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Mixed effects of remittances on child education

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Abstract

We exploit the size of the 2010 Ecuadorian Census to estimate the effect of remittances on secondary school enrollment across four key dimensions: gender, household wealth, rural vs. urban, and family migration status. Using a bivariate probit model that accounts for both endogeneity and non-linearity issues, we find both positive and negative effects of remittances on the likelihood of schooling. The strongest positive effects are for poorer, urban males, while the negative effects are for rural females. For children in wealthier households, the effects of remittances are either negative or non-significant. This suggests that the positive income effects of remittances may be offset by the negative effects of a missing parent due to migration, more visible in wealthier families where financial constraints may not be as binding. We find further support for this by estimating the effects of remittances conditional on migration status. Our results show positive effects on schooling for non-migrant households that receive remittances and no effects for children living in households where at least one parent has migrated. The sharp contrasts within and across groups, while using the same data and econometric specifications, help explain the lack of consensus in the literature.

Keywords: International migration, Remittances, Education, School enrollment, Ecuador, Latin America

JEL Classification: F24, O15, O54

1 Introduction

International remittances continue to be a major source of income in developing countries. In Ecuador, remittances as a share of GDP neared 7% for 2005–2007, roughly matching the revenue from oil, the country's number one export. These large financial inflows have the potential to benefit poorer households by increasing income, educational attainment, and promoting health.[1] However, as Amuedo-Dorantes (2014) has noted, the effects of remittances may be heavily determined by the idiosyncrasies of each country. To address potential heterogeneity in our findings, we first develop a theoretical model that accounts for some of these differences and then test it by partitioning our data into population sub-groups.

The effects of remittances on children's schooling are of particular interest, as human capital accumulation may break the intergenerational transmission of poverty through higher future income, especially in the case of Ecuador where large labor returns to schooling have been found (Bertoli et al. 2011). The majority of the evidence in the liter-

ature supports the existence of potentially opposing effects of migration and remittances on education (Amuedo-Dorantes et al. 2010; Bargain and Boutin 2015; Hu 2012; Koska et al. 2013). Some studies find evidence for a higher likelihood of schooling in the presence of migration (Shrestha 2017; Theoharides: Manila to Malaysia, Quezon to Qatar: international migration and its effects on origin-country human capital, forthcoming) and remittances (Alcaraz et al. 2012; Calero et al. 2009; Göbel 2013). They argue that the positive effects may be driven by the additional income, wage premiums for migrants, contribution to household capital accumulation, and higher propensities of migrant families to invest in education. Bouoiyour and Miftah (2016) conclude that with remittances, children in Morocco are less likely to drop out of school and delay their entry into the labor market and that these improvements are especially notorious among girls. With higher income from remittances, Coon (2016) finds that Bolivian children work fewer hours, potentially leading to improvements in human capital. Even in terms of quality, Salas (2014) finds that remittances increase the likelihood of investing in sending children to private schools.

On the other hand, while some find that migration might raise parental academic aspirations for their children (Böhme 2015), others find detrimental effects of migration on education (Amuedo-Dorantes and Pozo 2010; Bouoiyour and Miftah 2015; McKenzie and Rapoport 2011). These studies argue that the negative effect could be driven by children having to compensate for the missing parent, by joining the labor force, or by taking over domestic responsibilities. This argument is also supported by Cortes (2015), who finds robust evidence that the mothers' migration, in contrast to fathers', has a negative effect on the educational outcomes of Filipino children. In terms of the effect of remittances, research continues to find instances in which remittances have no significant effect on schooling (Bargain and Boutin 2015; Nepal 2016; Pilarova and Kandakov 2017), or even where they might hinder child schooling, as households discount the value of education needed to thrive abroad (Davis and Brazil 2016).

This paper develops a theoretical model where receiving remittances may relax the household financial constraints, but migration may also change the household members' labor participation and education decisions. Although remittances may increase the likelihood of schooling among children, the effect of migration on schooling may be negative. We empirically test this relationship via a bivariate probit model that accounts for both endogeneity and non-linearity issues. We exploit the size and coverage of the 2010 Ecuadorian Population and Housing Census, which allows us to look at specific groups that may not be well represented in smaller samples.

In this way, we add to the work on Ecuador of Calero et al. (2009) and Göbel (2013), who use a sample of households collected in 2005–2006 to find a positive effect of remittances on education in Ecuador. However, due to data limitations acknowledged by the authors, the in-depth exploration of population sub-groups is not possible. In contrast, in this paper, we are able to partition the data into four key dimensions: gender, wealth, rural vs. urban location, and nuclear family migration status. While using the same data and econometric specifications, our findings vary greatly across these subgroups, and it is this variation that seems to explain the heterogeneity of results in the literature.

We find both positive and negative effects of remittances on education, depending on the particular group being studied. First, our findings reveal large gender inequalities, as boys benefit from remittances while the effect for girls is generally negative or insignificant. Second, urban children gain more than their rural counterparts, supporting the existence of regional inequalities. Also, while remittances relax households' budget constraints, the impact on education varies strongly by income level, where school attendance increases the most for poorer children. In contrast, for wealthier households, the effects of remittances on education are either negative or insignificant. This suggests that the positive income effects of remittances may be offset by the negative effects of a missing parent due to migration, more visible in wealthier families where financial constraints may not be binding. We find further support for this by estimating the effects of remittances conditional on migration status. Our results show positive effects on schooling for non-migrant households that receive remittances and no effects for children living in households where at least one parent has migrated.

2 Background

During the latter part of the 1990s, the Ecuadorian economy suffered one of its most severe crises with a staggering real GDP contraction of 28% for 1999, when measured in US dollars. Roughly one third of the population fell below the poverty line, and people living in extreme poverty doubled (Acosta et al. 2006). The crisis was characterized by business failures, increased unemployment, the official dollarization of the economy, the freezing of bank deposits, increasing public debt, and a large drop in health and education indicators.

This period of economic turmoil had deep social repercussions, especially in the form of the unprecedented emigration of millions of Ecuadorians to the USA and Europe. Close to 20% of the economically active population left the country in the early 2000s, and almost a quarter of the households had one or both parents migrate (Camacho and Hernández 2008). Camacho and Hernández (2008) also report that, on average, every migrant left behind two children under the age of 18. As a result, many homes became mono parental, children were left under the care of extended kin, or older siblings became the head of household.

The massive migration to North America and Europe produced a large flow of remittances back to Ecuador. Between 1990 and 2002, the volume of remittances entering the country increased by 30% annually. After a short slowdown in 2003, the rate recovered to an annual increase of 22% until 2007. Since 1999, the volume of remittances has been higher than that of foreign direct investment (FDI), and in 2007 alone, remittances were 16 times higher than FDI (Quintana et al. 2014). Between 2005 and 2007, remittances as a share of GDP neared 7%, surpassing the share of GDP generated by the value-added tax, and roughly equal to the share of petroleum, Ecuador's number one export.

Similar to income, the distribution of remittances across Ecuador is highly unequal. Olivié et al. (2009) indicate that in 2006, the bottom two income quintiles of the population received less than 6% of the total volume of remittances, while the wealthiest 20% received over 34%. Further, the poorest 40% received remittances for an average period of 4.4 years, while the wealthiest 20% received them for almost seven years.

Stated differently, poor children who start receiving remittances during the first grade of primary school may stop receiving them before they are able to complete the fifth grade.

In terms of how remittances are being used by recipients, the United Nations Population Fund reported that roughly 90% of remittances received are used for current expenditures (UNFPA and FLACSO 2008). Education and human capital formation expenditures account for 18% of the total.

3 Theoretical framework

To relate the probability of a child attending school to remittance reception and migration, we develop a utility maximization model with two adults a and b, and a child c, who is too young to make her own decisions. The household's utility depends on consumption and on the child's education, e_c. The child can only use her time for work or education. Time is normalized to 1, and parents decide how it is allocated. The household's utility is given by

$$U = U\left(x, e_c\right),$$

where x represents the consumption bundle and e_c is the time the child dedicates to education. Consequently, $(1 - e_c)$ is the time the child spends working.

Each period, the household receives remittances r and maximizes their utility by choosing a consumption level as well as the study and work time allocation for the child. The household's budget constraint is given by

$$x = w_a + w_b + (1 - e_c)\, w_c + r, \tag{1}$$

where w stands for wages. Notice that receiving remittances is not conditional on either parent migrating, as our data section below confirms. Remittances can also originate from relatives such as grandparents, friends, or from a biological parent not part of the household. With this, we can maximize the household's utility through the use of the Lagrangian and its first-order conditions:

$$\mathcal{L} = U(x, e_c) - \lambda\left[x - w_a - w_b - r - (1 - e_c)\, w_c\right] \tag{2}$$

$$\frac{\partial \mathcal{L}}{\partial x} = \frac{\partial U}{\partial x} - \lambda = 0 \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial e_c} = \frac{\partial U}{\partial e_c} - \lambda w_c = 0 \tag{4}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = x - w_a - w_b - r - (1 - e_c)\, w_c = 0. \tag{5}$$

These lead to the optimal condition

$$\frac{\partial U}{\partial e_c} = \frac{\partial U}{\partial x} w_c. \tag{6}$$

The left-hand side is the change in the household's utility from a change in the child's education, which we label θ. The right-hand side denotes the change in utility as the level of consumption changes, times the wage the child would earn if she worked. We label this change in utility as ϕ. The Marshallian demand curve for education is then given by

$$e_c = 1 - \frac{\phi}{\theta}\left[x_b - w_b - w_a - r\right]. \tag{7}$$

Taking the partial derivative of education with respect to remittances, we obtain

$$\frac{\partial e_c}{\partial r} = \frac{\phi}{\theta}. \tag{8}$$

The sign and magnitude of the change in education with a change in remittances is ambiguous, as it depends on the trade-off between the benefits of education and the household's consumption. Also, if member a of the household migrates, then $w_a = 0$, but r potentially increases. Thus, the trade-off between lost local parental wages vs. increased remittances makes the sign of Eq. (8) unclear. In addition, the trade-offs may vary across urban and rural settings, as imperfect labor markets, usually more pervasive in rural settings, may affect demand for child labor differently. Further, the relationship may also differ by income levels, age, and gender of the child.

Given the above discussion, we remain agnostic about the expected signs in our empirical results, as they may vary by population subgroups.

4 Data

Our data comes from the 2010 Ecuadorian Population and Housing Census conducted by Ecuador's National Institute of Statistics and Census (INEC). The census collected information on schooling, remittances, household, and demographic characteristics for Ecuador's entire population. Household remittance reception was determined by whether any member received money from relatives or friends living abroad during 2010. Since the census was conducted in November 2010, there was a period of 11 months in which respondents could have received remittances intermittently, regularly, or just once. The data does not include information on frequency or amount of reception; thus, the results are interpreted as the average effect on all households that received remittances. To identify households with migrant family members, the survey asked whether any individuals who resided in the household during the 2001 census had moved to another country and had not returned permanently. Follow-up questions inquired about migrants' age, destination, and purpose, as well as year of emigration.

While there is variation in the effect of remittances across gender and income groups, the largest differences appear to be on the rural/urban dimension. Figure 1 presents the schooling rates for urban and rural regions by remittance reception status and age. Note

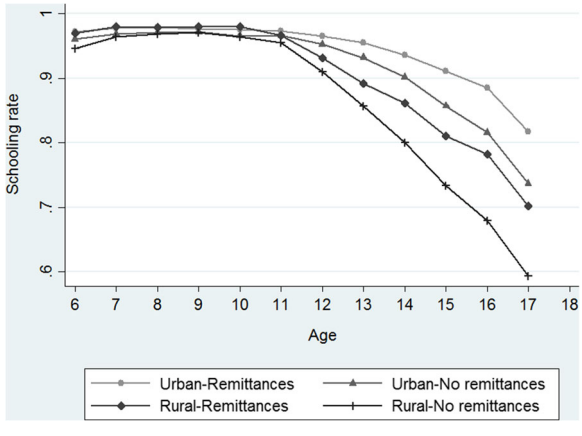

Fig. 1 Schooling rate by rural/urban region and remittance reception status

that before the age of 11, there is little difference in the schooling rates across groups and enrollment rates are close to 100%. However, starting at age 12, the schooling rates rapidly diverge, where urban children that receive remittances have the highest schooling rates, and rural children that do not receive remittances are the ones least likely to attend school. Even when Ecuadorian laws make it mandatory for children to attend school until the age of 14, Fig. 1 shows that this requirement has little impact on the rate at which enrollment rates decrease. Rather, it is the primary/secondary school jump that creates the discontinuity. While the slope of enrollment rates with changes in age is practically horizontal in primary school, it is clearly negative between the ages of 12 and 17 across groups. About 95% of 12-year-olds attend secondary school, but this proportion quickly drops and diverges to around 85% for urban remittance receivers and 60% among rural children who who do not receive remittances. At least in part, these differences may be explained by the increasing opportunity costs that arise from delaying the child's entry into the labor force. As children age, they become more capable of contributing to their households' income and taking over domestic responsibilities that often times make them drop out of school. The rapid decline in enrollment rates may be also explained by availability of secondary schools, especially in rural areas. While primary schools are common across Ecuador, the density of secondary schools is significantly lower, and secondary schools are often located in urban centers. Additional transportation costs added to an increased opportunity cost may push the marginal cost of education above its marginal benefit and force children out of school.

Due to the above discussion, our study focuses on the effect of remittances on the school enrollment of children who are between 12 and 17 years old. Although some children may graduate from school after the age of 17, restricting the bound ensures exclusion of non-schooling effects. Our final sample includes 1.7 million individuals.

The endogenous variable of interest, remittances, is instrumented via four variables. First, in line with the literature (Acosta 2011; Coon 2016; Davis and Brazil 2016), we connect an individual's likelihood of receiving remittances to historical migration networks. The expectation is that children who live in areas more prone to international migration are more likely to receive remittances. Note that migration of a nuclear family member is not a necessary condition to remittance reception, as relatives and friends commonly send income from abroad to one or more nuclear family units. In fact, Table 1 reports that only 32.5% of children who receive remittances have an immediate relative living overseas. To estimate historical migration networks, we use the 2001 census and calculate the proportion of migrants out of the total canton population.[2] This ensures that the historical migration patterns are not affected by our 2010 migration variable.

Second, we use migrants' characteristics to determine the probability of remitting without being directly related to the likelihood of education. We use migrants' age as an instrumental variable because it is potentially exogenous to socio-economic conditions in Ecuador, thus not affecting schooling decisions but having an effect on the probability to remit. We use a dummy variable as the instrument that indicates whether the migrants' ages at the time of survey were between 20 and 50 years old. In this way, we account for the higher probability of a migrant working and sending remittances if they are part of the working-age population. The identification strategy requires that variation in remittance reception as a result of the migrants' age is not directly related to education. As a matter of fact, our data shows that children with a migrant in this age group were 20 points

Table 1 Descriptive statistics by household remittance reception status

	Full sample		Recipients		Non-recipients	
	Mean	SD	Mean	SD	Mean	SD
Child attends school (1 = yes, 0 = no)	0.830	0.376	0.887	0.317	0.823	0.380
Household receives remittances (1 = yes, 0 = no)	0.075	0.264	1.00	0.00	0.00	0.00
Migrant household (1 = yes, 0 = no)	0.047	0.212	0.325	0.468	0.025	0.155
Relatives living abroad (excl. zeros)	1.445	0.935	1.484	0.912	1.405	0.912
Migrated to the USA or Canada (1 = yes, 0 = other)	0.340	0.474	0.403	0.490	0.273	0.445
Migrated to Europe (1 = yes, 0 = other)	0.520	0.450	0.540	0.498	0.498	0.500
Age of child in years (min = 12, max = 17)	14.49	1.700	14.53	1.701	14.49	1.700
Sex of child (1 = female, 0 = male)	0.493	0.500	0.497	0.500	0.492	0.500
Children younger than 5 in household (incl. zeros)	0.457	0.738	0.365	0.654	0.465	0.744
Continuous wealth index (0 = poorest, 1 = wealthiest)	0.670	0.148	0.754	0.124	0.663	0.148
Parents' highest level of education (1 = none, 10 = PhD)	6.05	2.188	6.60	2.208	6.00	2.181
Child lives in a rural area (1 = yes)	0.399	0.490	0.297	0.457	0.407	0.491
Child is Afro-descendant (1 = yes)	0.075	0.263	0.056	0.231	0.076	0.265
Child is Montubio (1 = yes)	0.065	0.247	0.024	0.152	0.069	0.253
Child is Indigenous (1 = yes)	0.081	0.273	0.052	0.222	0.083	0.277
Child is Mestizo (1 = yes)	0.723	0.447	0.800	0.400	0.717	0.450
Child is White (1 = yes)	0.053	0.223	0.065	0.246	0.052	0.221
Child has a disability (1 = yes)	0.036	0.185	0.032	0.175	0.036	0.186
Observations	1,737,152		130,406		1,606,746	

Notes: Montubio is an ethnic identity of the Ecuadorian lowlands

more likely to receive remittances, while their probability of education only increased marginally.

Third, following Antman (2011), we capture the main destination countries for Ecuadorian migrants by including dummies that control for migration to either the USA and Canada or Europe. These variables capture the economic conditions by destination and consequently the differing probabilities of remitting. The rationale is that general economic conditions in destination countries determine the likelihood of remittances without directly affecting school enrollment rates at the origin. More detailed information on migrants' destination would have allowed to include time-varying instruments such as unemployment and GDP per capita (see, e.g., Böhme 2015). However, Table 1 shows that individuals who receive remittances are over 10 points more likely to have a migrant relative in the USA, Canada, or Europe than those who do not receive remittances. Thus, we use destination to explain in part the different probabilities of remitting.

To further validate our instruments, Table 6 in the Appendix presents the results of a correlation analysis between the instruments and the dependent variables. The coefficients indicate a very weak association between school enrollment and the instruments and a much stronger relationship with remittances. We also run a simple probit model to assess the joint likelihood of the instruments in predicting schooling and remittance reception, and report the coefficients and model summaries in Appendix: Table 7. We find that our instruments have a low predictive power for education and a high predictive power for remittances. The likelihood ratio χ^2 test is significant in both cases, but the value for the remittances model is 30 times that of the school enrollment model. Similarly, McFadden's pseudo R^2 for the remittances regression is 0.171 while it equals 0.003 for school enrollment. In line with McFadden (1977), who describes a pseudo R^2 value between 0.2 and 0.4 as an "excellent fit," we conclude that the inclusion of instruments offers a considerable larger improvement for remittances than for school enrollment over their individual intercept models.

Our empirical model specifications control for province fixed effects to net out any potential local unobserved externalities that affect both recipient and non-recipient households, like quality of education and availability of schools. We also control for the following child, parent, and household characteristics: age, gender, number of children younger than five in the household, parents' highest level of education, location (urban/rural), ethnicity, presence of a disability, number of migrants, and wealth. As the the census does not collect information on actual income figures, nor its subgroup remittances, wealth is proxied by an index of 20 equally weighted variables that contain information on access to basic services and technologies, as well as materials, services, and housing conditions.[3] Although the use of a wealth index is a common control in studying the effect of remittances on household outcomes (e.g.,Acosta 2011; Antón 2010; Dustmann and Okatenko 2014), there is a potential for endogeneity if wealth is not assessed through pre-remittance reception data. Households who have received remittances for some time may be more likely to have moved up in the wealth distribution. To minimize this risk, we use variables that capture long-term socioeconomic status, like access to utilities and dwelling quality, rather than short-term measures, like income. The use of construction quality and asset ownership also allows us to use variables that are more responsive to past wealth than current flows of remittances. Furthermore, when we partition the sample to analyze effects within wealth groups, we use terciles as it is less likely that remittances would have caused households to cross the 33 and 66% thresholds to reach the next group.

Table 1 presents the descriptive statistics for the children, parent, and household variables by remittance reception status. Secondary school enrollment rate is 83%, with the remittance receiving group being 5.7% higher. We see that 7.5% of individuals between 12 and 17 reside in a remittance receiving household, meaning that over 130 thousand secondary school-aged children receive income from abroad. Not surprisingly, individuals who receive remittances are more likely to live in a migrant household and to have more relatives living outside the country. In terms of the migrants' main destinations, 40% of children who receive remittances see their relatives moving to the USA or Canada, while over 50% migrate to Europe. Table 1 additionally shows that families in the remittances group are relatively wealthier and more educated, with a lower proportion of recipients living in urban areas. In

terms of ethnicity, mestizos and whites are over-represented among remittance recipients whereas individuals who identify as Afro-descendants, Montubios, or Indigenous are under-represented. The remainder of this paper estimates remittance marginal effects on schooling across sub-groups while addressing the potential endogeneity of remittances.

5 Econometric framework

To estimate the effect of remittances on child schooling given by Eq. (8), and because the response variable education, e_c, is binary, we could use a probit model as a function of remittance reception, r, and a vector γ of child, parent, and household characteristics of the following form:

$$e_{ck} = 1\left[\alpha r_k + \gamma_{ck}\beta_s + \mu_{eck} > 0\right] \tag{9}$$

To estimate this model, we would have to make two assumptions that could yield inconsistent and biased estimates. First, we would have to assume that all the differences between recipient and non-recipient households are explained by the characteristics in γ. However, remittances are a consequence of migration, and if migration has an effect on education in addition to its effect through remittances, the error term in (9) would suffer from omitted variable bias (Mckenzie 2006). Second, we would have to assume that the child schooling decisions are not correlated with the decision of a migrant to send back remittances. In fact, if schooling, migration, and remittance decisions are correlated, then we would run into a simultaneous causality problem. To address this potential endogeneity, we use a bivariate probit model to account for the presence of r as a binary endogenous variable (Roodman 2011) that equals one if the household receives remittances and zero otherwise. In Section 6.3, we verify our results by repeating the analysis on households without migration and reach a similar conclusion. The empirical counterpart of Eq. (7) is given by the following recursive model:

$$e_{ck} = 1\left[\alpha r_k + \gamma_{ck}\beta_s + \epsilon_{eck} > 0\right] \tag{10}$$

$$r_k = 1\left[\gamma_{ck}\beta_r + z_r\beta_z + \epsilon_{rck} > 0\right] \tag{11}$$

$$\epsilon = (\epsilon_{eck}, \epsilon_{rck})' \sim \text{Normal}\left(0, \sum\right)$$

$$\sum = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix},$$

where the subscripts c and k indicate child and household, respectively. α is the counterpart of Eq. (8). The vector z_r includes observable instrumental variables for r_k such that $E(\epsilon_{eck}|z_r = 0)$. We could estimate this model through an IV-probit model by endogenizing remittances, r_k, as a continuous variable. This would approximate (11) with a linear probability model and (10) with a standard probit. However, the IV-probit framework does not yield consistent estimates as it does not respect the non-linearity of the first stage, a procedure that has been called a "forbidden regression" by Wooldridge (2010). A more appropriate method respects the binary nature of r_k to guarantee consistent and efficient parameters (Arendt and Larsen 2006). Thus, the preferred model to estimate (10) and (11) is a bivariate probit model that estimates remittances and education with ϵ_e and

ϵ_r jointly normally distributed. We treat r_k as a predetermined regressor in a SUR framework as the maximization of the likelihood function still generates consistent parameters (Wooldridge 2010).

6 Empirical results

Table 8 in the Appendix reports the bivariate probit first-stage results for the effect of our instruments on remittances. The instrument coefficients are consistently significant and positive across all specifications. We confirm the existence of an endogenous relationship between remittance reception and schooling via Wald's tests for $\rho = 0$, where we reject the null hypothesis of no error correlation. We use specification three for all two-stage specifications, as it includes all instruments and controls, and its estimates provide a lower bound for the effect of remittances on school enrollment.

While the bivariate probit model is preferred, Table 2 also reports the estimates obtained through the standard probit and IV-probit models for comparative purposes.[4] We present marginal effects, clustered standard errors, and number of observations for each model. The first row presents the effects of remittance receipt on child education for the whole sample. According to our bivariate probit results, the overall effect of receiving remittances increases the probability of school enrollment by 2.6 percentage points, relative to children that do not receive remittances. Notice that when we do not correct for the endogeneity of remittances in the standard probit model, all results are downward biased. When we split the sample by gender, we see that the benefits tend to be higher for boys than for girls. While males' probability of being enrolled in secondary school increases by 3.4 percentage points, females' probability increases by only 1.3%, less than half of the probability for boys. In absolute terms though, this translates into an additional 26,400 males and 10,000 females attending secondary school. This positive effect may be explained by a reduced need for recipient households to send children to work, as remittances relax their budget constraints. As we further divide the population, we will find larger and more interesting effects and differences across groups.

6.1 Wealth inequalities

Table 3 further inquires into these heterogeneous results by partitioning the data into wealth terciles.[5] For the poorest tercile, the overall probability of attending school is 4.3 points higher than for their non-recipient counterparts. A smaller effect is found for children in the middle wealth group, and in sharp contrast, children in the top tercile seem to not be affected by remittances. This suggests that the impact of remittances depends

Table 2 Marginal effects of remittances (1/0) on secondary school enrollment (1/0)

Population group	Probit	IV-probit	Bivariate probit	Obs.
Pooled data	0.010***	0.014***	0.026***	1,533,133
	(0.0013)	(0.0045)	(0.0044)	
Males	0.008***	0.012***	0.034***	776,830
	(0.0018)	(0.0061)	(0.0065)	
Females	0.012***	0.008*	0.013***	756,303
	(0.0018)	(0.0043)	(0.0039)	

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 3 By wealth terciles: effects of remittances on secondary school enrollment

	Bottom wealth tercile		Middle wealth tercile		Top wealth tercile	
	Bivariate probit	Obs.	Bivariate probit	Obs.	Bivariate probit	Obs.
Pooled data	0.043***	530,439	0.017***	517,853	− 0.001	484,841
	(0.0174)		(0.0067)		(0.0020)	
Males	0.078***	272,019	0.016*	261,252	− 0.001	243,559
	(0.0229)		(0.0087)		(0.0029)	
Females	0.011	258,420	0.017*	256,601	− 0.001	241,282
	(0.0233)		(0.0091)		(0.0026)	

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

on income levels and that levels in budget constraints may matter a great deal. In particular, the income effect of remittances may be stronger for poorer households with smaller budgets. In contrast, additional income may not offset the potential negative impact of a missing parent for wealthier households.

Table 3 also shows large gender differences for the poor, where remittances generally benefit boys more than girls. Males benefit the most the lower their wealth tercile, with a 7.8 point increase in schooling probability for the bottom third and a non-significant effect for the top category. Alternatively, effects on females seem to be mostly statistically and economically negligible. Only the middle tercile benefits from a mild improvement in the order of a 1.7 point increase in schooling probability. For both males and females, the effects for wealthier children remain insignificant in both magnitude and statistical significance.

6.2 Rural vs. urban

Table 4 further narrows our view by splitting the population across rural and urban sub-samples, gender, and wealth levels. Our results indicate that there are significant differences in the effects of remittances on education conditional on rural-urban location. Overall, urban children in the bottom two wealth terciles seem to benefit the most, while their rural counterparts have either smaller or negative effects. We again find that the largest positive effects occur to those relatively more financially constrained, while either negative or not significant effects are seen for the wealthier group.

The rural pooled sample seems to suggest that there is no effect of remittances on schooling across wealth groups. However, when we divide the observations into males and females, we observe that girls are driving the lack of effect. Boys who live in rural areas are better off if they receive remittances, with individuals in the bottom wealth tercile being the most affected by a 7.1 point higher likelihood of attending school. Unfortunately, these benefits do not transfer over to rural girls, with either no or negative effects on schooling probability. For more disadvantaged children, remittances might be the decisive factor that enables them to invest in human capital formation. However, these results may be attenuated by the parents' higher marginal utility for having an additional household member working, either to earn additional income or to do household work.

Turning to the urban sub-sample, Table 4 indicates that the gender differences are reversed for the most disadvantaged group as girls seem to be the most favored. In fact, remittances seem to increase the likelihood of secondary school enrollment for females by 13 points, the largest positive effect in our study. Even when looking at the pooled data,

Table 4 Rural-urban effects of remittances on secondary school enrollment

		Bottom wealth tercile		Middle wealth tercile		Top wealth tercile	
		Bivariate probit	Obs.	Bivariate probit	Obs.	Bivariate probit	Obs.
Rural	Pooled data	0.027	340,710	0.002	182,337	−0.007	73,644
		(0.0196)		(0.0151)		(0.0059)	
	Males	0.071***	175,775	0.012	92,706	0.002	37,514
		(0.0258)		(0.0210)		(0.0158)	
	Females	−0.017	164,935	−0.009	89,631	−0.011**	36,130
		(0.0258)		(0.0196)		(0.0054)	
Urban	Pooled data	0.106***	189,729	0.033***	335,516	0.0004	411,197
		(0.0386)		(0.0096)		(0.0021)	
	Males	0.074	96,244	0.024**	168,546	−0.001	206,045
		(0.0480)		(0.0116)		(0.0027)	
	Females	0.130***	93,485	0.041***	166,970	0.001	205,152
		(0.0486)		(0.0136)		(0.0030)	

Robust standard errors in parentheses. Note: Wealth index terciles created with the full sample
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

we see an overall improvement among the lowest wealth categories. The effects become non-significant for wealthier individuals, as this group's choice of education may be less constrained by their income level.

6.3 Remittance vs. migration

In this section, we disentangle the potentially positive effect of additional income via remittances vs. the potentially negative impact of a missing family member due to migration, hinted at in the previous sections and discussed in the literature (e.g., McKenzie and Rapoport 2011). To this end, we follow a similar approach to Amuedo-Dorantes and Pozo (2010) and estimate the effect of remittances conditional on migration status. The first group is composed of families where at least one parent has migrated, while the second group is limited to families in which no nuclear member has migrated. The latter could be families with children from previous relationships, or that receive remittances from grandparents, other relatives, and friends. These specific households are common in Ecuador, as over 65% of the children in our sample who receive remittances live in non-migrant households.

Unfortunately, the census data does not contain information on the senders nor the amount and frequency of remittances. Thus, we cannot assume that migrant and non-migrant households who receive remittances are strictly comparable. We are also unable to treat both groups as such after controlling for observables, because if these characteristics explained the systematic difference between the two, then we would observe similar migration and remitting behaviors. Migrant households that receive remittances are different from non-migrant households in difficult-to-capture areas such as drive, aptitudes, perceived returns from education, and concerns for their children (Mckenzie 2006). We therefore take the results in this section with caution. Still, if we find a negative effect among migrant households, and a positive effect for non-migrants, it suggests the existence of the two opposing effects. On the one hand, an increase in the schooling probability of children who live in non-migrant households would be driven by the income

effect from remittances. On the other hand, this positive effect could be outweighed by the missing-parent effect among migrant households.

Table 5 presents the marginal effects of remittances on schooling probability for secondary school-aged rural and urban children. Notice that the effects of remittances are largely driven not only by migration status but also by gender and rural/urban location. Regardless of location, the effect of remittances among children in migrant households is non-significant. In sharp contrast, for non-migrant households, the effects are positive and significant, regardless of gender or location. These results support the existence of the two opposing forces. It seems that remittances benefit children only when they have not been directly affected by migration.

In the context of our Marshallian demand for education presented in Eq. (7), these results can be explained in terms of θ and ϕ (Eq. (6)). The positive effect of remittances observed among non-migrant households seems to be driven by a higher perceived utility from education relative to the additional utility obtained from an increase in the household consumption level. Instead, the lack of an effect of remittances on migrant households appears to be determined by the additional utility from consumption counteracting that of education.

7 Conclusions

We exploit the full dimension of the 2010 Ecuadorian Population and Housing Census database to identify the effects of remittances on children's education. Even though this topic has been previously explored, the heterogeneity of results across studies warrants a new look. Using the same data and econometric specifications, we find both positive and negative effects across different subgroups. In addition to gender, socioeconomic status, and urban/rural inequalities, our proposed model indicates that the variation in the results is mainly driven by two effects. First, the additional income received in the form of remittances relaxes the households' budget constraints, which increases the probability of investing in children's human capital. Second, the evidence indicates that the remittances income effect may be offset by the absenteeism effect from migrant relatives. Our results show that the difference in the effect of remittances between migrant households and non-migrant households is at least five percentage points. It is possible that under migration, the likelihood of children going to secondary school decreases, as they

Table 5 By migration status: effects of remittances on secondary school enrollment

		Migrant households		Non-migrant households	
		Bivariate probit	Obs.	Bivariate probit	Obs.
Rural	Males	0.032	13,483	0.113***	292,512
		(0.0428)		(0.0378)	
	Females	−0.005	12,712	0.056*	277,984
		(0.0175)		(0.0360)	
Urban	Males	0.005	23,151	0.062***	447,684
		(0.0156)		(0.0152)	
	Females	0.013	23,038	0.025***	442,569
		(0.0117)		(0.0085)	

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

take on household responsibilities or are encouraged to work. Our evidence suggests that the magnitude of the effect depends on the group being considered. This highlights the importance of using large data sets, so that different sub-samples can be evaluated.

In terms of policy recommendations, the evidence suggests that the effect of remittances depends on the level of inclusion of the population sub-groups. Our findings suggest that girls living in rural areas are the most disadvantaged. Targeting policies toward them would would not only contribute to human capital formation but also contribute to the empowerment of these traditionally excluded groups.

Endnotes

[1] See Rapoport and Docquier (2006) for a comprehensive review.

[2] Cantons are second-level administrative divisions, below provinces. They are the equivalent of a county in the USA.

[3] Namely, access to dwelling, water source, plumbing, sewage, electricity, kitchen space, sanitation facilities, drinking water, landline telephone, cell phone, Internet access, computer access, and cable television, as well as roof, walls, and floor materials and condition.

[4] We also test the consistency of our results with a Tobit model and find no substantial differences.

[5] Table 9 in the Appendix provides school enrollment rates and remittance reception by wealth tercile and rural-urban location.

Appendix

Table 6 Correlations between dependent variables and instrumental variables

Potential instruments	Remittance reception	School enrollment
Lagged local migration network	0.18	0.04
Migrant's age between 20 and 50 (1/0)	0.36	0.02
Migrant resides in the USA (1/0)	0.26	0.01
Migrants resided in Europe (1/0)	0.28	0.02

Note: The phi coefficient is used for correlations between two binary variables

Table 7 Probit regressions on instruments

Potential instruments	Remittance reception	School enrollment
Lagged local migration network	12.750***	3.892***
	(0.0750)	(0.0601)
Migrant's age between 20 and 50 (1/0)	0.530***	0.074***
	(0.0102)	(0.0118)
Migrant resides in the USA (1/0)	1.167***	− 0.102***
	(0.0115)	(0.0133)
Migrants resides in Europe (1/0)	1.250***	0.152***
	(0.0102)	(0.0120)
Likelihood ratio χ^2	158,584.97	5,280.77
p value for LR χ^2	< 0.001	< 0.001
McFadden's pseudo R^2	0.171	0.003

Standard errors in parentheses. Notes: The sample includes children between 12 and 17 years old (N = 1,533,133). McFadden (1977) describes a pseudo R^2 value between 0.2 and 0.4 as an "excellent fit"
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 8 Bivariate probit results: probit coefficients for school enrollment and remittance reception

Panel A. First stage: remittance reception	(1)	(2)	(3)
Instruments			
Lagged migration network	9.983***	9.604***	9.528***
	(0.2105)	(0.2143)	(0.2154)
Migrant's age between 20 and 50		1.120***	0.483***
		(0.0119)	(0.0150)
Migrant resides in the USA			0.951***
			(0.0189)
Migrants resided in Europe			1.084***
			(0.0171)
Controls			
Age	0.023	0.022	0.021
	(0.2105)	(0.0183)	(0.0184)
Female (1 = yes)	0.003	0.003	0.004
	(0.0034)	(0.0034)	(0.0034)
Rural (1 = yes)	0.004	−0.007	−0.007
	(0.0055)	(0.0056)	(0.0056)
Migrant relatives	0.732***	0.315***	0.109***
	(0.0074)	(0.0071)	(0.0068)
Wealth index	2.333***	2.300***	2.294***
	(0.0220)	(0.0222)	(0.0223)
Infants in household	−0.028***	−0.018***	−0.015***
	(0.0035)	(0.0034)	(0.0034)
Panel B. Second stage: school enrollment	(1)	(2)	(3)
Remittance reception (1 = yes)	0.184***	0.169***	0.148***
	(0.0334)	(0.0246)	(0.0225)
Age	−0.228***	−0.228***	−0.228***
	(0.0159)	(0.0159)	(0.0159)
Female (1 = yes)	−0.012***	−0.012***	−0.012***
	(0.0027)	(0.0027)	(0.0027)
Rural (1 = yes)	−0.085***	−0.085***	−0.085***
	(0.0036)	(0.0036)	(0.0036)
Migrant relatives	−0.043***	−0.039***	−0.034***
	(0.0084)	(0.0068)	(0.0064)
Wealth index	1.958***	1.962***	1.968***
	(0.0173)	(0.0161)	(0.0158)
Infants in household	−0.152***	−0.152***	−0.152***
	(0.0019)	(0.0019)	(0.0019)
ρ	−0.069	−0.063	−0.052
χ^2 for Wald's test of $\rho = 0$	16.733	25.093	20.909
p value for Wald's test of $\rho = 0$	< 0.001	< 0.001	< 0.001

Robust standard errors in parentheses. *Notes*: The sample includes children between 12 and 17 years old (N = 1,533,133). All model specifications also control for age squared, ethnicity, presence of a disability, parental highest level of education, and province fixed effects. Additional model results available upon request

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 9 Proportion of children who are enrolled in school and who receive remittances

	School enrollment		Remittance reception		
	Yes	No	Yes	No	Observations
Pooled data (12–17)	0.83	0.17	0.08	0.92	1,737,152
Males (12–17)	0.83	0.17	0.07	0.93	881,241
Females (12–17)	0.83	0.17	0.08	0.92	855,911
Bottom wealth tercile					
Pooled data (12–17)	0.72	0.28	0.03	0.97	617,743
Males (12–17)	0.73	0.27	0.03	0.97	317,132
Females (12–17)	0.72	0.28	0.03	0.97	300,611
Middle wealth tercile					
Pooled data (12–17)	0.84	0.16	0.07	0.93	585,807
Males (12–17)	0.84	0.16	0.07	0.93	295,895
Females (12–17)	0.84	0.16	0.07	0.93	289,912
Top wealth tercile					
Pooled data (12–17)	0.94	0.06	0.13	0.87	533,602
Males (12–17)	0.94	0.06	0.13	0.87	268,214
Females (12–17)	0.94	0.06	0.13	0.87	265,388
Rural					
Pooled data (12–17)	0.77	0.23	0.06	0.94	693,189
Males (12–17)	0.78	0.22	0.06	0.94	356,130
Females (12–17)	0.76	0.24	0.06	0.94	337,059
Urban					
Pooled data (12–17)	0.87	0.13	0.09	0.91	1,043,963
Males (12–17)	0.87	0.13	0.09	0.91	525,111
Females (12–17)	0.87	0.13	0.09	0.91	518,852

Notes: Proportions may not add up to one due to rounding. The number of observations could differ from other tables due to data availability

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Availability of supporting data
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