School, Shocks, and Safety Nets: Can Conditional Cash Transfers Protect Human Capital Investments During Rainfall Shocks?

Dylan Fitz (Lawrence University) and Riley League (Duke University)*

April 2021

Abstract

Short-run income shocks can negatively impact school attendance when children are pulled out in order to work, either based on the need for greater income during negative shocks or the increased opportunity cost of child time during positive shocks. This paper proxies for income shocks using fluctuations in local rainfall and evaluates its impact on child schooling, labor force participation, and domestic work. We then investigate whether conditional cash transfers are able to protect school attendance during these temporary shocks. Using data on Brazil's *Bolsa Família* program along with municipal-level rainfall data, we find that positive rainfall shocks cause children to increase the likelihood of paid labor but Bolsa partially mitigates these effects, though less so among boys and older children. Furthermore, we find evidence that even when children do not drop out of school during these shocks, Bolsa may not fully maintain their intensity of school attendance and shocks may hinder academic progress. These results suggest that higher wages cause children to substitute time away from schooling, but that Bolsa acts as a partial safety net that stabilizes human capital investments during short-run shocks and may help produce larger long-run benefits. Key words: conditional cash transfer programs; income shocks; education; child labor; *Bolsa Família*; Brazil; safety nets.

*Dylan Fitz, Associate Professor of Economics, 711 E. Boldt Way – SPC 24, Lawrence University, Appleton, WI 54911. Telephone: 920-832-7359. Email address: dylan.b.fitz@lawrence.edu. Riley League, Graduate Student, Duke University Economics Department.

1 Introduction

Education is recognized as an important determinant of both macroeconomic growth and individual opportunity, and many countries prioritize educational programs with the goal of improving both growth and equity. This paper relates to two major determinants of educational investments: first, poor households may underinvest in education and, second, short-run income shocks often impact child schooling and labor decisions. Both of these factors impose considerable long-run costs on children, since households may fail to optimally invest in children's education in ways that limit their lifetime earnings. This paper analyzes how child schooling and labor participation in Brazil respond to short-run income shocks and investigates whether a large conditional cash transfer program can act as a safety net that protects school attendance during these temporary events. We utilize rainfall fluctuations to measure exogenous income shocks and evaluate the effect of Brazil's conditional cash transfer program (*Bolsa Família* or Bolsa) during these short-run shocks. Benefiting about a quarter of Brazil's population, Bolsa is the world's largest conditional cash transfer program and an important model for other countries. While previous studies find that Bolsa increases schooling (Glewwe and Kassouf, 2012; de Brauw et al., 2015b), our contribution is to explore whether it additionally protects schooling during short-run shocks.

We explore three main questions relating to child schooling and labor in the context of shocks. First, we ask whether short-run income shocks impact child schooling and labor outcomes. It is theoretically ambiguous as to whether a positive shock, for example, would increase schooling by making more resources available or decrease schooling by raising the opportunity cost of school. We analyze this question using rainfall deviations from long-run municipal averages as an exogenous proxy for income shocks while controlling for a range of individual, household, and municipal determinants of child schooling and labor.

Second, we ask whether Bolsa serves as a safety net that protects child schooling or mitigates increases in child labor during these shocks. If Bolsa helps to protect child enrollment during income shocks, then it may be even more effective at promoting educational investments than previously recognized. We utilize data collected for a Bolsa impact evaluation, which includes over 15,000 households interviewed in 2005 and 11,000 that were reinterviewed in 2009. Following other research using this data (de Brauw et al., 2014; 2015a; 2015b), our Bolsa identification strategy compares only those households that registered to become eligible but had not yet received Bolsa by the baseline survey. This approach helps control for selection bias and possible observable and unobservable differences between households that registered and those that failed to do so, but it reduces our overall sample size. We evaluate outcomes in 2009 and use propensity score weighting based on the 2005 survey to further improve our comparison by placing additional weight on those households that provide the best comparison to treated households. As an additional robustness check, we implement a separate panel methods identification strategy that enables the use of rainfall shocks concurrent to either survey round while including additional households, including those that received Bolsa before the baseline.

Third, we investigate potential heterogeneity in the responses of children to shocks and cash transfers based on children's location, gender, and age.

Our main results are as follows. First, current rainfall shocks impact child schooling and labor participation. Specifically, we find that a one standard deviation increase in rainfall increases the likelihood that a child does paid labor by 4.6 percentage points alongside some evidence of reduced school attendance (and, conversely, that a decrease in rainfall decreases paid labor and increases school attendance). These results are consistent with two related CCT studies, where droughts increase schooling in areas with relatively few child labor opportunities in Nicaragua (Gitter and Barham, 2009) and increase child labor but do not impact schooling in Mexico (de Janvry et al., 2006). While many children both attend school and work, we find that work is significantly more likely among children that do not attend school. Together, these findings indicate that positive income shocks increase child labor and reduce schooling, as occurs when the substitution effect of a higher opportunity cost of education dominates the income effect of having more resources available to devote to human capital investment. While higher short-run wages provide a benefit to families, these responses to rainfall deviations may pose long-term challenges given that children with lower schooling go on to earn lower adult incomes. This provides an opportunity for social programs to provide additional incomes while helping protect schooling during these short-run shocks.

Second, we find evidence that Bolsa transfers mitigate these effects by limiting changes in child labor during rainfall shocks. In particular, we find that a one standard deviation increase in rainfall raises the likelihood that a child does paid labor by 6.4 percentage points without Bolsa, but only an insignificant 2.3 percentage points among children in Bolsa households. When using panel methods, we find that Bolsa mitigates the reduction in schooling caused by positive rainfall shocks. Thus, we find that Bolsa works, in part, as a safety net that mitigates increases in child labor and reductions in schooling that result from positive rainfall deviations. This is partially consistent with evidence from Mexico, where Progresa protected child schooling during negative shocks but did not mitigate changes in child labor (de Janvry et al., 2006). While limiting opportunities to earn higher wages is not necessarily beneficial in the short run, Bolsa may provide larger long-run benefits by protecting human capital investments. Furthermore, when children leave school – even with the intentions of temporarily benefitting from higher wages – they often do not return to school, suggesting that these transient opportunities may cause permanent reductions in schooling and lifetime earnings. Since Bolsa is more effective at keeping older children in school than getting them to return to school after dropping out (Reynolds, 2015), it is important to better protect child schooling during short-run shocks. Our results indicate that Bolsa mitigates decreases in child schooling during positive shocks and increases during negative shocks, thus resulting in more stable school attendance. Larger transfers may reduce the need for increased child labor in response to positive short-run opportunities in a way that provides both larger short- and long-run benefits.

Based on two additional findings, there is room for Bolsa to work more effectively as a safety net. We explore heterogeneity and show that rainfall shocks have the biggest impact in rural areas, on boys, and on older children. Bolsa mitigates these impacts in rural areas, but is less successful among boys or older children. Thus, there is a justification for increasing payments to older children to ensure greater short- and long-run benefits. Next, we find evidence that the mitigation of child labor may occur through a reduction in the intensity of school attendance, with some evidence of negative medium-run effects on academic performance. First, we find that current positive rainfall deviations reduce the level of school attendance along the intensive margin, but only among Bolsa beneficiaries, who likely shift some of their time from school to labor. Second, the effect of lagged positive rainfall deviations increases current school attendance among non-Bolsa children, which is consistent with a positive income effect resulting from increased child labor at higher wages the previous year. In a hidden cost of the mitigation of child labor, lagged positive rainfall deviations decrease grade progression and increase dropout only for Bolsa beneficiaries, a result that is consistent with Bolsa children reducing their level of school attendance in the previous year and performing worse academically as a result. This finding that simultaneously attending school and working can negatively impact academic performance supports Schady (2001), who found the reverse process when a massive recession in Peru decreased child labor, resulting in greater educational attainment as children focused on school rather than both school and work. However, our panel results do not confirm this finding, with weakly significant evidence that Bolsa increases both the likelihood and level of school attendance during positive rainfall deviations.

These findings hold important policy implications. Primarily, they suggest that conditional cash transfers can help protect households against income shocks and maintain school enrollment. While Bolsa has been shown to increase several educational outcomes (Glewwe and Kassouf, 2012; de Brauw et al., 2015b), the overall long-run benefits may be even larger when Bolsa additionally acts as a safety net.[1] In particular, because Bolsa appears to function as a safety net primarily by altering the opportunity cost of schooling though the conditionalities rather than simply by providing additional income, we find support for maintaining and strengthening the conditional nature of the transfer. However, we note two important limitations in Bolsa's ability to protect human capital investments. First, Bolsa is less effective at mitigating the effect of wage shocks on boys and older children. Second, children may meet Bolsa's conditions while reducing their level of school attendance during positive short-run shocks, and we find that this may negatively impact their academic progress in the following year. Taken as a whole, our results indicate that increasing transfers either during shocks or for certain groups (including older children) while maintaining the program's conditional nature (and possibly increasing the required level of school attendance) may improve Bolsa's effectiveness as a safety net that provides needed short-run income while achieving high levels of academic attendance and progress.

2 Context

2.1 Literature

Our paper relates to two broad literatures and a third more specific one. First, a large literature analyzes how child schooling and labor respond to short-run income shocks. The relationship between short-run shocks and educational investments is theoretically ambiguous, since shocks impact child wages, thus causing both income and substitution effects. Higher child wages may lead to higher household incomes that then cause schooling to increase, but higher child wages also increase the opportunity cost of school in a way that may reduce schooling. Many empirical studies find that wages and human capital investments are positively related (Jacoby and Skoufias, 1997; Jensen, 2000; Thomas et al., 2004; Beegle et al., 2006; Björkman-Nyqvist, 2013; Bandara et al., 2015), including one study from Brazil (Duryea et al., 2007). In contrast, other studies find that higher wages cause children to decrease school and increase labor (Rosenzweig and Evenson, 1977), including studies on Brazil (Duryea and Arends-Kuenning, 2003; Kruger, 2007). Also in Brazil, Soares et al. (2012) find that while higher household income levels correspond to more child schooling and less child labor, short-run positive shocks cause schooling to decrease and child labor to increase. Furthermore, both schooling and child labor may increase or decrease together given that many children both work and attend school simultaneously and since other activities (such as leisure) also adjust (Ravallion and Wodon, 2000; Skoufias and Parker, 2001; Bourguignon et al., 2003;

de Janvry et al., 2006). Overall, while the net effect of income shocks on schooling is ambiguous, there is considerable concern that short-run shocks negatively impact schooling and that this, in turn, reduces lifetime earnings for those children. We additionally evaluate domestic labor, which may also respond to short-run shocks (Bandara et al., 2015). The impact of short-run shocks on children may depend on their age, gender, or location, but while the income effect may apply to all children, the substitution effect might be more important for boys or older children, who are often more likely to work. Shah and Steinberg (2017) provide evidence that higher wages increase educational investments among younger children but decrease educational investments among older children with an increased opportunity cost of schooling.

Second, this paper contributes to the literature on conditional cash transfer programs (CCTs), which are some of the most common and largest-scale social and educational programs in many countries. By providing cash transfers conditional on school attendance, CCTs cause both a substitution effect (by subsidizing the cost of education and conditioning program benefits on school attendance) and an income effect (by increasing total incomes), both of which often result in increased schooling and decreased child labor. A range of empirical studies across many countries find that CCTs increase schooling (see, for example, Schultz, 2004; Rawlings and Rubio, 2005; Attanasio et al., 2010; Parker and Vogl, 2018). In Brazil, Glewwe and Kassouf (2012) find that *Bolsa Escola* (the predecessor of Bolsa) increases attendance, reduces dropout rates, and increases grade promotion, but de Brauw et al. (2015b) find that while Bolsa increases school attendance and grade progression among girls, it is less effective among boys. Additionally, several CCT studies find evidence that transfers reduce child labor (Skoufias and Parker, 2001; Del Carpio et al., 2016). Basu and Tzannatos (2003) argue that increases in schooling caused by CCTs 'almost always' correspond to decreases in child labor, though by a smaller amount.

Third, a much smaller group of papers with conflicting findings analyze how economic shocks and conditional cash transfers interact. While the ability of CCT programs to increase education and reduce child labor are well established, we know less about the ability of CCTs to serve as safety nets that help maintain school enrollment during short-run household shocks. In one example, de Janvry et al. (2006) develop a model showing that conditional cash transfers can reduce the negative impact of income shocks on school attendance alongside empirical evidence that Mexico's Progresa program does so amidst a range of negative shocks. In contrast, Gitter and Barham (2009) find that Nicaragua's CCT is most effective at increasing schooling when child labor options are strongest (in coffee cultivating regions when coffee prices are high) and that it is less effective when there are fewer child labor options (in non-coffee regions) or during negative shocks (either droughts or negative price shocks).

2.2 Bolsa Família Background

Education is one of the most important indicators of nonfarm labor opportunities and incomes in Brazil (Kageyama and Hoffmann, 2000; Jonasson and Helfand, 2010) and evidence indicates that low education levels persist across generations (Behrman et al., 2001; Emerson and Souza, 2003). In this context, policies that increase schooling and sustain it amidst short-run shocks can provide long-run benefits by preventing households from underinvesting in the education of their children. In 2003, President Lula formed Bolsa as a combination of multiple programs and by 2007 Bolsa provided payments of R$7.5 billion (approximately US$4 billion) to over 11 million families, more than double the number of beneficiaries of Mexico's Progresa program (Glewwe and Kassouf, 2012). Bolsa transfers are conditional on schooling (at least 85% attendance) and regular health check-ups for children under seven years of age. As with most CCT programs, payments are targeted to female heads of household. While Bolsa initially covered children between the ages of 6 to 15, it was expanded to 16 and 17 year olds in 2008.

At the time of the 2009 survey, Bolsa provided payments for children under eighteen using three transfer components. First, households classified as living in extreme poverty (monthly per capita income less than R$60) receive the Basic Benefit of R$62 per month, regardless of the number of children. Households living in poverty (monthly per capita income less than R$120) are eligible for two additional benefits. The Variable Benefit provides a payment of R$20 per child age fifteen and under (for up to three children) and the Variable Youth Benefit provides a payment of R$30 per child age sixteen and seventeen (for up to two children).

To become eligible for Bolsa, households must register in the *Cadastro Único* (Single Registry) that oversees all government transfer programs and we restrict our analysis to registered households. To confirm that households are eligible, Bolsa verifies incomes in multiple ways and, 'as of late 2008, education conditionalities were monitored for 85 percent of beneficiaries, and health conditionalities were monitored for 59 percent of beneficiaries' (Soares et al., 2010).

Furthermore, Bolsa has a highly decentralized structure that should improve the targeting of poor households but means that the exact implementation depends on the municipality. Bolsa recipients are selected at both the national and municipal level. First, the national government determines a maximum number of recipients for each municipality then, if the total number of eligible households is greater than this maximum, the municipality selects which households will receive Bolsa. Although there are similar criteria across all municipalities (based on income levels and the number and ages of children), the possible variation across municipalities leads us to include municipal-level controls that may correlate with Bolsa transfers (de Brauw et al., 2015b).

3 Data and Descriptive Statistics

3.1 Rainfall Data

Rainfall data comes from the Terrestrial Air Temperature and Precipitation: 1900-2014 Gridded Monthly Time Series (Willmott and Matsuura, 2015), which provides monthly total precipitation data. We match this data to Brazilian municipalities to create an annual rainfall measure that captures the percentage deviation in annual rainfall from the long-run municipal mean. Greater detail on this dataset and our variable construction can be found in Supplementary Materials Section SM1.

Our empirical analysis focuses on rainfall during the current year (2009) and the previous year (2008). As shown in the summary statistics in Appendix Table A1, the average deviation in rainfall is positive for both years, but there is a wide range of negative and positive shocks across our sample.

Rainfall deviations is a commonly used variable that captures deviations from the local long-run mean (Maccini and Yang, 2009; Björkman-Nyqvist, 2013; Rocha and Soares, 2015). It is most appropriate when the relationship between rainfall deviations and the outcome of interest is monotonic, which we find to be appropriate in our data, and we interpret higher rainfall deviations as positively impacting local wages. We justify this assumption first by presenting robust evidence in Supplementary Materials Section SM2 that our rainfall deviations variable has a significant, positive, and economically meaningful relationship with municipal-level total agricultural production. Second, we note that these results are consistent with national studies showing that more rainfall increases agricultural productivity and wages.[2] We take the relationship between rainfall and higher agricultural production to indicate that our rainfall deviations measure captures higher local wages and a higher value of child time spent working in agriculture.

While our rainfall measure may be best suited for capturing the economic environment of rural areas that are heavily dependent on agriculture, we must note that rainfall is important for urban workers as well. Many urban workers work directly in agriculture, including a long history of urban-based agricultural laborers in Brazil being transported to rural farms based on daily contracts (Goodman and Redclift, 1977; Saint, 1981).[3] Furthermore, rainfall shocks may impact the wages of urban workers outside of agriculture as well, including for those in non-agricultural jobs that rely on agricultural production like street vending or more indirectly through increased demand for urban goods (Mueller and Osgood, 2009). Additionally, major weather shocks may impact urban areas more than rural areas due to a larger food price response in urban areas (Baez et al., 2017). Based on these results, we anticipate that higher rainfall will increase wages in rural areas and urban areas, although we investigate heterogeneity along this dimension.

3.2 Bolsa Data

This paper utilizes the *Avaliação de Impacto do Programa Bolsa Família* data collected in 2005 and 2009. The 2005 baseline survey interviewed 15,426 households before the 2009 follow-up survey reached 11,433 of those households. The baseline survey targeted households that were either already receiving Bolsa transfers, registered in the Cadastro but not receiving Bolsa transfers, and not registered in the Cadastro (and thus ineligible). As discussed below, our analysis excludes households not registered in the Cadastro to account for selection concerns and we use the 2005 survey to evaluate household propensity score weights before evaluating individual outcomes in 2009.

We focus on school-aged children (between 6 and 17 years of age) and evaluate educational and child labor outcomes. In terms of education, we focus on two measures: an indicator of attendance (1 if a child currently attends school and zero otherwise) and a continuous measure of attendance (the share of days attended in the last week, defined only for those in school). Together, these measure capture school attendance along the extensive and intensive margins. Furthermore, conditional on a child having attended school the previous year, we also analyze three potential outcomes in the current year: grade progression (1 if a child progresses upward a grade), repetition (1 if a child repeats the previous grade level), or dropout (1 if a child dropped out). Collectively, these educational outcomes inform us about both school attendance and performance. Appendix Table A1 indicates that school attendance is relatively high, with 89% attending school and a 96% attendance rate among those children, however there is variation in both measures.

We also focus on two child labor outcomes: indicators for paid work (1 if a child currently does any paid work) and domestic work (1 if a child currently does any domestic work at home).[4] While the overall rate of paid work is low (6%), it rises from 3% among children ages 6 to 14 to 13% among those between 15 and 17. Similarly, the overall rate of domestic work (45%) rises from 40% among children ages 6 to 14 to 58% for children 15 to 17. Among our sample, 84.5% attend school without engaging in paid labor, 1.5% work but do not attend school, 9.6% do neither, and 4.5% do both.

4 Methodology

4.1 Rainfall Shocks

We first evaluate the impact of rainfall shocks on schooling and child labor using the following regression for child i in household h in municipality m and state u:

$$S_{ihmu} = \alpha + \beta_2 R_m + \beta_4 R_{m,lagged} + \gamma X_i + \delta X_h + \eta X_m + \mu_u + \epsilon_{ihmu} \quad (4.1)$$

where S_{ihmu} is a specific outcome including measures for education and child labor as defined above. The coefficients of interest are β_2 and β_4, which represent the impact of rainfall deviations in the current and previous years.[5] Rainfall deviations provide a reliable exogenous measure of income shocks, and we further control for variables that explain education and child labor decisions. Individual controls (X_i) include age fixed effects, gender, and race. Household controls (X_h) include measures of household composition (including the number of members in the household as well as the number of children under 6 and under 15) and proxies for household wealth (including an indicator for whether the household owns their home, the number of rooms in the household, and a piped water indicator). Due to challenges with reliably matching parents to children in the data, we additionally include household head controls, including their age and indicators for their gender and literacy. Municipal-level controls (X_m) include life expectancy at birth, infant mortality per 1000 births, the percentage of children between 7 and 14 that attend school, and the percentage of households with piped water and telephones (all from the *Instituto de Pesquisa Econômica Aplicada* municipal data collected in 2000). Bolsa provides municipalities with discretion in how exactly Bolsa is implemented (especially in the case where more households are eligible than the number of households for which there is sufficient funding), and these variables control for municipal-level factors that may be correlated with child schooling, income levels, and eligibility for Bolsa. State fixed effects (μ_u) control for potential state-level education policies, aid in response to short-run shocks, and other state-level factors. Robust standard errors are clustered by municipality. In summary, we estimate the impact of municipal-level short-run rainfall deviations on child labor and schooling, while focusing on within-state variation and controlling for a range of individual-, household-, and municipal-level factors.

4.2 Bolsa and Rainfall Shocks

We next investigate whether Bolsa helps protect schooling during income shocks. Without being randomly assigned, our evaluation of Bolsa needs to determine a reliable control group in order to make the strongest possible comparison. As done in previous papers using the Bolsa data (de Brauw et al., 2014; 2015a; 2015b), our analysis includes only those households that voluntarily selected into the Cadastro. Since all households must register in the Cadastro to become eligible, households that fail to register may be fundamentally different from those that do. We restrict our analysis to only households that were registered in the Cadastro in both 2005 and 2009 and also exclude households that received Bolsa or predecessor programs in 2005. Within this subset of households, we define treated households to be those that received Bolsa transfers in 2009 and control households to be those that did not.

To further improve our analysis, we use propensity score weighting to address possible observable differences between treated and control households, also as done in de Brauw et al. (2015b). Using the 2005 household data, we estimate the following logit model for household h in municipality m:

$$\Pr\left(T_{hm}=1\right)=\frac{1}{1+e^{-(\alpha+\beta X_h+\gamma X_m)}} \tag{4.2}$$

where T_{hm} is our Bolsa treatment indicator.[6] We estimate the probability of being treated using household and municipal variables that likely correlate with Bolsa treatment and potential child schooling and labor outcomes. First, we include measures of household composition and wealth (including the same X_h variables listed above). Second, since Bolsa transfers are determined by municipalities, we also control for the same set of municipal-level variables (X_m) listed above.[7] Our analysis suggests that the treatment and control groups provide reliable comparisons (see Figure A1 and Table A2 in the Appendix). Based on these results, we calculate the propensity score (p) for each household, which measures their likelihood of being treated, and then determine a propensity score weight that we apply to each individual in a given household. Specifically, the weight is 1 for all treated households and $\frac{p}{1-p}$ for all control households, thus placing additional weight on control households with higher propensity scores in order to improve the comparison. As done in de Brauw et al. (2015b), we also calculate attrition weights equal to 1 divided by the probability a household remained in the sample in 2009 (see Table SM3.1 in the Supplementary Materials). The final weights utilized in our study are equal to the propensity score weight multiplied by the attrition weight.

The strengths of this approach are that it controls for selection into the program and improves the comparison across households based on observable characteristics. While households can be matched between the 2005 and 2009 surveys, individuals within households cannot be reliably matched (de Brauw et al., 2015b). As a result, we focus on individual outcomes in the 2009 survey to evaluate the impacts of income shocks and Bolsa transfers on school attendance and child labor. Our results are thus based on single-difference estimates of 2009 outcomes and propensity score weights from the 2005 baseline survey.

Using the weights defined above, we estimate the following regression for child i in household h in municipality m and state u:

$$S_{ihmu} = \alpha + \beta_1 T_{ihm} + \beta_2 R_m + \beta_3 T_{ihm} R_m + \beta_4 R_{m,lagged} + \beta_5 T_{ihm} R_{m,lagged} + \gamma X_i + \delta X_h + \eta X_m + \mu_u + \epsilon_{ihmu} \quad (4.3)$$

β_1 measures the effect of Bolsa and β_3 and β_5 estimate the additional effect of Bolsa in the presence of rainfall shocks in 2009 and 2008, while as before β_2 and β_4 measure the effects of rainfall shocks in 2009 and 2008.[8] All other control variables and fixed effects are the same as those in the rainfall shocks equation presented above. Robust standard errors are clustered by municipality.

5 Results

This section describes the results, focusing first on the effect of rainfall alone before interacting rainfall with Bolsa and testing for heterogeneity based on location, gender, and age. Finally, we introduce a robustness check using panel methods as an alternative Bolsa identification strategy that provides additional variation in rainfall.

5.1 Rainfall Shocks

When discussing the magnitude of rainfall shocks, we consider a one standard deviation or 15% change from the long-run mean rainfall level in a given municipality and focus primarily on positive rainfall deviations, though negative rainfall deviations cause opposite effects. Table 1 presents the impact of rainfall shocks on the likelihood that a child attends school, a continuous measure of attendance, the likelihood that a child does paid work, and the likelihood that a child does domestic work. Each outcome is analyzed first using only individual and household controls, then with municipality controls introduced, and then also with state fixed effects (which is our preferred specification).

Table 1: Effect of Rainfall Shocks on Child Schooling and Labor

	Attends School (=1)			School Attendance (Continuous)			Does Paid Work (=1)			Does Domestic Work (=1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Current Rainfall Deviation	-0.051	-0.046	-0.039	-0.042*	-0.042*	-0.052	0.265***	0.186***	0.304***	-0.029	0.004	-0.227
	(0.048)	(0.052)	(0.117)	(0.022)	(0.024)	(0.048)	(0.078)	(0.050)	(0.113)	(0.091)	(0.092)	(0.156)
Lagged Rainfall Deviation	0.119	0.126*	0.116	0.021	0.017	-0.140*	-0.013	-0.028	-0.057	-0.225**	-0.177*	0.244
	(0.075)	(0.074)	(0.107)	(0.024)	(0.024)	(0.072)	(0.051)	(0.055)	(0.116)	(0.114)	(0.101)	(0.164)
Individual/Household Controls	1	1	1	1	1	1	1	1	1	1	1	1
Municipality Controls	0	1	1	0	1	1	0	1	1	0	1	1
State Fixed Effects	0	0	1	0	0	1	0	0	1	0	0	1
Dep. Var. Mean	0.885	0.885	0.885	0.958	0.958	0.958	0.092	0.092	0.092	0.437	0.437	0.437
R^2	0.044	0.045	0.051	0.035	0.038	0.067	0.262	0.287	0.325	0.207	0.217	0.241
Observations	4,735	4,735	4,735	4,063	4,063	4,063	4,699	4,699	4,699	4,831	4,831	4,831

Notes: Estimates from equation (4.1). Sample consists of observations from 2009 of individuals between 6 and 17 years of age whose households are matched across survey waves, were registered in the Cadastro in 2005 and 2009, and did not receive Bolsa benefits in 2005. The sample is further limited to individuals for whom we observe all control variables. Rainfall deviation measures are the difference between the natural logarithm of a given year's rainfall in an individual's municipality of residence and the natural logarithm of the mean rainfall in that same municipality from 1940 to 2010. For those who attend school, the continuous school attendance measure is the share of days in the last week an individual reports attending school. Individual and household controls include age fixed effects, gender, race, measures of household composition, and proxies for household wealth. Municipal controls include life expectancy at birth, infant mortality per 1000 births, the percentage of children between 7 and 14 that attend school, and the percentage of households with piped water and telephones. Standard errors clustered at the municipality level are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Focusing first on current rainfall deviations, we see strong and robust evidence that current positive rainfall deviations increase the likelihood that a child engages in paid labor (columns 7-9). This is significant at the 1% level, robust across all three specifications, and is also economically meaningful. A 15% increase in current rainfall causes a 4.6 percentage point increase in the likelihood that a child does paid labor, which is a 50% increase from the weighted mean level of 9.2% across all children in 2009.[9] We also find evidence that positive rainfall deviations decrease the percentage of school days attended, although this finding is not robust to the inclusion of state fixed effects.

Focusing on lagged rainfall deviations, our results are less consistent across all specifications. We find mixed evidence on the effect of rainfall on school attendance and statistically significant evidence that lagged rainfall decreases current domestic work in two of three specifications.

5.2 Bolsa and Rainfall Shocks

Table 2 provides our main results integrating the impact of both rainfall deviations and Bolsa transfers. We highlight the effects of our key variables of interest and then under 'Coefficient Combinations' we report estimates of the marginal effect of Bolsa during current rainfall shocks ($\beta_1 + \beta_3$) and of current rainfall deviations for Bolsa beneficiaries ($\beta_2 + \beta_3$).

Focusing first on the Bolsa treatment indicator provides an estimate of the impact of Bolsa when there is no rainfall deviation from the long-run mean. Here we find strong and robust evidence that Bolsa increases school attendance. Across all specifications we find positive effects of Bolsa on schooling, with Bolsa leading to an increase in the probability of attending school by roughly 5.5 percentage points (which is consistent with the 4.5 percentage point increase found by de Brauw et al., 2015b) and an increase in the proportion of school days attended by 3 percentage points. The remaining columns provide evidence that Bolsa does not impact the likelihood that a child does paid or domestic work during times of normal rainfall.

Focusing instead on its effects during current rainfall deviations, we find evidence that Bolsa continues to increase the likelihood of school attendance while also decreasing the probability of engaging in paid work. During a positive rainfall shock of one standard deviation, Bolsa decreases the likelihood of doing paid work by 3.5 percentage points.[10]

Together, this evidence indicates that Bolsa increases school attendance in both normal and abnormal rainfall conditions. Furthermore, while Bolsa does not appear to affect paid or domestic work during times of normal rainfall, during positive rainfall shocks Bolsa serves to decrease the likelihood of engaging in paid labor.

We are not only interested in the impact of Bolsa given a fixed level of rainfall, but we are also interested in whether Bolsa serves to mitigate the negative effects of rainfall shocks. Here, we see that while positive rainfall deviations increase the likelihood that children do paid work, Bolsa strongly mitigates this effect. In column 9, we see evidence that a 15% increase in current rainfall causes the likelihood that a child does paid work to increase by 6.3 percentage points. However, Bolsa significantly reduces this impact (as indicated by the significant interaction term) such that among Bolsa recipients the effect of current positive rainfall deviations are not significantly different from zero (as seen in the coefficient combinations). Thus, current positive rainfall deviations increase the likelihood of paid work among children who do not receive Bolsa, but not among Bolsa recipients. Nonetheless, we find that positive rainfall deviations decrease the level of school attendance among Bolsa beneficiaries. This indicates that Bolsa children continue attending school in order to remain eligible for Bolsa, but reduce their attendance level along the intensive margin.[11] Working more when wages are higher provides additional short-run income, however, if the corresponding lower levels of attendance worsen human capital accumulation and educational outcomes, then this response might negatively impact children in the medium and long runs.

In fact, these negative effects are exactly what we find in Table 3. In this table we analyze the likelihood that a student has progressed to the next grade, repeated a grade, or dropped out, conditional on attending school the previous year.[12] Here, we see that the Bolsa interaction with lagged rainfall is significantly negative for the likelihood of progressing a grade and positive for dropping out. This result, in conjunction with our earlier results

Table 2: Effect of Rainfall Shocks and Bolsa on Child Schooling and Labor

	Attends School (=1)			School Attendance (Continuous)			Does Paid Work (=1)			Does Domestic Work (=1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Bolsa Treatment (=1)	0.054**	0.054**	0.055**	0.023**	0.025**	0.030***	0.011	0.009	0.005	-0.015	-0.018	-0.011
	(0.023)	(0.023)	(0.023)	(0.010)	(0.010)	(0.011)	(0.024)	(0.024)	(0.022)	(0.034)	(0.033)	(0.033)
Current Rainfall Deviation	-0.082	-0.084	-0.063	-0.036	-0.032	-0.033	0.434***	0.338***	0.416***	-0.126	-0.093	-0.281*
	(0.069)	(0.071)	(0.120)	(0.033)	(0.034)	(0.051)	(0.157)	(0.109)	(0.148)	(0.130)	(0.123)	(0.167)
Bolsa × Current Rainfall Deviation	0.073	0.080	0.075	-0.021	-0.029	-0.054	-0.359**	-0.312**	-0.264*	0.192	0.193	0.086
	(0.074)	(0.072)	(0.075)	(0.037)	(0.035)	(0.035)	(0.181)	(0.154)	(0.138)	(0.134)	(0.127)	(0.120)
Lagged Rainfall Deviation	0.236**	0.244**	0.224*	0.027	0.020	-0.131	-0.020	-0.037	-0.091	-0.298**	-0.231*	0.157
	(0.115)	(0.114)	(0.135)	(0.049)	(0.048)	(0.081)	(0.098)	(0.097)	(0.137)	(0.149)	(0.129)	(0.178)
Bolsa × Lagged Rainfall Deviation	-0.233**	-0.234**	-0.224**	-0.001	0.004	-0.002	0.037	0.039	0.081	0.138	0.098	0.204
	(0.115)	(0.114)	(0.113)	(0.054)	(0.053)	(0.051)	(0.109)	(0.107)	(0.100)	(0.150)	(0.151)	(0.140)
Coefficient Combinations												
Bolsa During Current Rainfall Deviations	0.127*	0.135**	0.129*	0.002	-0.004	-0.025	-0.347**	-0.303**	-0.259**	0.177	0.175	0.076
	(0.071)	(0.068)	(0.069)	(0.035)	(0.033)	(0.033)	(0.163)	(0.137)	(0.122)	(0.116)	(0.110)	(0.103)
Current Rainfall for Bolsa Beneficiaries	-0.009	-0.004	0.012	-0.057**	-0.061**	-0.087*	0.076*	0.026	0.152	0.066	0.100	-0.195
	(0.046)	(0.048)	(0.112)	(0.022)	(0.024)	(0.052)	(0.045)	(0.070)	(0.100)	(0.088)	(0.101)	(0.168)
Individual/Household Controls	1	1	1	1	1	1	1	1	1	1	1	1
Municipality Controls	0	1	1	0	1	1	0	1	1	0	1	1
State Fixed Effects	0	0	1	0	0	1	0	0	1	0	0	1
Dep. Var. Mean	0.885	0.885	0.885	0.958	0.958	0.958	0.092	0.092	0.092	0.437	0.437	0.437
R^2	0.050	0.050	0.050	0.039	0.039	0.039	0.278	0.278	0.278	0.211	0.211	0.211
Observations	4,735	4,735	4,735	4,063	4,063	4,063	4,699	4,699	4,699	4,831	4,831	4,831

Notes: Estimates from equation (4.3). Sample consists of observations from 2009 of individuals between 6 and 17 years of age whose households are matched across survey waves, were registered in the Cadastro in 2005 and 2009, and did not receive Bolsa benefits in 2005. The sample is further limited to individuals for whom we observe all control variables. Observations are weighted at the household level based on propensity score and probability of attrition. Rainfall deviation measures are the difference between the natural logarithm of a given year's rainfall in an individual's municipality of residence and the natural logarithm of the mean rainfall in that same municipality from 1940 to 2010. The Bolsa treatment indicator is defined to be 1 if the individual is a member of a household that reports receiving Bolsa benefits in 2009. For those who attend school, the continuous school attendance measure is the share of days in the last week an individual reports attending school. The estimated effect of Bolsa during current rainfall deviations is the sum of the estimated coefficent on the Bolsa treatment indicator and the estimated coefficeint on the interaction between the Bolsa treatment indicator and the current rainfall deviation measure. The estimated effect of rainfall for Bolsa beneficiaries is the sum of the estimated coefficent on the current rainfall deviation measure and the estimated coefficeint on the interaction between the Bolsa treatment indicator and the current rainfall deviation measure. Individual and household controls include age fixed effects, gender, race, measures of household composition, and proxies for household wealth. Municipal controls include life expectancy at birth, infant mortality per 1000 births, the percentage of children between 7 and 14 that attend school, and the percentage of households with piped water and telephones. Standard errors clustered at the municipality level are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

indicating that concurrent rainfall shocks cause Bolsa beneficiaries to reduce school attendance, indicates that positive labor market shocks negatively affect the academic success and progress even of Bolsa beneficiaries.

While Bolsa may not fully mitigate negative academic effects of improved labor market opportunities, the program nonetheless improves academic outcomes at normal rainfall levels, increasing the likelihood of grade progression by 11.3 percentage points and reducing the likelihood that a child drops out by 6.2 percentage points. The former result is consistent with de Brauw et al. (2015b), who find that Bolsa increases grade progression by 11.2 percentage points among children ages 15-17.

Overall, we find that rainfall deviations are positively correlated with child labor and negatively correlated with schooling and that Bolsa partially mitigates these effects. Focusing on positive rainfall deviations, our results indicate that positive rainfall shocks cause children to increase paid labor and stop attending school while Bolsa partially mitigates these effects, although this is accomplished by reductions in the frequency of school attendance that negatively impact medium-run academic progress. During periods of normal rainfall, however, Bolsa effectively increases school attendance and academic progress.

Table 3: Effect of Rainfall Shocks and Bolsa on Academic Performance

	(1) Grade Progression (=1)	(2) Grade Repetition (=1)	(3) Dropout (=1)
Bolsa Treatment (=1)	0.113***	-0.051	-0.062**
	(0.039)	(0.035)	(0.028)
Current Rainfall Deviation	0.106	0.006	-0.113
	(0.166)	(0.117)	(0.093)
Bolsa × Current Rainfall Deviation	-0.096	0.135	-0.039
	(0.136)	(0.114)	(0.077)
Lagged Rainfall Deviation	0.204	-0.121	-0.082
	(0.173)	(0.142)	(0.140)
Bolsa × Lagged Rainfall Deviation	-0.313*	0.090	0.223*
	(0.161)	(0.153)	(0.134)
Coefficient Combinations			
Bolsa During Current Rainfall Deviations	0.017	0.084	-0.101
	(0.117)	(0.097)	(0.069)
Current Rainfall for Bolsa Beneficiaries	0.010	0.142	-0.151*
	(0.138)	(0.107)	(0.080)
Individual/Household Controls	1	1	1
Municipality Controls	1	1	1
State Fixed Effects	1	1	1
Dep. Var. Mean	0.753	0.171	0.076
R^2	0.073	0.067	0.063
Observations	3,394	3,394	3,394

Notes: Please see Table 2.

5.3 Heterogeneity

Our main results may mask important heterogeneity. First, our previous results include young children and older children, whom de Brauw et al. (2015b) show to have different school participation rates (over 94% for ages 7-14, but well below 80% for age 17). Second, we include both rural areas and urban ones, where rainfall likely has smaller effects. Consequently, we ask whether the impact of Bolsa differs by the location, gender, or age of children. We focus on our preferred specification (with individual and household controls, municipal controls, and state fixed effects) and estimate a separate regression for each group being analyzed.

First, we disaggregate our analysis by whether a child lives in an urban or rural area. Table 4 provides evidence that positive rainfall deviations have a large effect on child labor in rural areas, but Bolsa mitigates these effects. In rural areas, a 15% increase in rainfall causes the likelihood of paid labor to increase by 13.1 percentage points, however this increase falls to only 5.5 percentage points among Bolsa beneficiaries, which we find is not significantly different from zero. However, while we find evidence that Bolsa may mitigate the effect of current rainfall on paid labor, it may be unable to protect human capital investment since we see a significant and large reduction in school attendance along the intensive margin. We also find that positive rainfall deviations cause rural children to decrease the likelihood of domestic work to by 16.4 percentage points among non-Bolsa

Table 4: Effect of Rainfall Shocks on Child Schooling and Labor by Location

	School (=1)		School (Cont.)		Paid Work (=1)		Domestic Work (=1)	
	(1) Urban	(2) Rural	(3) Urban	(4) Rural	(5) Urban	(6) Rural	(7) Urban	(8) Rural
Bolsa Treatment (=1)	0.047*	0.110*	0.026**	0.025	-0.025	0.081*	-0.008	-0.006
	(0.027)	(0.061)	(0.010)	(0.021)	(0.017)	(0.049)	(0.034)	(0.075)
Current Rainfall Deviation	-0.074	-0.010	-0.065	-0.128	0.104	0.859***	-0.095	-1.078***
	(0.139)	(0.254)	(0.067)	(0.127)	(0.106)	(0.276)	(0.187)	(0.289)
Bolsa × Current Rainfall Deviation	0.007	0.132	-0.020	-0.168**	-0.010	-0.497**	-0.098	0.621**
	(0.081)	(0.193)	(0.043)	(0.068)	(0.057)	(0.210)	(0.131)	(0.251)
Lagged Rainfall Deviation	0.253*	0.110	-0.218**	0.059	-0.047	-0.125	0.134	1.052***
	(0.144)	(0.224)	(0.091)	(0.110)	(0.120)	(0.314)	(0.202)	(0.348)
Bolsa × Lagged Rainfall Deviation	-0.215*	-0.239	-0.033	0.181**	0.130*	-0.045	0.398***	-0.806**
	(0.121)	(0.227)	(0.054)	(0.086)	(0.074)	(0.279)	(0.148)	(0.392)
Coefficient Combinations								
Bolsa During Current Rainfall Deviations	0.054	0.241	0.006	-0.143***	-0.035	-0.416**	-0.106	0.615***
	(0.072)	(0.154)	(0.040)	(0.053)	(0.050)	(0.184)	(0.114)	(0.205)
Current Rainfall for Bolsa Beneficiaries	-0.067	0.121	-0.086	-0.296**	0.094	0.362	-0.194	-0.457
	(0.126)	(0.231)	(0.061)	(0.127)	(0.082)	(0.257)	(0.189)	(0.281)
Individual/Household Controls	1	1	1	1	1	1	1	1
Municipality Controls	1	1	1	1	1	1	1	1
State Fixed Effects	1	1	1	1	1	1	1	1
Dep. Var. Mean	0.886	0.885	0.956	0.965	0.050	0.234	0.455	0.376
R^2	0.044	0.202	0.107	0.142	0.123	0.622	0.239	0.351
Observations	3,774	961	3,219	844	3,738	961	3,847	984

Notes: Please see Table 2. The results in even numbered columns are for a sample limited to individuals living in rural municipalities, while the results in odd numbered columns are for individuals in urban municipalities.

beneficiaries, but only 6.9 percentage points among Bolsa beneficiaries. During normal rainfall, we find that Bolsa increases the likelihood that a child attends school in both urban and rural areas, whereas de Brauw et al. (2015b) only find an effect in rural areas. Thus we find that while Bolsa is effective at increasing school attendance in all areas, the effect of rainfall and the value of Bolsa in mitigating rainfall shocks are both more important for children living in rural areas.

Table 5 disaggregates the results by gender. We find that current rainfall deviations positively impact both girls' and boys' likelihood of doing paid labor, but Bolsa fully mitigates this impact among girls but not boys. A 15% increase in rainfall causes the likelihood of doing paid labor to increase by 7.3 percentage points among boys but only 4.4 percentage points among girls, with the latter falling to 1.1 percentage points and being statistically indistinguishable from zero among Bolsa beneficiaries. Similarly to de Brauw et al. (2015b), who find that Bolsa increases schooling among girls but not boys, we find that Bolsa increases school attendance among girls along the intensive margin by 3.4 percentage points during periods of normal rainfall as well as along the extensive margin during periods of abnormally high rainfall. In contrast, we find evidence that Bolsa increases the likelihood that

Table 5: Effect of Rainfall Shocks on Child Schooling and Labor by Gender

	School (=1)		School (Cont.)		Paid Work (=1)		Domestic Work (=1)	
	(1) Girls	(2) Boys	(3) Girls	(4) Boys	(5) Girls	(6) Boys	(7) Girls	(8) Boys
Bolsa Treatment (=1)	0.043	0.061**	0.034**	0.020	0.013	-0.005	-0.048	0.004
	(0.034)	(0.027)	(0.015)	(0.013)	(0.023)	(0.026)	(0.038)	(0.044)
Current Rainfall Deviation	-0.160	0.016	-0.014	-0.040	0.289**	0.482***	-0.447***	-0.052
	(0.153)	(0.149)	(0.080)	(0.049)	(0.140)	(0.160)	(0.154)	(0.224)
Bolsa × Current Rainfall Deviation	0.144	0.051	-0.053	-0.024	-0.217*	-0.243	0.237	-0.003
	(0.119)	(0.093)	(0.053)	(0.040)	(0.124)	(0.158)	(0.152)	(0.170)
Lagged Rainfall Deviation	0.150	0.305**	-0.317***	0.044	-0.252**	0.088	0.340*	0.003
	(0.196)	(0.133)	(0.118)	(0.080)	(0.126)	(0.176)	(0.180)	(0.217)
Bolsa × Lagged Rainfall Deviation	-0.173	-0.287**	-0.009	-0.012	0.124	0.003	0.196	0.209
	(0.172)	(0.119)	(0.065)	(0.066)	(0.100)	(0.136)	(0.174)	(0.179)
Coefficient Combinations								
Bolsa During Current Rainfall Deviations	0.187*	0.111	-0.019	-0.004	-0.204*	-0.247*	0.189	0.002
	(0.112)	(0.082)	(0.050)	(0.037)	(0.109)	(0.141)	(0.133)	(0.144)
Current Rainfall for Bolsa Beneficiaries	-0.016	0.067	-0.067	-0.064	0.072	0.240*	-0.210	-0.055
	(0.141)	(0.137)	(0.078)	(0.052)	(0.094)	(0.127)	(0.155)	(0.227)
Individual/Household Controls	1	1	1	1	1	1	1	1
Municipality Controls	1	1	1	1	1	1	1	1
State Fixed Effects	1	1	1	1	1	1	1	1
Dep. Var. Mean	0.887	0.884	0.955	0.961	0.051	0.129	0.586	0.302
R^2	0.074	0.090	0.173	0.055	0.189	0.423	0.299	0.126
Observations	2,294	2,441	1,991	2,072	2,281	2,418	2,344	2,487

Notes: Please see Table 2. The results in odd numbered columns are for a sample limited to girls, while the results in even numbered columns are for boys.

boys attend school during normal rainfall as well. The likelihood of doing domestic labor does not change among boys, but for girls a 15% rainfall increase causes it to fall by 6.8 percentage points. Among Bolsa beneficiaries, we estimate the effect of rainfall shocks on the likelihood of doing domestic labor to be statistically indistinguishable from zero among both girls and boys.

Third, Table 6 presents results for younger children (ages 6-14) and older children (ages 15-17), analyzing the equivalent of elementary and middle school ages in the first regression and high school in the second. Given that older children are more likely to engage in paid labor, it is possible that the substitution effect from positive wage shocks is stronger, making them more likely to reduce schooling and increase paid labor. Indeed we find this to be the case, with a 15% increase in rainfall raising the likelihood of doing paid labor among 15-17 year olds by 9.7 percentage points. Importantly, this impact is not mitigated by Bolsa, indicating that Bolsa transfers may not be enough to protect older children from paid labor during shocks. Furthermore, we find that during a positive rainfall shock the likelihood of doing domestic work falls by 7.3 percentage points (though Bolsa receipt nullifies this change). This suggests that much of the adjustment happens as older children give up domestic work to work

Table 6: Effect of Rainfall Shocks on Child Schooling and Labor by Age

	School (=1)		School (Cont.)		Paid Work (=1)		Domestic Work (=1)	
	(1) Ages 6-14	(2) Ages 15-17	(3) Ages 6-14	(4) Ages 15-17	(5) Ages 6-14	(6) Ages 15-17	(7) Ages 6-14	(8) Ages 15-17
Bolsa Treatment (=1)	0.045*	0.071	0.024**	0.039**	0.026	-0.035	0.011	-0.075*
	(0.023)	(0.046)	(0.011)	(0.015)	(0.022)	(0.038)	(0.037)	(0.043)
Current Rainfall Deviation	0.029	-0.273	-0.122*	0.117*	0.255*	0.638***	-0.156	-0.482**
	(0.135)	(0.187)	(0.062)	(0.069)	(0.146)	(0.202)	(0.191)	(0.215)
Bolsa × Current Rainfall Deviation	-0.053	0.395***	0.005	-0.179***	-0.243	-0.259	0.009	0.302*
	(0.081)	(0.152)	(0.041)	(0.054)	(0.150)	(0.164)	(0.155)	(0.165)
Lagged Rainfall Deviation	0.268**	0.255	-0.129	-0.142*	-0.039	-0.288	0.146	0.242
	(0.116)	(0.254)	(0.106)	(0.078)	(0.126)	(0.230)	(0.196)	(0.206)
Bolsa × Lagged Rainfall Deviation	-0.167	-0.384*	-0.016	0.033	-0.064	0.396**	0.253	0.049
	(0.103)	(0.218)	(0.053)	(0.072)	(0.094)	(0.196)	(0.164)	(0.174)
Coefficient Combinations								
Bolsa During Current Rainfall Deviations	-0.008	0.466***	0.029	-0.140***	-0.217	-0.294**	0.020	0.227
	(0.073)	(0.135)	(0.040)	(0.048)	(0.133)	(0.149)	(0.137)	(0.138)
Current Rainfall for Bolsa Beneficiaries	-0.024	0.123	-0.117**	-0.062	0.012	0.378**	-0.147	-0.180
	(0.131)	(0.160)	(0.057)	(0.077)	(0.091)	(0.166)	(0.175)	(0.236)
Individual/Household Controls	1	1	1	1	1	1	1	1
Municipality Controls	1	1	1	1	1	1	1	1
State Fixed Effects	1	1	1	1	1	1	1	1
Dep. Var. Mean	0.909	0.832	0.957	0.960	0.061	0.160	0.375	0.577
R^2	0.051	0.093	0.098	0.095	0.494	0.202	0.219	0.276
Observations	3,233	1,502	2,851	1,212	3,187	1,512	3,297	1,534

Notes: Please see Table 2. The results in odd numbered columns are for a sample limited to individuals age 6 to 14, while the results in even numbered columns are for individuals age 15 to 17.

for money. We also find weak evidence that current rainfall shocks may increase the level of school attendance along the intensive margin, with Bolsa undoing this effect. In fact, we find that during shocks, Bolsa serves to increase the likelihood that older children attend school at all while decreasing the level of attendance among those attending school. Among younger children, we find weak evidence that current positive rainfall deviations cause the likelihood of doing paid work to increase and the level of school attendance to fall. This provides some evidence that younger children may also reduce schooling in order to benefit from positive wage shocks, but these results are each significant only at the 10% level.

Thus, overall we find evidence suggesting that positive current rainfall deviations increase the likelihood that children do paid work while Bolsa mitigates some of this effect. The effects of rainfall deviations primarily occur among children who are in rural areas, boys, or aged 15-17, with Bolsa effectively mitigating the increase in paid work in rural areas but being less effective among boys or older children.

5.4 Robustness Checks

Panel Methods

While our main analysis is preferable because it estimates propensity score weights using baseline data before analyzing outcomes after the receipt of Bolsa transfers, the use of both 2005 and 2009 data has the added benefit of providing more rainfall variation. Thus, we use panel methods as a robustness check for our main results. As above, we restrict our analysis to households that were registered in the Cadastro in both 2005 and 2009 in order to control for selection among households. We focus on both current shocks (in either 2009 or 2005) and lagged shocks (in either 2008 or 2004) and interact each with Bolsa treatment. Thus, we estimate the following regression for child i in household h in municipality m in year t:

$$S_{ihmt} = \alpha + \beta_1 T_{ihmt} + \beta_2 R_{m,t} + \beta_3 T_{ihmt} R_{m,t} + \beta_4 R_{m,t-1} + \beta_5 T_{ihmt} R_{m,t-1} + \gamma X_{it} + \delta X_{ht} + \mu_m + \mu_t + \epsilon_{ihmt} \quad (5.1)$$

A household is defined as treated by Bolsa ($T_{ihmt} = 1$) in the 2005 or 2009 survey year t if they receive Bolsa transfers in that particular year. Thus, the panel analysis increases our sample and allows for households to be never treated, treated in both years, treated in 2005 but not 2009, or treated in 2009 but not 2005 (which were the only households defined as treated above). X_{it} again includes child age fixed effects and indicators for gender and race. Since households can accurately be matched across both surveys, we control for household fixed effects (μ_h) to capture time-invariant household variables. Given that some household variables change through time, we additionally control for the household-level variables utilized above (X_{ht}), although the results are generally robust to their exclusion. We include municipality fixed effects (μ_m) to capture municipal-level factors that may be correlated with child schooling and labor decisions, the impacts of rainfall shocks, and the implementation of Bolsa. We also include survey wave fixed effects to control for common changes over time (μ_t). Note that our Bolsa identification relies upon variation within given families as they transition into or out of Bolsa between 2005 and 2009, controlling for a range of time variant and invariant characteristics, which may include, for example, unobservable preferences regarding education across various siblings.

Table 7 provides our main panel results, with domestic work dropped because it is unavailable for 2005. We find that Bolsa increases the likelihood of attending school by 1.8 percentage points. However, we see evidence that the level of school attendance falls with current positive rainfall deviations, with a one standard deviation increase in current rainfall causing the share of days attended to fall by 0.6 percentage points among non-Bolsa beneficiaries. Bolsa mitigates these negative effects, with the estimates of the effect of rainfall deviations among Bolsa

Table 7: Effect of Rainfall Shocks on Child Schooling and Labor (Panel Results)

	(1) Attends School (=1)	(2) School Attendance (Continuous)	(3) Does Paid Work (=1)
Bolsa Treatment (=1)	0.018*	-0.000	-0.009
	(0.011)	(0.006)	(0.009)
Current Rainfall Deviation	-0.031	-0.038*	0.060
	(0.036)	(0.019)	(0.039)
Bolsa × Current Rainfall Deviation	0.049	0.049*	-0.045
	(0.042)	(0.026)	(0.050)
Lagged Rainfall Deviation	0.002	0.027	-0.032
	(0.043)	(0.024)	(0.045)
Bolsa × Lagged Rainfall Deviation	-0.032	0.002	0.056
	(0.043)	(0.027)	(0.048)
Coefficient Combinations			
Bolsa During Current Rainfall Deviations	0.067*	0.049*	-0.054
	(0.041)	(0.025)	(0.049)
Current Rainfall for Bolsa Beneficiaries	0.018	0.012	0.015
	(0.031)	(0.019)	(0.037)
Individual/Household Controls	1	1	1
Household Fixed Effects	1	1	1
Municipality Fixed Effects	1	1	1
Survey Wave Effects	1	1	1
Dep. Var. Mean	0.913	0.964	0.064
R^2	0.428	0.504	0.522
Observations	20,663	17,936	20,554

Notes: Estimates from equation (5.1). Sample consists individuals between 6 and 17 years of age whose households were registered in the Cadastro in 2005 and 2009 and for whom we observe all control variables. Rainfall deviation measures are the difference between the natural logarithm of a given year's rainfall in an individual's municipality of residence and the natural logarithm of the mean rainfall in that same municipality from 1940 to 2010. The Bolsa treatment indicator is defined to be 1 if the individual is a member of a household that reports receiving Bolsa benefits in a given survey. For those who attend school, the continuous school attendance measure is the share of days in the last week an individual reports attending school. Individual and household controls include age fixed effects, gender, race, measures of household composition, and proxies for household wealth. All regressions include household, municipality, and survey wave fixed effects. Standard errors clustered at the municipality level are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

beneficiaries being significantly indistinguishable from zero for all outcomes and the interaction term in column 2 being statistically significant. Furthermore, we see that during positive rainfall deviations, Bolsa has a significantly positive impact on school attendance and the share of days attended. The impact of current rainfall deviations on the likelihood a child does paid labor is positive but not quite statistically significant. Even when not significant, we find consistent trends in the sign of the coefficients for both current and lagged rainfall. In Tables 1, 2, and 7, the coefficient for current rainfall is always negative for both schooling outcomes and positive for paid labor while the coefficient for lagged rainfall is instead positive for both schooling outcomes and negative for paid labor. Across both our identification strategies, these results are consistent with current wage opportunities pulling children out of school and into labor through a substitution effect and previous wage opportunities enabling more current school and less labor through an income effect.

Overall, our panel results are similar to our main results, adding credence to our findings that positive rainfall shocks increase child labor and decrease school attendance and that Bolsa is able to ameliorate these effects.[13]

Multiple Hypothesis Testing

Due to concerns about multiple hypothesis testing, we follow Evans et al. (2019) and perform three corrections to the results from our main propensity score specification, using the Benjamini and Hochberg (Benjamini and Hochberg, 1995), Benjamini-Krieger-Yekutieli (Benjamini et al., 2006), and Bonferroni correction methods. Supplementary Materials Section SM6 provides more detail on our implementation of these tests and our results. We find that nineteen, twenty-one, and four out of forty-two originally statistically significant results remain significant using the Benjamini and Hochberg, Benjamini-Krieger-Yekutieli, and Bonferroni methods, respectively.

6 Conclusion

In this article, we show that for children in Bolsa eligible households, the substitution effect of positive wage shocks dominates the income effect, finding robust and significant evidence that current rainfall deviations are positively correlated with child labor and negatively correlated with schooling. Furthermore, our results are economically meaningful, with a one standard deviation increase in current rainfall causing a 4.6 percentage point increase in the likelihood that a child does paid labor. While a large number of studies find that positive shocks tend to increase educational investments and reduce child labor, our paper aligns with several papers finding the opposite in Brazil, including Kruger (2007), Duryea and Arends-Kuenning (2003), and Soares et al. (2012). This effect is strongest among children in rural areas, where the impact of rainfall on wages is likely to be large, as well as among boys and children age 15-17, for whom the opportunity cost of attending school is likely higher and more responsive to economic conditions.

Whether the response to positive rainfall shocks is optimal in the long run is not obvious. For the poor, extra earnings in the short run are certainly valuable, potentially allowing greater consumption, saving, and investment. On the other hand, the decision to reallocate children's time away from school may have negative long-run consequences that are not properly being taken into account if, for example, households underestimate the returns to education. These long-run costs may be more likely to arise when children drop out of school. In our sample, only 39% of children who did not attend school last year subsequently return to school the following year, indicating that exits from school are often permanent. Furthermore, long-run costs may appear when children reduce schooling along the intensive margin, resulting in lower academic performance. We find evidence that lagged positive wage shocks lead to reduced academic progress among Bolsa beneficiaries, presumably because they reduced their level of school attendance at the time of the shock.

Additionally, we find that Bolsa is able to mitigate responses to shocks and that overall Bolsa improves school attendance. Reassuringly, this mitigation is especially strong for children in rural areas, where the effect of rainfall shocks are most pronounced, indicating that Bolsa is successfully serving as a safety net for this population. On the other hand, we also find that Bolsa is least effective at mitigating the impact of rainfall shocks among other populations that are especially responsive to variations in rainfall, specifically boys and older children. While it is not surprising that Bolsa is less able to mitigate shocks when the responses of the relevant population are stronger, it is nonetheless an area for potential increased effectiveness. Furthermore, during positive short-run wage opportunities, children can reduce their level of school attendance while remaining eligible, and we find evidence that this reduced attendance may cause children to suffer worse academic progression and greater dropout rates, indicating a potential hidden cost.

Overall, our research emphasizes the tradeoffs that households make between short-run income and long-run investments, a tradeoff policymakers must carefully weigh when crafting and enforcing the conditions of a social program. Our results indicate that Bolsa encourages school attendance through conditionalities successfully altering the opportunity cost of schooling during shocks. Nonetheless, larger transfers could help increase both short-run and long-run household benefits. Finally, our research indicates that while Bolsa could be more effective in targeting certain populations that respond more strongly to shocks, in general Bolsa serves as an effective safety net, keeping children in school and out of the labor force during short-run income shocks, potentially having positive long-run effects on human capital and the ability for children to escape poverty.

Acknowledgements

We are grateful for the suggestions from two anonymous referees and we also benefitted from feedback from participants at the Midwest International Economic Development Conference and the Latin American and Caribbean Economics Association Meetings. We would like to thank Davidson College for financial assistance in support of this project. While government approval for the data was required, we are happy to supply our code analyzing this data upon request.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Using the same data, de Brauw et al. (2015b) find that the educational effects of Bolsa are largest among rural girls and older children. We also find that Bolsa has the biggest impact in rural areas and among older children and find that this is especially true during shocks.

2. For example, Assunção and Feres (2009) find that rainfall positively affects agricultural output, especially when including a range of soil and geographic controls, while Mueller and Osgood (2009) use national household survey data from the 1990s to show that droughts reduce wages for all rural workers and urban workers with agriculture as their primary source of income.

3. The data we use includes very few responses to questions about specific occupations and sectors of work. Based on under 350 responses, 84% of rural children and 14% of urban children work in agriculture. If these averages were to hold for our entire sample, then our combined sample would include 1,331 individuals (28%) who work in agriculture. Agricultural worker is the most common occupation in rural areas and the third most common in urban areas. Additionally, many other individuals work in jobs that might be related to agricultural production and the strength of the regional economy, including vendors (the second most common urban occupation). Our data on a significant number of urban workers working in agriculture matches the historical importance of urban-based agricultural workers. Some of these workers combine informal urban work with temporary rural agricultural labor and are known as *bóias frias*, which means "cold lunch" due to the inability to take hot lunches to farms several hours away. Most relevant to our study, children long constituted a significant proportion of *bóias frias* and are most likely to work during periods of high labor demand such as planting and harvesting (see, for example, the references in Saint, 1981). As a result, these jobs likely respond to local rainfall deviations.

4. While the survey collected information on the number of hours devoted to paid labor and domestic work, we focus on participation instead given that the reported hours have outliers indicating possible misreporting and that there are relatively few observations for hours reported for paid labor.

5. This numbering of the coefficients matches that of our main regression of interest (4.3).

6. Like for our main analysis, we restrict estimation to households that are registered in the Cadastro in both 2005 and 2009, and the treatment indicator is equal to 1 if a household received Bolsa transfers in 2009 but not in 2005 and 0 if they did not receive Bolsa in either year.

7. Our results are robust to several alternative lists of variables, including our efforts to replicate the list of variables selected for the propensity score in de Brauw et al. (2015b).

8. We may be concerned that the inclusion of lagged rainfall in our estimating equations biases our results because of autocorrelation in rainfall from year to year, regression to the mean, or rainfall impacting the likelihood of receiving Bolsa. Due to these concerns, we present results that do not include lagged rainfall or the interaction of lagged rainfall with Bolsa treatment as regressors in Supplementary Materials Section SM5.

9. The summary statistics in Table A1 do not account for the propensity score and attrition weights, which are included in the regression results. This explains the slight difference in the dependent variable means reported in the results tables.

10. This effect is the Bolsa interaction term (β_3) multiplied by the standard deviation of rainfall plus the Bolsa treatment effect (β_1), i.e. $(-0.264) \times 0.152 + 0.005 = -0.035$.

11. Examining the effects of lagged rainfall deviation provides some useful insight into the mechanisms at play here. We find that lagged rainfall increases the likelihood of school attendance, which is consistent with previous positive shocks increasing current income but not opportunity costs of schooling. Interestingly, the interaction term provides strong evidence that Bolsa undoes this effect. This is consistent with positive rainfall deviations improving labor market conditions while Bolsa recipients do not significantly increase their labor force participation, forgoing this short-run opportunity for extra income. This means that Bolsa children are not as susceptible to being pulled out of school to enter the labor market, but it also means that the income effect from lagged rainfall is not as large as it otherwise would be. Thus, we see that Bolsa undoes the positive effect of lagged rainfall on current school attendance.

12. Because these measures are conditional on school attendance in the previous years, there may be concerns about selection bias. In particular, if weak students drop out in response to positive rainfall shocks, then our estimate of the effect of lagged rainfall will be biased toward seeming more beneficial for educational outcomes. If the strength of this selection effect depends on Bolsa receipt (which we find to be the case in Table 2), then our estimate of the interaction of Bolsa treatment and lagged rainfall deviations will similarly be biased. This potential source of bias should be kept in mind when interpreting these results.

13. We provide additional analysis of heterogeneity using this identification strategy in Supplementary Materials Section SM4.

References

Anderson, M. L. (2008). Multiple inference and gender differences in the effects of early intervention: A reevaluation of the abecedarian, perry preschool, and early training projects. *Journal of the American statistical Association*, 103(484):1481–1495.

Assunção, J. and Feres, F. C. (2009). Climate change, agricultural productivity and poverty. Technical report, Working paper, Department of Economics, Pontifícia Universidade Católica.

Attanasio, O., Fitzsimons, E., Gomez, A., Gutierrez, M. I., Meghir, C., and Mesnard, A. (2010). Children's schooling and work in the presence of a conditional cash transfer program in rural Colombia. *Economic Development and Cultural Change*, 58(2):181–210.

Baez, J. E., Lucchetti, L., Genoni, M. E., and Salazar, M. (2017). Gone with the storm: Rainfall shocks and household wellbeing in Guatemala. *The Journal of Development Studies*, pages 1–19.

Bandara, A., Dehejia, R., and Lavie-Rouse, S. (2015). The impact of income and non-income shocks on child labor: Evidence from a panel survey of Tanzania. *World Development*, 67:218–237.

Basu, K. and Tzannatos, Z. (2003). The global child labor problem: What do we know and what can we do? *The World Bank Economic Review*, 17(2):147–173.

Beegle, K., Dehejia, R. H., and Gatti, R. (2006). Child labor and agricultural shocks. *Journal of Development Economics*, 81(1):80–96.

Behrman, J. R., Gaviria, A., and Székely, M. (2001). Intergenerational mobility in Latin America. *Economia*, 2(1):1–44.

Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, 57(1):289–300.

Benjamini, Y., Krieger, A. M., and Yekutieli, D. (2006). Adaptive linear step-up procedures that control the false discovery rate. *Biometrika*, 93(3):491–507.

Björkman-Nyqvist, M. (2013). Income shocks and gender gaps in education: Evidence from Uganda. *Journal of Development Economics*, 105:237–253.

Bourguignon, F., Ferreira, F. H., and Leite, P. G. (2003). Conditional cash transfers, schooling, and child labor: Micro-simulating Brazil's Bolsa Escola program. *The World Bank Economic Review*, 17(2):229–254.

de Brauw, A., Gilligan, D. O., Hoddinott, J., and Roy, S. (2014). The impact of Bolsa Família on women's decision-making power. *World Development*, 59:487–504.

de Brauw, A., Gilligan, D. O., Hoddinott, J., and Roy, S. (2015a). Bolsa Família and household labor supply. *Economic Development and Cultural Change*, 63(3):423–457.

de Brauw, A., Gilligan, D. O., Hoddinott, J., and Roy, S. (2015b). The impact of Bolsa Família on schooling. *World Development*, 70:303–316.

de Janvry, A., Finan, F., Sadoulet, E., and Vakis, R. (2006). Can conditional cash transfer programs serve as safety nets in keeping children at school and from working when exposed to shocks? *Journal of Development Economics*, 79(2):349–373.

Del Carpio, X. V., Loayza, N. V., and Wada, T. (2016). The impact of conditional cash transfers on the amount and type of child labor. *World Development*, 80:33–47.

Duryea, S. and Arends-Kuenning, M. (2003). School attendance, child labor and local labor market fluctuations in urban Brazil. *World Development*, 31(7):1165–1178.

Duryea, S., Lam, D., and Levison, D. (2007). Effects of economic shocks on children's employment and schooling in Brazil. *Journal of Development Economics*, 84(1):188–214.

Emerson, P. M. and Souza, A. P. (2003). Is there a child labor trap? Intergenerational persistence of child labor in Brazil. *Economic Development and Cultural Change*, 51(2):375–398.

Evans, D. K., Holtemeyer, B., and Kosec, K. (2019). Cash transfers and health: Evidence from tanzania. *The World Bank Economic Review*, 33(2):394–412.

Gitter, S. R. and Barham, B. L. (2009). Conditional cash transfers, shocks, and school enrolment in Nicaragua. *The Journal of Development Studies*, 45(10):1747–1767.

Glewwe, P. and Kassouf, A. L. (2012). The impact of the Bolsa Escola/Familia conditional cash transfer program on enrollment, dropout rates and grade promotion in Brazil. *Journal of Development Economics*, 97(2):505–517.

Goodman, D. and Redclift, M. (1977). The ?Bóias-Frias?: rural proletarization and urban marginality in Brazil.

Hochberg, Y. (1988). A sharper bonferroni procedure for multiple tests of significance. *Biometrika*, 75(4):800–802.

Jacoby, H. G. and Skoufias, E. (1997). Risk, financial markets, and human capital in a developing country. *The Review of Economic Studies*, 64(3):311–335.

Jensen, R. (2000). Agricultural volatility and investments in children. *The American Economic Review*, 90(2):399–404.

Jonasson, E. and Helfand, S. M. (2010). How important are locational characteristics for rural non-agricultural employment? lessons from Brazil. *World Development*, 38(5):727–741.

Kageyama, A. and Hoffmann, R. (2000). Determinantes da renda e condições de vida das famílias agrícolas no Brasil. *Economia*, 1(2):147–183.

Kruger, D. I. (2007). Coffee production effects on child labor and schooling in rural Brazil. *Journal of development Economics*, 82(2):448–463.

Maccini, S. and Yang, D. (2009). Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review*, 99(3):1006–1026.

Mueller, V. A. and Osgood, D. E. (2009). Long-term impacts of droughts on labour markets in developing countries: evidence from Brazil. *The Journal of Development Studies*, 45(10):1651–1662.

Parker, S. W. and Vogl, T. (2018). Do conditional cash transfers improve economic outcomes in the next generation? evidence from mexico. Technical report, National Bureau of Economic Research.

Ravallion, M. and Wodon, Q. (2000). Does child labour displace schooling? evidence on behavioural responses to an enrollment subsidy. *The Economic Journal*, 110(462):158–175.

Rawlings, L. B. and Rubio, G. M. (2005). Evaluating the impact of conditional cash transfer programs. *The World Bank Research Observer*, 20(1):29–55.

Reynolds, S. A. (2015). Brazil's Bolsa Familia: Does it work for adolescents and do they work less for it? *Economics of Education Review*, 46:23–38.

Rocha, R. and Soares, R. R. (2015). Water scarcity and birth outcomes in the Brazilian semiarid. *Journal of Development Economics*, 112:72–91.

Rosenzweig, M. R. and Evenson, R. (1977). Fertility, schooling, and the economic contribution of children of rural india: An econometric analysis. *Econometrica*, pages 1065–1079.

Saint, W. S. (1981). The wages of modernization: A review of the literature on temporary labor arrangements in Brazilian agriculture. *Latin American Research Review*, 16(3):91–110.

Schady, N. (2001). The (positive) effect of macroeconomic crises on schooling and employment decisions taken by children in a middle-income country. *Policy Research Working Paper*, (2762).

Schultz, T. P. (2004). School subsidies for the poor: evaluating the Mexican Progresa poverty program. *Journal of Development Economics*, 74(1):199–250.

Shah, M. and Steinberg, B. M. (2017). Drought of opportunities: Contemporaneous and long-term impacts of rainfall shocks on human capital. *Journal of Political Economy*, 125(2):527–561.

Skoufias, E. and Parker, S. W. (2001). Conditional cash transfers and their impact on child work and schooling: Evidence from the Progresa program in Mexico. *Economia*, 2(1):45–96.

Soares, F. V., Ribas, R. P., and Osório, R. G. (2010). Evaluating the impact of Brazil's Bolsa Família: Cash transfer programs in comparative perspective. *Latin American Research Review*, 45(2):173–190.

Soares, R. R., Kruger, D., and Berthelon, M. (2012). Household choices of child labor and schooling a simple model with application to Brazil. *Journal of Human Resources*, 47(1):1–31.

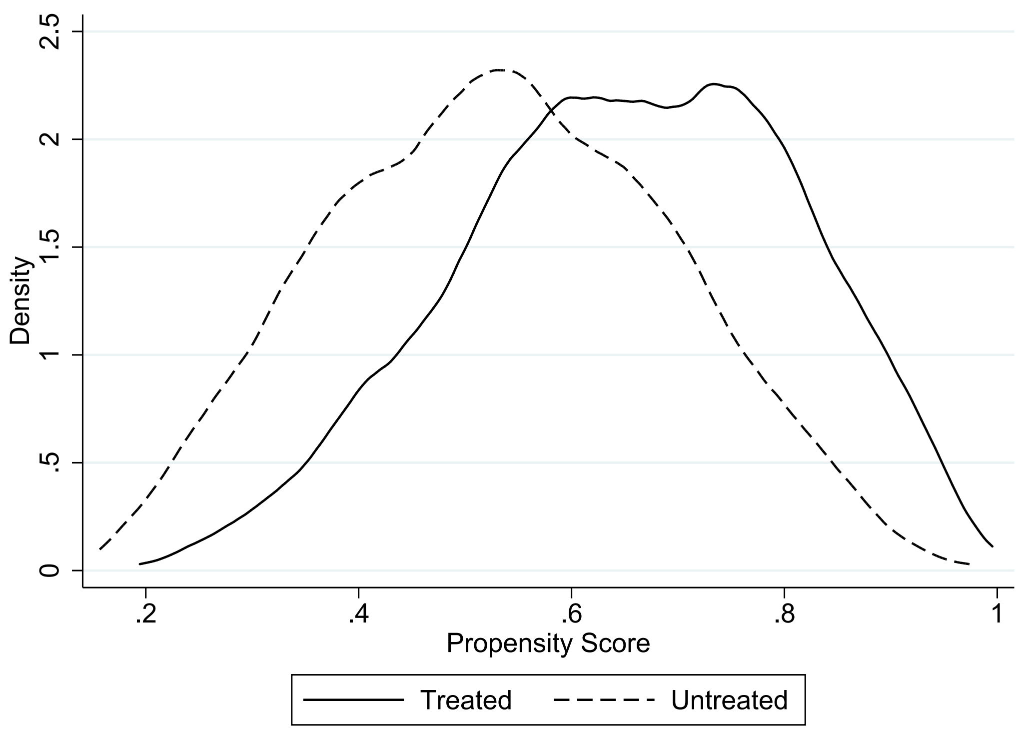
Thomas, D., Beegle, K., Frankenberg, E., Sikoki, B., Strauss, J., and Teruel, G. (2004). Education in a crisis. *Journal of Development Economics*, 74(1):53–85.

Willmott, C. J. and Matsuura, K. (2015). Terrestrial air temperature and precipitation: Monthly and annual time series (1950 - 2014).

Appendix

Table A1 presents summary statistics for our sample. Table A2 presents similar summary statistics for households in our sample in 2005, showing the differences across the treatment and control groups before and after applying our propensity score and attrition weights. Figure A1 shows the densities of propensity score weights for treament and control households. The significant overlap of the distributions along with the few significant differences across groups when applying our weights together indicate that our treatment and control groups provide a reliable comparison.

Figure A1: Propensity Score Densities



Notes: Propensity scores come from the estimation of Equation (4.2). The sample includes households that are registered in the Cadastro in both 2005 and 2009 and did not recieve Bolsa in 2005. The treatment group is households that received Bolsa in 2009 and the control group is those that did not.

Table A1: Summary Statistics

	Mean	St. Dev.	Obs.
Rainfall Deviations			
Current Rainfall Devation	0.19	0.15	4,841
Lagged Rainfall Devation	0.12	0.14	4,841
Treatment and Outcomes			
Bolsa Treatment (=1)	0.70	0.46	4,841
Attends School (=1)	0.89	0.32	4,745
School Attendance (Continuous)	0.96	0.13	4,073
Does Paid Work (=1)	0.06	0.24	4,709
Does Domestic Work (=1)	0.45	0.50	4,841
Progressed from Previous Grade (=1)	0.77	0.42	3,398
Repeated Previous Grade (=1)	0.16	0.36	3,398
Dropped Out of School (=1)	0.07	0.26	3,398
Controls			
Age	12.21	3.38	4,841
Female (=1)	0.48	0.50	4,841
White (=1)	0.29	0.46	4,841
Black (=1)	0.12	0.32	4,841
Head of Household is Female (=1)	0.41	0.49	4,841
Head of Household Age	44.48	11.23	4,841
Head of Household is Literate (=1)	0.79	0.41	4,841
Household Members under Age 6 (#)	0.40	0.70	4,841
Household Members under Age 15 (#)	2.16	1.49	4,841
Household Members (#)	5.25	1.94	4,841
Family Owns Home (=1)	0.61	0.49	4,841
Number of Rooms in Home	5.13	1.41	4,841
Piper Water in Home (=1)	0.85	0.36	4,841

Notes: Sample consists individuals between 6 and 17 years of age whose households were registered in the Cadastro in 2005 and 2009 and for whom we observe all control variables. All characteristics are from 2009. Rainfall deviation measures are the difference between the natural logarithm of a given year's rainfall in an individual's municipality of residence and the natural logarithm of the mean rainfall in that same municipality from 1940 to 2010. The Bolsa treatment indicator is defined to be 1 if the individual is a member of a household that reports receiving Bolsa benefits in a given survey. For those who attend school, the continuous school attendance measure is the share of days in the last week an individual reports attending school. Grade progression and repetition and dropout are defined for only individuals who attended school the year prior to the survey.

Table A2: Weighted Means for Treatment and Control Groups

	Unweighted				Weighted			
	Untreated	Treated	Difference	Significance	Untreated	Treated	Difference	Significance
Attends School (=1)	0.920	0.933	-0.013	0.06	0.922	0.934	-0.012	0.17
School Attendance (Continuous)	0.955	0.967	-0.012	0.00	0.959	0.966	-0.007	0.13
Does Paid Work (=1)	0.079	0.068	0.011	0.11	0.061	0.066	-0.006	0.43
Progressed from Previous Grade (=1)	0.642	0.636	0.006	0.65	0.621	0.636	-0.016	0.38
Repeated Previous Grade (=1)	0.220	0.234	-0.015	0.19	0.237	0.233	0.004	0.81
Dropped Out of School (=1)	0.039	0.034	0.005	0.35	0.033	0.034	-0.001	0.89
Current Rainfall Devation	0.023	-0.001	0.024	0.00	0.010	-0.001	0.011	0.13
Lagged Rainfall Devation	0.095	0.127	-0.031	0.00	0.132	0.116	0.016	0.10
Age	12.159	11.411	0.748	0.00	11.455	11.392	0.064	0.58
Female (=1)	0.492	0.482	0.010	0.46	0.478	0.481	-0.003	0.88
White (=1)	0.381	0.278	0.103	0.00	0.307	0.296	0.011	0.47
Black (=1)	0.090	0.106	-0.016	0.04	0.103	0.104	-0.001	0.95
Head of Household is Female (=1)	0.329	0.358	-0.029	0.02	0.360	0.359	0.000	0.99
Head of Household Age	44.626	42.799	1.828	0.00	41.298	42.587	-1.290	0.00
Head of Household is Literate (=1)	0.786	0.734	0.052	0.00	0.744	0.748	-0.004	0.83
Household Members under Age 6 (#)	0.447	0.717	-0.270	0.00	0.788	0.717	0.071	0.10
Household Members under Age 15 (#)	2.097	2.880	-0.783	0.00	2.951	2.869	0.081	0.28
Household Members (#)	5.059	5.742	-0.682	0.00	5.790	5.708	0.082	0.34
Family Owns Home (=1)	0.619	0.665	-0.046	0.00	0.611	0.653	-0.041	0.03
Number of Rooms in Home	5.367	4.964	0.403	0.00	5.048	4.965	0.084	0.09
Piper Water in Home (=1)	0.883	0.754	0.129	0.00	0.804	0.771	0.033	0.09

Notes: Sample consists individuals between 6 and 17 years of age whose households were registered in the Cadastro in 2005 and 2009 and for whom we observe all control variables. All characteristics are from 2005. Rainfall deviation measures are the difference between the natural logarithm of a given year's rainfall in an individual's municipality of residence and the natural logarithm of the mean rainfall in that same municipality from 1940 to 2010. The Bolsa treatment indicator is defined to be 1 if the individual is a member of a household that reports receiving Bolsa benefits in a given survey. For those who attend school, the continuous school attendance measure is the share of days in the last week an individual reports attending school. Grade progression and repetition and dropout are defined for only individuals who attended school the year prior to the survey. The first four columns give the unweighted means for the treatment and control groups, while the last four columns apply our propensity score and attrition weights.