Conditional Cash Transfers and Education Quality in the Presence of Credit Constraints

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Abstract

We investigate the relative merits of unconditional cash transfers (UCT), conditional cash transfers (CCT), and the effects of improvements in education quality on efficiency and welfare. In our setting, some parents underinvest in their children's education because capital market imperfections prevent them from borrowing. Under sufficiently accurate targeting, CCT are more effective than UCT in enhancing the efficiency of these households' decisions. However, UCT is superior to CCT in terms of welfare unless targeting is perfect, in which case UCT and CCT are equivalent. Education quality is welfare improving, but may not be efficiency enhancing when public education quality is very low.

1 Introduction

Conditional cash transfers (CCT) have been extensively implemented in developing countries since the 1990s. These programs provide low-income households with incentives to send their children to school by tying a cash transfer to school attendance.[1] The Mexican Oportunidades and the Brazilian Bolsa Familia constitute well-known examples of CCT programs.

To justify the implementation of CCT programs, the literature has focused on the existence of social externalities (de Janvry and Sadoulet, 2004), individual irrationality, impatience, or lack of self-control (Das et al., 2005).[2] Under these circumstances, it is well-known that conditional transfers have a larger impact on individual behavior, but in terms of utility are never superior to unconditional transfers. In contrast, little is known about the effect of CCT when poverty, combined with the inability to borrow, is the underlying reason for underinvesting in education, as noted in Das et al. (2005) and Martinelli and Parker (2003).

The large empirical literature evaluating CCT confirms that these programs boost school enrollment and decrease drop-out rates.[3] However, an often-raised concern regarding CCT is that the increase in school enrollment may not be the most effective way to raise human capital. Indeed, the impact of CCT in terms of learning is not obvious, since education quality is typically low in countries adopting CCT (e.g., Lockheed and Verspoor, 1991; Hanushek, 1995; Glewwe, 1999; Reimers et al., 2006). Thus, a natural question is whether increasing quality would in fact have a larger impact on human capital and, more generally, on lifetime

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[1]In this paper, we focus exclusively on the education component of these programs. Most CCT programs also place conditions such as regular check-ups and some also include a nutrition counterpart. For a review of CCT programs, see Das et al. (2005) and Rawlings and Rubio (2005).

[2]Another rationale for CCT is intra-household bargaining, as discussed in Martinelli and Parker (2003). Fiszbein et al. (2009) include a comprehensive discussion on the economic rationale for CCT. See also Bourguignon et al. (2003).

[3]Examples of empirical papers focusing on the education component of CCT programs include Attanasio et al. (2005), Baird et al. (2011), Barrera-Osorio et al. (2011), Behrman et al. (2005), Bursztyn and Coffman (2012), Coady and Parker (2004), de Brauw and Hoddinott (2010), Dubois et al. (2012), Ferreira et al. (2009), Maluccio and Flores (2005), Ponce and Bedi (2010), Schady and Araujo (2006), Schultz (2004), Skoufias and Parker (2001), Souza and Cardoso (2009), and Todd and Wolpin (2006).

income (efficiency) and utility (welfare).[4]

In this paper, we consider a two-period model based on Baland and Robinson (2000) in which parents underinvest in education because they are credit-constrained. In addition, we explicitly account for the role of education quality on human capital formation. In our framework, the government provides education free of charge for all households, but this is not sufficient to induce the efficient amount of time spent at school. This setting allows us to explore the relative merits of cash transfers (conditional and unconditional) and investments in education quality in terms of efficiency and welfare for credit-constrained households. More specifically, we assume that the government has an exogenously given budget that it can allocate to CCT, UCT, or increasing education quality. Unlike education quality, cash transfers can be targeted at constrained households, albeit imperfectly. We analyze the effect of marginal changes in each of the policy parameters separately when the three policies are in place. Hence, our approach is positive and aims to explore the relative merits of several commonly used policy instruments.[5]

In our model there are two inputs, time spent at school and education quality, which can be substitutes or complements in the human capital production function. Parents choose the fraction of time their children spend at school during childhood by considering the impact of this decision on household utility.[6] Since CCT are usually paid on a monthly basis over several years, we model time spent at school as a continuous variable. Each unit of time the child spends at school generates costs in the first period related to foregone child labor earnings and other indirect costs such as clothing, materials, and transportation. In return, it increases household income in the second period. We assume that some households do

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[4]Education quality can be raised by increasing school inputs, such as school facilities or teacher qualification. For a comprehensive discussion on education quality, see Hanushek (2006) and Hanushek and Rivkin (2006).

[5]Gahvari and Mattos (2007) deal with the optimal design of CCT in the presence of information asymmetries.

[6]By focusing on household utility, we allow for inter-generational transfers without explicitly accounting for these decisions. When intergenerational transfers are interior, considering household utility (as here) or the utility of the parent and the child separately (as in Baland and Robinson, 2000) yields identical results.

not have the means to defray the costs in the first period. Since credit market imperfections prevent them from borrowing, their children spend an inefficiently low amount of time at school for any given level of education quality.

Unconditional cash transfers (UCT) are a natural instrument to recover efficiency when poverty is the reason why households underinvest in education. By increasing household income in the first period, UCT lead credit-constrained households to increase the time their children spend at school. However, it is unclear whether UCT are more or less effective than CCT in enhancing efficiency. Indeed, in the presence of market imperfections, distorting individual behavior by imposing conditions may be more desirable (Lipsey and Lancaster, 1956). We contribute to this debate by investigating, first, the relative effect of UCT and CCT in terms of efficiency. Second, we explore the conditions under which policies that improve education quality prove more adequate to recover efficiency. Finally, we also evaluate the different policies from a welfare viewpoint.

We obtain the following results: when constrained households can be perfectly targeted, CCT are more efficiency enhancing than UCT, as in the previous literature. In contrast, both types of cash transfers are equivalent in terms of welfare. This happens for two reasons. First, if households were not credit-constrained, their choice of time spent at school would be optimal.[7] Thus, they increase the time spent at school when the credit constraint is relaxed, which happens both with an UCT and CCT (of equal amount). Second, CCT change the unit price of education, but allow households to adjust their behavior at the margin.[8]

These results may change when targeting is imperfect. Given that children in constrained households spend less time at school than those in unconstrained households, constrained

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[7]This is a consequence of the absence of externalities and the fact that households are not irrational or impatient.

[8]Alternatively, CCT can be seen as a lump-sum transfer conditional on having achieved a pre-established threshold of time spent at school. In that case, the transfer may push household choice to a corner where satisfying the requirement and receiving the transfer is better than not, but households would be better off if the transfer were not conditional on the amount of time spent at school. In our view, when studying household choice over the lifetime, the number of periods over which the transfer is received is large, and the continuous approach adopted in this paper is more appropriate.

households receive less income under CCT than UCT. This undermines the positive effects of CCT on efficiency and makes UCT superior to CCT in terms of welfare for constrained households. We provide an empirical illustration of the comparison of UCT and CCT in terms of efficiency using the Colombian setting. For commonly used utility functions, our results indicate that CCT are always superior to UCT in terms of efficiency in the Colombian context.

We also show that raising education quality always increases welfare, especially when education quality is low. The effect raising quality has on efficiency is more involved. In particular, not only do households respond to changes in quality by increasing or decreasing the time their children spend at school, depending on the human capital technology, but also changing quality modifies the efficient amount of time spent at school. Surprisingly, our model suggests that, when quality is very low, improving education quality may not be efficiency enhancing. Although we cannot derive general results, we indicate how the model can be empirically tested so that the effect of improving quality on efficiency can be assessed.

The rest of the paper is organized as follows. Section 2 presents the model and the alternative policies, then identifies the first best, and the credit-constrained solution. Sections 3 and 4 evaluate the effects of revenue-neutral changes on the policies in terms of efficiency and welfare. Section 5 concludes.

2   The Model

A household is composed of one parent and one child and lives for two periods. The parent is endowed with a units of efficient labor (or units of human capital) and the child is endowed with one unit of efficient labor. The wage per unit of efficient labor is w, determined exogenously in competitive markets.

In the first period, the parent works, supplying her efficient labor inelastically. She decides

on the allocation of her child's time between school, e, and work $1-e$, and on the amount of savings s. These are the only economic decisions, they are made by the parent, and determine household consumption of the numeraire good in the first and second periods.

We assume the existence of a public school that transforms q units of the numeraire into one unit of education of quality q (Besley and Coate, 1991). The tuition cost, qe, is covered by the government. For households, the cost of acquiring e units of education is the earnings forgone by children we and other indirect costs of education such as transportation, books, or clothing κe. Households consume c_1 and save s.

In the second period the child (now an adult) works, supplying $h(e, q)$ efficiency units of labor. The function h is twice continuously differentiable, strictly increasing, and strictly concave in its two arguments. We allow for e and q to be complements, $h_{eq}(e, q) > 0$, or substitutes, $h_{eq}(e, q) < 0$.[9] Consumption in the second period, c_2, is the sum of the parent's savings and the child's labor income, $wh(e, q)$.

Finally, capital markets are imperfect, so that parents can save but cannot borrow, i.e., $s \geqslant 0$. When the parental endowment of efficient labor a is low, households are credit-constrained, and their only source of revenue in the second period is the child's labor income. When a is large, households are unconstrained. We denote a_i with $i = \{c, u\}$ the endowment of a constrained/unconstrained household. There is a mass of households of size 1 and λ is the proportion of households with endowment a_c.[10]

There are two policies aimed at constrained households: an unconditional cash transfer (UCT), v, and a conditional cash transfer (CCT), θe. The government cannot target constrained households perfectly, so that only a proportion α of them receives these transfers. In contrast, a proportion β of the $1 - \lambda$ unconstrained households also receives these transfers.

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[9]This corresponds to the concept of q-complements and q-substitutes defined by Hicks (1970).

[10]For simplicity, we assume that a_c is sufficiently low so that households remain constrained even after receiving government transfers.

The government budget constraint is given by:

$$B = \left[\lambda\alpha + (1-\lambda)\beta\right]\upsilon + \left[\lambda\alpha e_c^b + (1-\lambda)\beta e_u^b\right](\theta + q) + \left[\lambda(1-\alpha)e_c^n + (1-\lambda)(1-\beta)e_u^n\right]q, \tag{1}$$

where e_i^j denotes the time spent at school by household ij, where $i = \{c, u\}$ and $j = \{b, n\}$ for beneficiary and non-beneficiary of the transfers.

We assume that public policies are financed by an exogenously given budget, e.g., provided by an international organization, such as The World Bank. This is equivalent to assuming that individuals do not anticipate the effect of those policies on taxes. This is done for simplicity of exposition, since allowing for lump-sum taxes does not change our qualitative results (see Del Rey and Estevan, 2011). We also assume that agents receive a zero interest rate on their savings and that they do not discount future utility. We assume that all policies are in place and we evaluate the effect of raising UCT, CCT, and education quality that is provided free of charge to families.

We now turn to the parent's choice of e and s. Household utility is denoted:

$$U_i^j = U(c_{1i}^j) + U(c_{2i}^j). \tag{2}$$

In the first period, the household's budget constraint is:

$$c_{1i}^b = wa_i + w(1-e) - \kappa e + \upsilon + \theta e - s, \tag{3}$$

if the household receives the transfer, and

$$c_{1i}^n = wa_i + w(1-e) - s, \tag{4}$$

otherwise. Second period consumption is given by:

$$c_{2i}^j = s + wh(e, q), \tag{5}$$

for all j. Parents maximize (2) with respect to e and s, subject to (3) or (4), and (5), and the constraint that $s \geq 0$. First-order conditions are sufficient for maximization since the second-order conditions are satisfied. When choosing e, parents equalize the marginal cost and the marginal benefit of spending time at school in terms of household utility. For beneficiary households:

$$(w + \kappa - \theta) U' \left(c_{1i}^b \right) = wh_e(e_i^b, q) U' \left(c_{2i}^b \right) \text{ and } e_i^b > 0, \tag{6}$$

assuming that there is an interior optimal solution for e when $\theta < w + \kappa$. Thus, we restrict our analysis to the cases where the CCT does not cover all the costs related to education, as supported by empirical evidence (e.g., Schultz, 2004). If they do, the optimal choice of e is 1. Similarly, for non-beneficiaries:

$$(w + \kappa) U' \left(c_{1i}^n \right) = wh_e(e_i^n, q) U' \left(c_{2i}^n \right) \text{ and } e_i^n > 0. \tag{7}$$

The optimal choice of s is given by:

$$U' \left(c_{2u}^j \right) = U' \left(c_{1u}^j \right) \text{ and } s_u^j > 0, \tag{8}$$

$$U' \left(c_{2c}^j \right) < U' \left(c_{1c}^j \right) \text{ and } s_c^j = 0. \tag{9}$$

When households are unconstrained, they choose the amount of savings that equalizes marginal utility in both periods. When they are credit constrained, savings are zero and the marginal utility of first-period consumption is larger: parents would like to borrow, but are prevented from doing so by credit market imperfections.

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2.1 Benchmark: Unconstrained Solution without Transfers

In the absence of transfers ($v = \theta = 0$) and when the savings choice is interior, we combine (7) and (8) to obtain:

$$wh_e\left(e_u, q\right) = \left(w + \kappa\right). \tag{10}$$

Condition (10) characterizes the amount of time spent at school that maximizes household lifetime income, i.e., the *efficient* level of e. This is given by the equality between the marginal benefit, $wh_e\left(e, q\right)$, and the marginal cost of time spent at school accrued to the household, $\left(w + \kappa\right)$. Thus, for unconstrained households the decision concerning education investment maximizes utility and is efficient.[11]

2.2 Constrained Solution without Transfers

When households are too poor, since they cannot borrow, their children spend an inefficiently low amount of time at school, as in Baland and Robinson (2000). Indeed, combining (7) and (9):

$$wh_e\left(e_c, q\right) > \left(w + \kappa\right). \tag{11}$$

The inefficiency arises from the fact that the marginal benefit of time spent at school is larger than its marginal cost. Increasing e would require transferring income from the second to the first period to cover education costs, and this cannot be done due to the borrowing constraint.

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[11]Note that this differs from global efficiency since education is provided free of charge by the government. Fully accounting for all the costs and benefits of investing in education would require a more general framework, allowing for social externalities among other considerations.

3 Efficiency

In order to explore the relative merits of alternative policies (UCT, CCT, and improvements in education quality) in enhancing efficiency in the education decision of credit-constrained households, we define:

$$I_c = wh_e(e_c, q) - (w + \kappa) > 0, \tag{12}$$

as the *inefficiency* of the decision concerning time spent at school by constrained households.[12]

3.1 Cash Transfers

An increase in UCT reduces the inefficiency of the decision of constrained households who benefit from the transfers:

$$\frac{dI_c^b}{dv} = wh_{ee}\left(e_c^b, q\right)\frac{de_c^b}{dv} < 0,$$

since, by (6) and the implicit function theorem, when $s = 0$:[13]

$$\frac{de_c^b}{dv} = -\frac{-(w + \kappa - \theta)U''\left(c_{1c}^b\right)}{(w + \kappa - \theta)^2\, U''\left(c_{1c}^b\right) + (wh_e(e_c^b, q))^2\, U''\left(c_{2c}^b\right) + wh_{ee}(e_c^b, q)U'\left(c_{2c}^b\right)} > 0. \tag{13}$$

By increasing income in the first period, an increase in UCT reduces the marginal utility of first-period consumption, and by (6), the marginal cost of investing in education. As a result, an increase in UCT always increases the amount of time the child spends at school, reducing the inefficiency of the education decision. This effect is intrinsically related to the relaxation of the credit constraint.

We now show that an increase in CCT also reduces the inefficiency of the constrained

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[12]Using (7) and (9), we obtain $wh_e(e_c, q) = (w + \kappa)\frac{U'(c_{1c})}{U'(c_{2c})} > (w + \kappa)$, since the household is constrained, i.e. $U'(c_{1c}) > U'(c_{2c})$. Although there are in principle two ways of enhancing efficiency, lowering $\frac{U'(c_{1c})}{U'(c_{2c})}$ or $wh_e(e_c, q) - (w + \kappa)$, they are univocally related, and both approaches yield similar qualitative results.

[13]Since $s = 0$, we only need to study the marginal effects on the education decision through (6).

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household decisions:

$$\frac{dI_c^b}{d\theta} = wh_{ee}\left(e_c^b, q\right)\frac{de_c^b}{d\theta} < 0,$$

since, proceeding as before:

$$\frac{de_c^b}{d\theta} = -\frac{U'\left(c_{1c}^b\right) - (w + \kappa - \theta)e_c^b U''\left(c_{1c}^b\right)}{(w + \kappa - \theta)^2 U''\left(c_{1c}^b\right) + (wh_e(e_c^b, q))^2 U''\left(c_{2c}^b\right) + wh_{ee}(e_c^b, q)U'\left(c_{2c}^b\right)} > 0. \quad (14)$$

Similar to UCT, the increase in CCT reduces the marginal cost of first-period consumption in terms of utility, leading to more time spent at school. As before, this effect alleviates the credit constraint. Moreover, the reduction in the marginal cost is now enhanced by the reduction in the price of education due to θ.

In order to compare the two policies, we now evaluate the effect of raising θ while reducing υ in order to keep the budget balanced. The effect of this change on inefficiency is given by $\Upsilon_c^{\theta,\upsilon} = \frac{dI_c^b}{d\theta}d\theta + \frac{dI_c}{d\upsilon}d\upsilon$ and, from (1), it is required that:

$$d\upsilon = -\frac{\lambda\alpha e_c^b + (1 - \lambda)\beta e_u^b}{\lambda\alpha + (1 - \lambda)\beta}d\theta \quad (15)$$

for given e_c^b and e_u^b. Using (15):

$$\Upsilon_c^{\theta,\upsilon} = h_{ee}\left(e_c^b, q\right)\left(\frac{de_c^b}{d\theta} - \frac{de_c^b}{d\upsilon}\frac{\lambda\alpha e_c^b + (1 - \lambda)\beta e_u^b}{\lambda\alpha + (1 - \lambda)\beta}\right)d\theta. \quad (16)$$

Plugging (13) and (14) into (16):

$$\Upsilon_c^{\theta,\upsilon} = h_{ee}\left(e_c^b, q\right)\left(\frac{-U'\left(c_{1c}^b\right) + (w + \kappa - \theta)e_c^b U''\left(c_{1c}^b\right) - (w + \kappa - \theta)U''\left(c_{1c}^b\right)\left(\frac{\lambda\alpha e_c^b + (1-\lambda)\beta e_u^b}{\lambda\alpha + (1-\lambda)\beta}\right)}{(w + \kappa - \theta)^2 U''\left(c_{1c}^b\right) + (wh_e(e_c^b, q))^2 U''\left(c_{2c}^b\right) + wh_{ee}(e_c^b, q)U'\left(c_{2c}^b\right)}\right)d\theta$$

The sign of this expression depends on the sign of the numerator, since $h_{ee} < 0$ and the sign

of the denominator is also negative:

$$sign\left(\Upsilon_c^{\theta,\upsilon}\right) = sign\left(-U'\left(c_{1c}^b\right) - (w + \kappa - \theta)U''\left(c_{1c}^b\right)\left[\frac{(1-\lambda)\beta\left(e_u^b - e_c^b\right)}{\lambda\alpha + (1-\lambda)\beta}\right]\right) \quad (17)$$

If constrained households can be perfectly targeted, i.e., $\beta = 0$, CCT are always more effective than UCT in reducing the inefficiency of the decision of constrained households who are beneficiaires, by (17). Indeed, CCT induce a higher increase in time spent at school through the price effect. CCT are clearly more distortive than UCT since they are conditioned on behavior. Still, in the presence of market imperfections, this result shows that it may be desirable to introduce additional distortions, in line with the Theory of the Second Best (Lipsey and Lancaster, 1956).

When unconstrained households cannot be excluded from receiving the transfer, i.e., $\beta > 0$, it is unclear whether UCT or CCT are the best policy in terms of efficiency. On the one hand, CCT has a larger effect on behavior through the price effect. On the other hand, constrained households receive less with CCT than with UCT, since their children spend less time at school than unconstrained households. Rearranging (17), CCT are more effective than UCT in reducing the inefficiency if:

$$\frac{\beta\left(1-\lambda\right)}{\alpha\lambda + \beta\left(1-\lambda\right)} < \frac{1}{\left(e_u^b - e_c^b\right)\left(w + \kappa - \theta\right)\left(-\frac{U''\left(c_{1c}^b\right)}{U'\left(c_{1c}^b\right)}\right)}. \quad (18)$$

This condition will be more easily satisfied the better the targeting of constrained households, i.e., the larger α and/or the smaller β, the smaller the difference in time spent at school by children in constrained and unconstrained households, and/or the smaller $(w + \kappa - \theta)\left(-\frac{U''\left(c_{1c}^b\right)}{U'\left(c_{1c}^b\right)}\right)$. For a logarithmic utility function, this last term reduces to $(w + \kappa - \theta)/c_{1c}^b$, i.e., the net cost of a unit of time spent at school relative to the first period consumption of a constrained household. It is then easy to verify that if consumption of constrained families is sufficiently

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high relative to the net cost of education, this condition will always be satisfied. Next we show an example where this is indeed the case.

3.1.1 A quantitative example comparing CCT and UCT on efficiency grounds

Since all the parameters and variables in (18) are observable, we can perform some back-of-the-envelope calculations to obtain an approximate targeting threshold that ensures that CCT are superior to UCT in terms of efficiency. As an illustration, we consider the Colombian case. Colombia introduced the CCT program *Famílias en Acción* in 2001. The program is targeted at households classified as level 1 in SISBEN,[14] which implies that 24.6% of Colombian households are eligible for it (DNP, 2003, p.131). Assuming that households classified at level 1 are constrained, $\lambda = 0.246$. The proportion of eligible households receiving the transfer is around 70.2% and the monthly transfer, θ, is 28,000 Colombian pesos for children aged 12 to 17 (DAPR-FIP-DNP, 2004, pp.1 and 110). In 2003, the average monthly revenue of families in the first quintile of the income distribution $(wa_i + w + \theta e_c^b)$ is 94,346 COP (DNP, 2006). Angrist et al. (2002) estimate that the annual private cost associated with public schooling, κ, is 58 US dollars, or 14,023 COP on a monthly basis (1 USD=2,901 COP in 2003). For net education costs, $w + \kappa - \theta$, we also use average monthly child labor earnings, w, equal to 33,091 COP (DANE/OIT-IPEC, 2001, p.62). Finally, the school attendance rates of the population aged 12 to 17 is on average 72.5 % for the three first income deciles and 83.2 % for the rest of the population in 2003 (Gordillo and Ramirez, 2005, p.5). Since we assume that families do not save, consumption c_{1c}^b equals revenues minus the costs of schooling $wa_i + w + (\theta - \kappa - w)e^b$, i.e., $c_{1c}^b = 60,188$. Combining this information in (18) with a logarithmic utility function, we obtain that CCT transfers are superior to UCT transfers for all $\beta \in [0,1]$: even if all unconstrained families receive the transfers, the positive

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[14]*SISBEN*, Selection System for Beneficiaries (in Spanish, Sistema de Identificación de Beneficiarios) classifies households and individuals into six levels of income based on surveys conducted at the household level. See DNP (2003) for more information on *SISBEN*.

effect of CCT on the efficiency of constrained families behavior outweighs the loss due to the additional cost of funding unconstrained families in Colombia.

3.2   Education Quality

In this section we disentangle the conditions under which quality improvements reduce the inefficiency of constrained households' decisions. In our model, since all children attend the same school system, any policy affecting education quality necessarily affects all households. For credit-constrained households, an increase in q has the following effect on the time children spend at school:

$$\frac{de_c^b}{dq} = -\frac{wh_{eq}(e_c^b, q)U'\left(c_{2c}^b\right) + wh_q(e_c^b, q)wh_e(e_c^b, q)U''\left(c_{2c}^b\right)}{(w + \kappa - \theta)^2 U''\left(c_{1c}^b\right) + (wh_e(e_c^b, q))^2 U''\left(c_{2c}^b\right) + wh_{ee}(e_c^b, q)U'\left(c_{2c}^b\right)}, \tag{19}$$

by (6) and the implicit function theorem with $s = 0$.

If e and q are complements, there are two opposite effects on time spent at school. On the one hand, households have an incentive to increase time spent at school since the marginal productivity of e is larger when q increases. On the other hand, households can attain the same income in the second period by devoting less time to school and therefore have an incentive to decrease e. The larger q is, the lower the second effect is (by concavity of the human capital function) and the more likely it is that parents increase their children's time at school as a response to an increase in quality. If e and q are substitutes, both effects go in the same direction: the marginal productivity of e falls and the same income in the second period can be attained with less time at school. Thus, in this case, an increase in q unambiguously decreases the time spent at school chosen by constrained households.

The literature shows mixed results on the impact of improvements in school quality on school attendance. Banerjee et al. (2007) evaluate the impact of two school interventions in India designed to increase quality and show that they fail to increase attendance levels.

In contrast, Aker et al. (forthcoming), Bommier and Lambert (2000), Handa (2002), Lavy (1996), and Paxson and Schady (2002) find positive effects of school quality on school attendance. According to our model, both types of evidence are consistent with complementarity between q and e.

Even if time spent at school increases as a result of quality improvements, this does not guarantee that efficiency increases. In contrast to UCT and CCT, an increase in quality alters the *efficient* level of time spent at school *itself*. This can be seen by differentiating (11) with respect to q:

$$\frac{dI_c^b}{dq} = wh_{ee}\left(e_c^b, q\right) \frac{de_c^b}{dq} + wh_{eq}\left(e_c^b, q\right). \tag{20}$$

The first term in (20) represents the change in time spent at school following an increase in q. The second term in (20) represents the change in the efficient level of e. More precisely, $h_{eq}(e, q)$ is the direct effect of quality on the marginal productivity of time spent at school. It is positive (negative) when time spent at school and education quality are complements (substitutes), implying that the efficient level of e increases (decreases) following the increase in q. For a given choice of e, the inefficiency increases (decreases) due to this second term. Thus, if $h_{eq}(e, q) > 0$, parents may increase the time their children spend at school, but the efficient level of investment also increases following an increase in q. In contrast, if $h_{eq}(e, q) < 0$, parents reduce their children's time at school when quality increases, but the efficient e also goes down.

3.2.1 An estimation strategy to test the model predictions

In order to extend the investigation further, we put (19) and (20) together. Raising q will reduce the inefficiency of time children spend at school if and only if:

$$wh_{eq}\left(e_c^b, q\right) < \frac{wh_{ee}\left(e_c^b, q\right) U'\left(c_{2c}^b\right)}{D} + \frac{wh_q(e_c^b, q)wh_e(e_c^b, q)wh_{ee}\left(e_c^b, q\right) U''\left(c_{2c}^b\right)}{D} \tag{21}$$

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where $D \equiv (w + \kappa - \theta)^2 U''(c_{1c}^b) + (w h_e(e_c^b, q))^2 U''(c_{2c}^b) < 0$. A threshold of complementarity/substitutability of e and q is implicitly defined by this expression. Since h_{eq} affects the decision variable, we cannot isolate this threshold. Still, we can test condition (21) if we assume specific functional forms for the utility and production function.

This would require the estimation of the education production function $h(e, q)$. The dependent variable should be a measure of achievement, such as test scores or adult productivity, and the explanatory variables should include school quality measures (possibly aggregated in an index) and school attendance. In order to allow for a flexible production function, one should allow for non-linearities and interaction effects between e and q. An example of a regression function would be:

$$h(e, q) = \gamma_0 + \gamma_1 e + \gamma_2 q + \gamma_3 e^2 + \gamma_4 q^2 + \gamma_5 eq + \gamma_6 e^2 q^2 + \varepsilon.$$

In this case, $h_e = \gamma_1 + 2\gamma_3 e + \gamma_5 q + 2\gamma_6 eq^2$, $h_q = \gamma_2 + 2\gamma_4 q + \gamma_5 e + 2\gamma_6 e^2 q$, $h_{ee} = 2\gamma_3 + 2\gamma_6 q^2$ and $h_{eq} = \gamma_5 + 4\gamma_6 eq$. Then, by assuming an explicit functional form for the utility function, our model can be used to predict the effect of raising quality on efficiency.[15]

For example, if $h_{ee}(e_c^b, q)$ is 0 (i.e., γ_3 and γ_6 are not significant), we see that $h_{eq}(e_c^b, q) < 0$ becomes a necessary and sufficient condition for an increase in quality to lead to an increase in efficiency, from (21). Nevertheless, there is little evidence for substitutability in developing countries, as discussed above. In the case of complements, an increase in q may lead to a reduction in inefficiency when the second term on the right-hand side of (21) is smaller in absolute value than the first term. Interestingly, the lower the quality and/or children's time spent at school, the larger the second term on the right-hand side of (21) by the concavity of h, making it less likely that increases in quality lead to a reduction in inefficiency.

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[15]For instance, if the estimated production function is $h(e, q) = \gamma_3 e^2 + \gamma_5 eq$ with $\gamma_3 < 0$ and $\gamma_5 > 0$ (e and q complements), it can be shown that raising quality increases the time children spend at school following an increase in quality and that the inefficiency of this decision also increases.

It can be argued that even if raising quality moves the ideal level of time spent at school further up, we should value the fact that children spend more time at higher quality schools when e and q are sufficiently strong complements. This would be particularly so in the presence of a social externality that increases with school quality. Still, our model suggests that it is better to first eliminate the inefficiency, i.e., the credit constraint, and *then* raise quality. It can be shown that once households are unconstrained, raising quality does not affect the efficiency, unlike CCT, and it raises output.

4 Welfare

In this section, we focus on the effect of cash transfers and education quality on constrained household utility. We start with cash transfers. Using (1)-(5) with and $s = 0$ and applying the envelope theorem, we obtain that an increase in UCT raises the welfare of constrained households:

$$\frac{dU_c^b}{dv} = U'\left(c_{1c}^b\right) > 0. \tag{22}$$

An increase in CCT also raises the welfare of credit-constrained households, but this effect is proportional to the amount of time their children spend at school:

$$\frac{dU_c^b}{d\theta} = e_c^b U'\left(c_{1c}^b\right) > 0. \tag{23}$$

As before, we consider the effect of raising θ while reducing v in order to keep the budget balanced and, using (15), we find the following effect on the welfare of constrained households:

$$W_c^{\theta,v} = -U'\left(c_{1c}^b\right)\left(\frac{(1-\lambda)\,\beta\left(e_u^b - e_c^b\right)}{\lambda\alpha + (1-\lambda)\,\beta}\right)d\theta < 0 \ \ \text{if } e_u^b > e_c^b.$$

When unconstrained households do not benefit from the transfers, i.e., $\beta = 0$, UCT and CCT involving the same budget have the same effect in terms of income. Thus, the credit constraint is relaxed to the same extent in both cases and the effect on welfare is equivalent. In Section 3 we have seen that UCT and CCT have different impacts on the choice of time spent at school. However, because households equalize marginal costs and benefits when choosing e, the final effect of the change from UCT to CCT on welfare is nil.

In contrast, when $\beta > 0$, the welfare effect of UCT is larger than the effect of CCT for constrained households. While UCT are equally shared among all beneficiaries, CCT are based on time spent at school, which is smaller for constrained households than for unconstrained households. As a result, constrained households receive a lower transfer under CCT than under UCT for a given global budget.

The effect of raising quality on the welfare of constrained households is positive. Using (1)-(5) with $s = 0$ and applying the envelope theorem, we obtain:

$$\frac{dU_c^j}{dq} = w h_q \left(e_c^j, q\right) U' \left(c_{2c}^j\right) > 0. \tag{24}$$

We now compare the welfare effects of transfers and education quality. Using (1), (22), and (24), the welfare effect of simultaneously increasing education quality and reducing UCT for a given budget is given by:

$$W_c^{q,v} = w h_q \left(e_c^b, q\right) U' \left(c_{2c}^b\right) - U' \left(c_{1c}^b\right) \frac{\lambda \alpha e_c^b + (1 - \lambda) \beta e_u^b + \lambda (1 - \alpha) e_c^n + (1 - \lambda)(1 - \beta) e_u^n}{\lambda \alpha + (1 - \lambda) \beta}. \tag{25}$$

We know that for constrained households, $U' \left(c_{1c}^b\right) > U' \left(c_{2c}^b\right)$. Thus, the larger (in absolute value) the second term in (25) is relative to the first, the more severe the household credit constraint is. In contrast, low quality contributes to a higher welfare effect of quality improvements due to the concavity of h.[16]

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[16]If increases in education quality could be targeted at constrained households, the second term on the

Summing up, CCT and UCT are equivalent in terms of welfare if constrained households can be perfectly targeted. Otherwise, UCT are preferred to CCT by constrained households. The effect of quality on welfare is positive. The comparison of the welfare effects of transfers and quality are not clear cut and need to be carefully examined in each particular case. The severity of the credit constraint and the fact that cash transfers can be targeted, albeit imperfectly, support cash transfers over raising quality. Finally, the lower the initial level of education quality, the higher its marginal productivity and positive welfare effects.

5   Conclusion

In this paper, we investigate the impact on efficiency and welfare of three alternative policies (UCT, CCT and improvements in education quality) aimed at households that spend an inefficiently low amount of time at school due to credit constraints.

When constrained households can be perfectly targeted, we show that CCT are more efficiency enhancing than UCT because they not only relax the credit constraint, but also change the unit price of education. In contrast, for a given budget both cash transfers are equivalent in terms of welfare. We also show that these results depend on the precision of the targeting mechanism. Under sufficiently precise targeting, CCT are more effective than UCT in enhancing efficiency, but they are only equivalent in terms of welfare if targeting is perfect.

Improving education quality by investing in schools, teachers, or any education input other than time spent at school, also increases welfare, especially when education quality is low, as in developing countries. However, the effects of improving education quality in terms of efficiency are less clear cut. We provide a testable condition that allows us to predict the impact of increasing quality on the efficiency of the constrained household decisions. Our

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right-hand side of (25) would be smaller, and the benefits of increasing q would be larger. All the other qualitative results would remain the same.

analysis suggests that when quality is low, cash transfers can be best in terms of efficiency, but not in terms of welfare.

In our model, time spent at school is a continuous variable and CCT, paid by unit of time, change the price of education. This is the most appropriate approach when considering decisions over the lifetime, as we do in this paper. Alternatively, CCT could be conditional upon achieving a pre-determined threshold of school participation. In this case household decisions could be distorted at the margin, and the equivalence of CCT and UCT in terms of welfare, when constrained households can be targeted, would no longer hold.

As we mentioned in the introduction, the literature has focused on arguments other than credit constraints to justify the implementation of CCT programs. Accounting for positive externalities of education would certainly increase the positive effects of time spent at school, but our qualitative results would remain unchanged. In contrast, accounting for arguments such as irrationality and self-control problems would increase the attractiveness of CCT relative to the other policies. Our approach allows to identify the conditions under which CCT are best, even when these arguments are neglected.

We have also neglected the effect of the different policies on taxes paid by the households. This has the advantage of isolating the impact of expenditures from any distortive effect of taxation. A previous version of this work considered a very simple structure of taxation with uniform lump-sum taxes paid on the second period and obtained similar qualitative results. It would be interesting to consider alternative sources of revenue more specific to developing countries. We leave these issues for future research.

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