INTERNATIONAL MIGRATION REVIEW

The Impact of Remittances on Nutritional Status of Children in Ecuador[1]

José-Ignacio Antón
University of Salamanca

This work analyzes the impact of remittances on nutritional status of children aged <5 years old in Ecuador in 2006. Using a set of anthropometric indicators constructed according to the new World Health Organization standards, the last household survey available for this country, and an instrumental variables strategy controlling for endogeneity of remittances, this study finds a positive and significant effect of remittance income on short-term and middle-term child nutritional status; nevertheless, no significant impact on long-run anthropometric indicators.

INTRODUCTION

During the last two decades, international migration has been an increasingly important phenomenon in Latin America, so it is not surprising that it has attracted a lot of interest among economists.[2] In fact, the Latin American region accounts for roughly a quarter of the remittance flows in the world (World Bank, 2006). Ecuador is not an exception to this rule, especially since the economic crisis suffered by the country in the late 1990s. From 1997 to 2006, roughly 900,000 Ecuadorians, around 7 percent of total population and 20 percent of economically active population,

[1]This article is a summary of my M.Sc. Dissertation at the University of Essex. A previous version of this article was presented at the 2009 European Society of Population Economics Annual Meeting in Sevilla (Spain). Three anonymous referees and Rafael Muñoz de Bustillo are gratefully acknowledged for helpful and detailed comments that contribute to substantially improve the paper. All remaining errors and omissions are of my complete responsibility.
[2]There is huge amount of literature on the effects of migration on development. *See*, among others, the comprehensive study of Fajnzylber and López (2007), and the work of McKenzie and Sasin (2007) for an extensive literature review.

DOI: 10.1111/j.1747-7379.2010.00806.x

migrated abroad, Spain, and the United States being the main host countries. These impressive figures resulted in a considerable remittance flow of more than 1,800 million dollars in 2005, which represented around 5 percent of Ecuadorian Gross Domestic Product (FLACSO, 2006). Because of the magnitude of the migration phenomenon, evaluating the impact of remittances – or, in general, migration – on development is a very relevant task. In addition, poverty and, particularly, malnutrition is a big and persistent issue in Ecuador nowadays, a phenomenon mainly associated to the bad macroeconomic performance and subsequent increase in poverty rates since 1990, the low and badly targeted social spending and the absence of well-designed nutritional programs (World Bank, 2004, 2007). Although remittances are not an income source especially concentrated on the poor, it is better distributed than overall income.[3] By relaxing households' budget constraints or as a smoothing mechanism for income shocks, remittances can contribute to improve health outcomes of children in Ecuador.

The aim of this work is to determine the impact of remittances on child nutritional status in Ecuador. To address this question, this study uses the last household survey available for this country, from 2005 to 2006, and three anthropometric indicators for children aged <5 years old: weight-for-height (WHZ), weight-for-age (WAZ), and height-for-age *z*-scores (HAZ), which represent short-, middle-, and long-term indicators of infant nutritional status, respectively. Using an instrumental variables (IV) strategy for dealing with endogeneity of remittances and implementing through two-stage least squares (2SLS), I find a statistically significant and positive effect of remittances on WHZ and WAZ, but no statistically significant impact on HAZ, suggesting that remittances have an effect on the short- and middle-term nutritional status, but not on a long-term anthropometric indicators of a child in this country, which may be related to the length of time households that have been profiting income from abroad and the possibility of using remittance income as an insurance mechanism for consumption smoothing against income shocks. Remittances received by households, a potentially endogenous variable, are instrumented with the number of Western Union offices per 100,000 people at province level, which is a source of exogenous variation of trans-

[3]According to Calero, Bedi, and Sparrow (2009), the poorest 40 percent of Ecuadorian population receives roughly 20 percent of total remittance flows, while they only concentrate 14.5 percent of total national income (ECLAC, 2008).

action cost of international transfers and the proportion of households with migrants by province in 2003, which is used as a proxy for migration networks abroad.

This work presents several contributions to the current literature on migration. First, to my knowledge is the first work that aims to determine the effects of remittances on child nutritional status in Ecuador.[4] Second, in contrast to previous studies aiming to determine the impact of remittances on anthropometric indicators, identification is achieved using IVs and not considering remittances as an exogenous variable. Finally, I use the new standards of child nutrition just released by the World Health Organization (WHO) in 2006, not used in previous studies in economics.

In addition, the question posed here is empirically relevant because of the last international economic events, particularly the current economic crisis that is affecting some national economies, such as Spain and the United States. If money sent by emigrants has a positive impact on households' welfare – and, particularly, on child health – a reduction of remittance flows could have negative consequences on child nutritional status. This is a cause of concern since the current global economic crisis is negatively affecting the amount of money sent to Latin America from Europe and the United States and large falls of remittance flows are expected in the future.[5]

Apart from this introduction, the article is organized in four sections. Section 2 presents the theoretical framework supporting the impact of remittances on health and a literature review of the effect of remittances on child health. The database and main variables used to carry out the empirical analysis are described in detail in the third section. The fourth one outlines the empirical strategy used in this paper, presents the results of the empirical analysis and, then, discusses their implications. The last section summarizes the main conclusions of this work.

[4]Nevertheless, there have been other authors who have studied the effect of migration on other dimensions of development, such as Acosta, Fajnzylber, and López (2007) and Calero, Bedi and Sparrow (2009), who analyze the impact of remittances on school enrollment and labor supply.

[5]The World Bank forecasts a fall in remittances inflows by 6–9 percent in Latin America in 2009 (World Bank, 2009). Particularly, according to the World Bank database on migration and remittances, while in the last quarter of 2006 inflows amounted to roughly U.S. $800 million in Ecuador, in the second quarter of 2009, they only meant barely U.S. $610 million.

REMITTANCES AND CHILD NUTRITIONAL STATUS

This section outlines the theoretical framework required to understand the effect of remittances on child health and presents a literature review of the main empirical works that have addressed the topic.

Following Hildebrandt and McKenzie (2005), the Grossman (1972) model of health production function is a good point of departure for establishing the theoretical framework for analyzing the effects of migration on child health and, in this particular case, on nutritional status. According to Grossman, individual utility can be characterized as a function of health in all periods that individuals maximize subject to a budget constraint. Inspired by this theoretical construction, Behrman and Skoufias (2004) suggest a simplified model for examining infant nutrition, which is slightly adapted here. Within such model, households choose child health (H), leisure (L), and consumption of goods and services (C) and they are assumed to maximize an unitary household utility function subject to a budget and a production function constraint, which can be represented as follows:

$$U = u(H, L, C, X), \tag{1}$$

where X is a vector of household characteristics such as, among others, the household average level of education. The health status of the child H is a normal good that depends on nutritional and medical inputs (from breast feeding to prenatal and postnatal care) (N), biologic endowments (B) (*i.e.*, genetic factors), and some household characteristics (X) and can be modeled as the following health production function:

$$H = h(N, B, X). \tag{2}$$

According to Hildebrandt and McKenzie (2005), the most obvious channel through which migration may positively affect child nutritional status is increasing household income and wealth and then allowing households to purchase nutritional and medical inputs, that is relaxing family budged constraint and thus allowing a higher investment in children. In addition, if remittances relax liquidity constraints, it may allow parents to make additional investments they could not have made otherwise. McKenzie and Sasin (2007) point out two reasons why remittance income may be spent in differently than "normal" income. First, if health is seen as an investment by parents and remittance income is considered temporary, according to permanent income hypothesis, remittances will be mainly invested, for example, in child health, instead of being spent on normal consumption. Second, it is possible that money is remitted with a specific purpose, favouring investment over consumption. For example, Adams (2005) reports that, at the margin, households receiving remittances in Guatemala spend more on education and health. Therefore, in principle, economic theory predicts a positive effect of remittances on child nutritional status. Finally, migration decisions could be part of a household's income and consumption smoothing strategy. In particular, remittances could function as an insurance mechanism to smooth away income shocks. For instance, a recent empirical work using cross-country data by Frankel (2009) seems to support this interpretation: remittances are procyclical with respect to income in the migrant's host country (the sender) and they are countercyclical with respect to income in the worker's country of origin. Although in the first two cases, one will expect positive effect on both short- and long-term health indicators, the last channel is related mainly to short-term improvements in child outcomes.

There are several empirical works documenting the effect of migration or remittances on child health.[6] For example, Brockerhoff (1990) reports that female rural–urban migration has a positive effect on child survival in Senegal, a finding that is confirmed by a later work of this same author analyzing surveys of 17 countries (Brockerhoff, 1994). A similar result is found by Ssegonzi, De Jong, and Stokes (2002) for Uganda. At a higher level of analysis, there is also evidence that remittances contribute to construction of health centers and hospitals in the country of origin (Martin, Martin, and Weil, 2002). Using data from Mexico, Kanaiaupuni and Donato (1999) show that remittances have a positive effect on child survival in the long term and Frank and Hummer (2002), also focused on Mexico find that having a migrant in the household has a positive effect on birth weight. It is worthy to mention that all these

[6]Although both concepts are not interchangeable, in practice, it is very difficult to separate the effect of each (McKenzie and Sasin, 2007). For example, it is possible that in long-term migration can have other different effects apart from those associated with remittances, mainly through the adoption of better health care practices (*e.g.*, a wider use of contraceptive methods) acquired in the host country (Menjívar, 2002; Hildebrandt and McKenzie, 2005). Nevertheless, when both variables are available, the empirical evidence suggests that the main channel of health improvement is the raise of financial resources implied by remittances (Lindstrom and Muñoz Franco, 2006).

authors do not take into account the possible endogeneity of migration or reception of remittances. López-Córdoba (2005), who is able to deal with the potential endogeneity of migration using the product of historic migration rates to the United States at the state level and the distance to the American frontier as IV, finds that migration and remittances measured at municipality level are associated with lower rates of infant mortality. Using cross-country data, the study of Chauvet, Gubert, and Mesplé-Somps (2008) reveals that remittance flows contribute to reduce infant mortality and malnutrition.

Nevertheless, the most comprehensive study is the work of Hildebrandt and McKenzie (2005), who, using historic migration rates at state level as instrument for the presence of migrants in the household, report a positive incidence of migration on birth weight and infant mortality, but a negative impact on the probability that children visit a doctor, are breast-fed and are fully vaccinated. Also for Mexico, Amuedo-Dorantes, Pozo, and Sainz (2007), using Western Union branches per count and proportion of households with migrants at state level, find that remittances allow households to increase health-care expenditure, especially in primary services, which are likely to affect positively health because of its preventive nature, and Gil-Valero (2008) reports that remittance income increases the proportion of household expenditure devoted to health, especially among households without access to medical insurance.

Nevertheless, it is worth mentioning there are also some works documenting a negligible or even a negative effect of migration in children's outcomes; for example, Kandel and Kao (2006) find that migration of their parents offers migrants' children left in Mexico economic opportunities that, on the other side, weaken incentives to accumulate human capital.

Finally, in a recent work on the effect of remittances on several aspects of development, including child health, Acosta, Fajnzylber, and López (2007) are the first researchers in studying the effect of remittances on anthropometric measures, such as weight and height. These authors point out that reception of remittance income at household level raise weight, the probability of immunization and visits delivered by a doctor in Guatemala and only the last indicator in El Salvador. These results correspond to ordinary least squares (OLS) regressions, since they fail to achieve identification using IVs. Apart from the mentioned results, in most other cases for these two countries, they find positive but not statistically significant coefficients, which they attribute to the availability of small sample sizes and which, according to these authors, provides certain evidence of the positive effects of migration on anthropometric parameters in children.

DATA

This section briefly describes the main features of the database, the construction of antrophometric indicators and the selection of variables used in the analysis.

Description of the Database

The main source of data used in this work is the Survey on Living Conditions 2005–2006 (SLC 2005−2006), the last household survey available for Ecuador carried out by the National Institute of Statistics and Census of Ecuador. A description of the sampling procedures and main characteristics of this survey can be found in INEC (2006). In contrast to the current procedures in Latin America, it is a single-stage survey; that is, households represent the only sampling units. This survey, carried out between the last quarter of 2005 and the last quarter of 2006, contains detailed information on 13,581 Ecuadorian households, of which roughly 8 percent receive money from relatives or friends living abroad. It collects information on the amount of remittances received and their periodicity, but, unfortunately, it does not tell us how many (if any) household members are abroad or how long household have been receiving remittances. Nevertheless, compared with previous national and other nationally representative Latin American surveys, the SLC comprises rich anthropometric measures of children under 5 years old and detailed information about previous migration experiences of household members. When the analysis is limited to this group, the available sample is reduced to less than 6,000 observations, with nearly 10 percent of these children living in households that receive remittances.

Furthermore, we use two additional sources of data to get appropriate IV used in the empirical analysis. First, the number of Western Union offices per 100,000 by province has been computed from the work of Calero, Bedi, and Sparrow (2009). Second, the proportion of the households with migrants before 2003 at the province level is computed from the migration module of the 2004 Demographic and Maternal-Child Health Survey, carried out by the Centre of Studies on Population and

Development in Ecuador.[7] This survey includes both a questionnaire on women and children health status and another on migration issues. Unfortunately, within each census sector considered in the sampling, half of the households were interviewed about child and female health and the rest answered the questionnaire on migration, making this database unsuitable for the purpose of the analysis presented in this work.

Finally, as it is explained in more detail below, several province controls referred to infant mortality rates and variables capturing health-care infrastructure are obtained from publications of the National Institute of Statistics and Census of Ecuador (INEC, 2005a,b).

Construction of Anthropometric Indicators

To analyze the effect of remittances on child nutritional status, the most common approach is to construct anthropometric indicators that, based on age and sex, take as reference a healthy population of children. There are basically three ways of expressing the comparisons with the reference group standard deviation units or *z*-scores, percent of median, and percentiles (Cogill, 2003). O'Donnell *et al.* (2008) argue that *z*-scores are the preferred and most commonly used anthropometric measures, since, unlike the other two indicators, they can be used as summary statistics, and percentiles do not necessarily reflect large changes in height or weight at the extreme of the distribution and the percent of median do not take into account the variability in the reference child population. Because of these reasons, the analysis presented here is limited to the use of *z*-scores. These measures can be expressed as the quotient of the difference between the value for an indicator (weight or height) and the median value for the same indicator and for the same sex and age (or height) and the standard deviation of the indicator in the reference population. Formally, a *z*-score can be computed as follows:

$$z\text{-score} = \frac{(\text{observed value}) - (\text{median reference value})}{\text{standard deviation of reference population}}. \tag{3}$$

To assess child nutritional status, three different indicators are used: WHZ, HAZ and WAZ. First, WHZ reflects measures body mass relative

[7]All the databases, questionnaires, and methodology documents of this survey are available at <http://www.cepar.org.ec>.

to height, without making use of age data and represents a short-term indicator useful to monitor short-term changes in nutritional status. Low values of WHZ indicate "thinness" or "wasting," and extreme low *z*-scores can be associated with starvation or diseases, such as diarrhea. Second, HAZ is a long-term indicator, able to capture chronic malnutrition or diseases, but which is unlikely to measure short-term changes in nutritional status. Finally, WAZ, which measures body weight relative to age, is a composite measure of the other two useful to assess nutritional changes over time, so it can confound short- and long-term health problems. These indicators, *z*-scores, have been widely used in development economics as a dependent variable of analysis to assess short-, middle- and long-term nutritional status (Duflo, 2003; Alves and Belluzo, 2004; Attanasio *et al.*, 2004; Morales, Aguilar, and Calzadilla, 2004; Valdivia, 2004; Borooah, 2005; Acosta, Fajnzylber, and López, 2007).

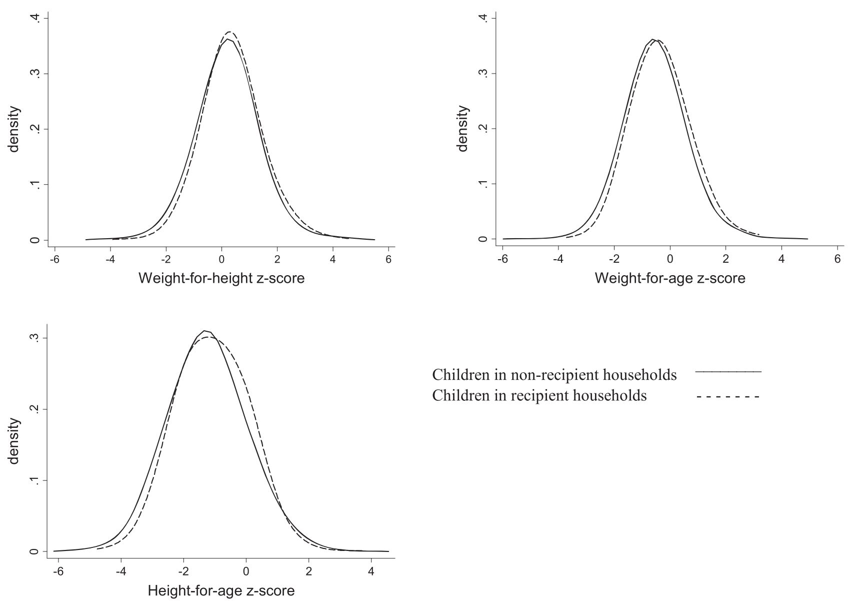
As mentioned above, to compute these anthropometric indicators, selecting a "healthy" reference population of children is required. The most common choice for the reference group has been the sample of children in the United States, known as the United States National Center for Health Statistics (NCHS) reference group. However, during the last decade, the WHO has pointed out several weaknesses of the NCHS approach, such as the limited variation of ethnic and cultural backgrounds in the NCHS sample (Garza and De Onís, 2004). In the early 1990s, the WHO started to work on the construction of new standards, taking a multiethnic and multicultural sample from several countries. This research produced new standards for children aged <5 years old issued in WHO (2006). According to De Onís *et al.* (2006) and Onyango *et al.* (2007), the use of the new growth standards can lead to significant differences when monitoring child growth and development, for example, regarding duration of breast feeding.

Z-scores are constructed in this article using these recently released standards. As far as I know, this is the first article in economics to consider the new reference group. Following the WHO recommendations, *z*-score values outside a certain range are removed from the sample because they are considered as biologically implausible (WHO, 2006).[8]

[8]Particularly, the exclusion ranges suggested by the WHO are the following ones: WHZ values below −5 or above +5, WAZ values below −6 and above 5, and HAZ values below −6 or above +6. This implied the exclusion of only around 20 observations, so there is not likely to be any sample selection bias.

The distributions of WHZ, WAZ, and HAZ among children in recipient and non-recipient households are depicted in Figure I, which shows that children in households that receive money from abroad tend to have higher values of all *z*-scores. To test if the distributions of *z*-scores in recipient and non-recipient households are significantly different, Kolmogorov–Smirnov equality-of-distributions tests are carried out. The mentioned tests indicate that the null hypothesis of equality can be rejected at 1 percent significance level in the case of the WAZ, at the 5 percent in the case of the HAZ, and at the 10 percent in the case of WHZ. These results indicate that the distribution of the anthropometric indicators between both types of households significantly differs.

Figure I Anthropometric measures for children aged less than five in Ecuador by remittance recipient.



Note: the bandwidth of the Gaussian kernel estimator is 0.5.
Source: author's analysis from SLC

Selection of Variables and Descriptive Statistics

To assess the impact of remittances on child nutrition, apart from the anthropometric measures described above, a set of children, mother and households characteristics are selected from the SLC 2005–2006.

In the first place, some personal variables like child's gender and child's age are selected. Regarding sex, some authors point to the existence of possible disadvantages for girls in developing countries because they can be neglected compared with boys, for example, having worse access to health-care facilities or suffering other kinds of discriminations that negatively affect their diet (Osmani and Sen, 2003). However, most empirical studies for Latin America show that male infants, other things being equal, have worse anthropometric indicators than girls (Alves and Belluzo, 2004; Rubalcava and Teruel, 2004; Borooah, 2005). Although *z*-scores are computed using child's age, Shan and Alderman (1997) suggest controlling for child's age when studying the determinants of child health in developing countries, since the growth retardation with respect to the reference population may be larger in the early years of life. Most works aiming to estimate the determinants of nutritional status in Latin America find such a negative effect of age on *z*-scores that decreases over time (Alves and Belluzo, 2004; Attanasio *et al.*, 2004; David, Moncada, and Ordóñez, 2004; Morales, Aguilar, and Calzadilla, 2004). To allow for non-linearities, age squared is also considered.

Secondly, mother-related variables, such as age, years of education, and ethnic group are considered to carry out the empirical analysis. It is argued that older mothers have a greater knowledge about child care (Borooah, 2005), so a positive effect is expected. With regard to education, schooling level is expected to positively affect child health, since more educated mothers tend to have higher access to information, formal education is useful for dealing with child health problems and they are more receptive to modern medical treatments (Behrman and Wolfe, 1984; Behrman, 1990; Thomas, Strauss, and Henriques, 1991; Glewee, 1999). Ethnicity also plays a role in child nutritional status according to some of the literature, which finds that, for example, indigenous tend to have worse anthropometric indicators, particularly height, although the reasons for this are unclear (Monárrez and Martínez, 2000; Morales, Aguilar, and Calzadilla, 2004; Benefice *et al.*, 2006) and in some cases, the effect of this variable depends of the antrophometric indicator used (Alves and Belluzo, 2004).[9]

Third, the following household characteristics are considered: household size, being the oldest children in the household and the number of children aged <5 and between 5 and 14 years old, an urban/dummy variable and a wealth index capturing the long-term socioeconomic status of the household, which is commented in detail below. The sign of the effect of household size and the number of children on infant outcomes is not clear, but recent studies suggest that the number of children and household size may reduce mother's labor supply and increase the probability of overcrowding in the household (Baez, 2008). The urban/rural dummy variable has no *a priori* effect on health. While some authors find a positive impact of urbanization on health (Thomas and Strauss, 1992), other works report the opposite result (Brockerhoff, 1994; Kassouf and Senour, 1996) or even a non-significant effect (Alves and Belluzo, 2004).

According to McKenzie and Sasin (2007), to estimate the impact of migration on household welfare, one should ideally control for premigration wealth, which is expected to have a positive effect on nutritional status (Behrman and Skoufias, 2004). For this purpose, I follow the approach proposed by Valdivia (2004) and Acosta (2006), who construct a wealth index able to capture the long-term household socioeconomic status using the first principal component obtained by applying principal component analysis (PCA). This technique basically consists in extracting from a set of variables a few orthogonal linear combinations of such variables that are able to capture the largest amount of information common to those variables. In this case, since the aim is to obtain a one-dimensional index, only the first linear combination – *i.e.*, the first principal component – is considered. To construct such wealth index, I have considered all the assets holdings available in the database: number of rooms per adult equivalent[10], floor and walls quality, having a kitchen as a separate room, satisfactory

[9]For example, Morales, Aguilar, and Calzadilla (2004) suggest that indigenous (Aimara and Quechua people) who do not speak Spanish tend to look for help from their elder relatives, who often have an inappropriate knowledge of modern child care. They also point out the possible existence of genetic differences.

[10]To compute the number of equivalent adults, the Organization for Economic and Co-operation Development modified scale is used. This scale assigns a value of 1 to the first adult in the household, of 0.5 to each additional adult, and of 0.3 to each child aged <14 years old.

water, toilet and electrical facilities, and having telephone, cable television, car or internet. The first principal component methodology assigns the weights such that the asset index gives us the maximum possible discrimination across households. The asset index obtained using this technique varies roughly from −3 to 6. More detailed results of the application of this technique are presented in Annex I.[11]

Finally, province per capita income, province health-care infrastructure (proxied by human health resources and hospitals per 10,000 people), province infant mortality rate in 2001, and dummy variables for regions are also selected for the empirical analysis. While province per capita income is computed from the SLC, health-care infrastructure variables are obtained from the 2005 Yearbook of Health Human Resources and Activities (INEC, 2005a,b) and infant mortality rates are taken from INEC (2005b).

Descriptive statistics of the variables described above are presented in Table 1, which includes mean and standard deviation of all variables and means tests that aim to determine if households that receive remittances and non-recipient households significantly differ in their basic characteristics. This information confirms that children living in households receiving remittance income have better anthropometric indicators than those in non-recipient households and significantly differs in most observable characteristics, which suggests that remittance income is not randomly distributed across households. The table also contains the summary statistics of the instruments used in the following parts of the analysis that are explained in detail in the next section. In addition, Table 2 shows the means of the three different *z*-scores according to different characteristics of the children.

EMPIRICAL ANALYSIS

This section outlines the econometric procedures used in the analysis, presents their results, and discusses the main implications derived from them.

[11]Other authors such as Amuedo-Dorantes and Pozo (2006) and Amuedo-Dorantes, Pozo and Sainz (2007) use an alternative approach consisting in controlling for household per capita income excluding remittances. Acosta (2006) points out that such approach is problematic, since it assumes that if emigrants were at homes they would earn zero income. Anyway, I also implemented this alternative approach and I obtained identical results.

TABLE 1
SUMMARY STATISTICS OF SELECTED VARIABLES

	Total		Non-recipients		Recipients		Means test
	Mean	SE	Mean	SE	Mean	SE	
Weight-for-height *z*-score	0.243	1.104	0.223	1.112	0.376	1.045	***
Weight-for-age *z*-score	−0.516	1.035	−0.542	1.036	−0.334	1.009	***
Height-for-age *z*-score	−1.207	1.211	−1.227	1.221	−1.063	1.125	***
Proportion of recipient households	0.124	0.33	–	–	1.000	0.000	–
Monthly remittances (U.S. $)	12.1	68.4	–	–	97.4	171.2	–
Gender (proportion of females)	0.482	0.500	0.479	0.500	0.502	0.500	
Child's age (months)	30.462	17.108	30.477	17.165	30.361	16.719	
Mother's age (years)	28.291	6.998	28.317	6.975	28.113	7.163	
Mother's years of education	8.408	4.180	8.163	4.194	10.134	3.636	***
Mother's ethnic group							
Proportion of mestizo	0.765	0.424	0.758	0.428	0.815	0.388	***
Proportion of whites	0.077	0.267	0.075	0.263	0.095	0.293	
Proportion of indigenous	0.098	0.297	0.105	0.307	0.047	0.211	***
Proportion of black/mulatto	0.060	0.237	0.062	0.241	0.043	0.204	*
Household size	5.622	2.298	5.597	2.317	5.795	2.156	**
Children aged less than 5 in the HH	1.595	0.731	1.615	0.742	1.465	0.643	***
Children aged between 5 and 14 years old in the HH	1.310	1.364	1.325	1.377	1.210	1.270	***
Wealth index	−0.086	1.772	−0.412	1.783	0.515	1.608	***
Rural area	0.370	0.483	0.39	0.488	0.228	0.420	***
Region							
Proportion living in Sierra	0.431	0.495	0.420	0.494	0.510	0.500	***
Proportion living in Costa	0.506	0.500	0.513	0.500	0.457	0.498	**
Proportion living in Amazonia	0.062	0.241	0.066	0.249	0.034	0.181	***
Western Union offices per 100,000 by province	1.200	0.621	1.185	0.612	1.305	0.673	***
Proportion of HH with migrants by province	0.084	0.06	0.081	0.058	0.102	0.072	***

Source: author's analysis from SLC.
***Significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

Identification Strategy

The main aim of this work is estimating a reduced-form model of the child health production function described in the second section by equation 2. The starting point for analyzing the effects of remittances on health care is the use of OLS. The equation to be estimated takes the following form:

$$H_{ij} = \beta_0 + X'_{ij}\beta_1 + M'_j\beta_2 + R_j\beta_3 + \varepsilon_{ij}, \tag{4}$$

where H_{ij} denotes the anthropometric outcome of interest; X_{ij} represents a vector of individual characteristics (gender, age, and age squared, in

TABLE 2
Average Z-scores by Different Observable Characteristics

	WHZ	WAZ	HAZ
Gender			
Boys	0.2813	−0.5804	−1.3826
Girls	0.2613	−0.5351	−1.2519
Child's age			
2 years old or less	0.1588	−0.4497	−1.0522
More than 2 years old	0.3409	−0.6254	−1.4839
Mother's years of education			
6 years of education or less	0.235	−0.763	−1.625
More than 6 years of education	0.305	−0.370	−1.039
Mother's ethnic group			
Mestizo	0.2676	−0.4981	−1.2175
Whites	0.2362	−0.4794	−1.1554
Indigenous	0.3454	−0.9551	−2.0540
Black/mulatto	0.1511	−0.4498	−0.9863
Area of residence			
Urban area	0.2730	−0.3941	−1.0444
Rural area	0.2702	−0.7427	−1.6279
Region			
Sierra	0.3831	−0.6274	−1.5732
Costa	0.1267	−0.4720	−0.9961
Amazonia	0.2902	−0.5588	−1.3377

Source: author's analysis from SLC.

months) for child i living in household j; M_j is a vector of household characteristics (mother's age, age squared and education, household size, a binary variable indicating if the child is the oldest in the household, number of children aged <5 and between 5 and 14 years in the household, a dummy variable indicating the location – rural or urban – of the household, a wealth index, two regional dummy variables and province per capita income); R_j is a dummy variable denoting if the household receives remittance income and ϵ_{ij} is an error term associated with individual unobserved heterogeneity. β_0, β_1, β_2, and β_3 represent different vectors of unknown parameters to be estimated. The main parameter of interest is β_3, which captures the effect of remittances on child health and is expected to be statistically significant from 0 and positive. I closely follow the suggestion of Acosta (2006), using a dummy variable for remittances instead of a continuous variable; this decision is based on two facts. First, families usually remember very well if they have received money from abroad but not the exact amount. Second, remittances in Latin America are underreported in household surveys compared with balance of payments figures (World Bank, 2006). It should also be mentioned that there is a risk of reverse causality between wealth and child health, since, for example, parents may work more to get more resources for ill children. This risk is expected to be attenuated by the use of a long-term measure of socioeconomic status like the asset index mentioned above.

If remittances were randomly assigned among households, the OLS estimates would be consistent. However, the most fundamental problem with this approach is that remittances may not represent an exogenous shock for the household and may be an endogenous variable. According to McKenzie and Sasin (2007), there are several possible sources of endogeneity. First, if unobservable characteristics of household with remittances and without remittances – or, more generally, migrant and non-migrant households – substantially differ, selection bias arises. If unobservable characteristics affecting child nutritional status and unobservable factors affecting remittance receipt are correlated, then ϵ_{ij} and R_j will be also correlated and OLS estimates will be inconsistent. If households more concerned about children nutritional status are more likely to migrate or, formally, if unobservable factors affecting remittance income – or, more generally, migration – are positively correlated with unobservable characteristics determining anthropometric measures, then OLS estimates will be upward biased and overstate the gains from migration. In this case, we say that households are positively self-selected into migration. However, it is also possible that migration (or remittance receipt) is more likely to occur in households with children with low-nutritional status. For example, if a child is sick or unhealthy and more money is needed for the child's care, it is possible to imagine that household members other to the mother may go abroad to increase the resources available for the household, which would mean that households are negatively selected into migration. In this case, OLS estimates will be downward biased. Hildebrandt and McKenzie (2005) suggest that neither both possibilities should be *a priori* excluded, and, in their work focused on birth weights and infant mortality in Mexican rural communities, they point that Mexican migrants are negatively selected in terms of health status of their children.

Second, it is also possible that there are unobservable shocks (crop failures, floods, droughts, etc.) that affect child health and that, at the same time, are correlated with remittances, for example, if migrants send more money to face these shocks. In this case, the error term ϵ_{ij} will be correlated with a covariate (remittances) and there will be a problem of omitted-variable bias, which will make OLS estimates inconsistent. If the unobservable shock have a positive effect on remittance receipt and a negative effect on child health (and assuming that the other covariates are uncorrelated with the shock), then the bias will be downward. A last possible source of endogeneity is the existence of two-way causality, which may arise if, for example, migrants send money for compensating bad nutritional outcomes. In this case, remittance receipt and the error term ϵ_{ij} will be correlated and OLS estimates will be again inconsistent. Again, they will be downward biased and even can lead to conclude the existence of a negative relationship between health outcomes and remittances in extreme cases.

To deal with these potential endogeneity problems, this works uses an IV (2SLS) approach. To obtain consistent estimates, one needs to find a set of variables affecting the reception of remittances and, at the same, time, exogenous to child nutritional status, or in other words, uncorrelated with ϵ_{ij}. The selection of IV made here heavily draws on previous works on migration. In the first place, I consider the number of Western Union offices per 100,000 people at the province level. This variable can be considered as a source of exogenous variation of the cost of receiving remittances and has been used by Amuedo-Dorantes and Pozo (2006) and Amuedo-Dorantes, Pozo, and Sainz (2007) in works focused on labor supply and health expenditure in Mexico, respectively, and Calero, Bedi, and Sparrow (2009) in their study on children's schooling in Ecuador. It is expected that the higher the number offices of per count, the larger the probability of receiving remittances. Secondly, the proportion of households with migrants in 2003 by province has been included as a proxy for the existence of social networks abroad. The presence of migrants from the same community in a foreign country lowers the costs of going abroad for other members of the local community, and, hence, it is expected to have a positive on remittance receipt. Ideally, one would want to include historic – or as lagged as possible – migration rates to ensure the exogeneity of the migration rate to child nutritional status. However, this is not possible in the case of Ecuador, since migration abroad only became an important phenomenon since the economic crisis in the late 1990s (Facultad Latinoamericana de Ciencias Sociales (FLACSO), 2006; Albornoz and Hidalgo, 2007). It is possible to quote several works that have used this variable as instrument, such as Acosta (2006), Acosta, Fajnzylber, and López (2007), Amuedo-Dorantes, Pozo, and Sainz (2007) and Pffeifer and Taylor (2007).

Since it is possible that the migration rate or the placement of Western Union offices are correlated with the province level of development, following the suggestion of Hildebrandt and McKenzie (2005),

TABLE 3
First-Stage OLS Estimation Results. Determinants of Remittance Receipt

	Coefficient	Robust SE
Gender (male = 0)	0.0011	0.0083
Child's age	0.0010	0.0010
Child's age squared	0.0000	0. 0000
Mother's age	−0.0136	0.0046***
Mother's age squared	0.0002	0.0001**
Mother's years of education	0.0058	0.0013***
Mother's ethnic group (mestizo = 0)		
White	0.0186	0.0159
Indigenous	−0.0055	0.0141
Mulato/black	−0.0028	0.0175
Household size	0.0212	0.0030***
Oldest children	−0.0091	0.0137
No. of children aged less than 5	−0.0405	0.0087***
No. of children aged 5–14 years	−0.0116	0.0052**
Area (urban = 0)	−0.0099	0.0109
Wealth	0.0252	0.0034***
Instruments		
WU offices per 100,000 people by province	0.0316	0.0068***
Proportion of HH with migrants by province	2.4572	0.1825***
Observations	5,798	
R^2	0.1025	
Test of excluded instruments	F (2, 5774) = 71.10***	

Source: author's analysis from SLC.
Notes: Province controls, regional dummies and an intercept are also included.
***Significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

several province controls (province per capita income, province infant mortality rate in 2001, health human resources, and hospitals by province in 2005) are included. Although the endogenous variable to be instrumented is binary, I use a linear probability model to estimate the remittance receipt, since consistency of 2SLS with a binary endogenous variable is not based on getting the functional form right in the first stage. Although *probit* or *logit* models can be more efficient, in those cases, consistency is achieved only if the functional form is exactly right and, therefore, in practical, terms 2SLS can work better (Angrist, 1991, 1999; Angrist and Krueger, 2001).

Regarding the validity of the IVs, the first task to address is testing the relevance of the instruments. To do so, Table 3 reproduces the results of first-stage OLS, showing that, as expected, both instruments have a statistically significant and positive effect on the probability of receiving remittances. The *F*-statistic used for testing for joint significance of excluded instruments is well above 10, which rules out the weakness of instruments. According to Kennedy (2008), if the *F*-statistic exceeds 10, the IV bias should be <10 percent of the OLS bias.

TABLE 4
OLS and IV Estimation Results for WHZ

	OLS		IV (2SLS)	
	Coefficient	Robust SE	Coefficient	Robust SE
Remittances	0.0411	0.0426	0.7409	0.2307***
Gender (male = 0)	−0.0246	0.0288	−0.0262	0.0293
Child's age	0.0125	0.0038***	0.0117	0.0039***
Child's age squared	−0.0001	0.0001**	−0.0001	0.0001*
Mother's age	−0.0333	0.0189*	−0.0213	0.0191
Mother's age squared	0.0006	0.0003**	0.0004	0.0003
Mother's years of education	0.0122	0.0047***	0.008	0.0050
Mother's ethnic group (mestizo = 0)				
White	−0.0228	0.0592	−0.0416	0.0604
Indigenous	0.1158	0.0491**	0.1218	0.0496**
Mulato/black	0.0267	0.0657	0.0373	0.0662
Household size	0.0028	0.0112	−0.0116	0.0124
Oldest children	0.0703	0.0476	0.0789	0.0484
No. of children aged less than 5	0.0055	0.0312	0.0354	0.0334
No. of children aged 5−14	−0.0177	0.0190	−0.0116	0.0196
Area (urban = 0)	0.1095	0.0381***	0.1118	0.0388***
Wealth	0.0440	0.0120***	0.0252	0.0135*
Observations	5,798			
R^2	0.033		−0.007	
Test of joint significance	F (22, 5775) = 9.20***		F (22, 5775) = 9.02***	
Wooldridge's regression test	–		F (1, 5774) = 10.28***	
Wooldridge's overidentification test	–			
Statistic	–		X^2 (1) = 0.037	
p-value	–		0.850	

Source: author's analysis from SLC.
Note: province controls, regional dummies, and an intercept are also included.
***Significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

Since I am using two instruments, I carry out the score test of over-identifying restrictions proposed by Wooldridge (1995) in all cases (WHZ, WAZ, and HAZ), which, unlike the widely used Sargan or Bassman tests, is robust to heteroskedasticity.[12] This robust score test does not reject the null hypothesis that all instruments are correlated with the error term in any of the regressions.

In both OLS and IV estimates, Huber-White heteroskedasticity-robust standard errors are computed. All the calculations are carried out using Stata 10.

[12]Anyway, in all cases, Sargan and Bassman tests were also carried out and the results remained the same. I also estimated the model using the Generalized Method of Moments and, then, I carried out a Hansen's J overidentification test, which is robust to heteroskedasticity, obtaining identical results. *See* StataCorp (2007) and the Stata commands *ivregress*, *estat endogenous*, and e*stat overid* for additional details.

TABLE 5
OLS and IV Estimation Results for WAZ

	OLS		IV (2SLS)	
	Coefficient	Robust SE	Coefficient	Robust SE
Remittances	0.0097	0.0390	0.6026	0.2003***
Gender (male = 0)	0.0503	0.0256**	0.0490	0.0261**
Child's age	−0.0216	0.0032***	−0.0223	0.0032***
Child's age squared	0.0003	0.0001***	0.0003	0.0001***
Mother's age	0.0068	0.0166	0.0169	0.0168
Mother's age squared	0.0000	0.0003	−0.0001	0.0003
Mother's years of education	0.0340	0.0042***	0.0305	0.0044***
Mother's ethnic group (mestizo = 0)				
White	0.0228	0.0515	0.0068	0.0527
Indigenous	−0.1145	0.0427***	−0.1094	0.0431**
Mulato/black	0.1733	0.0581***	0.1823	0.0586***
Household size	0.0132	0.0101	0.0010	0.0110
Oldest children	0.1253	0.0419***	0.1325	0.0424***
No. Of children aged less than 5	−0.0764	0.0277***	−0.0511	0.0293*
No. Of children aged 5−14	−0.0602	0.0168***	−0.0551	0.0172***
Area (urban = 0)	0.0903	0.0342***	0.0923	0.0347***
Wealth	0.0785	0.0106***	0.0625	0.0119***
Observations	5,798			
R^2	0.115		0.081	
Test of joint significance	F (22, 5775) = 34.81***		F (22, 5775) = 33.81***	
Wooldridge's regression test	–		F (1, 5774) = 9.83**	
Wooldridge's overidentification test	–			
Statistic	–		X^2 (1) = 1.105	
p-value	–		0.293	

Source: author's analysis from SLC.
Note: province controls, regional dummies and an intercept are also included.
***Significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

RESULTS

Estimation results for WHZ, WAZ, and HAZ are presented in Tables 4–6 and commented in detail below.

First, OLS and IV estimates for WHZ, a short-term measure of nutritional status, are presented in Table 4. According to OLS estimates, remittances have no significant effect on child nutrition. Gender and variables related to household composition have no statistically significant effect on the dependent variable. Age, age squared, and mother's age, education and ethnicity are statistically significant. For example, an additional month in child's age means an increase of 0.012 SD in the *z*-score. Mother's age, statistically significant at 10 percent, shows a negative effect on WHZ that decreases over time (−0.033 SD by each year). Mother's level of schooling positively affects the *z*-score and each additional year of

TABLE 6
OLS and IV Estimation Results for HAZ

	OLS		IV (2SLS)	
	Coefficient	Robust SE	Coefficient	Robust SE
Remittances	−0.0469	0.0422	0.2143	0.2130
Gender (male = 0)	0.1408	0.0281***	0.1402	0.0281***
Child's age	−0.0743	0.0036***	−0.0746	0.0036***
Child's age squared	0.001	0.0001***	0.0010	0.0001***
Mother's age	0.0467	0.0162***	0.0512	0.0166***
Mother's age squared	−0.0006	0.0003**	−0.0007	0.0003**
Mother's years of education	0.0445	0.0044***	0.0429	0.0046***
Mother's ethnic group (mestizo = 0)				
White	0.0624	0.0543	0.0554	0.0547
Indigenous	−0.2948	0.0489***	−0.2926	0.0489***
Mulato/black	0.2747	0.0615***	0.2786	0.0616***
Household size	0.0161	0.0104	0.0107	0.0113
Oldest children	0.1681	0.0477***	0.1713	0.0477***
No. Of children aged less than	−0.1180	0.0296***	−0.1069	0.0309***
No. Of children aged 5–14	−0.0773	0.0178***	−0.0750	0.0179***
Area (urban = 0)	0.0363	0.0375	0.0371	0.0375
Wealth	0.0862	0.0116***	0.0792	0.0129***
Observations	5,798			
R^2	0.257		0.253	
Test of joint significance	F (22, 7775) = 89.06***		F (25, 5775) = 88.22***	
Wooldridge's regression test	–		F (1, 5774) = 1.59	
Wooldridge's overidentification test	–			
Statistic	–		X^2 (1) = 2.480	
p-value	–		0.1173	

Source: author's analysis from SLC.
Note: province controls, regional dummies and an intercept are also included.
***Significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

education raise the dependent variable in 0.012. Ethnicity is also relevant and indigenous groups, other things being equal, exhibit a higher z-score (0.09 SD). Finally, living in a rural area and the asset index have a positive effect in short-term child nutritional status.

Following Wooldridge (2006), I carry out a test of endogeneity of the remittances variable appropriate when using robust standard errors. This test basically compares if there are statistically significant differences between OLS and IV estimates by regressing the dependent variable on the exogenous variable, the potentially endogenous variable, and the residuals from the first-stage OLS and, then, testing if the coefficient of the residuals of this regression is statistically different from 0. The test rejects the exogeneity of remittance income, so OLS are inconsistent and IV estimates are preferred in this case. IV estimates show very similar effects as those reported for OLS for most variables, with the exception of the coefficients of mother's age and wealth, which now are not statistically significant. However, the most important difference relates to the effect of remittances, which now have a statistically significant and positive effect on WHZ. IV estimates show that receiving remittances, on average, increases the *z*-score of 0.74 SD. It should be mentioned that, as pointed before, most works reports a negative relationship between age and WHZ and low WHZ values for indigenous. The findings reported here are not consistent with this literature but they are robust to more and less parsimonious specifications using both OLS and IV. This result may be related to the use of the new standards of the WHO or with the very short-term dimension of WHZ. It should also be mentioned that the negative R^2 reported in the second-stage is not a cause of concern, since the sum of squared residuals for IV can exceed the total variation of the dependent variable (Wooldridge, 2002). Actually, the aim of IV is not to maximize the R^2, in which case OLS should be used (Wooldridge, 2006).

In the third place, results for the WAZ, a middle-term measure of nutritional status, are presented in Table 5. Again, exogeneity of remittances is rejected by the regression test and the robust score test of over-identifying restrictions does not reject the null hypothesis that all instruments are uncorrelated with the error term. Therefore, IV estimates are again more appropriate than OLS and, hence, only the former are commented below. While OLS estimates show that remittances do not affect WAZ, IV estimates show that remittances have a significant and positive on WAZ. Particularly, receiving remittances, on average, implies an increase of 0.60 in WAZ. Regarding the other variables, first, child's age negatively affects *z*-score although its effect decreases with over time. An additional month decreases the *z*-score in 0.022 standard deviations. Second, WAZ is positively affected by mother's level of schooling (each of education raises the dependent variable in 0.0305) and there also significant differences based on mother's ethnic group, with indigenous and black and mulato groups showing lower and higher *z*-scores than whites and mestizos, respectively. This is a different picture from that found for WHZ. Other authors, such as Alves and Belluzo (2004), also find differences in child nutritional status dependent on the indicator used. Third, regarding household variables, being the oldest child in the household, living in a rural area and household wealth have a positive effect on the *z*-score, while child's WAZ is negatively affected by the number of children in the household. Particularly, being the oldest child in the household means, other things being equal, an increase in weigh-for-age of around 0.13 SD; and each additional child in the household reduces the *z*-score around 0.05. Finally, living in a rural area and the asset index positively affect this anthropometric indicator.

Finally, Table 6 presents the estimation results for height-for-age, a long-term measure of child nutritional status. Again, as mentioned in Identification Strategy, the Wooldridge's robust score test of overidentifying restrictions fails to reject the null hypothesis that all instruments are uncorrelated with the error term, but in this case, OLS and IV estimates, according to the test they are not statistically different, so OLS are preferred in this case, since they are more efficient (smaller standard errors). Therefore, comments are only limited to the OLS estimates. In this case, receiving remittances have no significant effect on HAZ, pointing out that remittances are not helping to improve long-term child nutritional status at the moment in Ecuador. According to them, almost all the coefficients are statistically significant. Being a female has a positive effect on the *z*-score (0.14 SD), while child's age negatively affects it, although the positive coefficient of the squared term indicates that this negative effect decreases over time (each month accounts for 0.07 SD less). Mother's age positively affects height-for-age (each year means an increase of HAZ of roughly 0.047 SD), although the squared term is negative and mother's schooling level raise the *z*-score (each year of education accounts for 0.045 SD). The existence of differences based on the mother's race is similar to those showed for WAZ. Again, other things being equal, being the oldest children in the household and the wealth index are positively related with height, while the presence of more children negatively affects the height-for-age *z*-score. Finally, the wealth index has a statistically significant and positive effect. The size of these coefficients is quite similar to those corresponding to WAZ.

To test the robustness of these results, I have also carried out the regression using remittances in U.S. dollar, finding very similar results: the average remittance income increases WHZ and WAZ by 0.35 and 0.44 SD, while its effect on HAZ is not significantly different from 0.

An interesting question is how these results compared with other findings reported in the literature. For example, Duflo (2003), using 2SLS, finds that having a female household member receiving a pension in South Africa implies an increase of more than 1 SD of girls' WHZ and HAZ. According to the work of Galiani and Schargrodsky (2004), who also use IVs, land titling in Argentina increases WHZ in 0.45 SD but does not have any effect on HAZ. Hildebrandt and McKenzie (2005), using the same technique, find that children born in families with migrants abroad, have around 400 g higher birth weights, other things being equal. Finally, Acosta, Fajnzylber, and López (2007), using OLS, report that receiving remittance income in Guatemala raises WAZ in roughly 0.3 SD and has no statistically significant effect on HAZ in Guatemala and Nicaragua.

DISCUSSION, LIMITATIONS, AND POSSIBLE EXTENSIONS

The results presented above suggest that remittances have a positive effect on short- and middle-term nutritional status of Ecuadorian children, but do not significantly affect long-term indicators, except for those children with highly educated mothers. This can be related to the length of time households have been receiving remittances, which is not available in the survey.[13] In fact, international migration in Ecuador is to a large extent a recent issue: according to the Central Bank of Ecuador, while remittances amounted to U.S. $500 million in 1999, in 2006 they meant roughly U.S. $2,500 million. This absence of long-run effect might also be associated to a role of remittance income as insurance against income shocks. In fact, this interpretation and utilization of remittances are supported by recent research for Bangladesh (Mohapatra, Joseph, and Ratha, 2009). This suggests that further research is required to disentangle the differential impact of remittances on anthropometric measures.

An important fact arising from the results presented above for WHZ and WAZ is that OLS estimates are downward biased. This fact may be due to a negative selection of migrants in terms of nutritional status of their children. A second explanation of these results may arise from simultaneity of remittances and child nutritional outcomes, since it is likely that migrants send more remittances if their children have worse health. Third, these findings may be related to the existence of unobserved shocks positively correlated with remittances and negatively correlated with short- and middle-term anthropometric indicators. A last possible cause of these findings is the existence of measurement error in remittance reception, since this variable is the result of a self-reported and retrospective survey question, which could help to explain the attenuation bias.

There are several ways in which this article can be extended in the future. A first direction to extend this work consists in exploring the

[13]A similar argument is pointed by Attanasio *et al.* (2004) for the effect of a program targeted on Colombian poor families.

particular channels through remittance income affects nutritional status of children. The main and most obvious channel is the effect of money sent from abroad on the diet of families. Secondly, remittances may allow the purchase of more and/or better health care inputs, as it was discussed in the second section. The empirical analysis of these channels is left for further research.

A second way of improving this study depends on the availability of new and better databases. Particularly, longitudinal databases can help to draw more accurate conclusions on long-term measures of health, which is especially interesting in the case of Ecuador, where, as mentioned, massive international migration is a relatively recent phenomenon.

CONCLUSIONS

The aim of this study has been to assess the impact of remittance income on child nutritional status in Ecuador, a country that has experienced a gargantuan increase of emigration during the last decade. Using an IV approach, it has been found that money sent from abroad has a positive effect on WHZ and WAZ, which assess changes of infant nutritional status in the short- and the middle-term, respectively. Nevertheless, no statistically significant effect on height-for-age, a long-term anthropometric indicator, has been found, which may suggests that further research based on richer and new databases is needed. These findings points that it is possible that the current economic crisis in the main host countries of Ecuadorian migration has a negative effect on child health if remittance flows are substantially reduced and there is no compensating behavior of Ecuadorian households.

REFERENCES

Acosta, P.
2006 *Labor Supply, School Attendance, and Remittances from International Migration: The Case of El Salvador*. World Bank Policy Research Working Paper 3903.

———, P. Fajnzylber and J. H. López
2007 *The Impact of Remittances on Poverty and Human Capital: Evidence From Latin American Household Surveys*. World Bank Policy Research Working Paper 4247.

Adams, R.
2005 *Remittances, Household Expenditure, and Investment in Guatemala*. World Bank Policy Research Working Paper 3532.

Albornoz, V., and J. Hidalgo
2007 "Características Provinciales de la Migración Ecuatoriana." Paper presented at the Encuentro Nacional de Historia del Azuay, Cuenca, Ecuador, May. <http://www.cordes.org/descargar/migracionCuenca.pdf>.

Alves, D., and W. Belluzo
2004 "Infant Mortality and Child Health in Brazil." *Economics and Human Biology* 2(3):391–410.

Amuedo-Dorantes, C., and S. Pozo
2006 "Migration, Remittances, and Male and Female Employment Patterns." *American Economic Review* 96(2):222–226.

———, ——— and T. Sainz,
2007 *Remittances and Health Care Expenditure Patterns of Population in Origin Communities*. Inter-American Development Bank-Integration and Regional Programs Department Working Paper 25.

Angrist, J. D.
1991 *Instrumental Variables Estimation of Average Treatment Effects in Econometrics and Epidemiology*. National Bureau of Economic Research Working Paper 115.

———
1999 "Estimated of Limited Dependent Variable Models With Dummy Endogenous Regressors: Simple Strategies for Empirical Practice." *Journal of Business and Economic Statistics* 19(1):2–16.

———, and A. B. Krueger
2001 "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives* 15(4):69–85.

Attanasio, O., L. C. Gómez, A. Gómez and M. Vera-Hernández
2004 "Child Health in Rural Colombia: Determinants and Policy Interventions." *Economics and Human Biology* 2(3):411–438.

Baez, J. E.
2008 "Does More Mean Better? Sibling Sex Composition and the Link Between Family's Size and Children's Quality." IZA Discussion Paper 3472.

Behrman, J. R.
1990 *The Action of Human Resources and Poverty on One Another. What We Have to Learn*. Living Standards Measurement Study Working Paper 74, the World Bank.

———, and E. Skoufias
2004 "Correlates and Determinants of Child Antrophometrics in Latin America: Background and Overview of the Symposium." *Economics and Human Biology* 2(3):335–251.

———, and B. L. Wolfe
1984 "More Evidence on Nutrition Demand: Income Seems Overrated and Women's Schooling Underemphasized." *Journal of Development Economics* 14(1):105–128.

Benefice, E., S. L. Monroy, S. Jimenez and R. Lopez
2006 "Nutritional Status of Amerindian Children From the Beni River (Lowland Bolivia) as Related to Environmental, Maternal and Dietary Factors." *Public Health Nutrition* 9(3):327–335.

Borooah, V. K.
2005 "The Heigh-for-age of Indian Children." *Economics and Human Biology* 3(1):45–65.

Brockerhoff, M.
1990 "Rural-Urban Migration and Child Survival in Senegal." *Demography* 27(4):601–616.

——
1994 "The Impact of Rural-Urban Migration on Child Survival." *Health Transition Review* 4(2):127–149.

Calero, C., A. S. Bedi and R. Sparrow
2009 "Remittances, Liquidity Constraints and Human Capital Investments in Ecuador." *World Development* 37(6):1143–1154.

Chauvet, L., F. Gubert and S. Mesplé-Somps
2008 "Are Remittances More Effective Than Aid to Improve Child Health? An Empirical Assessment Using Inter and Intra-Country Data." Paper presented at the *Annual World Bank Conference on Development Economics*, June 9–11, Cape Down, South Africa.

Cogill, B.
2003 *Anthropometric Indicators Measurement Guide*. Washington, D.C.: Food and Nutritional Technical Assistance Project, Academy for Educational Development.

David, V., M. Moncada and F. Ordóñez
2004 "Private and Public Determinants of Child Nutrition in Nicaragua and Western Honduras." *Economics and Human Biology* 2(3):457–488.

De Onís, M. *et al.*
2006 "Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO International Growth Reference: Implications for Child Health Programmes." *Public Health Nutrition* 9(7):942–947.

Duflo, E.
2003 "Grandmothers and Granddaughters: Old-Age Pensions and Intrahousehold Allocation in South Africa." *World Bank Economic Review* 17(1):1–25.

Economic Commission for Latin America, the Caribbean (ECLAC)
2008 *Social Panorama of Latin America and the Caribbean*. Santiago de Chile: ECLAC.

Facultad Latinoamericana de Ciencias Sociales (FLACSO)
2006 *Ecuador: Las Cifras de la Migración Internacional*. Quito: Facultad Latinoamericana de Ciencias Sociales.

Fajnzylber, P., and J. H. López
2007 *Close to Home: The Development Impact of Remittances in Latin America*. Washington, D.C.: The World Bank.

Filmer, D., and L. H. Pritchett
2001 "Estimating Wealth Effects Without Expenditure Data-or Tears: An Application to Educational Enrollment in States of." *Demography* 38(1):115–132.

Frank, R., and R. A. Hummer
2002 "The Other Side of the Paradox: The Risk of Low Birth Weight Among Infants of Migrant and Nonmigrant Households Within Mexico." *International Migration Review* 36(3):746–65.

Frankel, J. A.
2009 *Are Bilateral Remittances Countercyclical?* NBER Working Paper 15419.

Galiani, S., and E. Schargrodsky
2004 "Effects of Land Titling on Child Health." *Economics and Human Biology* 2(3):353–372.

Garza, C., and M. De Onís
2004 "Rationale for Developing a new International Growth Reference." *Food Nutrition Bulletin* 25(1):5–14.

Gil-Valero, J.
2008 *Remittances and the Household's Expenditure on Health*. MRPA Paper 9572.

Glewee, P.
1999 "Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence From Morocco." *Journal of Human Resources* 34(1):124–159.

Grossman, M.
1972 *The Demand for Health: A Theoretical and Empirical Investigation*. New York: National Bureau of Economic Research.

Hildebrandt, N., and D. McKenzie
2005 "The Effects of Migration on Child Health in Mexico." *Economía (Journal of the Latin American and Caribbean Economics Association)* 6(1):257–289.

Instituto Nacional de Estadísticas y Censos (INEC)
2005a *Anuario de Recursos y Actividades de Salud 2005*. Quito: INEC. <http://www.inec.gov.ec/web/guest/descargas/basedatos/inv_soc/act_sal>.

Instituto Nacional de Estadísticas y Censos (INEC)
2005b *La Mortalidad en el Ecuador en el Periodo 1990-2001*. Quito: INEC. <http://www.inec.gov.ec/c/document_library/get_file?folderId=155262&name=DLFE-6015.pdf>.

Instituto Nacional de Estadísticas y Censos (INEC)
2006 *Metodología de la ECV de la Quinta Ronda*. Quito: INEC. <http://www.inec.gov.ec/c/document_library/get_file?folderId=17415&name=DLFE-1112.pdf>.

Kanaiaupuni, S. M., and K. M. Donato
1999 "Migradollars and Mortality: The Effects of Migration on Infant Survival in Mexico." *Demography* 36(3):339–353.

Kandel, W., and G. Kao
2006 "The Impact of Temporary Labor Migration on Mexican Children's Educational Aspirations and Performance." *International Migration Review* 35(4):1205–1231.

Kassouf, A. L., and N. Senour
1996 "Direct and Indirect Effects of Parental Education on Malnutrition Among Children in Brazil: A Full Income Approach." *Economic Development and Cultural Change* 444(4):817–838.

Kennedy, P.
2008 *A Guide to Econometrics*, 6th edition. Oxford: Blackwell Publishing.

Lindstrom, D. P., and E. Muñoz Franco
2006 "Migration and Maternal Health Services Utilization in Rural Guatemala." *Social Science and Medicine* 63(6):706–721.

López-Córdoba, J. E.
2005 "Globalization, Migration and Development: The Role of Mexican Migrant Remittances." *Economía (Journal of the Latin American and Caribbean Economics Association)* 6(1):217–256.

Martin, P., S. Martin and P. Weil
2002 "Best Practice Options: Mali." *International Migration* 40(3):87–102.

McKenzie, D., and M. J. Sasin
2007 *Migration, Remittances, Poverty, and Human Capital: Conceptual and Empirical Changes*. World Bank Policy Research Working paper 4272.

Menjívar, C.
2002 "The Ties That Heal: Guatemalan Immigrant Women's Networks and Medical Treatment." *International Migration Review* 36(2):437–466.

Mohapatra, S., G. Joseph and D. Ratha
2009 "Remittances and Natural Disasters. Ex-Post Response and Contribution to Ex-Ante Preparedness." World Bank Policy Research Paper 4972.

Monárrez, J. and H. Martínez
2000 "Prevalencia de Desnutrición en Indígenas Tarahumaras Menores de Cinco Años en el Municipio de Guacochi, Chihuahua." *Salud Pública de México* 42(1):8–26.

Morales, R., A. M. Aguilar and A. Calzadilla
2004 "Geography and Culture Matter for Malnutrition in Bolivia." *Economics and Human Biology* 2(3):373–390.

O'Donnell, O. M., E. van Doorslaer, A. Wagstaff and M. Lindelow
2008 *Analyzing Health Equity Using Household Survey Data. A Guide to Techniques and Their Implementation*. Washington, D.C.: The World Bank.

Onyango, A. W. *et al.*
2007 "Field-Testing the WHO Child Growth Standards in Four Countries." *Journal of Nutrition* 137:149–152.

Osmani, S., and A. Sen
2003 "The Hidden Penalties of Gender Inequality: Fetal Origins of ill-Health." *Economics and Human Biology* 1(1):105–121.

Pffeifer, L., and J. E. Taylor
2007 "Gender and the Impacts of International Migration: Evidence From Rural Mexico." In *The International Migration of Women*. Ed. A. Morrison, M. Schiff and M. Sjöblom. New York: Palgrave McMillan. Pp. 99–124.

Rabe-Hesketh, S. and B. Everitt
2000 *A Handbook of Statistical Analyses Using Stata*, 2nd edition. London: Chapman & Hall.

Rubalcava, L. N., and G. M. Teruel
2004 "The Role of Maternal Cognitive Ability on Child Health." *Economics and Human Biology* 2(3):439–455.

Shan, D. E., and H. Alderman
1997 "On the Determinants of Nutrition in Mozambique: The Important of Age-Specific Effects." *World Development* 25(4):577–588.

Ssegonzi, R., G. F. De Jong and C. S. Stokes
2002 "The Effect of Female Migration on Infant and Child Survival in Uganda." *Population Research and Policy Review* 21(5):403–431.

StataCorp
2007 *Stata Base Reference Manual A-H (vol. 2)*. Texas: Stata Press.

Thomas, D., and J. Strauss
1992 "Prices, Infrastructure, Household Characteristics and Child Age." *Journal of Development Economics* 39(2):301–331.

——, —— and M.E. Henriques
1991 "How Does Mother's Education Affect Child Height?" *Journal of Human Resources* 26(2):183–211.

Valdivia, M.
2004 "Poverty, Health Infrastructure and the Nutrition of Peruvian Children." *Economics and Human Biology* 2(3):489–510.

Wooldridge, J. M.
1995 "Score Diagnostics for Linear Models Estimated by two Stage Least Squares." In *Advances in Econometrics and Quantitative Economics: Essays in Honor of Professor C. R. Rao*. Ed. G. S. Maddala, T. N. Srinivasan and P. Phillips. Oxford: Blackwell. Pp. 66–87.

——
2002 *Econometric Analysis of Cross Section and Panel Data*. Cambridge: The MIT Press.

——
2006 *Introductory Econometrics A Modern Approach*, 3rd edition. Mason, Ohio: Thomson.

World Bank
2004 *Ecuador Poverty Assessment*. Washington, D.C.: The World Bank.

——
2006 "The Development Impact of Workers' Remittances in Latin America. Volume II: Detailed Findings." World Bank Report 37026.

——
2007 *Nutritional Failure in Ecuador. Causes, Consequences, and Solutions*. Washington, D.C.: The World Bank.

——
2009 "Outlook for Remittance Flows in 2009: Remittances Expected to Fall by 7-10 Percent in 2009." *Migration & Development Brief* 10. <http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934–1110315015165/Migration&DevelopmentBrief10.pdf>.

World Health Organization (WHO)
2006 *Child Growth Standards, Length/Height-for-Age, Weight-for-Age, Weight-for-Length and Body Mass Index-for-Age: Methods and Development*. Geneva: WHO.

ANNEX I

The asset index for household j can be expressed as

$$A_j = \sum_v f_v \frac{a_{jv} - m_v}{s_v}, \tag{5}$$

where a_{jv} denotes a dummy variable that indicates the presence of the asset v in household j (or the number of rooms per adult equivalent), m_v

TABLE A1
SCORING FACTORS AND SUMMARY STATISTICS FOR VARIABLES ENTERING THE COMPUTATION OF THE FIRST PRINCIPAL COMPONENT

	Scoring factor	Mean	Standard deviation
Rooms per equivalent household size	0.267	1.528	0.834
Adequate floor	0.367	0.634	0.482
Adequate wall	0.348	0.699	0.459
Kitchen a separate room	0.199	0.641	0.480
Satisfactory water facilities	0.409	0.478	0.500
Satisfactory toilet facilities	0.381	0.679	0.467
Connection to electricity	0.211	0.942	0.234
Telephone	0.365	0.326	0.469
Cable TV	0.230	0.086	0.281
Internet	0.146	0.018	0.132
Own car	0.263	0.156	0.362
Eigenvalue of first component	3.618		
Share of variance explained	0.330		
Observations	13,581		

SOURCE: Author's analysis from SLC.
NOTE: The whole household survey is used in the principal component analysis. Each variable apart from number of rooms takes the value 1 if true and 0 otherwise. The scoring factor is the weight assigned to each variable (normalized by its mean and standard deviation) in the linear combination of variables constituting the first principal component.

and s_v are the sample mean and the standard deviation for asset v across households, and f_v represents the weight that the PCA technique assigns to household asset v. In a few words, the application of the PCA in this context consists in finding the orthogonal transformation of the original variables that gives a linear combination of the original variables able to capture most of variability of data (the first principal component). The whole survey was used to construct the weights, which are presented in Table A1. In this case, the first principal component is able to capture more than one-third of the variability, similarly to the work of Filmer and Pritchett (2001). The interpretation of the weights is simple: beside number of rooms, an increase from 0 to 1 in a dummy variable raises the wealth index in an amount equal to the scoring factor. *See* Rabe-Hesketh and Everitt (2000) and Filmer and Pritchett (2001) for additional details on the implementation of this approach.