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A cost-effectiveness analysis of social transfers on human capital accumulation

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Abstract. The paper reports on an ex-ante evaluation of the long-term effect of the Ecuadorian social transfer programme called "Bono de Desarrollo Humano (BDH)" on human capital accumulation. A dynamic cohort microsimulation model is used to analyse for cost-effectiveness of different policy scenarios. Results show that cash transfers do promote human capital accumulation but with rather small effect. Transfers targeted at critical ages are the most cost-effective to promote human capital accumulation.

Key Words: human capital; cash transfer; economic development.

Un análisis costo-eficiencia de transferencias sociales en la acumulación de capital humano

Resumen. Este artículo reporta una evaluación ex-ante del efecto de largo plazo del programa de transferencias sociales ecuatoriano, "Bono de Desarrollo Humano (BDH)", en la acumulación de capital humano. Se usó una micro simulación de un modelo dinámico de cohortes para analizar su costo-eficiencia bajo diferentes escenarios de política. Los resultados muestran que las transferencias de efectivo promueven la acumulación de capital humano, aunque su efecto es pequeño. Las transferencias enfocadas a edades críticas son las que muestran mayor costo-eficiencia para promover la acumulación de capital humano.

Palabras clave: capital humano; transferencias de efectivo; desarrollo económico.

Clasificación JEL: I22; I38; O1.

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1. Introduction

This paper studies the effect of social transfers on human capital accumulation as it is a main driver for social mobility and long-term economic effects of investments on social protection. Becker and Tomes (1986, 1994) argue that in the case of poor households underinvestment can be seen as a result of "poverty traps" related with households size, high opportunity costs and credit constrains, and state the role of investments on children on intergenerational mobility. Similarly, Heckman and Mosso (2014) argue on the importance of early childhood conditions on social mobility.

Social transfers support poor households to invest on human capital as they directly increase households' disposable income (*i.e.* income effect), but the way social transfers are implemented or conditioned may also enforce certain behaviour (*i.e.* non-income effect). Nevertheless, effects on human capital is conditioned on the level of coverage, quality of service and the elimination of different access barriers regarding health, education and sanitation services (Mideros *et al.*, 2012). Under this perspective, the research question this paper aims to answer is: whether and to what extent social transfers foster long-term human capital accumulation?

The contribution goes on two directions. First, the effect of social transfers on human capital accumulation over the lifecycle is empirically explored; something that the literature has not completely covered yet.[1] Second, alternative designs of social transfers are evaluated by their cost-effectiveness. Even though human capital is multidimensional the scope of this study is limited to the income effect of social transfers on schooling, measured by the years of education achieved.

A dynamic cohort microsimulation model is developed for a cohort of 5-years-old children, simulating 14 years as discrete periods, to calculate the level of human capital accumulated up to the age of 18 years old. The model uses age specific surviving rates estimated from official demographic projections and own calculations for school attendance and marriage status, while social transfers, education policies, household income, education achievements (*i.e.* grade promotion) are exogenous in the model. Data is from the Ecuadorian National Survey of Employment, Unemployment and Underemployment (Encuesta Nacional de Empleo, Desempleo y Subempleo, ENEMDU, by its acronym in Spanish) of the National Institute of Statistics and Censuses

[1] For a recent evaluation see Milllán *et al.* (2020). While Millán *et al.* estimate intent-to-treat effect exploiting municipal-level randomized assignment, this study is based on an ex-ante strategy to evaluate cost-effective scenarios.

(Instituto Nacional de Estadística y Censos, INEC, by its acronym in Spanish) which provides necessary information about individuals, households and social transfers.

The rest of the paper is organized as follows. Section two discusses the theoretical framework to link social transfers with human capital accumulation. Section three presents the model and exposes the data and the parameters. A cost-effectiveness analysis of policy options is discussed in section four, and final remarks are elaborated in section five.

2. SOCIAL TRANSFERS AND HUMAN CAPITAL

Social transfers provide additional secure income to poor households, affecting their consumption and investment patterns by allowing them to consume more goods and services of any kind, including nutritious food, health care and education, and promoting economic returns (Mideros *et al.*, 2016). In the case of education, for example, social transfers help households to cover fees, materials and transportation costs. Moreover as poverty and income insecurity "lead to distortions in inter-temporal resource allocation, forcing a focus on current consumption in preference to investment" (Barrientos, 2012, p. 15), social transfers help households to cover opportunity costs such as the labour income of school age members. In addition, social transfers may include human capital conditionalities to promote non-income effects on school attendance, health care and other dimensions of human capital.

Regarding empirical evidence of the effect of social transfers in the case of education, Bastagli *et al.* (2016) provide an extensive literature review analysing school attendance, test scores, and cognitive and problem solving skills. By reviewing 42 studies, they report that most of them show positive effects for boys and girls on school attendance and reduction on absenteeism. For example, Schady and Araujo (2008) found an increase in school enrolment of 10% in Ecuador. Results in the same direction are presented by Arnold *et al.* (2011) in Pakistan (11 percentage points (p.p.)), Malawi (5 p.p.) and Cambodia (30 p.p.); and reduction in the incidence of absence and drop out of 20 and 63%, respectively, in Brazil. In the case of Mexican programme "Oportunidades", Debowicz and Golan (2014) shows that extending the cash transfer programme increases school attendance.

The World Bank (2015) also presents evidence of reduction on the drop-out rate in Cambodia, and improvements on cognitive outcomes in Nicaragua. Similarly, UNICEF (2012) presents evidence of an increment in the probability

to complete high school of between 4 and 8 p.p. in Colombia. However, Bastagli *et al*. (2016) also report some studies where no effect has been found. They relate it with the baseline enrolment rate and transfer size. In the first case it is intuitive that "programmes in countries with lower baseline enrolment/attendance may deliver larger impacts compared to countries in which baseline enrolment is high" (Bastagli *et al*., 2016, p. 75), because there is more room for improvements. In addition, if there is not enough supply of education services, any kind of effect can be expected. In the case of transfer size, the authors mention that if it is not enough to cover opportunity costs, there may be no effect especially for higher education levels (Bastagli *et al*., 2016).

While school attendance can be intuitively related with a direct income effect which helps poor households to overcome demand side barriers (*e.g*. financial constraints), the effect of social transfers on test scores and cognitive development is less clear as they are mainly related with other social and environmental factors, including quality of education services (*i.e.* supply side policies). However some effects may be expected when social transfers promotes more regular school attendance, and due to an increase "in household expenditure resulting in better food security and nutritional status of children, which in turns may also positively affect child's cognitive ability and child's efficiency of learning while in school in the long term" (Bastagli *et al*., 2016, p. 75). Even more in the case of positive effects on cognitive development it happens under specific conditions related with complementary policies, socio-economic context, and age range.

Looking at cash transfer design, Bastagli *et al*. (2016) report higher effects for conditional cash transfers than for unconditional transfers, especially for girls, younger children and lower ability children, based on studies for the cases of Morocco (Benhassine *et al*., 2013), Burkina Faso (Akresh *et al*., 2013) and Malawi (Baird *et al*., 2011). Moreover, Baird *et al*. (2010) found that a conditional cash transfers targeted to young women in Malawi reduces early marriage, teenage pregnancy, and self-reported sexual activity. In the case of transfer size results are inconclusive.

Regarding timing, evidence suggests that "tying the transfer schedule to critical moments of the school year decision cycle can have an impact, especially on enrolment" (Bastagli *et al*., 2016, p. 118). In addition, Villa (2014) found that a longer exposure to Colombia's *Familias en Accion* conditional cash transfer programme leads to a higher human capital accumulation and school registration rates. Moreover, Fernald *et al.* (2008, 2009) found that the combined effect of longer exposure and higher cash transfer size is positive and significant for cognitive development results.

3. THE MODEL

Microsimulation is being increasingly applied to analyse economic and social policies on individuals and households (see for example Merz (1993) and Li and O'Donoghue (2013)). Dynamic cohort models simulating a single cohort over their lifetime have been applied to evaluate the effect of economic and social policies over the lifetime on income distribution (*e.g.* Baldini, 2001), public pensions (*e.g.* Geyer and Steiner, 2010) and cohort earnings (*e.g.* Van de Ven, 2006).

In this paper a dynamic cohort microsimulation model is developed to evaluate the effect of social transfers on human capital accumulation, measured by the years of education (*i.e.* schooling) accumulated by a person throughout her life. The model follows a cohort from the age of 5 years-old up to the age of 18 years-old by calculating four linear equations.

Equation 1 estimates the stock of schooling at a specific age (t), as a measure of the accumulation of human capital. It is accounted for each individual (i), based on the previous level of schooling (at $t-1$) plus an addition year if the individual attended school in the previous year times the grade (d)-area (a) specific probability to be promoted (see table 4 in the following subsection).

$$schooling_{i,t} = schooling_{i,t-1} + \left(attendance_{i,t-1} * Pr(promotion)_{d,a}\right) \quad (1)$$

Equation 2 estimates school attendance based on the age (t)-gender (g)-area (a) specific probability of attending school but adjusted on the social transfer's amount received (bdh_pc), past behaviour (*i.e.* school delay), and marriage status. Past behaviour $\left(past_{i,t}\right)$ is equal to $t - \left(5 + schooling_{i,t}\right)$.

$$attendance_{i,t} = Pr(attendance)_{t,g,a} + \left(\gamma * bdh\_pc_{i,t}\right) + \left(\delta * past_{i,t}\right) + \left(\rho * married_{i,t}\right) \quad (2)$$

Being married is estimated based on the age (t)-gender (g)-area (a) specific probability to get married, the effect of receiving a social transfer (bdh) as a dummy variable and the education level ($schooling_{i,t-1}$) (equation 3).

$$married_{i,t} = Pr(marriage)_{t,g,a} + \left(\alpha * bdh_{i,t}\right) + \left(\beta * schooling_{i,t-1}\right) \quad (3)$$

In this sense the effect of the Bono de Desarrollo Humano (BDH) on human capital accumulation is driven by its direct effect on school attendance by covering opportunity and transaction costs, but indirectly by reducing the probability of being marriage (see Baird *et al.*, 2010), which is also driven by school attendance (see Delprato *et al.*, 2015).

Finally, the model considers demographic changes (*i.e.* ageing) by adjusting weights (equation 4) using age specific survival rates (see table 5 in the following subsection).

$$weight_{i,t} = weight_{i,t-1} * survival_{t-1} \quad (4)$$

The model is kept as simple as possible to highlight the effects of interest. While it means that we accept strong "everything else constant" type of assumptions, they do not affect comparison between different scenarios of social transfers (BDH) which is the aim of this paper. Exogenous variables including the probabilities of attendance, marriage and promotion, as well as average marginal effects (α, β, γ, δ, ρ) are empirically calculated for the case of Ecuador on the following subsections.

Programme, data and variables

The Ecuadorian social transfer called BDH pays a flat cash transfer to poor households independent of labour conditions and the number of household members. The BDH transferred US$35 per month to each eligible household between 2009 and 2012, and US$50 since 2013. Recipient households were identified in 2009 by a proxy-mean test called Registro Social index (RS index). It is a multivariate welfare indicator estimated by non-linear principal components analysis with a value between 0 and 100. The eligibility threshold was estimated as a proxy of the consumption poverty line at a value of 36.50, mainly targeting poor households with children. Recipients are informed about their responsibility to ensure that children must attend school and visit health services, but accomplishment is not monitored.

The empirical analysis uses data from the ENEMDU, rounds of December from 2009 to 2013, of the INEC, which provides necessary information about individuals, households and the BDH.[2] The period correspond to the years

[2] Pooled data from the rounds of December between 2009 and 2013 are used to estimate average coefficients in order to avoid potential cyclical effects.

between the global financial crisis and the local economic slowdown due to the drop of oil prices, to avoid additional external shocks. The final data set is pool data including five years of cross-sectional information.

Pooled data during period 2009-2013 includes 80.940 observations of individuals between 5 and 18 years old during the period, from which 38.7% receive the BDH. Almost all children at primary education age (*i.e.* between 6 and 11 years old) attend school, though the rate is lower among pre-school age children (*i.e.* 5 years old). The rate of school attendance decreases during secondary education (*i.e.* between 12 and 18 years old). Children receiving the BDH (*i.e.* poor and vulnerable households) have a lower probability of attending school at any age, further the decline of school attendance at secondary education age is higher for them. In addition, males and rural children have lower probabilities to attend to school than females and urban children of attending. This evidence is consistent with the accumulated level of human capital (*i.e.* schooling, measured by the years of education). On average, at the age of 18 years old urban females achieve 11.0 years of education, followed by urban males (10.6), rural females (9.7), and rural males (9.1). Moreover, those who receive the BDH had accumulated lower human capital than the rest of individuals (see table 1).

Fall behind school measures the difference between the education level a child should had achieved at a specific age and her actual level of schooling. It is close to 1 year (*i.e.* on average, a child has one year less education than what she should had have for her age) up to 8 years old. This falling behind is mainly due to low enrolment in pre-school education (which is not compulsory in Ecuador). Later, it increases with age which may be related with children having to repeat a year and because some of them drop out school. The major increments on falling behind school happens after the age of 16, which correspond to upper secondary education and tertiary education. Falling behind school has a cumulative effect on school attendance especially at older ages as it reduces a child fit to her peers. In addition, being married which at young ages is closely related with having a child to take care of and then with school dropout, becomes higher than 1% for children around the age of 15. It is higher for females than for males, except for rural males at older ages (see table 2).

Table 1. BDH recipients, school attendance, and schooling by age; pooled average 2009-2013 (percentages of the population and years of education)

	Age			
	5	*6 to 11*	*12 to 17*	*18*
Observations	4 158	32 889	38 103	5 790
BDH recipient				
Urban male	22.7%	22.8%	22.0%	19.1%
Urban female	23.1%	23.6%	21.4%	14.9%
Rural male	66.8%	69.3%	66.7%	63.3%
Rural female	67.6%	68.7%	67.0%	60.8%
School attendance				
Urban male (BDH)	90.1%	98.0%	85.8%	46.7%
Urban male (No-BDH)	95.7%	99.1%	94.5%	67.0%
Urban female (BDH)	91.2%	99.2%	89.5%	49.5%
Urban female (No-BDH)	98.0%	99.6%	95.9%	71.6%
Rural male (BDH)	86.3%	98.0%	80.7%	44.7%
Rural male (No-BDH)	86.3%	97.8%	87.3%	53.4%
Rural female (BDH)	85.9%	98.8%	82.0%	44.4%
Rural female (No-BDH)	86.6%	97.8%	88.7%	59.8%
Schooling				
Urban male (BDH)	0.0	2.3	7.2	9.2
Urban male (No-BDH)	0.0	2.6	8.1	10.9
Urban female (BDH)	0.0	2.5	7.5	9.6
Urban female (No-BDH)	0.0	2.6	8.2	11.3
Rural male (BDH)	0.0	2.4	7.0	8.8
Rural male (No-BDH)	0.0	2.5	7.6	9.7
Rural female (BDH)	0.0	2.4	7.0	9.1
Rural female (No-BDH)	0.0	2.7	7.8	10.6

Source: own calculations using ENEMDU, rounds of December 2009 to 2013.

Table 2. Falling behind school and marriage by age; pooled average 2009-2013 (years of falling behind and percentages of the population)

Age	*Falling behind*							
	Urban				*Rural*			
	Male		*Female*		*Male*		*Female*	
	BDH	*No-BDH*	*BDH*	*No-BDH*	*BDH*	*No-BDH*	*BDH*	*No-BDH*
8	1.4	1.1	1.2	1.0	1.3	1.2	1.3	1.1
9	1.4	1.1	1.2	1.1	1.4	1.3	1.3	1.1
10	1.6	1.1	1.4	1.0	1.5	1.3	1.4	1.1
11	1.6	1.1	1.4	1.0	1.6	1.3	1.5	1.3
12	1.6	1.2	1.5	1.1	1.7	1.4	1.5	1.3
13	1.8	1.3	1.6	1.1	1.9	1.6	1.8	1.5
14	2.0	1.4	1.6	1.2	2.2	1.7	1.9	1.6
15	2.4	1.5	1.8	1.3	2.4	2.0	2.3	1.9
16	2.4	1.6	2.0	1.4	2.8	2.1	2.6	1.8
17	3.1	1.7	2.5	1.6	3.4	2.7	2.9	2.2
18	3.8	2.1	3.4	1.7	4.2	3.3	3.9	2.4
Age	*Married*							
	Urban				*Rural*			
	Male		*Female*		*Male*		*Female*	
	BDH	*No-BDH*	*BDH*	*No-BDH*	*BDH*	*No-BDH*	*BDH*	*No-BDH*
14	0.0%	0.0%	0.6%	0.1%	0.0%	0.0%	0.8%	0.4%
15	0.4%	1.2%	2.0%	1.3%	1.1%	1.0%	1.1%	0.7%
16	1.0%	1.6%	1.3%	2.3%	1.0%	1.4%	2.2%	2.7%
17	4.4%	1.4%	3.2%	4.1%	3.5%	1.7%	3.6%	4.5%
18	6.5%	2.5%	6.0%	4.3%	3.8%	4.4%	5.3%	6.3%

Source: own calculations using ENEMDU, rounds of December 2009 to 2013.

Regarding economic status, four monthly household's per-capita income brackets are used: extreme poor (less than US$37.64), moderate poor (between US$37.64 and US$66.78), vulnerable (between US$66.78 and US$133.56) and middle-&-upper class (higher than US$133.56). Extreme poverty and poverty thresholds are based on official poverty lines at prices of 2009, while the threshold between vulnerable and middle class-&-upper is equivalent to two times the poverty line as proposed by Lopez-Calva and Ortiz-Juarez (2014). School attendance increases with income, especially for males and older ages. All this information is used at the age-specific level to parametrize the model in the next section in order to account for age, gender and socio-economic specific conditions (see table 3).

Table 3. School attendance by age and income level; pooled average 2009-2013 (percentages of the population)

Age	*5 to 11*	*12 to 18*	*5 to 11*	*12 to 18*
	Male		*Female*	
Urban				
Observations	9 788	12 044	9 135	10 700
Extreme poor	97.2%	86.3%	98.3%	85.2%
Moderate poor	97.6%	86.9%	98.3%	89.2%
Vulnerable	98.6%	86.1%	99.3%	91.3%
Middle and upper class	99.0%	93.5%	99.8%	93.5%
Rural				
Observations	9 292	11 234	8 908	9 839
Extreme poor	95.5%	80.3%	96.8%	77.2%
Moderate poor	96.5%	78.5%	96.7%	79.6%
Vulnerable	97.8%	76.9%	97.9%	82.4%
Middle and upper class	99.1%	78.0%	99.6%	86.8%

Source: own calculations using ENEMDU, rounds of December 2009 to 2013.

In addition, grade and gender specific promotion rates for primary and secondary education are estimated using administrative data of the Ecuadorian Ministry of Education (see table 4). Finally, age specific survival rates (see table 5) are estimated as the average between 2011 and 2020 from the official population projections of the INEC.

Table 4. Grade specific promotion rate (percentages of the population)

	Promotion	
Grade	*Males (%)*	*Females (%)*
1	99.27	99.18
2	98.80	98.43
3	99.10	98.88
4	99.31	99.07
5	99.41	99.26
6	99.47	99.28
7	99.57	99.42
8	98.32	96.98
9	98.46	97.53
10	98.64	97.95
11	97.37	95.92
12	98.92	98.26
13	99.69	99.46

Source: own calculations using the 2013's Master Archive of Educational Institutions (AMIE) of the Ecuadorian Ministry of Education.

Table 5. Age specific survival rate (percentages of the population)

Age	*Survival (%)*
5	99.95
6	99.96
7	99.97
8	99.97
9	99.97
10	99.96
11	99.95
12	99.94
13	99.92
14	99.90
15	99.87
16	99.84
17	99.81
18	99.79
19	99.77
20	99.76
21	99.75
22	99.74
23	99.75

Source: own calculations using the Population Projections of the INEC.

Marginal effects

The causal effect of the BDH is calculated following Ponce and Bedi (2010) who rely on a regression discontinuity (RDD) model using instrumental variables (IV). This strategy allows identifying the effect on those close to the targeting threshold to control for non-observable characteristics. However, it cannot capture the effect on the extremely poor. The model is estimated using

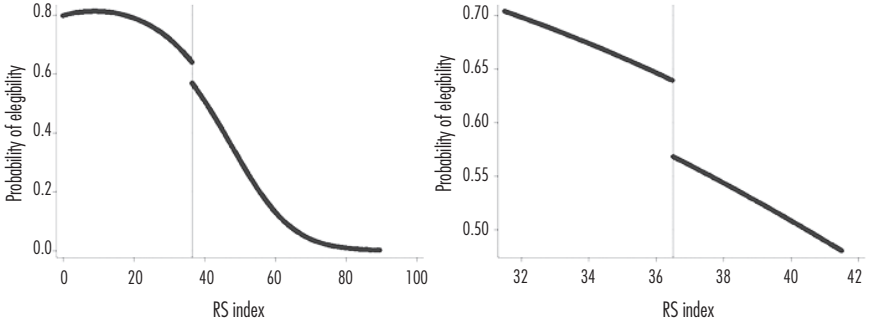
the 2009-2013 pooled data for children between 5 and 18 years old with a RS index, in 2009, between 31.50 and 41.50 (*i.e.* +/- 5 points around the RS threshold of 36.50). The RS index is estimated using administrative data from the Registro Social. The 2009's RS index uses 30 variables, but only 26 variables can be replicated in the ENEMDU. Therefore, it is necessary not only to impute the RS index in the ENEMDU, but to rescale the index due to the lack of variables. This is done by firstly estimating a partial index ($RS\ 2009^{26}$) using the available variables and official RS index's weights. Secondly, an equation to replicate the RS 2009 index is estimated using Registro Social's administrative data (equation 5).

$$\widehat{RS\ 2009} = -5.310639 + (1.199731 * RS\ 2009^{26}) \quad (5)$$

After the estimation of the RS index in the ENEMDU the BDH's eligibility threshold of 36.50 is localized at the percentile 41 in the ENEMDU 2009 (which corresponds to the date of the Registro Social). However, households' welfare conditions are likely to change over time. Because of this reason the eligibility threshold is estimated for the years between 2010 and 2013 as the value at the percentile 41 of the $\widehat{RS\ 2009}$.

Treatment discontinuity occurs on the RS index. The probability to be eligible to receive the BDH in 2009 is 25% for those households with a $\widehat{RS\ 2009}$ higher than 36.50, while it is 75% if the $\widehat{RS\ 2009}$ is lower than the cut-off. If reduced to those +/- 5 points around the threshold these probabilities are 53 and 67%, respectively (see figure 1).

Figure 1. Relation between eligibility and RS index (2009)



Source: own calculations using ENEMDU, round of December 2009.

This non-linear relationship provides exogenous variation in treatment status. However, as it is unlikely that treatment is solely assigned by these criteria a fuzzy discontinuity is assumed, and then the evaluation strategy includes an IV approach. The first stage equation includes an instrument (T_i) the RS index ($\widehat{RS\ 2009}$) and its square value ($\widehat{RS\ 2009}^2$) as well as other variables (X_i) value assuming an independent and identically distributed (i.d.d.) error term (ε) with mean zero (equation 6). The instrument is the assignment rule and then it is correlated with BDH eligibility, and we assume that it is not correlated with the unobserved characteristics that determine the evaluated variables (*i.e.* school assistance and married status).

$$bdh_i = (\zeta * T_i) + \left(\theta * \widehat{RS\ 2009}\right) + \left(\vartheta * \widehat{RS\ 2009}^2\right) + (\kappa * X_i) + \varepsilon_i \quad (6)$$

Following this strategy, the probability of school attendance and marriage is estimated by a two stages probit model. The first stage is calculated by equation 6, while second stage estimates are obtained by:

$$Pr\ (attendance)_i = \Phi\big(\tau * \widehat{bdh_i} + \gamma * bdh\_pc_i + \delta * past_i + \rho * married_i + \eta * K_i + \psi_i\big) \quad (7)$$

$$Pr\ (married)_i = \Phi\big(\alpha * \widehat{bdh_i} + \beta * schooling_{i,t-1} + \theta * H_i + \omega_i\big) \quad (8)$$

Where Φ is the cumulative distribution function of the standard normal distribution, K_i and H_i are vectors of observables characteristics and a constant and, ψ_i and ω_i are independent and identically distributed (i.d.d.) error terms with mean zero.

Household income has a negligible effect on the probability of school attendance. While it is statistically significant in the expect direction (positive effect) the coefficient is low. However, the cost of opportunity has a negative and significant effect. It means that a higher opportunity cost in terms of forgone income reduces the probability of attending school at any age. On average females have a lower probability of attending school in comparison with males. The coefficients of interest for the model show that falling behind school and being married reduces the probability of attending school. In the case of the BDH it shows a negative coefficient reducing the constant term for those who receive the transfers, while the amount received increases the probability of attending school. It means that the BDH do not necessarily increases

school attendance, as it is not strongly conditioned but also because school attendance is almost universal in Ecuador, while the transfer amount is relevant to cover opportunity costs of those not going to school. In terms of average marginal effects each US$1 per month per capita of transfer increases the probability of attending school by 5.17 p.p. In the case of past behaviour each year of school delay reduces the probability by 3.03 p.p., while being married reduces it by 9.51 p.p. (see table 6).

Table 6. Two stages probit model and average marginal effects on school attendance and marriage status, ENEMDU 2009-2013 (coefficients and standard errors)

IV probit (RDD, +/- 5)	*School attendance*	*IV probit (RDD, +/- 5)*	*Married*
Receiving the BDH (Yes= 1 / No= 0)	-2.8775***	Receiving the BDH (Yes= 1 / No= 0)	-0.1792***
	(0.0202)		(0.0311)
BDH amount per month per capita	0.2966***	Expected paid labour income per month per capita	0.0014***
	(0.0023)		(0.0002)
Expected paid labour income per month per capita	-0.0527***	Household income per month per capita	0.0000
	(0.0004)		(0.0000)
Household income per month per capita	0.0001***	Age	0.7775***
	(0.0000)		(0.0083)
Age	0.3745***	Age squared	-0.0167***
	(0.0037)		(0.0002)
Age squared	-0.0148***	Female (Yes= 1 / No= 0)	0.0292***
	(0.0002)		(0.0037)
Past (= age - 5 - schooling)	-0.1739***	Schooling	-0.0217***
	(0.0020)		(0.0008)
Female (Yes= 1 / No= 0)	-0.0294***	Households dependency ratio	-0.0582***
	(0.0029)		(0.0031)
Married (Yes= 1 / No= 0)	-0.5459***	Households size	0.1090***
	(0.0092)		(0.0012)
Indigenous/montubio/afro (Yes= 1 / No= 0)	0.0749***	Water and sanitation (Yes= 0 / No= 1)	0.1453***
	(0.0029)		(0.0041)

Continue

Table 6. Two stages probit model and average marginal effects on school attendance and marriage status, ENEMDU 2009-2013 (coefficients and standard errors) (*continuation*)

IV probit (RDD, +/- 5)	*School attendance*	*IV probit (RDD, +/- 5)*	*Married*
Rural (Yes= 1 / No= 0)	0.0534***	Rural (Yes= 1 / No= 0)	-0.1733***
	(0.0023)		(0.0056)
2010 (Yes= 1 / No= 0)	0.4929***	Parish's poverty head count	-0.0184
	(0.0045)		(0.0147)
2011 (Yes= 1 / No= 0)	0.6992***	2010 (Yes= 1 / No= 0)	0.0829***
	(0.0055)		(0.0056)
2012 (Yes= 1 / No= 0)	0.5436***	2011 (Yes= 1 / No= 0)	0.0472***
	(0.0057)		(0.0062)
2013 (Yes= 1 / No= 0)	0.0629***	2012 (Yes= 1 / No= 0)	-0.0144**
	(0.0035)		(0.0063)
		2013 (Yes= 1 / No= 0)	0.0790***
			(0.0060)
Constant	0.1685***	Constant	-10.5098***
	(0.0134)		(0.0732)
Observations	2 346 555	Observations	1 864 102
Average marginal effects at (BDH amount per month per capita = 0) and (Past = 0)		**Average marginal effects at (schooling = 0)**	
BDH amount per month per capita	0.0517***	Receiving the BDH (Yes= 1 / No= 0)	-0.0192***
	(0.0003)		(0.0035)
Past (= age - 5 - schooling)	-0.0303***	Schooling	-0.0023***
	(0.0008)		(0.0001)
Married (Yes= 1 / No= 0)	-0.0951***		
	(0.0025)		

Note: heteroskedasticity consistent standard errors are between brackets. Estimations uses pooled data between 2009 and 2013; School attendance is estimated for children between 5 and 18 years old, while being marriage for individuals between 12 and 23 years old; *** Significance at 1%; ** significance at 5%; * significance at 10%.

Source: own calculations using ENEMDU, rounds of December 2009 to 2013.

Child marriage is a crucial determinant of school attendance. The probability of marriage increases with age, being a female, household size and poverty conditions as for example deprivation on access to water and sanitation. On the other hand, schooling reduces the probability of marriage as well as receiving the BDH. Average marginal effects show that a person living in a BDH' recipient household has a probability 1.92 p.p. lower. In the case of schooling an addition year of education reduces the probability of marriage by 2.17 p.p. (see table 6). This result shows that the BDH may encourage school attendance solely based on its amount, but also due to its effect on the reduction of child marriage.

4. RESULTS: HUMAN CAPITAL ACCUMULATION

The model simulates a cohort of 1.056 children (197 892 using weights) starting at 5 years old, from which 52.3% are girls, and 40.9% are currently receiving the BDH. Data is from ENEMDU, round of December 2013. In the base line model (Scenario 1 – no social transfer), the cohort achieves 12 years of education (schooling) at the age of 18 years old, which is equivalent to incomplete secondary education[3] (see table 7). In order to analysis the cost-effectiveness of a social transfer on human capital accumulation three additional scenarios are simulated. Scenario 2 simulates the BDH in its actual design. A flat transfer of US$50 to each eligible household identified in ENEMDU 2013 up to age of 18 years old. Scenario 3 simulates a variable transfer to households on extreme income poverty. The transfer is defined as the specific household's poverty gap (up to US$37.64 per month at prices of 2009). It aims at testing a perfect targeting design on the poorest. Finally, scenario 4 transfers an amount equal to the poverty line (US$66.78 per month at prices of 2009) to poor individuals at the ages between 12 and 18, which are critical periods of school attendance. It tests targeting at critical ages.

All scenarios achieve lower rates of marriage (equation 1), higher school attendance (equation 2) and schooling (equation 3) at any age in comparison to the scenario with-out a social transfer, while cohort population declines equally for all scenarios (equation 4). Scenario 2 evaluates the BDH in its actual design. At the age of 18 years old it reduces the percentage of child marriage from 1.5 to 0.9%. School attendance increases by 4.2 p.p. at the age of 5 years

[3] Own estimations using pooled data from ENEMDU shows that in average between 2009 and 2013 a cohort at the age of 18 years old achieved 10.31 years of education.

old, between 0.6 and 1.1 p.p. between the ages of 6 and 11 years old, and between 2.1 and 18.4 p.p. between the ages of 12 and 18 years old. These results promote higher human accumulation of 0.4 additional years of education per person at the age of 18 years old. It means 88 551 additional years of education in terms of total cohort's human capital. Scenarios 3 and 4 have lower effects on child marriage, school attendance and schooling. It was expected as these scenarios has lower coverage (see table 7). In general, social transfers proves to have a positive effect on human capital accumulation, but rather low in the case of Ecuador.

The cost of the transfer is between US$48.1 and US$48.5 million per year in the case of scenario 2. It is around 0.05% of Ecuadorian GDP in 2013.[4] The annual cost of scenarios 3 and 4 are between US$32.7 and US$33.1 (0.03 of GDP), and US$57.2 and US$57.6 (0.06% of GDP), respectively (see table 8).

In order to compare scenarios in terms of their cost-effectiveness total cost is calculated adding-up the annual cost of each policy option, while total cohort's human capital accumulation is measured adding-up the years of education achieved for each person within the cohort. A cost-effectiveness indicator is then estimated as the relation between the additional cohort's total schooling in comparison with scenario 1 and the cost in US$ million. In this sense the indicator measures how many additional years of education are achieved by a cohort for each million invested on social transfers.

At the age of 18 years old, the cost-effectiveness ratio has a value of 130.7 for scenario 2, 76.0 for scenario 3, and 169.8 for scenario 4 (see table 8). The latest is the most cost-effective. This shows that in order to promote human capital accumulation the best option is to target critical ages. However, it is also important to evaluate the effect on inequality. It is done by looking at average schooling achieved for different income brackets and its ratio with mean schooling. In the case where no social transfer is implemented the average years of schooling for extreme poor individuals is 11.3, at the age of 18 years old, while it is 12.5 for middle-&-upper class persons. In this sense, it generates a vicious circle of poverty and inequality. All policy scenarios reduce the gap, but the most efficient is scenario 3 where social transfers are designed to eradicate extreme income poverty and then promoting school attendance of the poorest of the poor (see table 9).

[4] World Bank (2017).

Table 7. Dynamic cohort microsimulation: married, school attendance and schooling by age (percentages of the population and years of education)

Age	*Married*				*School attendance*				*Schooling*				*Population*
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	
5	0.0%	0.0%	0.0%	0.0%	92.6%	96.8%	94.4%	92.6%	0.0	0.0	0.0	0.0	197 892
6	0.0%	0.0%	0.0%	0.0%	98.0%	99.2%	98.5%	98.0%	0.9	1.0	0.9	0.9	197 797
7	0.0%	0.0%	0.0%	0.0%	98.6%	99.4%	99.0%	98.6%	1.9	1.9	1.9	1.9	197 722
8	0.0%	0.0%	0.0%	0.0%	98.8%	99.5%	99.1%	98.8%	2.9	2.9	2.9	2.9	197 657
9	0.0%	0.0%	0.0%	0.0%	98.6%	99.3%	98.9%	98.6%	3.8	3.9	3.9	3.8	197 600
10	0.0%	0.0%	0.0%	0.0%	98.5%	99.2%	98.8%	98.5%	4.8	4.9	4.8	4.8	197 538
11	0.0%	0.0%	0.0%	0.0%	98.1%	99.1%	98.6%	98.1%	5.8	5.8	5.8	5.8	197 461
12	0.0%	0.0%	0.0%	0.0%	96.3%	98.4%	97.1%	98.5%	6.7	6.8	6.8	6.7	197 365
13	0.0%	0.0%	0.0%	0.0%	94.2%	97.5%	95.6%	97.4%	7.7	7.8	7.7	7.7	197 240
14	0.0%	0.0%	0.0%	0.0%	91.0%	96.1%	92.9%	96.2%	8.6	8.8	8.7	8.7	197 077
15	0.0%	0.0%	0.0%	0.0%	87.7%	94.3%	90.2%	94.2%	9.5	9.7	9.6	9.6	196 871
16	0.0%	0.0%	0.0%	0.0%	84.4%	92.7%	87.6%	92.2%	10.4	10.6	10.5	10.5	196 613
17	0.8%	0.4%	0.7%	0.5%	77.7%	88.8%	81.8%	88.1%	11.2	11.5	11.3	11.5	196 300
18	1.5%	0.9%	1.3%	1.0%	56.0%	74.4%	62.2%	74.6%	12.0	12.4	12.1	12.3	195 931

Source: own calculations using ENEMDU 2013.

Table 8. Cost-effectiveness analysis of policy scenarios by age
(US$ thousands, years and years of education)

Age	*Cost per year (US$ 1 000)*			*Total cost (US$1 000)*			*Total schooling (years)*				*Cost-effectiveness (total schooling)*		
	Scenario 2	*Scenario 3*	*Scenario 4*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Scenario 2*	*Scenario 3*	*Scenario 4*
5	48 571	33 084	-	48 571	33 084	-	0	0	0	0	0.0	0.0	0.0
6	48 547	33 068	-	97 118	66 151	-	180 587	188 746	184 110	180 587	84.0	53.3	0.0
7	48 529	33 055	-	145 647	99 207	-	371 565	381 934	376 070	371 565	71.2	45.4	0.0
8	48 513	33 044	-	194 160	132 251	-	563 514	575 425	568 813	563 514	61.3	40.1	0.0
9	48 499	33 035	-	242 659	165 286	-	755 866	769 029	761 678	755 866	54.2	35.2	0.0
10	48 484	33 025	-	291 142	198 311	-	947 554	962 174	953 948	947 554	50.2	32.2	0.0
11	48 465	33 012	-	339 607	231 322	-	1 138 811	1 154 954	1 145 854	1 138 811	47.5	30.4	0.0
12	48 441	32 996	57 655	388 048	264 318	57 655	1 329 083	1 347 150	1 337 054	1 329 083	46.6	30.2	0.0
13	48 410	32 975	57 619	436 459	297 292	115 274	1 515 410	1 537 552	1 524 972	1 519 732	50.7	32.2	37.5
14	48 371	32 947	57 571	484 829	330 240	172 845	1 697 101	1 725 653	1 709 378	1 707 745	58.9	37.2	61.6
15	48 320	32 913	57 511	533 149	363 153	230 356	1 871 820	1 910 400	1 887 961	1 892 683	72.4	44.4	90.6
16	48 257	32 870	57 436	581 406	396 023	287 792	2 039 322	2 090 636	2 060 346	2 072 699	88.3	53.1	116.0
17	48 180	32 818	57 344	629 586	428 840	345 136	2 199 320	2 266 582	2 226 633	2 247 708	106.8	63.7	140.2
18	48 089	32 756	57 236	677 675	461 596	402 373	2 345 253	2 433 804	2 380 341	2 413 572	130.7	76.0	169.8

Source: own calculations using ENEMDU 2013.

Table 9. Schooling inequality by income bracket (years of education and ratio)

Income bracket	*Schooling*			
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 4*
Extreme poor	11.3	12.3	12.8	12.5
Moderate poor	11.7	12.5	11.7	12.6
Vulnerable	12.0	12.4	12.0	12.0
Middle and upper class	12.5	12.5	12.5	12.5
Total	12.0	12.4	12.1	12.3
Income bracket	*Schooling / mean schooling*			
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 4*
Extreme poor	0.95	0.99	1.05	1.01
Moderate poor	0.98	1.00	0.96	1.02
Vulnerable	1.01	1.00	0.99	0.98
Middle and upper class	1.04	1.01	1.03	1.01
Total	1.00	1.00	1.00	1.00

Source: own calculations using ENEMDU 2013.

5. CONCLUDING REMARKS

Social transfers have the potential to promote human capital accumulation and to produce long-term economic returns by covering transaction and opportunity costs because of a higher poor households' disposable income and then promoting investments in human capital. However, the effect depends on the existence of supply side policies to guarantee coverage and quality of education services.

Results show that social transfers do promote higher levels of schooling in the case of Ecuador. At the age of 18 years old the average level of schooling is between 0.2 and 0.5 higher under social transfer scenarios. The effect (*i.e.* the difference with no social transfer) is higher under actual design of the BDH. However, social transfers are more cost-efficient to promote human capital accumulation if targeted at critical ages, and more efficient to reduce schooling inequality if targeted at the poorest of the poor.

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