University of Groningen

Remittances and household expenditure patterns in India and selected states

Mahapatro, Sandhya ; Bailey, Ajay; James, K.S. ; Hutter, Inge

Published in:
Migration and Development

DOI:
[10.1080/21632324.2015.1044316](https://doi.org/10.1080/21632324.2015.1044316)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Mahapatro, S., Bailey, A., James, K. S., & Hutter, I. (2017). Remittances and household expenditure patterns in India and selected states. *Migration and Development*, 6(1), 83-101.
<https://doi.org/10.1080/21632324.2015.1044316>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Remittances and household nutrition: evidence from rural Kilimanjaro in Tanzania

Rosemary E. Isoto¹ · David S. Kraybill²

Received: 19 May 2016 / Accepted: 30 January 2017 / Published online: 25 February 2017
© Springer Science+Business Media Dordrecht and International Society for Plant Pathology 2017

Abstract This paper examines the role of remittances in the livelihoods of households in developing countries. Previous studies have shown that remittances are mostly utilized for investment in estates, agricultural inputs or education; however, remittances may also be useful for smoothing consumption by poor rural households. Hence, we estimated the differences in consumption patterns for macronutrients and micronutrients between remittance recipients and non-recipients using data from Kilimanjaro, Tanzania. An instrumental variable strategy was adopted in econometric estimations of nutrient consumption to address issues of self-selection and endogeneity of net income and remittances. Furthermore, the instrumental variable quantile regression method was used to estimate the distributional effects of remittances. A major finding was that remittances increased investment in intake of nutrients such as proteins, vitamin A, vitamin C and calcium; these are nutrients that are vitally important for physical development of children and for improving the health of adults. Remittances did not have a significant effect on consumption of macronutrients such as carbohydrates and fats, or total calories.

Keywords Remittances · Macronutrients · Micronutrients · Tanzania · Sub-Saharan Africa · Quantile regression

Introduction

Remittances have become a major source of external development finance in low-income countries, providing households with income for investment, insurance and capital accumulation (Adams 1991; Chami et al. 2003; World Bank 2014; Yang 2008). Developing countries have realized a significant increase in remittances in real terms from US\$68 billion in 1990 to US\$325 billion in 2010 (Anyanwu 2011; Bettin and Zazzaro 2012; Imai et al. 2014). During the same period, international remittances to Africa in real terms increased from US\$9 billion to nearly US\$40 billion (Mohapatra et al. 2011). In Sub-Saharan African (SSA) countries, poverty remains a major problem with 46% of households living below US\$1.25 per day (Chen and Ravallion 2010). As a consequence of high poverty rates in these countries, food insecurity and malnutrition have been persistently high. FAO (2014) reported that SSA accounts for 206 million of the 806 million malnourished people in developing countries. This has caused many people to migrate to either urban areas or to more developed countries as a livelihood strategy (Yaro 2008). Many of these migrants send remittances home to family members and relatives. Furthermore, migration leads not only to a transfer of money in the form of remittances but also to a transfer of information obtained by the migrant at the destination, either on healthy foods or on agricultural practices that allow for growing different kinds of food crops.

The literature on remittances has focused on two major motives for sending remittances— the insurance motive and the investment motive. The insurance motive emphasizes remittances being used as a risk management strategy, i.e. a

✉ Rosemary E. Isoto
emegur@gmail.com; rosemary.isoto@tufts.edu

David S. Kraybill
kraybill.1@osu.edu

¹ Tufts Friedman School of Nutrition Science and Policy, Jaharis Building, Tufts University, 150 Harrison Avenue, Boston, MA 02111, USA

² Department of Agricultural, Environmental, and Development Economics, Ohio State University, Columbus, OH 43210-1067, USA

means for minimizing income risks and also a means for smoothing consumption (Briere et al. 2002; Mohapatra et al. 2012; Stark 1991). The investment motive focuses on the use of remittances to increase agricultural productivity and to invest in housing, purchase of domestic real and financial assets and as a source of startup capital for microenterprises (Adams 1991; Dustmann and Kirchkamp 2002; El-Sakka and McNabb 1999; Massey and Parrado 1998).

Another important strand of literature relevant to this study relates migration (remittances) to consumption and anthropometric measures (Azzarri and Zezza 2011; De Brauw 2011; IDS 2006; Karamba et al. 2011; Nguyen and Winters 2011). These studies emphasize the effect of remittances on caloric intake and child anthropometric measures. For example, Azzarri and Zezza (2011) estimated the impact of migration on kilocalories and height-for-age z-scores (HAZ scores) in Tajikistan. They found that migration has a positive role in enhancing child growth patterns by increasing households' kilocalorie consumption. Similarly, a study by De Brauw (2011) in rural El Salvador showed the effect of migration to the United States on child HAZ scores during a period of rapidly increasing food prices and declining HAZ scores. They found that children in households with international migrants had much lower declines in HAZ scores.

One feature of the migration (remittance) studies cited above is the use of anthropometric measures and calorie intake as outcome measures for malnutrition and food insecurity among households. This approach is flawed because the relationship reveals nothing about how remittances affect dietary composition of the entire household. In addition to reliance on anthropometric measures, the studies cited above use mostly an instrumental variable (IV) approach that provides mean estimates, yet remittances may have distributional effects on nutrient intake. In contrast, our study examines the relationship between remittances and macronutrient and micronutrient intake in order to examine whether effects differ across the nutrient consumption distributions conditional on observable covariates. For example, it might be the case that the differences in the effects of remittances on nutrient intake are larger for individuals towards the bottom of the nutrient distribution. To analyze nutrient distribution, the instrumental variable quantile regression approach was used in addition to ordinary least squares (OLS) and ordinary IV methods. This provides a complete understanding of the impact of remittances on macronutrient and micronutrient intake among rural households, especially in Sub-Saharan Africa where such vital studies are still lacking.

This study utilized data from Tanzania to explore the effect of remittances on the intake of macronutrients (calories, proteins, carbohydrates, fats) and micronutrients (vitamin A, vitamin C, calcium) in rural households. To relax the sample homogeneity assumption imposed in mean regression and to control for endogeneity of the treatment variable (remittances), the instrumental variable quantile regression method was

used to estimate the distributional effects of remittances (Chemozhukov and Hansen 2006)

Conceptual framework

The conceptual framework for this study is based on the neo-classical model of the household in which consumption is a function of income and prices. Each individual in the household derives utility from two composite goods: nutrients (C) and non-nutrient producing goods (Q). A nutrient itself is not purchased directly but, rather, its intake depends on the amount of food item (X), which is either purchased, produced by the household, or received as a gift. For simplicity, it is assumed here that the household purchases all food or if it produces the food, the value of the food is determined by market prices. The amount of food item (X) consumed depends on its price (p) and tastes, which are determined by household level characteristics (H). The household solves the maximization problem stated below:

$$\text{Maximize } U_i = U_i(C_i(X_{ij}), Q_i) \quad (1)$$

subject to:

$$Y_i = \sum_{j=1}^m p_{ij} X_{ij} + Q_i$$

$$Y_i = Y_i^d + R_i$$

where Y_i is total household income composed of disposable income generated from farm sales and other sources (Y_i^d) and remittances (R_i). From the constrained maximization problem above, we can derive a demand function for nutrients as a function of prices, remittances, household non-remittance income, and household level characteristics (H_i).

Formally:

$$C_i = C_i(X_1(p_1), \dots, X_m(p_m), R_i, H_i, Y_i^d) \quad (2)$$

Since the focus here is on nutrients, which are not sold as distinct items in markets, prices are not included in the empirical model. The model used is a conditional Engel function in which demand is specified as a function of income.

Empirical model specification

To analyze the impact of remittances on nutritional status of households in the Kilimanjaro area of Tanzania, a model similar to one used by Aromolaran (2004) was estimated:

$$C_{it} = \alpha_0 + \beta_1 H_{it} + \beta_2 R_{it} + \beta_3 Y_{it} + \beta_4 V_{it} + \varepsilon_{it} \quad (3)$$

where C_{it} is the natural log of per-capita nutrient intake of household i at time t and α_0 is an intercept term. The variable

H represents household characteristics (age, sex and education of spouse and household head), R is a dummy variable for both intra-national and inter-national remittances, Y is the net income, V represents village level characteristics, and ε is the error term. The parameters to be estimated are β_1 , β_2 , β_3 , and β_4 . The main parameter of interest is β_2 . The dependent variable is a set of macronutrients (calories, proteins, fats, and carbohydrates) and selected micronutrients (vitamins A and C and calcium) that households consume. The objective was to compare expenditure on a high-quality diet versus expenditure on a low-quality diet, which, when considered from an investment perspective, is a portfolio of nutrients. A high-quality diet, then, is one with the proper amount of each type of required nutrients, particularly protein, vitamins, and minerals. A low-quality diet is one that contains an inadequate level of particular nutrients. Low-quality diets are often dominated by carbohydrates and calories but low in protein and certain vitamins and minerals. A low-quality diet may meet most of the energy consumption needs of the moment but fail to provide the other nutrients needed over time to produce bones, develop and maintain nervous systems, heal wounds, and bolster the immune system. Income constrains overall household expenditures on goods and services, of which nutrients are one type. Income nutrient elasticities are generally positive but the magnitude of these elasticities is important in determining the impact of income transfer policies on nutrient intake (Behrman and Wolfe 1984).

Quantile regression

First introduced by Koenker and Bassett (1978), quantile regression is analogous to the OLS regression model, which expresses the conditional mean in a linear form. However, quantile regression permits conditional functions to be specified at any quantile, hence, enabling one to describe the entire conditional distribution of the dependent variable given a set of covariates. Conditional quantile regression is useful when the data are heteroskedastic; that is, conditional variance of the dependent variable distribution may not be constant but may differ by the level of the independent variables and the slope parameters of the conditional quantile functions may differ from each other. Therefore, estimating conditional quantiles at various points of the distribution of the dependent variable allows analysts to trace out the different marginal responses of the dependent variable to changes in the explanatory variables at these points. This study estimates conditional quantile functions for macronutrients and micronutrients at two selected quantiles ($q = 2$). Since endogeneity is suspected, instrumental variable quantile regression is estimated.

Identification strategy

Remittances do not occur randomly across households and this causes remittances to be endogenous. According to

McKenzie and Sasin (2007), there are several possible sources of endogeneity of remittances. The first possible source of endogeneity is two-way causality, which may arise if migrants send money to compensate bad nutritional outcomes. Remittance receipt and the error term will then be correlated; hence, OLS estimates will be inconsistent (Göbel 2013). The estimated effect of remittances would be downward biased and could even lead to the finding of a negative relationship between nutritional outcomes and remittances in extreme cases. Secondly, if unobservable characteristics of households with remittances and without remittances differ substantially, selection bias arises. If unobservable characteristics affecting nutrient intake and unobservable factors affecting remittances receipt are correlated, the error term and remittances will be correlated and, as indicated above, OLS estimates will be inconsistent. For example, if households concerned about their household nutrient intake are more likely to have migrant members (and, hence, remittances) or if unobservable factors affecting remittances are positively correlated with unobservable characteristics determining nutrient intake, then OLS estimates will be upward biased and overstate the gains from migration. This would imply that households are positively self-selected into migration. However, it is also possible that migration with a remittance motive is more likely to occur among households that have poor nutrient intake but would like to improve their nutrient status. This implies that households are negatively selected into migration. In this case OLS estimates will be downwardly biased. According to Hildebrandt and McKenzie (2005) neither possibility should be excluded a priori. In their work in Mexico, Hildebrandt and McKenzie (2005) focused on birth weight and infant mortality in rural communities. They found that Mexicans self-select into migration negatively based on the health status of their children.

To deal with these potential endogeneity problems, in this paper we used two-stage least squares (2SLS). In the first stage, consistent estimates require a set of variables that affect the receipt of remittances while being exogenous to nutrient intake. This study used the proportion of households within a 50-m radius with migrants as a proxy for the existence of migration networks abroad, drawing on previous studies on migration (Acosta 2006; Carrington et al. 1996; Nguyen and Winters 2011). The presence of migrants from the same community in a foreign country lowers the costs of migrating to a new place for other members of the local community, increases the chance of finding a job and reduces the job search time; hence, networks are likely to influence migration, but do not directly influence household choice of macronutrient and micronutrient intake. Hence, the migration network is expected to have a positive effect on remittances. On the other hand, the effect of remittances on nutrient consumption is expected to be positive and statistically significant.

A second possible endogenous variable is net income. There may be reverse causality between net income and nutrient intake since healthy households are more likely to engage in productive activities that generate income which is, in turn, used to purchase nutrients. This possible endogeneity is addressed by using an instrumental variable (IV), mobile phone possession, used in the first stage and predicted values of income used at the second stage. Households with more income tend to have phones but phones do not have a direct effect on nutrient consumption (Yameogo 2014)

Significance of migration in Tanzania

Tanzania is one of the poorest countries in the world (Jones and Rodgers 2011). The Poverty and Human Development Report (2014) indicates that general poverty in Tanzania has only marginally declined from 33.3% in 2007 to 28.2% in 2012. Migration is seen as one avenue that can lead to economic development since it is a process that potentially confers economic benefits to source areas (Lu 2013). According to the Migration and Remittance Fact Book (2011), 0.7% of all Tanzanians were living outside the country in 2010. However, rural-urban migration within Tanzania remains a dominant form of migration, accounting for over 66.7% of migrants in Tanzania (Msigwa and Mbongo 2013). Economic activities, such as industries are located in urban areas and cities, which are believed to be magnets that attract migrants (Msigwa and Mbongo 2013). Most of these unskilled migrants are engaged in activities in the service sector, in construction or informal employment such as operating small-scale businesses (Wenban-Smith 2015).

Data

This paper utilizes data from the 2008–2010 Kilimanjaro Livelihood and Climate Survey (Kraybill 2008). The survey was funded by the Ohio State University Climate, Water, and Carbon (CWC) program. The project surveyed 15 villages, where 15 households were randomly selected from each village to make up a sample of 225 households. The 15 villages are located within three districts on the slopes of Mt. Kilimanjaro. The three districts are Hai, located on the southwestern slope of the mountain, Moshi, located on the southern slope, and Rombo, located on the eastern slope of the mountain (Kraybill 2008). The survey collected information on household consumption quantities, total expenditure data on food and nonfood commodities and demographic characteristics. Information was collected on consumption from own production, consumption from purchases and consumption from in-kind transfers from other households. Other information collected in the survey included household land ownership, assets, age, sex, marital

status, educational level of family members, occupation of the household head and spouse, and other variables.

Macro and micronutrient consumption data

There are two major ways in which demand for nutrient estimates can be derived: the indirect approach and the direct approach. The indirect approach uses statistical methods to estimate food expenditure systems for a relatively small number of food aggregates and assumes that nutrient elasticities equal food elasticities at that level of aggregation by using constant nutrient-to-food conversion factors to translate from food elasticities to nutrient elasticities (Murty and Radhakrishna 1981; Pitt 1983; Strauss 1982). The direct approach derives nutrient income elasticity estimates by aggregating the nutrient content of food items consumed by households (Behrman and Wolfe 1984; Pitt and Rosenzweig 1985; Wolfe and Behrman 1983). Nutrient expenditure elasticities estimated by the indirect approach tend to be larger than those obtained by the direct approach. Behrman and Deolalikar (1987) argue that direct estimates lead to better results because they account for each nutrient in the food consumed, which the indirect method ignores. This study used the direct method.

Household consumption information was collected by a questionnaire administered by field assistants working under the direction of a field supervisor. Households were visited twice per year. In each visit, households were asked how much they had consumed in the previous seven days. Consumption information was collected on a total of 65 food items. Using conversion tables from the Tanzania Food and Nutrition Centre, food quantities were converted into constituent nutrients for each household. The total quantity of nutrient C_i consumed by household i was obtained as follows:

$$C_i = \sum_{j=1}^m q_{ij} k_j \quad (4)$$

where q_j is the weight in grams of the average daily intake of the food commodity j while k_j is the standard measure of the nutrients (calories, proteins, etc.) found in the j^{th} commodity. The total household nutrient intake was then divided by seven (the number of days in the consumption reporting period) and adjustment was made for the number of adult equivalents in the household in order to obtain daily calories, proteins, fats, carbohydrates, vitamin A, vitamin C and calcium intake per adult equivalent. Hence, the analysis is based on the daily per-capita adult equivalent of nutrients consumed.^{1,2}

¹ Resulting nutrient values were divided by the number of adult equivalents in a household to obtain numbers that are comparable across households of different size and composition.

² Total nutrients consumed were obtained as the sum of food consumed both at home and away from home.

Results and discussion

Socio-demographic characteristics of sampled households

Table 1 presents household descriptive statistics disaggregated by remittance and non-remittance status. A representative household can be summarized as one consisting of an average of five members and is headed by a 55-year-old individual who has an average of seven years of education. Fifty four percent of the sampled households received either domestic or international remittances in 2008, while 46% of households received no remittances in 2008.³ For remittance-receiving households, the average remittance received in 2008 was US\$154.⁴ Households that did not receive remittances were generally larger than those that received remittances and the mean difference was statistically significant at the 5% level of significance. For remittance-receiving households, the age of the household head was on average higher (60 years) than for non-remittance receiving households (50 years). The mean age difference was statistically significant at the 1% level for both household head and spouse. There was no statistical difference in the mean annual net incomes of remittance-receiving households and non-remittance receiving households.⁵

Uses of remittances

Figure 1 explores the uses of remittances. As shown in Fig. 1, remittances are used mainly for the purchase of food (71%). This was followed by education (8%) while the rest was distributed in small shares across health services, working capital for non-farm enterprises, agricultural purchases, and other uses.

Nutrients per-adult equivalent

Table 2 presents nutritional intake statistics for three groups of households (all households, households receiving remittances, and households not receiving remittances). These groups are disaggregated at the 25th and 75th percentiles. The general pattern is that the daily per adult equivalent intake of each nutrient was lower for households at the 25th percentile of the income distribution than for households at the 75th percentile. For example, households receiving remittances but at the 75th percentile consumed more calories, proteins, fats, carbohydrates, vitamin A, vitamin C, and calcium than those in the 25th percentile. This pattern is the same for households

not receiving remittances. The only anomaly in the results was for calorie intake in which households not receiving remittances consumed higher quantities of calories at the 75th percentile than remittance-receiving households. Households in the 75th percentile for both categories consumed at least 2500 kcal, the FAO standard minimum daily requirement, while those at the 25th percentile consumed less than the minimum daily requirement.

Econometric results

OLS estimates of the effect of remittances on daily per adult equivalent nutrient intake were obtained and are reported in Appendix Table 6 but not discussed in detail. This is because these results may be biased and inconsistent due to the endogeneity of remittances and net income, as explained above.

Results of the instrumental variable estimation

Equation (3) was estimated using the instrumental variable method and estimates are presented in Table 3. The dependent variable was the daily per adult equivalent nutrient intake of macronutrients (calories, proteins, fats and carbohydrates) and micronutrients (vitamin A, vitamin C, and calcium).⁶ Remittance income, the main explanatory variable of interest, was measured first as a dummy variable where those who received remittances take on 1 and 0 otherwise. After which the remittance variable was estimated as a continuous variable but the model was restricted to only those that received remittances. The results of first-stage regression as well as tests for the IV are presented in Appendix Tables 7 and 8. The results for when the remittance was estimated as a continuous variable are presented in Appendix Table 9, but are not discussed in detail.

Instrumental variable estimates for macronutrients

In Table 3, the coefficients on predicted remittances and predicted income were positive but not significant in the calorie and carbohydrate equations. This is probably because calories and carbohydrates are necessities and given the high-calorie, banana-based diet in the area, households may already be consuming the needed level of calories and, when incomes or remittances rise, they spend the additional income on foods rich in higher quality nutrients. These results are similar to those of Behrman and Deolalikar (1987), who found that the point estimate of income-calorie elasticity is 0.37 but statistically insignificant in India. For protein intake in Table 3, households that received remittances consumed 18% more

³ In the survey, the respondent was asked if they received remittances from within the country or from outside the country and for what intended uses the person sent the remittances.

⁴ This is equivalent to 181,427.4 Tanzania shillings using the 2008 exchange rate (US\$1 = 1178.1 TShs).

⁵ Net income includes all other household income except remittances.

⁶ To simplify the presentation, all nutrients were measured in daily per adult equivalent terms and from now on per adult equivalent will not be mentioned in the discussion.

Table 1 Descriptive statistics disaggregated by remittance and non-remittance status of sampled households in Kilimanjaro in 2008

Variables	Combined sample	Received remittances	Did not receive remittances	T-test of mean differences
Household size	5.17 (2.38)	4.78 (2.30)	5.62 (2.41)	2.64**
Age of head (years)	55.30 (14.50)	60.11 (14.00)	49.80 (13.10)	-5.51***
Age of spouse (years)	49.60 (14.40)	54.10 (14.30)	44.50 (12.80)	-5.15***
Educ. of head (years)	6.68 (3.31)	6.22 (3.52)	7.19 (2.99)	2.15*
Educ. of spouse (years)	5.95 (2.66)	5.17 (2.72)	2.72 (2.40)	3.76***
Farm size (acres)	2.40 (1.91)	2.70 (2.15)	2.05 (1.52)	-2.53***
Net annual income (TShs '000)	276.10 (665.40)	258.74 (671.00)	296.40 (296.40)	0.42
Amount of remittances (TShs '000)	97.40 (37.89)	180.90 (35.10)	0 (00)	-4.77***
Number of observations	(<i>N</i> = 221)	(<i>N</i> = 119) 53.85%	(<i>N</i> = 102) 46.15%	

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses. Source: Author's estimates from survey data, 2008

proteins than households that did not receive remittances. Receipt of remittances did not have a significant effect on fat intake but its coefficient on income was positive and significant implying that households spend additional income on foods that are rich in fat. In most rural areas, households tend to incorporate oily foods in their diets as a way to show improvement in their welfare. Remittances can be argued to be serving a dual purpose, as financial resources as well as an avenue for nutrition information. We tested this assumption by estimating models that included net income and remittances separately, finding that the two variables have quite different effects on nutritional intake. Remittances increased the intake of four nutrients while income increased intake of two nutrients and only one nutrient was influenced by both. Remittances, therefore, seem to bring an added benefit as emigration can result in transfer of knowledge, attitudes, and practices (Levitt 1998).⁷

Further, the results in Table 3 reveal that being male as household head is important in explaining protein intake. The coefficient on gender implies that male-headed households have a protein intake level that is 50.4% higher than that of female-headed households. The coefficient is significant at the 5% level. This is probably because female-headed households are often disadvantaged in terms of social status and economic opportunities. Generally, in rural areas in developing countries women have less bargaining power in households; this influences the level of decision making by the woman. Women's involvement and engagement is important in decision-making about the types of food to buy, types of food to cook, and how to spend the income earned in the household. On the other hand, being a male as the head of the household does not significantly affect consumption of calories, fats and carbohydrates.

As expected, household size had a negative and significant effect on intake of all macronutrients (calories, proteins, fats and carbohydrates). This result implies that as household size increased, there were more mouths to feed with limited available nutrients; hence, calorie, protein, fats and carbohydrate intakes decreased. This result further implies that additional household members did not offset increased intake by increased labor availability that would raise the amount of food produced or purchased.

The education level of the household head was categorized into three dummy variables. Using the education category of less than 6 years as the base category, the results in Table 3 show that household heads with an education level greater than 6 years consumed more proteins than those households with less than 6 years of education. However, education of the household head did not have any significant effect on the intake of calories, fats and carbohydrates. Surprisingly, education of the spouse for all categories did not have an effect on intake of any of the macronutrients. Overall, education of the head seems to be important in determining the level of protein intake among households in Kilimanjaro but there was no effect on other macronutrients. Other covariates were included in the model and in the Table of results as controls.

Instrumental variable estimates for micronutrients Table 3 also presents results for intake of micronutrients (vitamin A, vitamin C, and calcium). Remittances positively and significantly affected intake of all three micronutrients: vitamin A, vitamin C, and calcium. The coefficient estimates were positive and significant at the 5% level for vitamin A and vitamin C and at the 1% level for calcium. These coefficients imply that households that received remittances consumed more vitamin A by 28.7%, more vitamin C by 13.4% and more calcium by 29.1% than non-remittance-receiving households.

⁷ The results of that analysis are not included in this article but can be obtained from the authors.

Fig. 1 Proportion of uses of remittances. Source: Author's estimates from survey data, 2008, based on the question, "For what intended uses did the person(s) send the remittances and assistances?"

Age of the household head positively and significantly affected intake of vitamin A and C but had a negative effect on intake of calcium. These findings corroborate previous research that micronutrient intake is important for better cognitive and physical activity (Alderman et al. 2006; Behrman 1993; Bouis 1994; Deolalikar 1998).

As correctly predicted, household size is consistently negative and significant for vitamin A, vitamin C, and calcium. This implies that as household size increases, intake of these micronutrients decreases. This is probably because there would be more mouths to feed with the same amount of nutrient. Other control variables such as education categories for household head and spouse did not have any significant effect on the intake of vitamin A, vitamin C and calcium besides spousal education that has a negative effect on consumption of calcium.

In summary, the coefficient on remittances was positive and significant for proteins, vitamin A, vitamin C, and calcium intake. The remittance coefficient for calories, carbohydrates and fat intake was positive but not significant. This implies that remittances make it possible for households to "invest" more in foods that are important in physical and cognitive development. Households that do not receive remittances are

more likely to spend their income on less nutritious foods so as to be able to first meet their energy requirements. These results are similar to those of Ward and Sanders (1980) who estimated nutritional demand relations for a sample of households from northeastern Brazil. For calories and protein, they reported income elasticities of demand ranging from 0.33 to 0.74, elasticities of household size ranging from -0.20 to -0.32 , and no significant effects of the education level of the wife.

Results of the instrumental variable quantile regression (IVQR)

IVQR results for macronutrients Results in Table 4 help us understand the distributional effects of remittances on intake of macronutrients (calories, proteins, fats and carbohydrates). The parameter estimates are different from one another and comparable across quantiles in terms of absolute effect. The estimates indicate that remittances significantly benefit households at the lowest quantile ($q = 0.25$) but not households at the upper quantile ($q = 0.75$) for intake of calories and proteins. There is no evidence of distributional effects of remittances for intake of fats and carbohydrates at both quantiles.

Table 2 Daily per adult equivalent nutrient consumption by percentile

Nutrient (/day/AE)	All		Remittances		No remittances	
	25%tile	75%tile	25%tile	75%tile	25%tile	75%tile
Calories (Kcal)	1298	3107	1361	3031	1206	3131
Proteins(g)	38	144	32	148	40	135
Fats (g)	24	62	27	67	23	57
Carbohydrates (g)	209	527	207	562	216	507
Vitamin A ($\mu\text{g RE}$)	360	1037	385	1168	341	853
Vitamin C ($\mu\text{g RE}$)	70	172	73	185	68	170
Calcium (mg)	141	1593	155	1624	131	1467

Source: Author's estimates from survey data, 2008. AE is adult equivalent

Table 3 Instrumental variable estimates for macronutrients and micronutrients

Variables	Calories	Proteins	Fats	Carbohydrates	Vitamin A	Vitamin C	Calcium
Remittances (predicted)	0.01 (0.07)	0.18*** (0.04)	0.11 (0.09)	0.08 (0.11)	0.29** (0.13)	0.13** (0.06)	0.29*** (0.02)
Net income (predicted)	0.01 (0.13)	0.34 (0.27)	0.35** (0.14)	0.04 (0.18)	-0.09 (0.36)	0.08 (0.20)	0.82** (0.35)
Gender of head (1 if male, 0 if female)	0.12 (0.13)	0.50** (0.23)	0.17 (0.14)	0.18 (0.18)	0.26*** (0.03)	-0.10 (0.12)	0.61* (0.31)
Age of head (ln)	0.11 (0.17)	-0.67* (0.34)	-0.17* (0.09)	0.36 (0.25)	0.89* (0.47)	0.57** (0.25)	-1.06** (0.47)
Household size (ln)	-0.89*** (0.08)	-1.13*** (0.16)	-0.91*** (0.08)	-0.91*** (0.10)	-0.89*** (0.19)	-0.88*** (0.10)	-1.52*** (0.23)
Head, 6–9 years of education	0.06 (0.17)	0.60* (0.35)	-0.15 (0.17)	0.15 (0.26)	0.11 (0.45)	-0.31 (0.23)	0.56 (0.49)
Head, >10 years of education	0.11 (0.12)	0.57** (0.22)	0.01 (0.12)	0.10 (0.15)	0.10 (0.29)	-0.14 (0.18)	0.47 (0.30)
Spouse, 6–9 years of education	0.09 (0.09)	0.05 (0.18)	-0.11 (0.10)	0.04 (0.13)	0.01 (0.24)	-0.10 (0.14)	-0.07 (0.24)
Spouse, >10 years of education	0.10 (0.17)	-0.08 (0.38)	0.18 (0.15)	0.39 (0.30)	0.73 (0.45)	0.08 (0.14)	-1.39*** (0.48)
Farm size (ln)	0.02 (0.06)	-0.13 (0.11)	0.01 (0.07)	-0.05 (0.07)	0.03 (0.14)	0.00 (0.08)	-0.32** (0.15)
Moshi town	0.40*** (0.12)	0.52** (0.21)	0.37** (0.15)	0.23 (0.17)	0.14 (0.26)	0.20 (0.18)	0.49* (0.28)
Another village	0.38*** (0.14)	0.11 (0.24)	0.06 (0.15)	0.44** (0.19)	0.87** (0.35)	0.47** (0.20)	0.16 (0.36)
This village	-0.10 (0.08)	-0.17 (0.16)	-0.42*** (0.09)	-0.20 (0.13)	-0.61*** (0.21)	-0.27* (0.14)	-0.54** (0.26)
Constant	8.01*** (1.51)	3.43 (2.67)	1.54 (1.44)	5.01** (2.01)	5.24 (4.02)	3.05 (2.10)	2.05 (3.61)
Observations	214	212	205	217	221	207	204
R-squared	0.53	0.29	0.50	0.39	0.22	0.41	0.28

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

Generalized mean results reported earlier showed no statistical impact of remittances on calories. However, the quantile regression results showed that households do in fact significantly benefit in terms of calories from remittances. This impact is relatively strong for the poorest quantiles, and declines along the income distribution. In addition, remittance receiving households tend to allocate the resulting income surplus to calories rather than fats or carbohydrates, with a stronger effect for the poorest. This suggests that policies supporting ease of remittance-sending, especially for the poorest, are likely to bring substantial long-lasting economic welfare benefits through enhanced nutrition.

The instrumental variable quantile regression estimates in Table 4 further reveal heterogeneity in effects of other determinants of intake of macronutrients. For example, gender of the household head significantly affects protein intake for

households in the lower quantile ($q = 0.25$). However, there is no statistically significant effect for households in the upper quantile of the distribution ($q = 0.75$). Sex of household head had no effect on both quantiles for intake of calories, fats and carbohydrates.

As expected, household size negatively and significantly affected the intake of calories, proteins, fats and carbohydrates at both quantiles ($q = 0.25, 0.75$). All other variables were included as controls in the model.

IVQR results for micronutrients Table 5 presents the results of IVQR for micronutrient intake at the 0.25 and 0.75 quantiles. The results show that remittances have a significant effect on vitamin A at both 0.25 and 0.75 quantiles but only at the 0.25 quantile for vitamin C. This implies that remittances are much more important for the population in the poorest

Table 4 Instrumental variable quantile regression results for macronutrient intake

Variables	Calories		Proteins		Fats		Carbohydrates	
	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75
Remittances	0.27*** (0.03)	0.05 (0.43)	0.31*** (0.09)	0.17 (0.87)	0.15 (0.48)	0.13 (0.48)	-0.12 (0.57)	0.02 (0.57)
Net Income	-0.03 (0.03)	-0.01 (0.03)	0.00 (0.07)	-0.06 (0.07)	0.07** (0.04)	0.01 (0.04)	-0.06 (0.04)	-0.03 (0.04)
Gender of head (1 if male, 0 if female)	0.08 (0.13)	0.15 (0.13)	0.60** (0.27)	0.12 (0.26)	0.11 (0.15)	0.15 (0.15)	0.05 (0.17)	0.00 (0.17)
Age of head (ln)	0.27 (0.19)	0.16 (0.19)	-0.22 (0.41)	-0.29 (0.40)	-0.11 (0.22)	0.33 (0.22)	0.82*** (0.26)	0.23 (0.26)
Household size (ln)	-0.83*** (0.09)	-0.86*** (0.09)	-0.95*** (0.19)	-0.88*** (0.18)	-0.75*** (0.10)	-0.87*** (0.10)	-0.78*** (0.12)	-0.88*** (0.1)
Head, 6–9 years of education	0.11 (0.17)	0.08 (0.17)	0.21 (0.36)	0.34 (0.35)	-0.33 (0.19)	-0.33 (0.19)	0.11 (0.23)	0.11 (0.23)
Head, >10 years of education	0.09 (0.13)	0.22* (0.13)	0.41 (0.29)	0.33 (0.28)	-0.15 (0.15)	-0.07 (0.15)	0.19 (0.18)	0.12 (0.18)
Spouse, 6–9 years of education	0.16 (0.11)	0.03 (0.11)	-0.16 (0.24)	0.16 (0.23)	-0.10 (0.13)	-0.01 (0.13)	0.19 (0.15)	-0.03 (0.15)
Spouse, >10 years of education	0.26 (0.24)	-0.10 (0.24)	0.28 (1.00)	0.04 (0.94)	0.20 (0.27)	0.07 (0.27)	0.39 (0.31)	-0.06 (0.32)
Farm size (ln)	0.03 (0.07)	0.04 (0.07)	-0.19 (0.15)	0.02 (0.14)	0.10 (0.08)	0.04 (0.08)	-0.02 (0.10)	-0.03 (0.10)
Moshi town	0.42*** (0.16)	0.34** (0.16)	0.53 (0.35)	0.60* (0.34)	0.36** (0.18)	0.49*** (0.18)	0.28 (0.21)	0.34 (0.22)
Another village	0.49*** (0.12)	0.26** (0.12)	0.90*** (0.26)	0.10 (0.25)	0.32** (0.14)	0.30** (0.14)	0.55*** (0.16)	0.36** (0.17)
This village	-0.06 (0.11)	0.07 (0.12)	-0.49** (0.24)	0.01 (0.24)	-0.53*** (0.13)	-0.43*** (0.13)	-0.20 (0.15)	-0.08 (0.15)
Constant	7.38*** (0.82)	8.09*** (0.83)	5.31*** (1.78)	7.27*** (1.72)	4.31*** (0.95)	4.00*** (1.00)	3.79*** (1.12)	6.67*** (1.13)
Observations	214	214	212	212	205	205	217	217

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

stratum as well as the richer stratum for vitamin A intake, but for only the poorest stratum for vitamin C intake. Remittances positively and significantly affected calcium intake at both quantiles ($q = 0.25, 0.75$). Calcium seems to be an important micronutrient regardless of the quantile to which a household belongs.

Age of the household head affected intake of vitamin A and vitamin C at the lower quantile ($q = 0.25$) but not at the higher quantile. The coefficient of age is negative and significant for calcium intake at the upper quantile. Household size consistently leads to a decrease in vitamin A, vitamin C and calcium intake at both quantiles.

These findings suggest that the elasticities of remittances at the tails of the intake distribution are often quite different from those at the mean. Quantile regression estimates

give a more complete picture of nutrient intake differences in the population.

Conclusion and recommendations

This paper examined the extent to which household daily per-adult equivalent nutrient intake responds to remittances in rural Kilimanjaro region in Tanzania. Various authors have found that remittances are used for investment in housing, businesses, and consumption of non-food items or insurance against risks. This study argues that remittances are useful in poor rural households for boosting nutrition. The study utilized the instrumental variable approach and the instrumental variable quantile regression approach to circumvent the

Table 5 Instrumental variable quantile regression results for micronutrient intake

Variables	Vitamin A		Vitamin C		Calcium	
	0.25	0.75	0.25	0.75	0.25	0.75
Remittances	0.44*** (0.10)	0.41*** (0.10)	0.03*** (0.00)	0.06 (0.62)	0.06*** (0.01)	0.21*** (0.03)
Net Income	-0.09 (0.08)	-0.06 (0.08)	0.00 (0.05)	-0.02 (0.05)	0.01 (0.09)	0.01 (0.09)
Gender of head (1 if male, 0 if female)	-0.22 (0.33)	0.11 (0.34)	-0.29 (0.19)	0.035 (0.19)	0.40 (0.38)	0.23 (0.37)
Age of head (ln)	1.96*** (0.50)	0.17 (0.50)	0.96*** (0.29)	0.30 (0.29)	0.24 (0.57)	-1.31** (0.56)
Household size (ln)	-0.77*** (0.23)	-0.85*** (0.23)	-0.85*** (0.13)	-0.91*** (0.13)	-1.26*** (0.27)	-1.06*** (0.26)
Head, 6–9 years of education	-0.05 (0.43)	0.25 (0.43)	-0.45* (0.25)	-0.09 (0.25)	-0.39 (0.50)	0.02 (0.49)
Head, >10 years of education	0.37 (0.34)	0.16 (0.35)	-0.18 (0.19)	-0.07 (0.19)	-0.18 (0.40)	-0.09 (0.40)
Spouse, 6–9 years of education	0.07 (0.29)	-0.05 (0.29)	-0.05 (0.16)	0.08 (0.16)	-0.05 (0.33)	-0.18 (0.33)
Spouse, >10 years of education	0.55 (0.61)	0.10 (0.61)	0.44 (0.39)	-0.19 (0.40)	0.26 (1.92)	-3.09 (1.90)
Farm size (ln)	-0.09 (0.18)	0.06 (0.18)	-0.08 (0.11)	0.09 (0.11)	-0.06 (0.21)	-0.19 (0.20)
Moshi town	0.27 (0.41)	0.02 (0.42)	0.14 (0.24)	0.19 (0.24)	1.54*** (0.51)	0.527 (0.501)
Another village	1.06*** (0.31)	0.35 (0.31)	0.59*** (0.18)	0.34* (0.18)	1.08*** (0.36)	0.36 (0.35)
This village	-0.62** (0.30)	-0.18 (0.30)	-0.29* (0.16)	-0.03 (0.17)	-0.34 (0.34)	-0.32 (0.33)
Constant	0.60 (2.16)	7.91*** (2.17)	2.30* (1.24)	5.18*** (1.26)	5.58** (2.47)	13.93*** (2.44)
Observations	221	221	207	207	204	204

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

problem of endogeneity of remittances and net income in the model and to account for distributional differences in nutrient intake response to remittances. We found that remittances do improve household nutrition. Increases in amounts remitted are associated with significant and sizeable increases in the consumption of vital nutrients among poor households in rural Kilimanjaro. Remittances are invested in high quality nutrients such as proteins, vitamin A, vitamin C and calcium that are especially important for the cognitive development of the younger population. The results reveal that the subpopulations at the bottom quantile benefit the most from remittance receipts. It is therefore recommended that government seek to lower transaction costs that migrants incur when sending remittances. In addition, migration and remittances should be recognized and utilized as components of food security programs in developing countries. These programs should aim to

help households understand that good nutrition is an investment and that remittances are a potential source of funding a more nutritious diet. Besides, remittances may be accompanied with nutritional knowledge for food preparation, increased awareness of the benefits of nutrition, and sanitation that benefits recipients beyond easing the financial burden.

Acknowledgments The authors acknowledge the Kilimanjaro Livelihood and Climate Survey for providing the data used for this study. We thank the anonymous reviewers and the editor for their constructive comments to improve the quality of the paper. Any errors and omissions are the responsibility of the authors.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Table 6 Results of OLS for macronutrient and micronutrient intake

Variables	Calories	Proteins	Fats	Carbohydrates	Vitamin A	Vitamin C	Calcium
Remittances	0.038 (0.063)	0.201 (0.147)	0.138* (0.081)	-0.052 (0.100)	-0.286 (0.185)	-0.128 (0.102)	0.327 (0.213)
Net Income	-0.030 (0.022)	-0.021 (0.046)	0.018 (0.027)	-0.070** (0.032)	-0.116** (0.058)	-0.018 (0.039)	0.052 (0.069)
Gender of head (1 if male, 0 if female)	0.117 (0.112)	0.397** (0.201)	0.062 (0.121)	0.139 (0.142)	0.261 (0.262)	-0.141 (0.104)	0.368 (0.293)
Age of head (ln)	0.126 (0.152)	-0.439 (0.286)	0.0422 (0.187)	0.418* (0.224)	0.905** (0.423)	0.638*** (0.216)	-0.580 (0.404)
Household size (ln)	-0.879*** (0.063)	-0.997*** (0.125)	-0.825*** (0.071)	-0.870*** (0.081)	-0.878*** (0.157)	-0.839*** (0.079)	-1.271*** (0.199)
Head, 6–9 years of education	0.039 (0.125)	0.383 (0.279)	-0.380*** (0.132)	0.079 (0.202)	0.097 (0.355)	-0.394** (0.183)	0.066 (0.405)
Head, >10 years of education	0.086 (0.094)	0.369** (0.177)	-0.189* (0.099)	0.038 (0.115)	0.089 (0.225)	-0.207 (0.132)	0.045 (0.257)
Spouse, 6–9 years of education	0.104 (0.088)	0.141 (0.174)	0.0052 (0.098)	0.070 (0.130)	0.019 (0.227)	-0.082 (0.123)	0.098 (0.247)
Spouse, >10 years of education	0.101 (0.171)	0.391* (0.211)	0.176 (0.148)	0.344 (0.269)	0.719* (0.392)	0.049 (0.131)	-1.176** (0.476)
Farm size (ln)	0.023 (0.057)	-0.077 (0.100)	0.062 (0.061)	-0.037 (0.068)	0.028 (0.129)	0.010 (0.074)	-0.221 (0.149)
Moshi town	0.415*** (0.113)	0.712*** (0.158)	0.499*** (0.148)	0.270* (0.148)	0.146 (0.223)	0.232 (0.168)	0.923*** (0.225)
Another village	0.406*** (0.082)	0.366** (0.151)	0.352*** (0.095)	0.527*** (0.121)	0.886*** (0.208)	0.549*** (0.130)	0.736*** (0.229)
This village	-0.095 (0.080)	-0.10 (0.164)	-0.393*** (0.095)	-0.194 (0.123)	-0.606*** (0.207)	-0.259* (0.132)	-0.407 (0.266)
Constant	8.354*** (0.671)	6.738*** (1.109)	4.629*** (0.790)	6.040*** (0.886)	5.508*** (1.838)	4.008*** (1.011)	9.245*** (1.706)
Observations	214	212	205	217	221	207	204
R-squared	0.532	0.281	0.484	0.405	0.237	0.406	0.261

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

Table 7 First stage-results for macronutrient intake

Variables	Calories		Proteins		Fats		Carbohydrates	
	Net Income	Remittances	Net Income	Remittances	Net Income	Remittances	Net Income	Remittances
Migration networks		4.187*** (0.128)		4.192*** (0.125)		4.156*** (0.133)		4.202*** (0.124)
Own mobile	0.531** (0.206)		0.563*** (0.204)		0.555** (0.214)		0.553*** (0.205)	
Gender of head (1 if male, 0 if female)	-0.383 (0.255)	-0.020 (0.037)	-0.309 (0.259)	-0.029 (0.038)	-0.365 (0.270)	-0.029 (0.041)	-0.457* (0.254)	-0.018 (0.036)

Table 7 (continued)

Variables	Calories		Proteins		Fats		Carbohydrates	
	Net Income	Remittances	Net Income	Remittances	Net Income	Remittances	Net Income	Remittances
Age of head (ln)	0.671 (0.425)	0.047 (0.05)	0.649 (0.437)	0.064 (0.050)	0.633 (0.446)	0.054 (0.055)	0.660 (0.429)	0.041 (0.050)
Household size (ln)	0.237 (0.207)	-0.022 (0.022)	0.275 (0.209)	-0.023 (0.029)	0.171 (0.219)	-0.019 (0.025)	0.242 (0.209)	-0.022 (0.022)
Head, 6–9 years of education	-0.615* (0.336)	-0.012 (0.042)	-0.396 (0.342)	-0.005 (0.040)	-0.510 (0.354)	-0.018 (0.044)	-0.539 (0.333)	-0.005 (0.040)
Head, >10 years of education	-0.522** (0.247)	0.002 (0.027)	-0.419 (0.266)	0.006 (0.028)	-0.500* (0.260)	0.007 (0.027)	-0.478* (0.256)	0.002 (0.027)
Spouse, 6–9 years of education	0.273 (0.250)	-0.026 (0.033)	0.289 (0.247)	-0.008 (0.031)	0.363 (0.259)	-0.023 (0.035)	0.297 (0.245)	-0.021 (0.031)
Spouse, >10 years of education	-0.065 (0.516)	0.001 (0.084)	1.176 (0.883)	0.168 (0.164)	0.055 (0.537)	0.006 (0.085)	-0.362 (0.551)	-0.003 (0.078)
Farm size (ln)	0.081 (0.155)	0.015 (0.018)	0.0706 (0.152)	0.010 (0.019)	0.092 (0.158)	0.009 (0.020)	0.059 (0.162)	0.016 (0.019)
Moshi town	0.147 (0.354)	0.001 (0.037)	0.367 (0.381)	0.009 (0.039)	0.249 (0.362)	-0.005 (0.037)	0.215 (0.355)	0.006 (0.037)
Another village	0.813*** (0.250)	0.029 (0.027)	0.635** (0.262)	0.028 (0.028)	0.768*** (0.265)	0.038 (0.028)	0.709*** (0.258)	0.022 (0.027)
This village	0.118 (0.287)	-0.069** (0.030)	0.295 (0.282)	-0.064** (0.029)	0.174 (0.288)	-0.072** (0.031)	0.187 (0.287)	-0.065** (0.029)
Constant	9.104*** (1.789)	-0.017 (0.202)	8.791*** (1.856)	-0.095 (0.205)	9.093*** (1.866)	-0.039 (0.227)	9.097*** (1.808)	-0.004 (0.202)
Observations	214	214	212	212	205	205	217	217
R-squared	0.159	0.900	0.163	0.900	0.161	0.894	0.149	0.902
Kleibergen-Paap rk LM statistic):	0.549* 0.011		7.313*** 0.007		7.233*** 0.007		6.979*** 0.008	
Chi-sq. (1) P-val								
F-tests	12.00		18.56		18.23		16.08	

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

Table 8 First-stage results for micronutrient intake

Variables	Vitamin A		Vitamin C		Calcium	
	Net income	Remittances	Net income	Remittances	Net income	Remittances
Migration networks		4.190*** (0.123)		4.193*** (0.131)		4.186*** (0.128)
Own mobile	0.541*** (0.202)		0.484** (0.215)		0.600*** (0.213)	
Gender of head (1 if male, 0 if female)	-0.435* (0.252)	-0.028 (0.036)	-0.428* (0.259)	-0.023 (0.038)	-0.321 (0.268)	-0.028 (0.039)
Age of head (ln)	0.532 (0.423)	0.052 (0.048)	0.703 (0.444)	0.030 (0.055)	0.647 (0.443)	0.066 (0.050)
Household size (ln)	0.247 (0.203)	-0.016 (0.023)	0.289 (0.217)	-0.023 (0.023)	0.217 (0.222)	-0.020 (0.024)
Head, 6–9 years of education	-0.431	-0.018	-0.693**	-0.017	-0.430	-0.003

Table 8 (continued)

Variables	Vitamin A		Vitamin C		Calcium	
	Net income	Remittances	Net income	Remittances	Net income	Remittances
	(0.331)	(0.040)	(0.342)	(0.042)	(0.346)	(0.040)
Head, >10 years of education	-0.402	-0.001	-0.605**	-0.004	-0.419	0.008
	(0.256)	(0.027)	(0.252)	(0.027)	(0.267)	(0.028)
Spouse, 6–9 years of education	0.277	-0.017	0.248	-0.031	0.254	-0.010
	(0.245)	(0.031)	(0.258)	(0.032)	(0.257)	(0.031)
Spouse, >10 years of education	-0.378	-0.001	-0.203	-0.070	0.743	0.145**
	(0.547)	(0.076)	(0.446)	(0.076)	(0.532)	(0.065)
Farm size (ln)	0.077	0.010	0.0163	0.023	0.047	0.016
	(0.152)	(0.019)	(0.169)	(0.019)	(0.157)	(0.020)
Moshi town	0.226	0.001	0.197	0.014	0.410	0.007
	(0.354)	(0.036)	(0.359)	(0.040)	(0.406)	(0.043)
Another village	0.661***	0.033	0.754***	0.020	0.678**	0.030
	(0.251)	(0.026)	(0.259)	(0.027)	(0.267)	(0.028)
This village	0.196	-0.067**	0.181	-0.054*	0.240	-0.053*
	(0.288)	(0.03)	(0.296)	(0.029)	(0.286)	(0.028)
Constant	9.518***	-0.040	9.025***	0.048	8.942***	-0.117
	(1.785)	(0.197)	(1.889)	(0.227)	(1.879)	(0.206)
Observations	221	221	207	207	204	204
R-squared	0.141	0.900	0.151	0.903	0.160	0.901
Kleibergen-Paap rk LM statistic:	6.571* 0.0104		6.979*** 0.008		7.211*** 0.008	
Chi-sq. (1) P-val						
F-tests	17.00		19.56		18.23	

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Standard errors are in parentheses

Table 9 Results of IV regression when remittances are measured as a continuous variable but restricted to only those who received remittances

Variables	Calories	Proteins	Fats	Carbohydrates	Vitamin A	Vitamin C	Calcium
Remittances (ln)	0.427	0.347***	0.983**	0.303**	0.0960	0.312	0.833
	(0.840)	(0.083)	(0.055)	(0.026)	(1.280)	(0.853)	(1.829)
Net income (ln)	-0.281	-0.0587	-0.150	-0.296	-0.208	0.00950	-0.0978
	(0.358)	(0.432)	(0.556)	(0.349)	(0.551)	(0.355)	(0.826)
Gender of head (1 if male, 0 if female)	0.0493	0.322	-0.0680	0.107	-0.266	-0.122	0.154
	(0.165)	(0.256)	(0.293)	(0.188)	(0.303)	(0.164)	(0.358)
Age of head (ln)	0.308	-0.383	-0.849	0.446	1.455	0.741	-0.846
	(0.565)	(0.691)	(2.172)	(0.542)	(0.985)	(0.585)	(1.205)
Household size (ln)	-0.595	-0.678*	-0.354	-0.729**	-0.929	-0.965**	-0.499
	(0.365)	(0.372)	(0.691)	(0.344)	(0.584)	(0.379)	(0.814)
Head, 6–9 years of education	0.171	-0.188	-0.0125	-0.0297	0.632	0.547**	0.119
	(0.226)	(0.375)	(0.633)	(0.306)	(0.390)	(0.214)	(0.522)
Head, >10 years of education	-0.0891	-0.648	-0.335	-0.254	0.463	0.923*	-0.542
	(0.532)	(0.549)	(1.362)	(0.508)	(0.881)	(0.548)	(1.216)
Spouse, 6–9 years of education	0.189	0.451*	-0.0763	0.309	0.115	-0.171	-0.00996
	(0.169)	(0.243)	(0.407)	(0.198)	(0.261)	(0.160)	(0.369)
Spouse, >10 years of education	0.331	1.182	-0.226	0.389	0.789	0.469	0.264
	(0.572)	(1.453)	(1.430)	(0.566)	(0.666)	(0.354)	(1.044)

Table 9 (continued)

Variables	Calories	Proteins	Fats	Carbohydrates	Vitamin A	Vitamin C	Calcium
Farm size (ln)	0.0475 (0.111)	0.0353 (0.151)	0.176 (0.218)	0.0231 (0.111)	-0.0527 (0.199)	0.0682 (0.111)	-0.00950 (0.255)
Moshi town	0.502** (0.229)	0.806*** (0.255)	0.363 (0.481)	0.474** (0.213)	0.498* (0.288)	0.112 (0.229)	0.354 (0.522)
Another village	0.414 (0.298)	0.0771 (0.318)	-0.162 (0.856)	0.498 (0.332)	1.193*** (0.458)	0.800*** (0.294)	0.123 (0.658)
This village	0.0122 (0.217)	0.141 (0.347)	-0.0725 (0.385)	-0.0160 (0.221)	-0.680** (0.342)	-0.323 (0.215)	-0.0868 (0.503)
Constant	5.447 (3.980)	3.078 (3.387)	-1.350 (6.802)	4.846 (3.298)	5.037 (6.253)	6.077 (4.191)	2.175 (8.858)
Observations	112	111	106	113	112	112	112
R-squared	0.120	0.161	2.505	0.131	0.266	0.240	0.322

References

- Acosta, P. (2006). Labor Supply, School Attendance, and Remittances from International Migration: The Case of El Salvador, Policy Research Working Paper Series No. 3903, The World Bank.
- Adams, R.H. Jr. (1991). *The effects of international remittances on poverty, inequality and development in rural Egypt*, Research Reports 86. Washington, DC: International Food Policy Research Institute (IFPRI).
- Alderman, H., Hoddinott, J., & Kinsey, B. (2006). Long term consequences of early childhood malnutrition. *Oxford Economic Papers*, 58(3), 450–474.
- Anyanwu, C. J. (2011). International remittances and income inequality in Africa. *Review of Economic and Business Studies*, 7(5), 117–148.
- Aromolaran, A. B. (2004). Household income, women's income share and food calorie intake in south western Nigeria. *Food Policy*, 29, 507–530.
- Azzari, C., & Zezza, A. (2011). International migration and nutritional outcomes in Tajikistan. *Food Policy*, 36, 54–70.
- Behrman, J. R. (1993). The economic rationale for investing in nutrition in developing countries. *World Development*, 21(11), 1749–1771.
- Behrman, J., & Deolalikar, A. (1987). Will developing country nutrition improve with income? A case study for rural South India. *Journal of Political Economy*, 95, 492–507.
- Behrman, J. R., & Wolfe, B. L. (1984). More evidence on nutrition demand: income seems overrated and women's schooling underemphasized. *Journal of Development Economics*, 14(1), 105–128.
- Bettin, G., & Zazzaro, A. (2012). Remittances and financial development: substitutes or complements in economic growth? *Bulletin of Economic Research*, 64(4), 509–536.
- Bouis, H. E. (1994). The effect of income on demand for food in poor countries: are our food consumption databases giving us reliable estimates? *Journal of Development Economics*, 44, 199–226.
- Briere, D. B., Sadoulet, E., Janvry, A., & Lambert, S. (2002). The roles of destination, gender, and household composition in explaining remittances: an analysis for the Dominican sierra. *Journal of Development Economics*, 68, 309–328.
- Carrington, W., Detragiache, E., & Vishnawath, T. (1996). Migration with endogenous moving costs. *American Economic Review*, 86, 909–930.
- Chami, R., Fullenkamp, C. & Jahjah, S. (2003). *Are immigrant remittance flows a source of capital for development?* Working Papers No. 03/189 (IMF Washington: International Monetary Fund, 2003).
- Chen, S., & Ravallion, M. (2010). The developing world is poorer than we thought, but no less successful in the fight against poverty. *Quarterly Journal of Economics*, 125(4), 1577–1625.
- Chernozhukov, V., & Hansen, C. (2006). Instrumental quantile regression inference for structural and treatment effect models. *Journal of Econometrics*, 132, 491–525.
- De Brauw, A. (2011). Migration and child development during the food price crisis in El Salvador. *Food Policy*, 36(1), 28–40.
- Deolalikar, A. (1998). Nutrition and labor productivity in agriculture: estimates for rural South India. *The Review of Economics and Statistics*, 70, 406–413.
- Dustmann, C., & Kirchkamp, O. (2002). The optimal migration duration and activity choice after re-migration. *Journal of Development Economics*, 67(2), 351–372.
- El-Sakka, M. I. T., & McNabb, R. (1999). The macroeconomic determinants of emigrant remittances. *World Development*, 27(8), 1493–1502.
- Göbel, K. (2013). Remittances, expenditure patterns, and gender: parametric and semiparametric evidence from Ecuador. *IZA Journal of Migration*, 2(1), 1–19.
- Hildebrandt, N. & McKenzie, D. (2005). *The effects of migration on child health in Mexico*. Policy Research Working Paper Series No. 3573, The World Bank.
- IDS. (2006). *Sending money home, can remittances reduce poverty?* UK: Institute of Development Studies, University of Sussex.
- Imai, K. S., Raghav, G., Abdilahi, A., & Nidhi, K. (2014). Remittances, growth and poverty: new evidence from Asian countries. *Journal of Policy Modeling*, 36(3), 524–538.
- Jones, G., & Rodgers, D. (2011). The World Bank's world development report 2011 on conflict. Security and development. *Journal of International Development*, 23 (7).
- Karamba, W. R., Quinones, E. J., & Winters, P. (2011). Migration and food consumption patterns in Ghana. *Food Policy*, 36(3), 41–53.
- Koenker, R. W., & Bassett, G. J. (1978). Regression quantiles. *Econometrica*, 46, 33–50.
- Kraybill, D. (2008). Kilimanjaro Livelihood and Climate Survey, Available at: <http://digitalunion.osu.edu/R2/summer09/yoona/>.

- Levitt, P. (1998). Social remittances: migration driven local-level forms of cultural diffusion. *International Migration Review*, 32(4), 926–948.
- Lu, Y. (2013). Household migration, remittances, and its impact on health in Indonesia. *International Migration*, 51(Suppl 1). doi:10.1111/j.1468-2435.2012.00761.x.
- Massey, D. S., & Parrado, E. A. (1998). International migration and business formation in Mexico. *Social Science Quarterly*, 79(1), 1–20.
- McKenzie, D. & Sasin, M. J. (2007). *Migration, remittances, poverty, and human capital. Conceptual and empirical challenges*. Policy Research Working Paper Series No. 4272, The World Bank.
- Mohapatra, S., Ratha, D. & Silwal A. (2011). *Outlook for remittance flows 2012–2014. Migration and development brief*. Migration and remittances unit. The World Bank.
- Mohapatra, S., Joseph, G., & Ratha, D. (2012). Remittances and natural disasters: ex-post response and contribution to ex-ante preparedness. *Environment, Development and Sustainability*, 14(3), 365–387.
- Msigwa, R. E., & Mbongo, J. E. (2013). Determinants of internal migration in Tanzania. *Journal of Economics and Sustainable Development*, 4(9), 28–35.
- Murty, K. N., & Radhakrishna, R. (1981). *Agricultural prices, income distribution and demand patterns in a low-income country in computer applications in food production and agricultural engineering*, edited by Robert E. Kalman and Jesus Martinez. Amsterdam.
- Nguyen, M., & Winters, P. (2011). The impact of migration on food consumption patterns: the case of Vietnam. *Food Policy*, 36, 71–87.
- Pitt, M. M. (1983). Food preferences and nutrition in rural Bangladesh. *The Review of Economics and Statistics*, LXV, 105–114.
- Pitt, M. M., & Rosenzweig, M. R. (1985). Health and nutrient consumption across and within farm households. *The Review of Economics and Statistics*, 67(2), 212–223.
- Stark, O. (1991). Migration in LDCs: risk, remittances, and the family. *Finance and Development*, 28(4), 39–41.
- Strauss, J. (1982). *Joint determination of food consumption and production in rural Sierra Leone: estimates of a household model*. Charlottesville: University of Virginia.
- Ward, J. O., & Sanders, J. H. (1980). Nutritional determinants and migration in the Brazilian northeast: a case study of rural and urban Ceara. *Economic Development and Cultural Change*, 29, 141–163.
- Wenban-Smith, H. (2015). Population growth, internal migration, and urbanization in Tanzania, 1967–2012 Phase 2. Working paper. International Growth Centre, London School of Economic and Political Science, London, UK.
- WHO/FAO (2014). *The State of Food Insecurity in the World 2014 Meeting. The 2015 International Hunger Targets: Taking Stock of Uneven Progress. 2015 Hunger Report*. <http://www.fao.org/hunger/en/>.
- Wolfe, B. L., & Behrman, J. R. (1983). Is income overrated in determining adequate nutrition? *Economic Development and Cultural Change*, 31, 525–549.
- Yameogo, N. D. (2014). Analysis of household expenditures and the impact of remittances using a latent class model: the case of Burkina Faso. Working Paper Series No. 200, African Development Bank, Tunis, Tunisia.
- Yang, D. (2008). International migration, remittances and household investment: Evidence from Philippine migrants' exchange rate shocks. *Economic Journal*, 118 (528), 591–630.

- Yaro, J. A. (2008). Development as push and pull factor in migration. *Journal of Migration and Entwicklung*, 16, under publication.

Rosemary Isoto is an IMMANA post-doctoral fellow at Tufts Friedman School of Nutrition Science and Policy in Boston. She received her PhD from The Ohio State University, USA in Agricultural, Environmental and Development Economics. Rosemary's research focuses on the interlinkages between agriculture and nutritional intake among rural households whose livelihoods majorly depend on subsistence farming. As an IMMANA fellow, she is working on

assessing the nutritional barriers to agricultural productivity among rural households in Uganda. She is also involved in many research projects including evaluating cash for food programs among refugees in Uganda and impact of landfills on environmental amenities among others.

David Kraybill's primary research interest is economic development. His work focuses on regional and spatial development processes that interact with markets and national government policies to determine the economic and social wellbeing of individuals, households, and communities. Dr. Kraybill's recent research includes studies of household poverty, household savings, governmental decentralization, primary and secondary education, and adaptation to climate change.

Fluent in French and a Swahili speaker, he has lived in Africa a total of five years, including a sabbatical year as Fulbright Scholar at Makerere University in Uganda. Kraybill has served as Associate Editor or member of editorial boards of seven academic journals. He has received research and advisory awards at Ohio State, and received the International Award of Merit from the Gamma Sigma Delta honor society. He has been consultant advisor to World Bank, Rockefeller Foundation, and Southeast Consortium for International Development, U.S. Department of Agriculture, and numerous governments and other organizations. He came to Ohio State in 1992.