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The effects of parental migration on child nutrition

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Abstract

Remittances can affect child nutrition in two main ways, through increased income from remittances and changes in time allocation within the household. It is not theoretically apparent how a parent migrating and sending back remittances will affect child nutrition. Any added income will likely improve child nutrition by relieving any household income constraint, while the loss of a parent or other adult may reduce the time available to prepare food and care for the child. This study uses data from Peru to find that to 3000 Soles in remittances will make up for a parent not being in the household.

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Introduction

International remittances have become an important source of income for many households in the developing world. In 2009, remittances accounted for a total of 7% of GDP in countries defined as low income by the World Bank, up from 3% at the beginning of the decade[1]. This is more than twice as much as foreign direct investment to low income countries which only accounted for 3% of GDP in 2009. In Peru, the country of interest in this study, remittances were 2% relative to GDP in 2009 and were 50% the size of foreign direct investment and over five times as large as overseas development assistance in the same year. Although not as big of a percentage as some other countries in Latin America, this is comparable in percentage terms to Mexico, considered a major receiver of remittances, where remittances were 3% of GDP in 2009. As international remittances become a larger source of income for the developing world it is increasingly important to study how international migration and remittances affect a variety of household level outcomes. Household level outcomes related to poverty, livelihood strategies, food security and other welfare indicators are of particular interest. In this paper, I investigate the relationship between migration of parents and nutritional status of children left behind.

Child malnutrition is a critical and enduring problem in many developing countries. In 2008, 45% of children under five years old in low income countries were undernourished as measured by height-for-age, and 28% as measured by weight-for-age according to the World Development Indicators put out by the World Bank. In Peru 30% of children were undernourished as measured by height for age and 5% as measured by weight for age in 2005 which is the last year with available data. One of the primary causes of malnutrition is simply

[1] This number can be much higher in countries such as Haiti where it is 21% of GDP or Honduras and El Salvador where it is 18% and 17% respectively

the lack of income to buy enough food or the lack of production of sufficient food at the farm level. Lack of income or food production would lead to a lack of entitlement to food which Sen (1999) argues is the primary cause of hunger. As such, remittances present an opportunity for households to help improve child nutrition through increased income. As indicated above, many households in the developing world send a migrant abroad in order to send money back, increasing the income available to the households. In the case of remittances from migration, however, the additional income comes at a cost in terms of a household's labor and time endowment. For example, if the person going abroad is a parent or caretaker for a child, this loss of time could have negative effects on the child, including the child's nutrition. Parental time is important for child nutrition in the time they spend preparing food, or making sure that the child eats food that is nutritious. If the person who is responsible for spending time preparing food and caring for a child migrates away, or if another adult migrates away and the person responsible for caring for the child has to take up extra household or production activities, this can have a negative effect on child nutrition because of less time spent on those activities that help child nutrition (Zezza, et. al, 2011). It may be possible to make up for this loss through increased income from remittances sent back to the household by a migrant. The relative magnitude of these opposing effects is ambiguous and must be empirically estimated. The high rates of malnutrition in the developing world and the increasing contribution of remittances to increase household income makes the relationship between remittances and child nutrition an important policy area.

Many recent studies have looked into this topic; however there has been no conclusive empirical answer to this question. In this paper section 2 will give a brief review of the literature, section 3 will present the theoretical approach used in this study, section 4 will give the empirical strategy used, section 5 will summarize the data, section 6 will present the results, and section 7 gives policy implications from the results and section 8 concludes.

Literature Review

The increasing importance of remittances to developing economies has led to increased attention in the literature on the effect of migration and remittances on children. A bulk of these studies appears in a special issue of Food Policy in February of 2011 which contains multiple studies examining the effect of migration on food security.

These studies have been mixed in terms of the direction they find remittances and migration to effect child nutrition. de Brauw and Mu (2011) investigate migration and its effect on child nutrition in rural China. They find that in households where the parent migrates, older children, between seven and twelve years old are more likely to be underweight, however this result does not hold if a non-parent migrates. Although the actual caloric intake increases when a parent migrates, the portion of protein in a child's diet goes down. Further, they find that time allocation within the household changes forcing older children to spend more time on chores. Cameron and Lin (2007) also find that not having a parent in the household has a negative effect on short term child nutrition in Thailand. However they find that receiving remittances of over $200 can help to lessen the negative effect on child nutrition.

Other studies have found that migration has an overall positive effect on child nutrition indicators. Anton (2010) finds a positive impact of remittances on short-term nutritional status measured by weight-for-height and weight-for-age z-scores; however he finds no impact on the long term nutritional indicator of height-for-age z-scores in Ecuador. This result may be due to the length of time that households in the study have been receiving remittances, although that information was not available in the dataset that was used. Azzarri and Zezza (2011) study the effect of migration on child nutrition and food security in Tajikistan, finding that migration overall has a positive effect on child nutrition as measured by height-for-age z-scores. They found that this was true not just for children within the household, but also for children in communities with large migrant populations. This indicates that there may be some network effect of migration resulting in positive spillovers that affects households beyond primary remittance receiving households. Carletto, et. al (2011) find that in Guatemala, child nutrition tends to be better in households with a migrant, although they do not differentiate between parent migrants and non-parent migrants. de Brauw (2011) studies migration's effect on child nutrition in El Salvador during the 2008 world food price crisis. During this crisis households with migrants were better able to deal with price shocks, and lessen the negative effect these shocks had on child nutrition. It may be that during a time such as a food crisis the income constraints households face are more severe in terms of being able to buy enough food, giving the income effect from remittances an increased importance compared to the loss of parental time due to migration.

All of these studies suggest that migration can have an effect on child nutrition both through income effects, and changes in household time allocation. de Brauw and Mu (2011) discuss how migration typically occurs because a household expects an increase in income. This allows the household to buy more or better food. The tradeoff is that the household must make up for the household labor that the migrant supplied previous to migration. If the household is unable to completely compensate for all of this lost labor it may have a negative effect on child nutrition, especially if the migrant was involved in activities directly related to child nutrition.

One of the problems in this literature is the endogeneity between child health outcomes and the choice to migrate. The choice to migrate may not be independent of a child's health status, and may in fact be determined in part by a child's health or nutritional status. For example, if a household has a child who has poor nutrition they may be more likely to send a migrant in hopes that increased income through remittances will allow for increased food consumption. If the household decides that parental time is more important to nutritional outcomes then they will be less likely to send a migrant. In the first case migration will be correlated with lower child nutrition, while in the second case it will be correlated with higher child nutrition. In both cases this correlation will be caused not by the effect of migration on child nutrition, but the effect of child nutrition on a household's decision to send a migrant, creating a problem of endogeneity. Only a study by Gibson, et. al (2011) has used data from a natural experiment which addresses this causality problem in the research design. This study looks at the effects of a migration lottery program on the diets of children who do and do not migrate. The data are of people that apply to migrate from Tonga to New Zealand. The health impacts for children who stay while a household member migrates, and those who migrate with a parent are mixed. Children who stay tend to have a higher prevalence of low height-for-age. However those who stay also have a lower prevalence of obesity, a more common problem in Tonga than being underweight. This study argues that in the short term remittances may not enough to make up for the lost income caused by a migrant leaving for those who stay behind, meaning migration may actually reduce income for a household.

Most studies use some statistical method for dealing with endogeneity. Typically studies employ a two stage least squares method. This requires identifying an instrumental variable that is correlated with migration but not child nutrition. One of the most common instrumental variables used in the literature has been a measure of a network effect of migration within a community (Anton, 2010; Azzarri and Zezza, 2011; Mckenzie, 2006). All of these studies use some measure of the number or proportion of migrants within the communities that are being studied, with the idea that having more migrants in an area will make it easier and more likely that others from the area will migrate. Anton also used the number of Western Unions in the area, with the assumption that more Western Unions would reduce the cost of sending remittances.

Not all studies have been able to find a suitable instrumental variable and have relied on other statistical techniques to deal with endogeneity. de Brauw and Mu (2011) use a fixed effects model, which accounts for all unobserved characteristics that do not change over time. They assume endogeneity is caused by unobserved characteristics that are unchanging over time. A model with fixed effect for the household will account for these in a way that one without such a fixed effect cannot. This fixed effect model is only possible using panel data, over multiple years.

In addition to an inconsistency in methods within this literature, there is an inconsistency in results for how migration affects child nutrition, as highlighted above. de Brauw and Mu (2011) and Gibson, et. al (2011) find a negative effect of migration on child nutrition, while Anton (2010), Carletto, et. al (2011) and de Brauw (2010) find a positive effect of migration on child nutrition. Because of this discrepancy there is room for more research within this area, to add to the understanding of how migration may affect children, specifically in the tradeoff between income and time allocation. My study will do this using the Young Lives Survey from Peru, a dataset previously unused within the literature. I will attempt to deal with endogeneity using a two stage least squares method similar to many other studies in the area.

Theory

To understand the ways in which parental migration will affect child nutrition it is important to understand how migration will affect both income and time allocation within the household. To predict the influence of migration and remittance on child nutrition a utility maximizing household model is employed. It is assumed that a household will maximize the utility function:

$$U = U(l_h, l_m, c_h, c_m, CN) \tag{1}$$

similar to the household utility function found in Bardhan and Udry (1999) where l is leisure, c is consumption, subscripted by h for the household and m for a migrant, and CN, is child nutrition. Both consumption and leisure are standard in a household utility function. We can assume that the entire household will benefit from having healthy children from improved child nutrition. Child nutrition is produced within the household and is a function of both time spent child rearing and the share of consumption that is spent on food for the child.

$$CN = CN\ (\sigma c_h, Lcn_h) \tag{2}$$

In equation (2), Lcn_h is the amount of time spent by adults in the household on activities that improve child nutrition outcomes, such as educating the child on the importance of nutrition and the types of foods necessary to stay well nourished, and time spent preparing food for the children that is of high nutritional value. Sigma is the proportion of household consumption that is actually food for the child. It is assumed that an overall increase in c_h will correspond with an increase in food for children, or that intra-household allocation of food is constant as income increases. Consumption for both the household and a migrant are limited by an income constraint for each defined by:

$$P_h c_h = W_h L_h + \theta W_m L_m \tag{3}$$

$$W_m L_m = P_m c_m + \theta W_m L_m \tag{4}$$

where (3) represents the income constraint for those household members who stay, and equation (4) is the income constraint for the migrant. Theta is the percentage of income that the migrant sends back to the household in the form of remittances. An increase in remittances will increase the possible consumption for those who remain in the household, and decrease the possible consumption for the migrant. In addition to income constraints both the migrant and household have time constraints defined by:

$$T_h = L_h + l_h + Lcn_h \qquad (5)$$

$$T_m = L_m + l_m \qquad (6)$$

where (5) indicates the time constraint for the household, and (6) gives the time constraint for a migrant. Time spent on child nutrition is only possible for non-migrants, while a person migrating will lead to a drop in T_h and an increase in T_m. All four of the income and time constraints can be combined into a full budget constraint:

$$W_h T_h + W_m T_m = P_h c_h + W_h l_h + W_h Lcn_h + P_m c_m + W_m l_m \qquad (7)$$

The optimization problem can be constructed by maximizing (1) subject to (7) and choosing c_h, c_m, l_h, l_m, and Lcn_h. The Lagrangian is then:

$$L = U(l_h, l_m, c_h, c_m, CN) - \lambda(P_h c_h + W_h l_h + W_h Lcn_h + P_m c_m + W_m l_m - W_h T_h - W_m T_m)$$

(8)

and the first order conditions for this problem are:

$$\frac{dU}{dc_h} + \frac{dU}{dCN} * \frac{dCN}{dc_h} = P_h \qquad (9)$$

$$\frac{dU}{dc_m} = P_m \qquad (10)$$

$$\frac{dU}{dl_h} = W_h \qquad (11)$$

$$\frac{dU}{dl_m} = W_m \qquad (12)$$

$$\frac{dU}{dCN} * \frac{dCN}{dLcn_h} = W_h \qquad (13)$$

From these first order conditions we see that that both household consumption (c_h) and time spent by adults on improving child nutrition (Lcn_h) affect household utility indirectly through child nutrition as shown in equation (9). Household consumption also has a direct effect on child nutrition. This direct, as well as indirect effect of household consumption may be one of the driving factors of remittances. This is because remittances are a way of shifting consumption from the migrant to the household. As we can see from equation (10) consumption by the migrant only has a direct effect on consumption. Because household consumption has an indirect as well as direct effect on utility there may be incentive to shift consumption from the migrant to the household through remittances.

One of the key factors driving possible migration is the possibility of higher wages abroad. This higher wage abroad will likely have an effect on household time allocation

$$W_m > W_h \tag{14}$$

$$\frac{du}{dl_m} > \frac{du}{dl_h} \tag{15}$$

Equation (15), which follows from equation (14), shows that if the household and migrant have similar marginal utilities for leisure the migrant will tend to work more assuming this higher wage abroad. Because this added income can be sent to the household in the form of remittances, having a person go abroad could free up those in the household to spend a higher percentage of their time on leisure or improving child nutrition. However, because migration leads to an overall decrease in time for the household, it is theoretically ambiguous whether this will lead to an absolute increase in time spent improving child nutrition. A study by Cameron and Lin (2007) found that having less than two parents in a household will have a negative effect on a child’s short term nutritional status. They found, however, that if the household receives over $200 worth of remittances in a year this can partially offset this negative effect of not having a parent in the household. This indicates that if the migrant sends enough money back this may allow those adults still in the household to spend less time working and more time improving child nutrition. Because migration affects both household income and household time allocation it is theoretically ambiguous how it will affect child nutrition, for this reason it must be answered empirically.

Data Description

For this study I will be using the Young Lives survey (YLS) from Peru, a country in which the effect of migration on child health has not been studied. The YLS is a longitudinal study that interviewed 12,000 children across four countries (Peru, Vietnam, Ethiopia, and India) in 2002. For each country approximately 2,000 one year olds and 1,000 eight year olds were interviewed. The survey included information about the children as well as their household. The same households were then interviewed four years later when the children were five and twelve years old. Only the data from Peru was used for this study because they include information on household remittances for both rounds one and two. For Peru, in round one, the households of 2,052 one year olds and 714 eight year olds were interviewed. Round two was collected four years later, and 1,963 of the same households that had one year olds and 685 of the same households that had eight year olds during round one were interviewed again.

The data include measures of height and weight-for-age z-scores which are used as proxies for nutritional status. These z-scores were calculated from the World Health Organization's standards for height and weight. Height-for-age is used as a proxy for long term health and weight-for-age is used as a proxy for short term health (Anton 2010). In the data, the height-for-age z-scores are available for all children, while weight-for-age z-scores are not available for the older children during round two. Because these z-scores are calculated using international standards the mean height and weight-for-age z-scores are both below 0. This is true for all age cohorts of children, although it is less for the one year olds interviewed in round one, as can be seen in tables 1 through 4.

In total there are 885 cases of households receiving remittances, combining all age groups. For each of the child age groups, between 124 and 335 households receive remittances and across all age groups 16% of households receive remittances. For round 2 there is also information on the amount of remittances that have been sent (Tables 1 and 2). Remittance amounts are measured in Soles, and are calculated by taking the amount of the most recent remittance received and multiplying it by the number of times per year they receive remittances. This is making an assumption that the last remittance received was the average amount the household receives. If this is not the case this method of measuring remittances will be inaccurate.

There are some basic variables on household characteristics in the data. Each household is identified as urban or rural. The majority of households are urban. Anton (2010) found that children in urban areas had better nutritional outcomes than children in rural areas. There is also information on how many parents are in the household. The measure used in this study is whether the child sees both parents, only the mother, only the father, or neither parent on a daily basis. For all age groups the share of children that do not see either parent is relatively small, below 5%. The percentage of children that see only their father is even smaller for both age cohorts within round 2, while children that only see their mother account for between 20 and 30% of children. This variable can be used as a proxy for parental time, which should have a positive impact on child nutrition from theory. There is also information on mother's education and age, which have been shown to affect child nutrition in previous studies (Anton 2010). Both of these variables will be included in as a part of the vector of household controls that were a part of the guiding equation.

From theory, income or expenditure data should also be included as an explanatory variable, but expenditure data are only available in the round two survey. This is because consumption is one of the determinants of child nutrition which is constrained by household income. A variable for food expenditure is calculated as a proxy for income (Tables 1-4). The original data has information broken down by type of food and the food expenditure combines all of these to create an overall expenditure.

Because expenditure or income data are not available for the first round of surveys wealth is used as a proxy. There are examples in the literature of wealth being used instead of income in explaining child nutritional outcomes (Anton 2010). The data have an overall wealth index that is calculated on a 0 to 1 scale for each household that is interviewed. Included within this wealth index are the housing quality index, consumer durable index, and services index. The housing quality index takes into account the number of rooms and housing material used in the home of the household being interviewed. The consumer durable index takes into account the ownership of various goods within the household such as radios, cars and telephones. The services index measures whether the household gets electricity, where the household gets its water and what type of toilet the household has. All of these are calculated on a 0 to 1 scale and the average of these three is the wealth index. Both wealth and income should have a positive effect on child nutrition outcomes. Because wealth is a stock concept it may not be as accurate in determining consumption. Wealth as measured in the data includes many assets that a household might not be able to easily liquidate in order to increase food expenditure.

Empirical Strategy

First, a standard Ordinary Least Squares (OLS) model using data from the round two survey is estimated. The basic form of the OLS regression will be:

$$Child\ Nutrition_c = \alpha + \beta_1 Parental\ Time_h + \beta_2 Remittances_h + \beta_3 Income_h + \beta_4 Z_{hc} + \varepsilon$$

where Z are a list of household and child level control. This OLS regression will be run using only data from the round two survey because some relevant variables were only included in the round two survey. The variables that round one is missing include household expenditure and remittance amounts. For round one the data only indicated whether the household received remittances and did not indicate the amount of remittances received. In addition, only wealth indices were available. No information on income or expenditure was collected. In order to include the theoretically important remittance amounts and expenditure it is necessary to only use round two of the survey in a cross-sectional analysis.

Using a standard OLS model is potentially problematic given that it may not account for endogeneity and cause parameter estimates to be biased. As a result one of the key assumptions of an OLS regression is violated, specifically that the explanatory variables are uncorrelated with the error terms. The reason for this simultaneity can be seen in the theory and was discussed above. Remittances may change child nutrition through affecting household time allocation and income constraints. Conversely child nutrition may change the migration decision by affecting the household utility. Because child nutrition is one of the factors in the utility function, it may be that migrating is utility maximizing at certain levels of child nutrition, but not at others. This could mean that there will be a difference in child nutrition levels for those who do and do not migrate in a way that skews the results.

Similar to the literature, I employ an instrumental variable approach in the two stage least squares model. The first stage of this method consists of estimating remittances using an instrumental variable. Then instead of using the remittances directly, the estimates from this first stage equation will be used to estimate child nutrition variables. The variable used to instrument remittances was a dichotomous variable indicating whether the mother was originally from the community, as well as the proportion of households surveyed within a community received remittances. This attempted to get at a possible network effect of migration which has been used in previous studies (Anton, 2010; Azzarri and Zezza, 2011; Mckenzie, 2006). All of these studies used some variation of the proportion of households receiving remittances within a community along with other variables as an instrument for remittances. Whether or not the mother is originally from the community has not been used previously, and attempts to measure the extent to which a household is a part of any social network that may increase the chances of migration.

In order to test the quality of the instrumental variable an F-test was run to test for a possible weak instrument. A weak instrument means that the instrument does not adequately predict remittances. This would mean that the prediction using the instrumental variable will not account for a large proportion of the variation in remittances. In addition, the results using an instrumented variable will be compared to the standard OLS regression to see how much the estimations change. If the coefficient on remittances changes greatly for the regression using an instrumented variable this would indicate that there is bias in the OLS results due to endogeneity.

As an alternative, a fixed effects regression will be run using both rounds one and two of the survey. A fixed effects regression will account for all time-invariant unobserved variables. Having this fixed effect for the household is only possible when using panel data, that follows the same households over multiple years. As mentioned in the theory section the basic form for the regression will be:

$$Child\ Nutrition_c = \alpha + \beta_1 Parental\ Time_h + \beta_2 Remittances_h + \beta_3 Income_h + \beta_4 Z_{hc} + \Delta_h + \varepsilon$$

where Δ is the fixed effect for each household. This will include all those household level effects that are constant over time. Because of this it is only unobserved variables that affect both child nutrition and remittance levels of migration decisions that change over time that can create problems of endogeneity. This would be something such as a health or income change that would lead a household to be more or less likely to migrate. This method of using a fixed effects model to capture household level fixed effects is similar to de Brauw and Mu (2011).

Analysis

Because all variables were not available for round one, cross-sectional regressions were run using data from round two, one with height-for-age z-scores as the response variable and one with weight-for-age z-scores as the response variable. Using only round two data allowed the remittance variable to be a measure of amounts of remittances in thousands of Soles, and for regressions to be run using a wealth index or food expenditure. The results from these regressions can be found in tables 6 and 7. There is not a significant difference in results for regressions using the wealth index and food expenditure. In both cases the coefficient on remittance amounts is significant at the 10% level for the results using height-for-age z-score as the dependent variable, and insignificant when weight-for-age z-score is used. This would seem to signify that remittances only have an effect on long term nutritional status. It must be noted that the weight-for-age z-score is not available for the twelve year olds in the round two survey. As a result, the number of observations is only 1,935 in the regressions using weight-for-age z-score, as opposed to 2,583 observations in the regressions using height-for-age z-scores. On all of these regressions the p-value for the Breusch Pagan/Cook Weisberg test was significant indicating the results have a problem with heteroskedasticity. In order to solve this regressions were run with robust standard errors, which are reported.

In both case the number of parents in the household is also significant and positive at the 10% level using height-for-age z-scores after accounting for heteroskedasticity. The estimate of the coefficient on parents in a household is .0705, which is about three times as large as the coefficient for an increase in 1000 soles of remittance which was equivalent to $300 in 2005 when data were collected. This indicates that to make up for the loss of a parent in terms of height-for-age z-scores a household must receive about 3000 soles. This is roughly equivalent to 1000 US dollars, and indicates that this is the level at which the increase in income from remittances will make up for the loss of a parent. Cameron and Lin (2007) also find that having fewer parents in the household has a negative effect on child nutrition for their study in Thailand, which can be offset by high amounts of remittances, although this result was only significant for short term child nutrition as measured by weight for height.

These regressions were again run using only those households which received remittances. For the regression using height-for-age as the dependent variable reported in table 6 number of parents in the household and remittance amounts were still positive although not significantly so. The coefficient on remittances decreases from the regression using all of round 2, while the coefficient on number of parents increases. Other variables have the same sign, although many lose statistical significance, likely due to the lower number of observations used in the regression. For the regression using weight-for-age as the dependent variable reported in table 7 both number of parents in the household and remittances are now negative. However neither are even one standard deviation away from 0, indicating that there is no effect that can be found of remittances or number of parents in the household on height-for-age when only using those households which receive remittances.

Examining the rest of the regression results, signs of coefficients tend to be as expected. An increase in mother's education or age will result in an increase in height and weight-for-age z-scores. This variable is a categorical variable, and each increasing level of schooling causes an increase in the estimated coefficient. Significance is compared to a mother having no schooling, and every level past primary schooling is significant at the 1% level in all OLS regressions. de Brauw (2011) also found mother's education to have a significant positive effect on height-for-age z-scores in El Salvador, while Anton (2010) found mother's education to have a significant positive effect on both weight for height and weight-for-age z-scores. Living in a rural site as opposed to an urban one results in a significant decrease in both height and weight-for-age z-scores across all OLS regressions. The estimates indicate a drop in height-for-age z-scores of 0.311 for children in rural areas compared to those in urban areas in the regression using wealth index, and of 0.448 for the regression using food expenditure. The regression using wealth index indicates a drop of 0.217 in weight-for-age z-scores for children in rural areas compared to urban, and 0.407 in the regression using food expenditure. The sign and significance of this urban or rural variable is consistent with the previous studies by Anton (2010) in Ecuador and Azzarri and Zezza in Tajikistan(2011).

One key difference between the regressions is how wealth affects child nutrition compared to income. The coefficient for the wealth index is large and significant, while the coefficient for food expenditure is insignificant, and switches signs between the regressions using height and weight-for-age z-scores. This may indicate that the stock concept of wealth is more important than the flow concept of income for child nutrition. This makes sense for a more long term health measure such as height-for-age z-score. However the lack of significance for food expenditure may be due to inaccuracies in measurement and calculation. Food expenditure was calculated as the total amount of expenditure and consumption on foods that included those produced by the household and those bought by the household for over 30 types of foods. The number of estimations and complexity of calculating this variable may lend itself to some inaccuracies. If this variable is not measured accurately may misrepresent the relationship between expenditure and child nutrition.

Table 8 separates the parental time variable by gender. These results indicate that having the mother in the household has a larger positive effect on child nutrition than just having the father in the household. This is true for both height and weight-for-age, but only statistically significant for height-for-age. This table also includes regressions with the parental time variable interacted with remittances. For both height and weight-for-age these results that remittances have a much larger effect if neither parent is in the household or the mother is not in the household. These results indicate that the gender of the parent that is in the household is important for child nutrition, and that having a mother in the household has a much larger positive effect on child nutrition than having just the father in the household.

Because of possible problems with endogeneity a regression was estimated instrumenting remittances using a two stage least squares method. As stated in the empirical section the instrument for remittances was the proportion of households interviewed that received remittances and whether the mother was from the community. This is similar to the previous studies that use the network effect to instrument remittances (Anton, 2010; Azzarri and Zezza, 2011; Mckenzie, 2006). One limitation is that this information is only available for those households that took part in the Young Lives Survey, so it may not be a completely representative sample of how much of the community receives remittances. The proportion of households that receive remittances measures the strength of a network community, while whether the mother is from the community measures how much of a connection the household might have to others within the community.

The results using the instrumental variable are found in tables 9 and 10. The second stage of the instrumented regressions is found in table 10. The instrumented coefficient for remittances is positive for both height and weight-for-age z-score, but only significant at the 10% level for weight-for-age z-scores. After instrumenting for remittances the coefficient for remittance amounts (in thousands of Soles) increases. Even though the instrumented coefficient for remittances is no longer significant in the regression for height-for-age z-scores, the value of the coefficient increases. In the regression using weight-for-age as the outcome variable the coefficient goes from insignificantly positive in the OLS estimate, to positive and significant at the 10% level in the instrumental variable regression. The actual estimate of the coefficient also increases from 0.005 to 0.25. This indicates that if anything the OLS estimations underestimate the effect of remittances on child nutrition. In the instrumented results the coefficients for remittance amounts in thousands of Soles are larger than for number of parents, indicating that it takes less than 1,000 Soles of remittances to make up for a parent not being in the household. This is much smaller than the roughly 3,000 Soles that were indicated in the OLS regressions.

Other variables within the regression tend to have similar signs and levels of significance compared to the OLS regressions. One variable that is significant in the instrumented regressions at the 5% level on the regressions using weight-for-age is the number of parents in the household. This is insignificant, but positive in the OLS regressions on weight-for-age. For all instrumented and OLS regressions using height-for-age z-scores as the response this variable is positive and significant at the 10% level. Similar to the OLS results mother's age, household wealth and mother's education have a significant positive effect on child nutrition, while living in a rural site has a significant negative effect.

Table 10 gives the first stage results. It indicates that there is a significant positive relationship between whether the mother is originally from the community and the amount of remittances that the household receives. The proportion of households that receive remittances is also positive, but not significantly so. The f-statistic for excluded instruments is 7.62 for weight-for-age z-scores and 8.17 for height-for-age z-scores. The difference between these two values is due to the fact that there are a smaller number of children who have a weight-for-age z-score. This is below the generally accepted value of 10 that indicates a strong instrument (Stata 2010). A Hausman test comparing the instrumental regression to the OLS regression gave a p-value of 0.44 using height-for-age as the dependent variable and 0.06 for the regression using weight-for-age as the dependent variable. This gives evidence at the 10% level that the instrumented regression removes bias compared to the OLS regression for the regressions using weight-for-age. Given the f-statistics of the first stage regressions and p-values for the Hausman tests the results using the instrumented variable should be interpreted with caution, particularly in the regression using height-for-age z-scores. In the case of a weak instrument the two stage least squares estimate will not remove bias and will cause a loss in efficiency.

In an attempt to use both rounds of data a fixed effects panel regression was run using both round 1 and 2. This method is similar to that used by de Brauw and Mu (2011). The use of a fixed effects regression is also consistent with the result from a Hausman test between fixed and random effects, which has a p-value of 0.00 on a test statistic of 109.96. This indicates that the random effects model is inconsistent and fixed effects should be used. Because of limitations caused by the round 1 survey the fixed effects model used a categorical variable for remittances that simply indicated whether the household received them. Although this makes it impossible to differentiate between households that receive larger and smaller amounts of remittances, it helps to show whether on the whole families that receive some sort of remittances are better or worse off than those that do not. The results from this regression are found in Table 11. The coefficient on remittances shows no significant effect on either height or weight-for-age z-scores and switches signs between the two. The sign on remittances is positive for height-for-age z-score, but negative on the weight-for-age z-score. The fixed effects panel also causes many variables that were insignificant in the cross-sectional panel to be insignificant. Two of these variables that were significant in the cross-sectional regressions are not only insignificant in the fixed effects regression, but change signs. This is somewhat surprising because the idea that wealth affects child nutrition in a positive way is in line with theory, and as mentioned above children from rural areas having lower nutritional outcomes than those from urban areas is consistent with previous research (Anton, 2010; Azzarri and Zezza, 2011). The fixed effects regressions give no evidence that migration affects child nutrition one way or the other

Policy Implications

There is evidence that migration can effect child nutrition both through time allocation and income effects. This indicates that any policy targeted at improving child nutrition should consider effects on both of these factors. One type of policy that has been tried in the developing world, including in Peru, at least in part to improve child nutrition and health are conditional cash transfer (CCT) programs. The program in Peru which is called Juntos was started in 2005, and gives monthly payments to households conditional on them having their child attend school regularly and receiving various health services(Jones et. al, 2007). A similar program called Progresa in Mexico has been shown to have a positive effect on child health (Gertler, 2004). The results from my paper indicate that in addition to providing households with income, CCT programs may be able to positively affect child nutrition by easing household income constraints and allowing parents to stay at home who otherwise may have had to migrate. More research should be done to see if current programs are having an effect through household time allocation and if there is a way to structure them in order to maximize any positive effects from having parents spend more time with their children

Similarly my paper has important implications for those communities where migration for remittances is common. In communities where this is happening it would be important to have policies in place to help children where one or more parents is not in the household. It may be that in these communities programs that provide children with health and nutritional services outside the home will have the biggest effect. If many children have parents who are out of the household programs run by the government or local schools could be much more cost effective than in those communities where most children have both parents within the household. Given how important both income and time allocation are for child nutrition, it is important that any program to address nutrition considers how it will affect both of these factors.

Conclusion

It appears that both the added income from remittances and parental time have a positive impact on child nutrition, particularly long term child nutrition as proxied by height-for-age z-score. The direction of the parental time coefficient is consistent both with theory and previous literature (Bronte-Tinkew and Dejong 2004; Cameron and Lin 2007). Estimates from the cross sectional OLS regressions indicate that in order to make up for the loss of a parent a house must receive about 3,000 Soles in remittances. The instrumental variable regressions indicate this value is much lower, not even 1,000 Soles. This is also consistent with the previous work of Cameron and Lin (2007) which only found a significant impact on nutrition if a household received over $200 in remittances. The results from the cross-sectional OLS and instrumented regressions both indicate that if a migrant sends back a significant amount of remittances this will have a positive effect on child nutrition. This is necessary to make up for the loss of a parent, which has a negative effect on child nutrition. The OLS results estimate that $1000 in remittances is necessary to make up for the loss of a parent, while the instrumented results estimate this to be much lower, below $300.

The validity of all results from this paper, including those with an instrument variable, depends on the extent to which the problem of endogeneity has been dealt with. The reason for including an instrument for remittances is to deal with this problem. The results from this regression show that remittances have a positive effect on short term child nutrition, which is different from the OLS regression that indicates a significant positive effect of remittances on long term child nutrition. For both long and short term child nutrition the difference in point estimates between the OLS and instrumented regressions indicate that standard OLS underestimates the effect of remittances on child nutrition. However, diagnostic tests indicate that the instrument used is weak, particularly in the case of height-for-age z-scores. This suggests that an improved instrument is needed to adequately deal with endogeneity.

This does not discount all possible conclusions that can be taken from the results. There is evidence that decreased parental time within the household negatively affects child nutrition and remittances can positively affect child nutrition. There is evidence that migration that does not lead to significant or any remittances being sent back to the household would result in lower child nutrition. Given the differing results in this paper and across the literature the effect of parental migration on child nutrition may be different from household to household and community to community depending on the specific migration experience.

Table 1 Summary Statistics for Round Two, 5 year olds

Variable	Obs	Mean	SD	Min	Max
Height-for-age z-score	1950	-1.5	1.12	-5.92	4.53
Weight-for-age z-score	1955	-0.51	1.03	-4.04	3.83
Remittance Amounts (Soles)	283	1347.7	4669.52	1	57600
Wealth Index	1963	0.51	0.23	0.01	0.98
Monthly Food Expenditure (Soles)	1963	211.94	122.66	20	1426
Monthly Other Expenditure (Soles)	1963	149.08	356.18	0	10204
Mother Age	1955	31.13	6.8	18	53
	Neither	Only Dad	Only Mom	Both	
Parents In HH	74	36	409	1,444	
%	3.77	1.83	20.84	73.56	
	Urban	Rural			
Type of HH	1086	877			
%	55.32	44.68			
	Yes	No			
Receive Remittances	285	1678			
%	14.52	85.48			

Table 2 - Summary Statistics for Round Two, 12 year olds

Variable	Obs	Mean	SD	Min	Max
Height-for-age z-score	680	-1.46	1.06	-4.66	2.37
Remittance Amounts (Soles)	123	919.4	1444.7	20	8400
Wealth Index	684	0.54	0.22	0.02	1
Monthly Food Expenditure (Soles)	685	228.09	160.79	0	3040
Monthly Other Expenditure (Soles)	685	194.62	731.83	2	17138.3
Mother Age	660	38.36	6.74	27	59
	Neither	Only Dad	Only Mom	Both	
Number of Parents in HH	28	12	199	446	
	4.09	1.75	29.05	65.11	
	Urban	Rural			
Type of HH	414	271			
%	60.44	39.56			
	Yes	No			
Receive Remittances	124	561			
%	18.1	81.9			

Table 3 - Summary Statistics for Round One, 1 year olds

Variable	Obs	Mean	SD	Min	Max
Height-for-age z-score	2035	-0.78	1.33	-5.52	5.45
Weight-for-age z-score	2038	-0.09	1.20	-5.47	4.22
Wealth Index	2047	0.46	0.23	0.01	0.94
Mother Age	2036	26.83	6.77	14.00	49.00
	0	1	2		
Number of Parents in HH	12	379	1661		
%	0.58	18.47	80.95		
	Urban	Rural			
Type of HH	1357	690			
%	66.29	33.71			
	Yes	No			
Receive Remittances	335	1717			
%	16.33	83.67			

Table 4 - Summary Statistics for Round One, 8 year olds

Variable	Obs	Mean	SD	Min	Max
Height-for-age z-score	710	-1.37	1.01	-5.60	2.23
Weight-for-age z-score	711	-0.47	0.96	-3.87	2.70
Wealth Index	708	0.51	0.22	0.03	0.93
Mother Age	678	34.03	6.72	22.00	56.00
	0	1	2		
Number of Parents in HH	26	175	513		
	3.64	24.51	71.85		
	Urban	Rural			
Type of HH	529	185			
%	74.09	25.91			
	Yes	No			
Receive Remittances	141	573			
%	19.75	80.25			

Table 5 - Mother's Schooling by child cohort

	Round 2, 5 year olds		Round 2, 12 year olds		Round 1, 1 year olds		Round 1, 8 year olds	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
None	171	8.77	67	9.84	162	7.96	69	10.22
Primary	705	36.15	247	36.27	748	36.77	248	36.74
Secondary	715	36.67	262	38.47	796	39.13	278	41.19
Some Technical College	101	5.18	28	4.11	98	4.82	23	3.41
Technical College	161	8.26	50	7.34	170	8.36	40	5.93
Some University	34	1.74	13	1.91	29	1.43	8	1.19
University	63	3.23	14	2.06	31	1.52	9	1.33
Total	1,950	100	681	100	2,034	100	675	100

Table 6 - Cross Sectional Regressions for Height-for-age z-score

	(i)	(ii)	(iii)
Remittances in Thousands of Soles	0.0204*	0.0239**	0.012
	(0.011)	(0.012)	(0.011)
Number of Parents	0.0705*	0.0713*	0.090
	(0.039)	(0.039)	(0.096)
Wealth Index	0.599***		0.519
	(0.138)		(0.375)
Food Expenditure in Thousands of Soles		-0.002	
		(0.015)	
Gender (Male=1 Female =2	0.018	0.015	0.040
	(0.040)	(0.040)	(0.118)
Age in Months	0.0748***	0.0766***	0.0575*
	(0.010)	(0.010)	(0.034)
Age Squared	-0.000353***	-0.000361***	-0.000286*
	0.000	0.000	(0.000)
Mother age in years	0.002	0.003	0.008
	(0.003)	(0.003)	(0.009)
Mother School Primary	0.116	0.145*	0.070
	(0.081)	(0.080)	(0.281)
Mother School Secondary	0.390***	0.479***	0.229
	(0.087)	(0.086)	(0.280)
Mother School Some Technical College	0.471***	0.602***	0.367
	(0.113)	(0.111)	(0.325)
Mother School Technical College	0.476***	0.627***	0.237
	(0.111)	(0.108)	(0.328)
Mother School Some University	0.600***	0.748***	0.778**
	(0.161)	(0.161)	(0.382)
Mother School University	0.735***	0.912***	0.922**
	(0.157)	(0.155)	(0.465)
Area (Urban=1 Rural=2)	-0.311***	-0.448***	-0.630***
	(0.055)	(0.046)	(0.166)
Constant	-5.159***	-4.845***	-4.451***
	(0.491)	(0.484)	(1.558)
Observations	2583	2583	391
R-squared	0.176	0.169	0.179

Standard errors in parentheses

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

(i) Regression using Wealth Index and robust standard errors

(ii) Regression using Food Expenditure and robust standard errors

(iii) Regression using only households receiving remittances and robust standard errors

Table 7 - Cross Sectional Regressions for Weight-for-age z-score

	(i)	(ii)	(iii)
Remittances in Thousands of Soles	0.005	0.008	-0.004
	(0.011)	(0.012)	(0.010)
Number of Parents	0.058	0.057	-0.031
	(0.040)	(0.041)	(0.097)
Wealth Index	0.962***		1.719***
	(0.142)		(0.402)
Food Expenditure in Thousands of Soles		0.029	
		(0.020)	
Gender (Male=1 Female =2	-0.140***	-0.143***	-0.069
	(0.042)	(0.042)	(0.114)
Age in Months	-0.175*	-0.179*	-0.494
	(0.100)	(0.102)	(0.330)
Age Squared	0.00143*	0.00149*	0.004
	(0.001)	(0.001)	(0.003)
Mother age in years	0.002	0.004	0.002
	(0.003)	(0.003)	(0.008)
Mother School Primary	0.154**	0.204***	0.456**
	(0.073)	(0.072)	(0.231)
Mother School Secondary	0.411***	0.549***	0.647***
	(0.083)	(0.082)	(0.241)
Mother School Some Technical College	0.568***	0.757***	0.893***
	(0.124)	(0.123)	(0.280)
Mother School Technical College	0.587***	0.803***	0.730**
	(0.109)	(0.106)	(0.307)
Mother School Some University	0.720***	0.939***	1.464***
	(0.197)	(0.204)	(0.356)
Mother School University	0.836***	1.085***	1.269***
	(0.157)	(0.156)	(0.443)
Area (Urban=1 Rural=2)	-0.217***	-0.407***	-0.277*
	(0.056)	(0.051)	(0.159)
Constant	4.330	4.882	14.090
	(3.141)	(3.179)	(10.380)
Observations	1,935	1,935	276
R-squared	0.218	0.2	0.318

Standard errors in parentheses

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

(i) Regression using Wealth Index and robust standard errors

(ii) Regression using Food Expenditure and robust standard errors

(iii)Regression using only households receiving remittances and robust standard errors

Table 8 - Parents separated by gender

	Height-for-Age Z-score	Weight-for-age Z-Score	Height-for-Age Z-Score	Weight-for-age Z-Score
Remittances in Thousands of Soles	0.0212*	0.005	0.0981***	0.0725***
	(0.012)	(0.011)	(0.021)	(0.020)
Parents : Dad Only	0.235	0.048	0.317	-0.010
	(0.229)	(0.214)	(0.230)	(0.208)
Parents : Mom Only	0.314**	0.139	0.380***	0.197
	(0.126)	(0.123)	(0.127)	(0.124)
Parents : Both	0.328***	0.172	0.393***	0.224*
	(0.121)	(0.118)	(0.122)	(0.119)
Remittances * Dad Only			-0.105	0.076
			(0.095)	(0.089)
Remittances * Mom Only			-0.0818***	-0.0866***
			(0.027)	(0.025)
Remittances * Both			-0.0875***	-0.0759***
			(0.021)	(0.021)
Wealth Index	0.605***	0.964***	0.607***	0.958***
	(0.138)	(0.142)	(0.138)	(0.143)
Gender (Male=1 Female =2	0.017	-0.141***	0.014	-0.143***
	(0.040)	(0.042)	(0.040)	(0.042)
Age in Months	0.0746***	-0.178*	0.0754***	-0.175*
	(0.010)	(0.100)	(0.010)	(0.101)
Age Squared	0.000353***	0.00146*	0.00036***	0.00143*
	(0.000)	(0.001)	(0.000)	(0.001)
Mother age in years	0.002	0.002	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Mother School Primary	0.116	0.152**	0.119	0.152**
	(0.081)	(0.073)	(0.081)	(0.073)
Mother School Secondary	0.388***	0.408***	0.387***	0.403***
	(0.087)	(0.083)	(0.087)	(0.083)
Mother School Some Technical College	0.468***	0.565***	0.470***	0.569***
	(0.112)	(0.124)	(0.113)	(0.125)
Mother School Technical College	0.473***	0.583***	0.472***	0.587***
	(0.111)	(0.109)	(0.111)	(0.109)
Mother School Some University	0.590***	0.711***	0.592***	0.712***
	(0.161)	(0.198)	(0.161)	(0.199)
Mother School University	0.737***	0.833***	0.740***	0.839***
	(0.157)	(0.158)	(0.157)	(0.158)
Area (Urban=1 Rural=2)	-0.306***	-0.216***	-0.303***	-0.216***
	(0.055)	(0.057)	(0.055)	(0.057)
Constant	-5.628***	4.024	-5.729***	3.869
	(0.476)	(3.141)	(0.477)	(3.147)
Observations	2583	1,935	2,583	1,935
R-Squared	0.177	0.219	0.179	0.222

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

Table 9- First Stage Regression Estimating Remittance Amounts

	(i)	(ii)
Number of Parents in Household	0.258***	-0.284***
	(0.066)	(0.079)
Wealth Index	0.692***	0.819***
	(0.213)	(0.275)
Gender (Male=1 Female=2)	-0.098	-0.156*
	(0.062)	(0.081)
Age	0.001	0.095
	(0.016)	(0.201)
Age squared	0.000	-0.001
	(0.000)	(0.002)
Mother's Age	0.001	0.001
	(0.005)	(0.006)
Mother School Primary	-0.009	0.001
	(0.120)	(0.159)
Mother School Secondary	-0.043	-0.072
	(0.132)	(0.176)
Mother School Some Technical	-0.234	-0.287
	(0.191)	(0.248)
Mother School Technical College	-0.094	-0.207
	(0.169)	(0.221)
Mother School Some University	-0.184	-0.258
	(0.269)	(0.355)
Mother School University	-0.123	-0.160
	(0.225)	(0.287)
Area (Urban=1 Rural=2)	-0.061	-0.115
	(0.093)	(0.125)
Proportion receive remittances	1.039	1.104
	(0.721)	(0.952)
Mother from Community	0.258***	0.326***
	(0.066)	(0.085)
Constant	-0.223	-2.967
	(0.872)	(6.361)
Observations	2583	1935
R-squared	0.024	0.028
F Value	8.165	7.615

Standard errors in parentheses

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

(i) First Stage Height-for-age Z Score

(ii) First Stage Weight-for-age Z Score

Table 10 - Instrumented Regressions

	Height-for-age z score	Weight-for-age z score
Instrumented Remittances	0.140	0.250*
	(0.160)	(0.150)
Number of Parents in Household	0.103*	0.130**
	(0.060)	(0.060)
Wealth Index	0.521***	0.771***
	(0.170)	(0.190)
Gender (Male=1 Female=2)	0.029	-0.103**
	(0.040)	(0.050)
Age	0.0744***	-0.207*
	(0.010)	(0.120)
Age squared	-0.000351***	0.00169*
	(0.000)	(0.001)
Mother's Age	0.002	0.002
	(0.003)	(0.004)
Mother School Primary	0.119	0.160*
	(0.080)	(0.090)
Mother School Secondary	0.396***	0.432***
	(0.080)	(0.100)
Mother School Some Technical	0.495***	0.633***
	(0.130)	(0.140)
Mother School Technical College	0.486***	0.636***
	(0.110)	(0.130)
Mother School Some University	0.624***	0.787***
	(0.180)	(0.200)
Mother School University	0.747***	0.867***
	(0.150)	(0.160)
Area (Urban=1 Rural=2)	-0.304***	-0.191***
	(0.060)	(0.070)
Constant	-5.212***	5.123
	(0.500)	(3.620)
Observations	2583	1935
R-squared	0.146	0.037

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

* The instruments for these equations are proportion receiving remittances in community and if mother is from the community

Table 11-Fixed effects panel regression using rounds 1 and 2

	Regression Coefficients	
Variable	Height-for-age Z-Score	Weight-for-age Z-Score
Remittances	0.0124	-0.0213
	(0.0482)	(0.0445)
Number of Parents	0.0724	0.0575
	(0.0506)	(0.0449)
Wealth Index	-0.0246	0.115
	(0.165)	(0.144)
Gender (Male=1 Female =2)	2.141*	1.495
	(1.182)	(0.924)
Age in Months	-0.0160***	-0.0420***
	(0.0023)	-0.00455
Age Squared	7.51e-05***	0.000454***
	(0.000006)	(0.00005)
Mother age in years	-0.0451*	-0.00475
	(0.0258)	(0.0248)
Mother School Primary	0.0702	0.272**
	(0.143)	(0.131)
Mother School Secondary	0.0574	0.261
	(0.179)	(0.165)
Mother School Some Technical College	0.0691	0.389**
	(0.213)	(0.196)
Mother School Technical College	-0.00528	0.3
	(0.224)	(0.208)
Mother School Some University	0.275	0.536**
	(0.276)	(0.253)
Mother School University	0.137	0.543**
	(0.283)	(0.253)
Area (Urban=1 Rural=2)	0.0968	-0.033
	(0.0622)	(0.0562)
Constant	-2.785	-2.27
	(1.881)	(1.516)
Observations	5,252	4,609
Number of id	2,725	2,707
R-squared-Within	0.227	0.207
Between	0.005	0.002
Overall	0.016	0.01

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix

Figure A1- Residual verse fitted plot for height-for age cross-sectional OLS regression

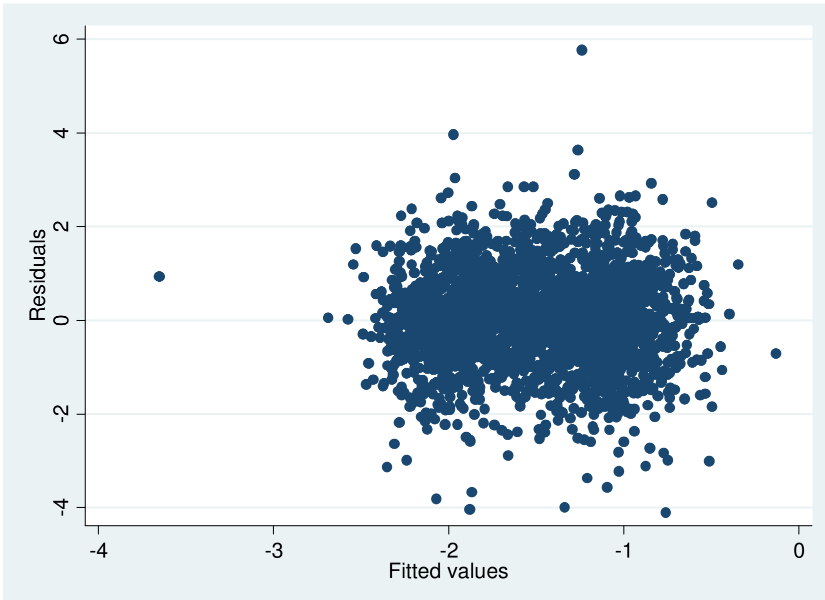
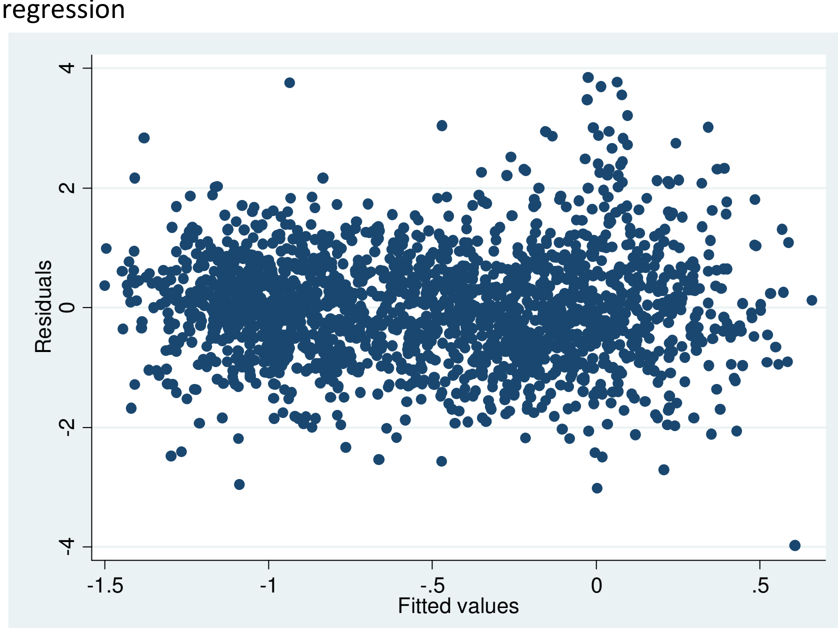


Figure A2 – Residual verse fitted plot for weight-for-age cross-sectional OLS regression



The residual verse fitted plot for the OLS regression using height-for-age as a dependent variable is shown in figure A1, and the same plot for the regression with weight-for-age as a dependent variable is shown in figure A2. Both of these plots are a random scatter around 0 indicating that the residuals and fitted values are uncorrelated with each other which is what is expected for a well fitting OLS regression.

Figure A3- Residual verse predictor plot for height-for-age cross-sectional OLS regression

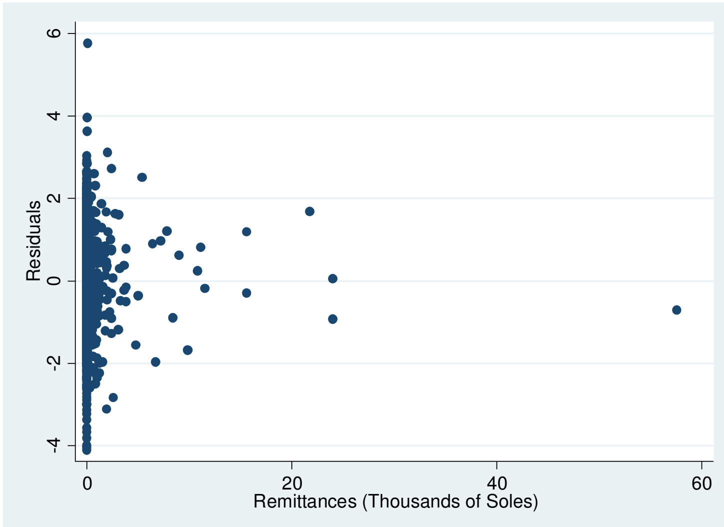


Figure A4 –Residual verse predictor plot for weight-for-age cross-sectional OLS regression

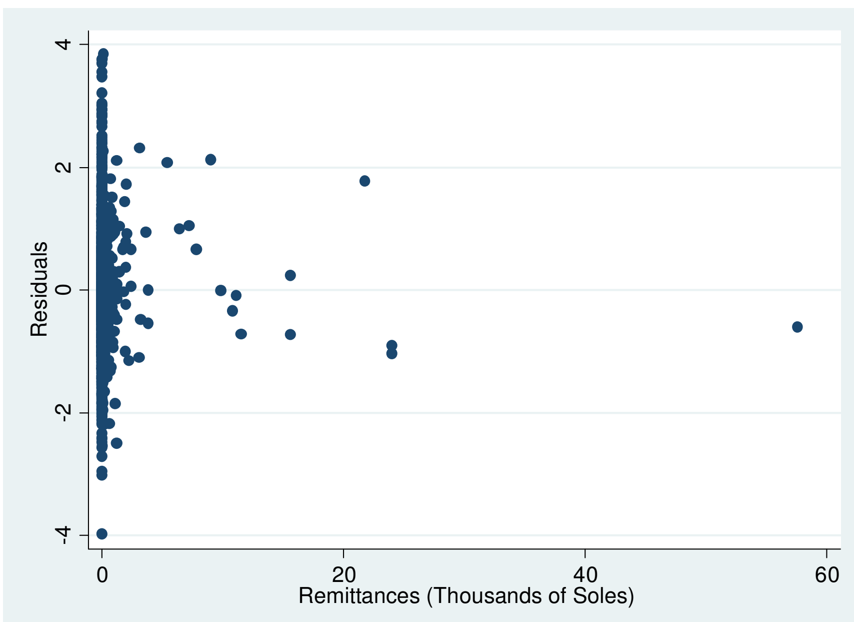


Figure A3 shows the residual verse predictor plot for Remittances for the height-for-age cross-sectional OLS Regression, and figure A4 shows the same thing for the weight-for-age regression. Neither of these plots shows a strong correlation between remittances and the residuals.

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