural activity	0.83	0.38	0.00	1.00	5226
Familias en Acción	0.67	0.47	0.00	1.00	5735
Natural disaster aid	0.02	0.13	0.00	1.00	5735
Number of farms	1.39	0.96	0.00	15.00	5426
Distance to weather station	6068.14	3054.58	23.78	15467.61	5692
Financial inclusion variables					
Formal loans	0.35	0.48	0.00	1.00	5735
Household saves	0.21	0.41	0.00	1.00	5735
Formal savings	0.03	0.18	0.00	1.00	5735
Bank account ownership	0.03	0.16	0.00	1.00	5735
Insurance	0.34	0.47	0.00	1.00	5735
Agricultural insurance	0.00	0.03	0.00	1.00	5735
Financial inclusion score	-0.06	0.98	-0.95	3.79	5735
Num. of formal loans before shock	0.42	0.77	0.00	11.00	5735
Num. of up to date formal loans before shock	0.34	0.68	0.00	10.00	5735
Num. of formal loans after shock	0.05	0.23	0.00	2.00	5735
Num. of up to date formal loans after shock	0.03	0.18	0.00	2.00	5735
Agricultural loans (%)	0.17	0.36	0.00	1.00	5735

Notes: This table presents summary statistics for the main variables of interest.

TABLE 2. Shock-related summary statistics

	(1) Mean	(2) Standard deviation	(3) Min	(4) Max	(5) Obs
Self-reported shock					
Flood	0.24	0.43	0.00	1.00	5735
Job loss	0.12	0.33	0.00	1.00	5735
Agricultural loss	0.38	0.49	0.00	1.00	5735
Crop failure	0.29	0.45	0.00	1.00	5735
Livestock shock	0.20	0.40	0.00	1.00	5735
Shocks					
Rainfall shock	0.10	0.29	0.00	1.00	5692
Exposure to rainfall shock (3 months)	0.58	0.68	0.00	3.00	5692
Weak rainfall shock	0.11	0.32	0.00	1.00	5692
Moderate rainfall shock	0.10	0.30	0.00	1.00	5692
Severe rainfall shock	0.07	0.25	0.00	1.00	5692
Deviation from mean	-25.26	82.22	-315.44	242.88	5692
Z-score	-0.10	1.13	-2.36	5.75	5692
Rainfall (log)	4.23	1.87	0.00	6.72	5692
Drought shock	0.22	0.41	0.00	1.00	5692
Aggregate shock	0.31	0.46	0.00	1.00	5692

Notes: This table presents summary statistics for the shock-related variables of interest.

TABLE 3. Climate shocks summary statistics

Number of shocks by child	Freq.	Percent	Cum.
0	9,072	88.05	88.05
1	1,219	11.83	99.88
2	12	0.12	100.00
Total	10,303	100.00	

Notes: This table presents the summary statistics for number of shocks a child is exposed to during the two rounds.

TABLE 4. Rainfall shock vs. self-reported shock

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Flood shock		Job loss shock		Agro shock		Crop shock		Animal shock	
Rainfall shock	0.087***	0.099***	-0.003	0.029	-0.040	-0.121**	-0.007	-0.118**	-0.023	-0.028
	(0.030)	(0.040)	(0.020)	(0.030)	(0.030)	(0.050)	(0.030)	(0.050)	(0.020)	(0.030)
Observations	10183	9478	10183	9478	10183	9478	10183	9478	10183	9478
Households	3181	2477	3181	2477	3181	2477	3181	2477	3181	2477
R-squared	0.175	0.686	0.066	0.669	0.120	0.693	0.103	0.692	0.114	0.657
Household FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	0.144	0.142	0.125	0.125	0.452	0.453	0.338	0.338	0.231	0.233
SD DV	0.351	0.349	0.331	0.331	0.498	0.498	0.473	0.473	0.422	0.423

Notes: This table presents the results from the first specification in equation (4.1) for different self-reported shocks. The list includes: floods (columns 1 and 2), the loss a job by any member of the household (columns 3 and 4), crop failure or pests, or animal death or illness (columns 5 and 6), crop failure or pests (columns 7 and 8), and animal death or illness (columns 9 and 10). *Rainfall shock* is defined as a discrete measure that takes the value one for households with rainfall above one standard deviation from the long-run mean. Robust standard errors are clustered at the household level and presented in parenthesis. * is significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level.

TABLE 5. Children activities and exposure to rainfall shocks: Extensive margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Child labor			Household chores			School attendance		
Rainfall shock	0.095***	0.066*	0.064*	0.034	0.113***	0.102***	-0.039**	-0.042*	-0.036*
	(0.020)	(0.030)	(0.030)	(0.030)	(0.040)	(0.040)	(0.020)	(0.020)	(0.020)
Observations	7786	7786	7786	5480	5480	5480	8156	8156	8156
Households	2130	2130	2130	1715	1715	1715	2194	2194	2194
R-squared	0.053	0.392	0.462	0.054	0.442	0.522	0.025	0.355	0.403
Household FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	Yes	No	No	Yes	No	No	Yes
Mean DV	0.133	0.133	0.133	0.739	0.739	0.739	0.927	0.927	0.927
SD DV	0.340	0.340	0.340	0.439	0.439	0.439	0.260	0.260	0.260

Notes: This table presents the results from the main specification in equation (4.2). The main outcomes on the extensive margin are: child labor (columns 1, 2, and 3), household chores (columns 4, 5, and 6), and school attendance (columns 7, 8, and 9). *Rainfall shock* is defined as a discrete measure that takes the value one for households with rainfall above one standard deviation from the long-run mean. The controls included are, gender age, household size, head of household age and age squared, head of household gender, head of household educational attainment, the household carries out any agricultural activity, distance to the nearest weather station, indicator of older children (older than 10) and the household receives benefits from Familias en Acción. Robust standard errors are clustered at the household level and presented in parenthesis. * is significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level.

TABLE 6. Children activities and exposure to rainfall shocks: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Percentiles			Exposure		Intesity				Distance	
	80^{th}	90^{th}	95^{th}	3 months	6 months	Mean deviation	Z score	Rainfall (log)	Machine learning controls	95^{th}	99^{th}
Panel A: Child labor											
Rainfall shock	0.045*	0.062*	0.057	0.020	0.008	0.000	0.003	0.004	0.062*	0.060*	0.065*
	(0.030)	(0.040)	(0.040)	(0.010)	(0.010)	(0.000)	(0.010)	(0.000)	(0.030)	(0.030)	(0.030)
Observations	7825	7825	7825	7825	7825	7825	7825	7825	7896	7460	7746
Households	2146	2146	2146	2146	2146	2146	2146	2146	2168	2038	2125
R-squared	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.463	0.460	0.461
Mean DV	0.134	0.133	0.136	0.136	0.144	0.133	0.133	0.122	0.132	0.132	0.132
SD DV	0.341	0.340	0.342	0.343	0.351	0.340	0.340	0.327	0.338	0.339	0.339
Panel B: Household chores											
Rainfall shock	0.040	0.082**	0.098**	0.021	0.003	0.000**	0.013	0.011**	0.112***	0.099**	0.100***
	(0.030)	(0.040)	(0.050)	(0.020)	(0.010)	(0.000)	(0.010)	(0.010)	(0.040)	(0.040)	(0.040)
Observations	5509	5509	5509	5509	5509	5509	5509	5509	6414	5260	5456
Households	1727	1727	1727	1727	1727	1727	1727	1727	1969	1645	1712
R-squared	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.514	0.523	0.522
Mean DV	0.739	0.739	0.739	0.753	0.763	0.739	0.739	0.746	0.733	0.737	0.737
SD DV	0.439	0.439	0.439	0.432	0.425	0.439	0.439	0.436	0.443	0.441	0.440
Panel C: School attendance											
Rainfall shock	-0.030*	-0.034	-0.025	0.002	0.002	0.000	0.001	0.002	-0.032	-0.030	-0.036*
	(0.020)	(0.020)	(0.030)	(0.010)	(0.010)	(0.000)	(0.010)	(0.000)	(0.020)	(0.020)	(0.020)
Observations	8201	8201	8201	8201	8201	8201	8201	8201	9489	7812	8118
Households	2213	2213	2213	2213	2213	2213	2213	2213	2492	2099	2191
R-squared	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.399	0.407	0.408
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Mean DV	0.927	0.926	0.925	0.925	0.922	0.927	0.927	0.926	0.927	0.925	0.926
SD DV	0.261	0.262	0.263	0.264	0.268	0.260	0.260	0.262	0.261	0.263	0.262

Notes: This table presents the results for the robustness checks for the three main outcomes. The main outcomes on the extensive margin are: child labor (Panel A), household chores (Panel B), and school attendance (Panel C). Columns 1-3 define the *Rainfall shock* as a discrete measure that takes the value one for households with rainfall above the 80^{th}, 90^{th}, and 95^{th} percentile from the long-run mean according to Burke, Hsiang, and Miguel (2015); Skjeflo (2015) . Columns 4-5 define the *Rainfall shock* like Dell et al. (2014); Deschênes and Greenstone (2011); Brando and Santos (2015) . Columns 6-8 define the *Rainfall shock* as a measure of intensity by Marchetta, Sahn, and Tiberti (2018); Dell, Jones, and Olken (2014). Column 9 selects the controls following the methodology of Belloni, Chernozhukov, and Hansen (2014). Finally, Columns 10 and 11 restrain the sample using the distance of the household to the nearest weather station. The controls included are, gender age, household size, head of household age and age squared, head of household gender, head of household educational attainment, the household carries out any agricultural activity, distance to the nearest weather station, indicator of older children (older than 10) and the household receives benefits from Familias en Acción. Robust standard errors are clustered at the household level and presented in parenthesis. * is significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level.

TABLE 7. Children activities and exposure to rainfall shocks: Heterogeneous effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Financial Inclusion					Formal loans					Other characteristics			
	Formal loans	Formal savings	Bank account	Insurance	Agricultural insurance	Before shock	Before shock: Payments Up to date	After shock	After shock: Payments Up to date	Agricultural loans (%)	Age group	Female	Natural disaster aid	Familias en Acción
Panel A: Child labor														
Rainfall shock × Z	0.017	0.078	-0.117	0.036	-0.539***	0.038*	0.050**	-0.010	0.079**	-0.251*	0.108***	-0.052*	-0.182**	0.073
	(0.060)	(0.140)	(0.090)	(0.060)	(0.180)	(0.020)	(0.020)	(0.030)	(0.030)	(0.140)	(0.040)	(0.030)	(0.080)	(0.070)
Rainfall shock	0.049	0.051*	0.058*	0.042	0.055*	0.059**	0.063**	0.055*	0.061**	0.245**	-0.017	0.077**	0.057*	-0.001
	(0.060)	(0.140)	(0.090)	(0.060)	(0.180)	(0.020)	(0.020)	(0.030)	(0.030)	(0.140)	(0.040)	(0.030)	(0.080)	(0.070)
Z	0.033*	0.036	0.023	0.010	0.487***	0.017**	0.009	0.004	0.002	-0.019	0.095***	-0.127***	0.066	-0.025
	(0.060)	(0.140)	(0.090)	(0.060)	(0.180)	(0.020)	(0.020)	(0.030)	(0.030)	(0.140)	(0.040)	(0.030)	(0.080)	(0.070)
Observations	8958	8958	8958	8958	8958	8958	8958	8958	8958	3146	8958	8958	8958	8958
Households	2394	2394	2394	2394	2394	2394	2394	2394	2394	2394	2394	2394	2394	956
R-squared	0.383	0.383	0.383	0.383	0.384	0.384	0.384	0.383	0.384	0.432	0.396	0.404	0.383	0.383
Mean DV	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.149	0.125	0.125	0.125	0.125
SD DV	0.331	0.331	0.331	0.331	0.331	0.331	0.331	0.331	0.331	0.356	0.331	0.331	0.331	0.331
Panel B: Household chores														
Rainfall shock × Z	-0.052	0.011	0.029	-0.011	0.000***	-0.024	-0.025	-0.015	0.002	0.090	0.046	-0.001	-0.117	-0.124*
	(0.060)	(0.120)	(0.090)	(0.060)	(0.000)	(0.020)	(0.020)	(0.030)	(0.010)	(0.130)	(0.040)	(0.040)	(0.100)	(0.070)
Rainfall shock	0.127***	0.108***	0.107***	0.111***	0.108***	0.106***	0.105***	0.109***	0.108***	0.016	0.080*	0.107***	0.109***	0.203***
	(0.060)	(0.120)	(0.090)	(0.060)	(0.000)	(0.020)	(0.020)	(0.030)	(0.010)	(0.130)	(0.040)	(0.040)	(0.100)	(0.070)
Z	-0.004	0.005	-0.005	0.007	0.502**	-0.004	0.001	-0.002	-0.007	0.038	0.250***	0.132***	0.049	0.035
	(0.060)	(0.120)	(0.090)	(0.060)	(0.000)	(0.020)	(0.020)	(0.030)	(0.010)	(0.130)	(0.040)	(0.040)	(0.100)	(0.070)
Observations	6382	6382	6382	6382	6382	6382	6382	6382	6382	2149	6382	6382	6382	6382
Households	1956	1956	1956	1956	1956	1956	1956	1956	1956	717	1956	1956	1956	1956
R-squared	0.436	0.436	0.436	0.436	0.437	0.436	0.436	0.436	0.436	0.435	0.484	0.447	0.436	0.437
Mean DV	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.749	0.733	0.733	0.733	0.733
SD DV	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.433	0.442	0.442	0.442	0.442
Panel C: School attendance														
Rainfall shock × Z	-0.063*	0.015	0.029	0.028	-0.062	-0.012	0.002	-0.008	0.019	0.011	-0.006	-0.003	0.112	0.026
	(0.040)	(0.050)	(0.070)	(0.030)	(0.060)	(0.020)	(0.020)	(0.020)	(0.020)	(0.070)	(0.020)	(0.030)	(0.080)	(0.040)
Rainfall shock	-0.009	-0.035*	-0.035*	-0.045*	-0.034*	-0.034*	-0.033*	-0.034*	-0.033*	-0.063	-0.031	-0.033	-0.035*	-0.048
	(0.040)	(0.050)	(0.070)	(0.030)	(0.060)	(0.020)	(0.020)	(0.020)	(0.020)	(0.070)	(0.020)	(0.030)	(0.080)	(0.040)
Z	-0.004	0.022	0.010	0.016	0.081	0.004	0.004	0.002	0.004	-0.002	-0.061***	0.029***	-0.029	0.059***
	(0.040)	(0.050)	(0.070)	(0.030)	(0.060)	(0.020)	(0.020)	(0.020)	(0.020)	(0.070)	(0.020)	(0.030)	(0.080)	(0.040)
Observations	9434	9434	9434	9434	9434	9434	9434	9434	9434	3356	9434	9434	9434	9434
Households	2469	2469	2469	2469	2469	2469	2469	2469	2469	1005	2469	2469	2469	2469
R-squared	0.349	0.348	0.348	0.349	0.348	0.348	0.348	0.348	0.349	0.370	0.356	0.350	0.348	0.350
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Mean DV	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.930	0.927	0.927	0.927	0.927
SD DV	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.255	0.260	0.260	0.260	0.260

Notes: This table presents the results for the heterogeneous effects from the equations (4.3) and (4.4) for the three main outcomes. The main outcomes on the extensive margin are: child labor (Panel A), household chores (Panel B), and school attendance (Panel C). Columns 1-5 consider financial inclusion variables such as formal loans, formal savings, bank account, insurance and agricultural insurance. Columns 6-10 consider particular characteristics of formal loans such as if it was acquired before or after the occurrence of the shock, and if the household is up to date with the payments of loans, and the agricultural destination of the credit. Finally, Columns 11-12 consider other relevant information such as age, gender, natural disaster aid, and Familias en Acción. *Rainfall shock* is defined as a discrete measure that takes the value one for households with rainfall above one standard deviation from the long-run mean. Robust standard errors are clustered at the household level and presented in parenthesis. * is significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level.