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Marco Stampini
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Inter-American
Development Bank

scl-sph@iadb.org

www.iadb.org/SocialProtection

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Abstract

Social, political, and economic instability in Venezuela has led to a shift in the region's migration patterns in recent years, with millions of Venezuelans migrating to find better job opportunities or to better provide for the families they leave behind. In this context, remittances play a key role as part of the available income of households that receive them. This study analyzes how these monetary flows, in the context of a migratory crisis, become a livelihood strategy for coping with the food insecurity that Venezuelan households face. Based on data from the 2019 National Standard of Living Survey (*Encuesta Nacional de Condiciones de Vida*—ENCOVI), we use an instrumental variables estimation model to measure the effects of remittances on three food security metrics: i) per-capita daily caloric intake, ii) household dietary diversity, and iii) the food insecurity experience scale.

We found that receiving remittances is associated with increased caloric intake and household dietary diversity, as well as fewer food access limitations.

JEL classification codes: F24, F22, Q18, R23
Keywords: remittances, migration, food security, Venezuela.

Introduction

In many developing countries, migration is key to ensuring the livelihoods of large numbers of households. Remittances are generally linked to higher levels of wellbeing and consumption (Cohen, 2011; UNDP, 2009; Zezza et al., 2011). They also make it easier to buy food and eat a more diverse diet, which can positively impact nutritional status (Cuarteto, 2006). The role of remittances as a determinant of food security has been extensively explored in international research. The results of these studies show that, in general, receiving remittances is positively correlated to the food security of recipient households (see, for example, Isoto and Kraybill, 2014; Thow et al., 2016; Atuoye et al., 2017; Babatunde, 2018; Sulemana et al., 2019; Obi et al., 2020)

As for migration in recent decades in Latin America and the Caribbean, the increased flow of migrants leaving Venezuela for other countries in the region has drawn significant attention due to both its magnitude and the different social problems surrounding it. The country's economic, social, and political crisis has taken a major toll on the population's standard of living and has driven people to migrate in search of better quality of life. National statistics show that from 2013 to 2019, the country's gross domestic product (GDP) fell by 70%. Over the same period, the extreme poverty rate jumped from under 20% to 79.3% in 2019. The most recent data from the National Standard of Living Survey (Spanish acronym: ENCOVI) shows poverty levels of around 95% in 2019. Since labor market conditions in neighboring countries are comparatively favorable, migration has become an investment and livelihood strategy as a buffer against unfavorable conditions in Venezuela.

This study aims to assess whether remittances from Venezuelan migrants help address food insecurity in their home country. This is the first study to examine this important issue for Venezuela, and its analysis is set against a backdrop of mass migration and the collapse of virtually all economic activity in the migrants' home country. This analysis uses the data from the 2019 ENCOVI, the most recent household survey currently available.[2] To measure food security, we use indicators for caloric intake, dietary diversity, and food access limitations. For our estimates, we used a model with instrumental variables associated with to emigrant characteristics, with the aim of correcting for any endogeneity bias.

This document is organized into six sections, the first of which is this introduction. The second describes migration, remittances, and food security in Venezuela. The third reviews evidence on the relationship between remittances and food security, and the fourth describes the data and methodology used in this study. The fifth presents the results of the descriptive and multivariate analyses, while the final section contains the conclusions.

1.   Migration, remittances, and food security in Venezuela

According to the Coordination Platform for Refugees and Migrants from Venezuela (*Plataforma de Coordinación para Refugiados y Migrantes de Venezuela*—R4V), there were an estimated 5.4 million migrants, refugees, and asylum-seekers from Venezuela as of October 2020. Meanwhile, the Economic and Social Research Institute of the UCAB (IIES, 2020a) estimates around 820,000 emigrants in 2017, 1.64 million in 2018, and

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[2] This data is prior to the COVID-19 pandemic, which affected the job opportunities and income sources of households in Venezuela and migrants abroad. Our analysis does not reflect the phenomena and possible effects on the relationship between remittances and food security stemming from the pandemic.

2 million in 2019, based on the ENCOVI.[3] To understand the disparity between these estimates, one must understand that the ENCOVI only counts migrants who still have family in Venezuela; it does not record the migration of entire families, and information on their current living conditions cannot be obtained. Of the total number of emigrants reported in the 2019 ENCOVI, 54% are men. Young people ages 15 to 29 make up 57% of emigrants. In terms of level of education, 15% of Venezuelan migrants only have primary-level schooling, 51% have secondary-level schooling, 11% have vocational education, and 23% have done university-level studies. Colombia receives the most Venezuelan migrants at 42%, followed by Peru (21%), Chile (12%) and Ecuador (8%). Brazil, Argentina, United States, and Spain each received around 3%.[4] The lack of jobs and precarious conditions in Venezuela have been a growing reason for why people emigrate from the country, rising from 67% in 2017 to 82.8% in 2019 (IIES, 2020a).

One plausible explanation for these migratory dynamics is the country's faltering food security indexes (IIES, 2020b). Under this hypothesis, emigration can be viewed as a sort of coinsurance agreement under which members of a household work together to send a person abroad with the expectation that remittances will help meet the needs of those who stayed behind, which, in the context of food and nutritional vulnerability, translated to higher caloric intake and a more varied diet (Choithani, 2016; Obi et al., 2020; Maharjan et al., 2017).

The country's overall food situation has been jeopardized by constant drops in purchasing power and the scarcity and shortage of basic goods. This crisis also takes the form of business closures, job losses, and widespread shortages. According to statistics from Datanálisis, 8 out of every 10 essentials are unavailable in supermarkets, which has led to long wait times and lines for the chance to buy certain products. The supply of these products is also regulated by the government, which establishes the day on which each family can buy them, as well as the quantities each family can purchase (Castro and Renguant, 2017).

In line with these difficulties, in 2019, only 3% of households could be considered food secure, while 23% of households experienced mild food insecurity, 41% moderate insecurity, and 33% severe insecurity.[5] In general, the population can only meet 45% of its caloric needs and 43% of its protein needs (Madrigal, 2020). The ENCOVI also reports that 30% of children under the age of five are chronically malnourished, which goes hand in hand with the flawed implementation of the School Meals Program (*Programa Alimenticio Escolar*—PAE). Estimates show that the PAE, which is intended for students ages 3 to 17, only reaches two thirds of its target population. Additionally, the benefit is only partial because 74% of beneficiaries report only receiving lunch, and only 28% report benefiting from the program every day.[6]

Venezuela's food situation is affected not only by a decline in demand, but also by a sustained drop in industrial production capacity, which fell to 21% during the fourth quarter of 2019, as reported by the Venezuelan Industries Confederation (Spanish acronym:

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[3] The ENCOVI is a survey that collects of set of information on the Venezuelan population's standard of living through 13 modules: food security, education, health, housing, household, jobs, income (including remittances), access to banking services, emigration, food consumption and expenditure on food, and others. The ENCOVI provides insights about the living conditions and socioeconomic disparities and vulnerabilities of the Venezuelan population.
[4] Calculations by the authors based on data from the 2019 ENCOVI.
[5] Calculations by the authors based on data from the 2019 ENCOVI.
[6] Calculations by the authors based on data from the 2019 ENCOVI.

CONINDUSTRIA) in the results of the Qualitative State of Industry Survey (CONINDUSTRIA, 2020). This drop in capacity translates to reduced production of basic foodstuffs in recent years, as reported by the Venezuelan Health Observatory (OVS, s.f.). The shortage problems generated by falling production and imports are compounded by and correlate to problems such soaring inflation in Venezuela and the out-of-date Food Shortage Index (*Índice de Escasez de Alimentos*—IEA). As of March 2020, inflation in Venezuela was close to 3350% (BBC, 2020), one of the highest rates in the world, which shows how vulnerable consumers are. Meanwhile, the last official update of the IEA was in 2015, when it registered a shortage rate of around 30% (OVS, s.f.). More recent non-official estimates for 2018 place this figure at around 80% (Reyes, 2018). This deterioration of the standard of living in Venezuela, which is especially acute in relation to food and nutrition, is directly linked to the search for opportunities in other job markets. According to data from the 2019 ENCOVI survey, 19% of households reported that at least one member of the household had emigrated to another country between 2014 and 2019.

The 2019 ENCOVI also reports that 11.2% of Venezuelan households receive remittances. The likelihood of receiving remittances is significantly higher in households with members who have emigrated (36.4%) than in households without migrants (5.3%). The head of household is a woman in 61.6% of households that receive remittances, and 57% of these female heads of households are over age 50. In terms of education, most of these households have a member with a post-secondary education (45.3%) or secondary-level education (39.6%). 21.2% of the households have children under age 5, and 83.2% receive CLAP food bags.[7] The geographic areas with the most homes receiving remittances are Mérida (where 36.4% of households receive remittances), Guarico (26.4%), and Táchira (24.1%).[8]

2.   Evidence on the relationship between remittances and food security

Thow et al. (2016) identify 20 studies (2 qualitative and 18 quantitative) on the effects of remittances on diet and nutrition, and they find that remittances can increase access to food and help stabilize consumption over time, reducing the vulnerability of households and helping to ensure health and to address the problems of being underweight. They also underscore the fact that remittances have a low impact on indicators of chronic malnutrition and can foster shifts in eating habits towards less healthy foods.

Other studies, like those by Sulemana et al. (2019) and Regmi and Paudel (2016), which use more refined quantitative methods, find that receiving remittances, and receiving them more frequently, is associated with greater food security in some countries in sub-Saharan Africa. Waidler and Devereux (2019) show remittances to have a positive impact on dietary diversity scores in South Africa, but no effect on spending on food and anthropometric measurements. Meanwhile, Babatunde (2018) finds that remittances have no significant impact on diet quality or child nutritional status in Nigeria, but that they do influence buying low quality food. Atuoye et al. (2017) conclude that remittances are not enough to make food security less precarious in Ghana.

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[7] CLAP bags or boxes are a Venezuelan government food distribution system that provides essentials to households within the country. CLAP is an acronym for the Local Committees for Supply and Production, which is in charge of delivering the food items. The most common problems this program faces are related to the content and temporariness of access to the program. Specific research on this mechanism includes the studies by Aponte (2020) and Pérez (2019).
[8] Calculations by the authors based on data from the 2019 ENCOVI.

In Nepal, Maharjan et al. (2017) find that remittances are used chiefly to supplement agricultural income to meet basic needs. According to Chaothanani (2016), remittances are also used to invest in the agricultural sector, which has a positive impact on the food security of households in Bihar, India. Meanwhile, Franzen and Mazzucato (2014) show that remittances in Burundi have significant and positive effects on standard of living and food security, but a weak impact on the purchase of productive assets.

In Latin America, Antón (2010) finds a positive correlation between remittances and short- and medium-term child nutritional status in Ecuador and Peru. Longworthy (2011) estimates that in Peru around 3,000 soles can offset the impact on child nutrition of a father who has migrated. In the case of El Salvador, de Brauw (2011) finds that during the food price crisis of 2007-2008, the nutritional status of children in homes that received remittances was significantly less affected than that of children in homes that did not receive remittances.

Another trend underscored in the literature is that remittances do not always flow from migrants to the household of origin. For example, in Harare, Zimbabwe, the main flow of resources is from rural households to urban family members, which helps address the income crisis in highly uncertain urban labor markets (Tawodzera, 2010). This finding goes hand-in-hand with the conjectures of Stark (1991), who holds that spreading family members across different activities and places helps families achieve a diversified portfolio of livelihoods.

3. Data and analytical method

The data used in this study was taken from the 2019 ENCOVI. Of the 9,930 households interviewed with full information, 1851 indicated that at least one member emigrated and 1139 received remittances.[9]

To study the effect of remittances on food security, the research reviewed above generally uses three types of dependent variables: (i) per-capita calorie/nutrient intake (Babatunde, 2018; Hernández et al., 2017; Isoto and Kraybill, 2014); (ii) indicators for food quality, diversity, or insecurity, such as the Household Food Insecurity Access Scale-HFIAS (Atuoye et al., 2017; Kangmennaang et al., 2018), Food Consumption Score-FCS, Household Hunger Scale-HHS and Latin American and Caribbean Food Security Scale-ELCSA (Schmeer et al., 2015; Silva et al., 2017; Fernández-Niño et al., 2019); (iii) anthropometric measurements like body mass index (Waidler and Devereux, 2019), and Z scores for weight-for-height, weight-for-age, and height-for-age (Antón, 2010).

Using information from the ENCOVI's food security and food consumption modules, as well as food composition tables from the United Nations Food and Agriculture Organization, we estimated the number of calories per 100 grams of each product consumed in the household. Based on this information, we created three indicators associated with food security: daily caloric intake, household dietary diversity, and access to food. The method used for each indicator is described below.[10]

a. Per-capita daily caloric intake: This indicator measures calorie consumption based on the quantity of food consumed. It is estimated by adding together all calories associated with

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[9] The expanded numbers are 8,609,874, 1,637,004, and 966,970 households, respectively.
[10] Based on the literature reviewed above and the recommendations of the United Nations Food and Agriculture Organization on creating food security indicators (see the platform https://inddex.nutrition.tufts.edu/data4diets/indicators).

all foods consumed and dividing this total by the number of members in the household and by the number of days in the period used to report food consumption (seven days in the case of the ENCOVI).

$$Per\ capita\ daily\ caloric\ intake = \frac{\frac{\sum_i Calories}{Household\ size}}{\#days} \tag{1}$$

b. Household dietary diversity score (HDDS): This score describes the number of food groups consumed by a household during a specific reference period. The ENCOVI covers 15 food groups containing 91 types of products and 242 forms (table 1). Each food group is assigned a score of one if the household consumes any of the products in that group, or zero if they consume none of them. The dietary diversity score is calculated by adding up the zeros or ones for the 15 categories, for a final score ranging from 0 to 15 (maximum dietary diversity).

$$Dietary\ diversity\ (HDDS) = \sum_1^{15} Food\ groups \tag{2}$$

c. Food insecurity experience scale (FIES): This scale measures the level of access households have to food based on yes or no answers to eight questions that capture the severity of the food insecurity households faced in the preceding month.[11] The questions open with the premise "due to lack of money or other resources, have you ever…" In other words, they establish a connection between access and income. The food insecurity experience score is calculated by adding up the zeros or ones for the eight questions for a final score ranging from zero to eight (maximum insecurity).

$$Food\ insecurity\ (FIES) = \sum_1^{8} Access\ \text{to food} \tag{3}$$

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[11] The eight food security questions in the 2019 ENCOVI are: Were you ever worried that food will run out in your household? In your household, did you ever stop eating a healthy diet (containing meat, fish, vegetables, greens, fruit, grains)? In your household, did you ever run out of food? Did you or any other adult in your household ever eat a diet with little variety (you always ate the same thing)? Did you or any adult in your household ever skip breakfast, lunch, or dinner? Did you or any adult in your household ever eat less than what you should eat? Did you or any adult in your household ever feel hungry but not eat? Did you or any adult in your household ever eat only once a day or go without food for an entire day?

Table 1. Food groups

Group		Number of products	Number of forms
A	Bread and grains	9	20
B	Meat	9	18
C	Fish	6	18
D	Milk, cheese, and eggs	8	21
S	Oils and fats	4	19
F	Fresh fruits	6	18
G	Fresh vegetables	10	29
H	Legumes	5	10
I	Dried fruits	3	6
J	Potato, cassava, tubers	6	14
K	Sugars and sweeteners	6	14
L	Coffee, tea, etc.	4	14
M	Condiments and sauces	6	16
N	Beverages	6	16
O	Tobacco	3	9
	Total	91	242

Source: prepared by the authors based on the 2019 ENCOVI.

The empirical strategy aims to evaluate the role of remittances on food insecurity in Venezuelan households. We therefore estimated the following equation for each dependent variable alternative:

$$Y_i = \alpha + \beta R_i + \gamma X_i + \delta E_e + \varepsilon_i \tag{4}$$

In this equation, Y_i can be per capita calorie intake, the dietary diversity score, or the food insecurity experience (FIES) of household i. R_i is a variable equal to 1 if household i receives cash remittances or equal to 0 the household does not receive remittances or receives them in kind (medicine, food, etc.)? X_i represents the observable characteristics of household i, selected based on the literature reviewed in section 3: number of members; sex of head of household (1 if male); presence of children under the age of five; age of head of household (31-40, 41-50, and older than 50, under 31 as the reference value); highest level of education of adults (secondary school and post-secondary, primary education as the reference value); whether the household receives food subsidies from the Local Committees for Supply and Production (CLAP bag); whether any member of the household is a beneficiary of the school meals program (PAE); the household's per capita income quintile (first quintile is the reference value); dichotomous variables on possession of assets (home, car, refrigerator, washing machine, dryer, computer, internet, television, radio, air-conditioning, cable, microwave oven, landline); whether the increase in food prices has impacted the household in any way. E are the entity fixed effects that control for unobservable factors that can affect

food security in each geographical or administrative entity.[12] β is the parameter of interest that captures the marginal effect of remittances on food security, and, lastly, ε is the error term with the usual assumptions of independence and identical distribution and with an expected value of zero and a constant variance.

The inclusion of the household's per-capita income in vector X, with remittances included in that income, means the coefficient β captures the differential effects of remittances relative to other types of income. This differential effect can be due, for example, to the fact that remittances are received in foreign currency, or crypto currency, and are therefore protected from losing value due to inflation.

We start by estimating equation 4 by ordinary least squares (OLS).[13] The coefficient β that is estimated measures the empirical association between receiving remittances and the food security indicators. To interpret this association in terms of causality, the challenge of the potential endogeneity of the variable R needs to be resolved. First, it is possible that the household characteristics defining food consumption can also influence its decisions about migration to receive remittances, especially when insecurity influences remittances (reverse causality). Second, some of characteristics that can affect both remittances and food security, such as skills or risk aversion, are unobservable (omitted-variable bias). Third, there is the problem that the characteristics of households with remittances can be different from those of households that do not receive remittances (selection bias).

To avoid bias in the estimation, it is necessary to find one or more instruments related to receiving remittances that are also orthogonal to the food security variables. The main instrument used in the literature is migration networks (McKenzie and Rapoport, 2007; Obi et al., 2020; Maharjan et al., 2017). If many members of a community have migrated and a migration network has formed, it is easier for other members to migrate because the costs of moving and adapting will be lower. This heightens the likelihood of increased remittances. Implicit to the use of this instrument is that the migration network is unrelated to current nutrition in a specific household, since it is made up of members of other households or family members who are outside of the country.

In this study, we use the following instruments: a dichotomous variable that indicates whether the household has at least one migrant member; a vector of dichotomous variables indicating whether the household has a migrant in a given country; a vector of dichotomous variables indicating whether the household has a migrant that left Venezuela in a given year; a dichotomous variable indicating whether the household has a migrant with post-secondary education; and a dichotomous variable indicating whether the household has a migrant who is male. We argue that the country to which the person migrated and the amount of time that has passed since they did so, as well as the level of education and sex of the person who migrated, are associated with the likelihood of the household receiving remittances, but that

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[12] Venezuela is divided into 23 states, plus the Capital District and Federal Dependencies, which consist of Venezuela's island territories. These division are collectively referred to as entities, so entity fixed effects refer to the fixed effects within each of these geopolitical divisions.

[13] Despite the fact that Y is dichotomous in the dietary diversity (HDDS) and food insecurity (FIES) models, this study uses a linear probability model because it allows the marginal effects of the variables of interest to be measured directly, unlike nonlinear probability models that are dependent on the average values of the regressors. Also, since ordinary least-squares estimation of binary dependent variables leads to heteroscedasticity, we use robust standard error estimates that are heteroscedasticity-consistent. Additionally, it was verified that the probabilities predicted by the models fall between zero and one, and, therefore, our estimates are consistent.

they do not determine the household's food security through other channels, after controlling for the characteristics vector X.[14]

The first step to estimating equation 4 using instrumental variables is estimating the following equation.

$$R_i = \alpha_0 + \alpha_1 Z_i + \gamma X_i + \delta E_e + \mu_i \tag{5}$$

In this equation, Z_i represents the vector of instrumental variables related to R_i and orthogonal to vector μ_i. Finally, we run statistical tests to evaluate the instruments' relevance and exogeneity.

4. Relationship between receiving remittances and food security indicators

a. Description of the households and food security metrics

The average daily per-capita caloric intake of Venezuelans is 1859 calories, 10% below the average energy requirement in the region of 2075 calories (ECLAC 2018). This result is consistent with an average of five food access limitations, despite consumption of almost 10 out of the 15 categories of food that were included (Appendix 1).

The households have an average of 3.4 members. The head of household is 51 years old on average and is male in 40% of cases. The households' most common maximum level of education is secondary school (46%). Lastly, 87.3% of the households are CLAP bag beneficiaries (appendix 1).

11.2% of the households receive remittances, and 19% have a member who migrated (appendix 1). In other words, not all households with migrants receive remittances (and there are also households without migrants that do receive remittances). Appendix 2 contains additional descriptive statistics by household income quintile and according to whether or not the household receives remittances. In general, it can be observed that households in all income quintiles that receive remittances have better food security conditions.

Households with remittances consume an average of 2,152 calories per capita per day, as opposed to 1822 in households without remittances. The differences in averages are significant for all households and for the two highest income quintiles. Appendix 2 also shows that the higher the income quintile, the more nutrients are consumed.

In terms of diversity, households with remittances had access to an average of 10.6 of the 15 food groups, as opposed to 9.8 in households without remittances. The differences are significant across all household income quintiles. Diversity increases with income level. Homes without remittances in the first quintile are the group with the least diversity (9 out of 15 groups), and households with remittances in the highest quintile are the group with the most diversity (11 out of 15) (Appendix 2).

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[14] Some of the instruments used, such as level of education and sex of the migrant, are retrospective. That is, they measure characteristics at a time prior to the decision to migrate or prior to receiving remittances. The problem of reverse causality does not exist for these instruments.

Food access limitations are found to be smaller for households receiving remittances (limitations in 4.2 of 8 food security categories) than for households without remittances (limitations in 5 of 8 categories). The differences are significant starting with the second income quintile. As is the case for the other indicators, increases in income quintile are associated with less vulnerability. However, the limitations situation differs little between the first and second quintile (Appendix 2).

Lastly, Appendix 2 shows that households that receive remittances have characteristics that are different from households that do not, both overall and within each income quintile. Among other differences, they are smaller and have fewer male members. These and other characteristics of the households should be isolated to determine the role of receiving remittances on food security, that is, through a multivariate analysis. We describe the results of this analysis in the following section.

b.   Multivariate analysis of the relationship between receiving remittances and food security indicators

Table 2 and 3 show the results of the ordinary least squares (OLS) estimations of equation 4 for per-capita calorie intake, dietary diversity, and limitations in access to a good diet. Columns 1, 3, and 5 present the results without controls, and columns 2, 4, and 6 with controls.

Receiving remittances is associated with an increase in daily caloric intake of 148.3 calories per capita (table 2, column two). Appendix 3 shows that receiving CLAP bags is not statistically associated with households' caloric intake.

As for dietary diversity, remittances are associated with access to a higher number of food groups: 0.37 groups more than households without remittances (table 2, column 4). In contrast to the case of caloric intake, CLAP bags are associated with a more diverse diet (0.35 groups more than in households that do not receive them).

Lastly, receiving remittances is associated with a 0.36-point drop in food access limitations compared to households without remittances (table 2, column 6). CLAP bags are also associated with a drop in these limitations. Other variables associated with the three food security variables—such as household size, level of education, or assets and income quintile—show the expected signs and significance (Appendix 3).

Table 2. Results of OLS estimations

Variable	Calories		Diversity		Access Lim.	
	(1)	(2)	(3)	(4)	(5)	(6)
Household receives remittances	331.150***	148.352***	0.823***	0.374***	-0.956***	-0.359***
	(53.078)	(42.374)	(0.067)	(0.058)	(0.084)	(0.074)
Controls	No	Yes	No	Yes	No	Yes
Entity fixed effects	No	Yes	No	Yes	No	Yes
Observations	9,480	9,047	9,480	9,047	9,480	9,047
R-Squared	0.006	0.400	0.012	0.329	0.014	0.314
Average value in households that do not receive remittances	1,822	1,822	9.77	9.77	5.03	5.03

Source: prepared by the authors based on the 2019 ENCOVI. See appendix 3 for more details. **Notes:** Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 3 and Appendix 4 present the results of the instrumental variables estimations, including the results of the first stage (equation 5). As discussed previously, this method aims to eliminate biases in estimating coefficient β of equation 4 so it can be interpreted in causal terms. The results from the first stage evaluate the relevance and strength of the instrumental variables used. The probability of households receiving remittances increases by 23 percentage points (p.p.) if they have at least one migrant. It also increases if the migrant is in Chile (by 6 p.p.), or if he or she left Venezuela in 2017 (by 7 p.p.) or 2018 (by 8 p.p.). Lastly, it increases if the migrant has post-secondary education (by 6 p.p.) and if the migrant is male (by 6 p.p.).

The results at the bottom of the table evaluate, first, whether the instruments used are sufficiently correlated with the endogenous variable. The value of the F statistic, which evaluates the combined significance of the coefficients of the instruments used, is 175.7. This value exceeds the threshold of 104.7 proposed in the study by Lee et al. (2020).

Second, we tested the null hypothesis that remittances are exogenous. Given that the Wooldridge and Wu-Haussman tests yielded p-values of less than 0.05 for the caloric intake and dietary diversity models, the hypothesis can be rejected, and remittances should be treated as an endogenous variable of the model. The same cannot be said for food access limitations, so the hypothesis of exogeneity cannot be rejected.

Third, we tested the instruments to confirm they are not correlated with the error term, because if they are, the estimates cannot be assumed valid. Our results are consistent with the hypothesis that they are not correlated with the error term. The p-values from the Sargan and Bassmann tests are greater than 0.05 for all models. In other words, all instruments used satisfy the condition that they not be correlated with the error.

The instrumental variables estimation yields higher values for the β coefficients than the estimation in table 2, and the expected signs observed previously remain the same. Receiving remittances increases daily intake by 312.1 calories per capita. In other words, it allows the recipient to exceed the average energy requirement for the region. Under the proposed methodology, the effect found measures a local average treatment effect (LATE). Receiving remittances also improves dietary diversity. On average, remittances increase diversity by 0.84 food groups in comparison to non-recipient households. Finally, we found

that receiving remittances reduces food access limitations by 0.47 points. However, the tests for this equation rejected the endogeneity of the variable R, so it is more appropriate to use the OLS estimation in table 2.[15]

In line with the expectations laid out previously, the results indicate that variables such as household size and having a female head of household are associated with a poorer food security situation. Meanwhile, households with higher income, assets, or property are more protected from food insecurity. In terms of age, the variable does not behave in a linear fashion. Rather, it seems to depend on the age range people fall into. This is consistent with the findings of Sulemana et al. (2019).

In terms of education, after controlling for other characteristics, including income level (which strongly correlates to level of education itself), the coefficients estimated suggest a peculiar situation. Higher level of education is associated with lower per-capita daily caloric intake but higher dietary diversity and fewer food access limitations. These results support the idea that more vulnerable households, in this case associated with those with less human capital, generally eat a diet with little variety, usually based on flours and grains. Furthermore, the results found using possession of asset variables are similar to those found by Kangmennaang et al. (2018), where accumulation of assets has a positive effect on food security. Lastly, dietary diversity increases with household size and subsidized CLAP bags.

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[15]This result is very similar to the β coefficient estimated using OLS, which is consistent with the fact that the "endogeneity" tests suggest that the exclusion restriction is not violated.

Table 3. Instrumental variables estimations

Variable	First stage: Receives remittances	Second stage: Calories per capita	Diversity	Access Lim.
Household receives remittances		312.1***	0.839***	-0.471***
		(84.34)	(0.159)	(0.172)
Controls	Yes	Yes	Yes	Yes
Entity-level fixed effects	Yes	Yes	Yes	Yes
Instruments				
Household with members who are migrants	0.233***			
	(0.022)			
Country they migrated to, reference value: Other countries				
Country they migrated to: Colombia	-0.028			
	(0.018)			
Country they migrated to: Ecuador	0.012			
	(0.026)			
Country they migrated to: Chile	0.059*			
	(0.025)			
Country they migrated to: Peru	-0.037*			
	(0.020)			
Year of migration, reference value: before 2017				
Year of migration: 2017	0.072***			
	(0.020)			
Year of migration: 2018	0.075***			
	(0.018)			
Year of migration: 2019	0.013			
	(0.018)			
Year of migration: 2020	-0.195***			
	(0.037)			
Migrant with post-secondary education	0.060***			
	(0.015)			
Sex of migrant: male	0.061***			
	(0.015)			
Observations	9,047	9,047	9,047	9,047
R-Squared	0.235	0.398	0.325	0.314
IV F-stat		175.7	175.7	175.7
Wooldridge (p-value)		0.0321	0.00123	0.470
Wu-Hausman (p-value)		0.0326	0.0013	0.4715
Sargan (p-value)		0.0511	0.077	0.0808
Basmann (p-value)		0.0525	0.079	0.0828

Source: prepared by the authors based on the 2019 ENCOVI. **Note:** Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5. Conclusions

The preceding analysis confirms the relevance of remittances for the food security of households that receive them. Against a backdrop of enormous migratory flows of Venezuelans to other countries and an unprecedented economic crisis that particularly affects the availability of food in Venezuela, remittances sent by immigrants play a fundamental role in the wellbeing of families that receive them. According to the estimates presented here, receiving remittances is associated with better nutritional indicators, with effects that could be significant enough to close the gaps between the actual situation and desirable levels according to international standards (in caloric intake, for example).

This study has limitations due to the cross-sectional nature of the data. In other studies, on migration, the potential endogeneity of the treatment variable has been addressed by using

rainfall or previous migratory flows as instruments, taking advantage of longitudinal data and occasionally including information on both recipients and migrants themselves (Munshi, 2003 and Hunter et al., 2013). In our case, the potentially endogenous variable is receiving remittances, which, as we showed in section 5.a, is not directly associated with the migration of a member of the household. In the future, it is possible that new rounds of the ENCOVI with a longitudinal sampling framework will allow for improvements on the identification strategy used in this study. Until then, the results estimated using OLS can be interpreted as statistical association. The instrumental variables estimations are consistent, and the tests we carried out inspire confidence in the validity of our bias correction strategy.

In terms of public policies, the study emphasizes that despite the harsh conditions that Venezuelan migrants face abroad, they have been able to send a substantial amount of resources through remittances that have been essential for members of their households who stayed in Venezuela. In this regard, measures to facilitate and make these transfers more efficient have great potential to maximize their impact on wellbeing and food security.

Although 2020, due to the worldwide COVID-19 pandemic, was a year marked by an unprecedented health and economic crisis (for example, GDP fell by around 9% in the countries receiving Venezuelan migrants), further complicating prospects for these migrants (which can be studied in future versions of the ENCOVI), at the beginning of 2020, the government of Colombia decided to grant legal status to nearly one million Venezuelan migrants, thus giving them more opportunities to participate and be included in this country and improving, over the medium-term, their ability to send larger remittances to Venezuela.[16] This creates an opportunity for studying the impact of policies that legalize migration on the sending of remittances and the wellbeing of households that receive them.

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[16] This legalization was achieved through the Temporary Protection Statute for Venezuelan Migrants. https://www.cancilleria.gov.co/newsroom/news/estatuto-proteccion-temporal-migrantes-venezolanos-decision-historica-region-mundo and https://www.cancilleria.gov.co/sites/default/files/FOTOS2020/borrador_propuesta_etpv_version_05-02-2021.pdf

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7. Appendices

Appendix 1. Descriptive statistics for Venezuelan households in the 2019 ENCOVI

Variable	Mean	Std. Dev.
Calories per capita	1,859	1,310
Dietary diversity	9.859	2.353
Food security: access limitations	4.942	2.627
Receives remittances	0.112	0.316
Households with migrants	0.190	0.392
Migrant's destination country: Colombia	0.082	0.275
Migrant's destination country: Ecuador	0.016	0.127
Migrant's destination country: Chile	0.025	0.157
Migrant's destination country: Peru	0.045	0.207
Year migrated: 2017	0.043	0.204
Year migrated: 2018	0.080	0.271
Year migrated: 2019	0.069	0.254
Year migrated: 2020	0.007	0.082
Number of members in household	3.408	1.862
Head of household is male	0.399	0.490
Households with children under age 5	0.236	0.425
Age of head of household (under 30)	0.105	0.307
Age of head of household (31-40)	0.165	0.371
Age of head of household (41-50)	0.196	0.397
Age of head of household (over 50)	0.533	0.499
Maximum level of education in household: none, basic, primary	0.139	0.346
Maximum level of education of household: secondary	0.459	0.498
Maximum level of education of household: post-secondary	0.402	0.490
Receives CLAP bag	0.873	0.333
Income in first quintile	0.174	0.379
Income in second quintile	0.193	0.395
Income in third quintile	0.195	0.396
Income in fourth quintile	0.206	0.404
Income in fifth quintile	0.231	0.422
Has a house	0.794	0.404
Has a car	0.119	0.324
Has a refrigerator	0.840	0.366
Has a washing machine	0.569	0.495
Has a drying machine	0.077	0.266
Has a computer	0.271	0.445
Has internet	0.206	0.404
Has a television	0.890	0.313

Variable	Mean	Std. Dev.
Has a radio	0.553	0.497
Has a water heater	0.048	0.215
Has air conditioning	0.355	0.479
Has cable TV	0.485	0.500
Has a microwave oven	0.163	0.369
Has a landline	0.202	0.402
Access to school meals program (PAE)	0.303	0.460
Impact on food prices (increase)	0.392	0.488

Source: prepared by the authors based on the 2019 ENCOVI.

Appendix 2. Descriptive statistics for Venezuelan households by income quintiles and receipt of remittances

Per-capita income quintile	Household receives remittances	Calories per capita	Dietary diversity	Access Lim.	Number of members	Male	Female	Average age of head of household
1	NO	1,478	9.08	5.50	3.95	1.82	2.11	46.60
1	YES	1,466	9.54	6.01	3.46	1.73	1.73	41.50
Diff			*					**
2	NO	1,706	9.33	5.39	3.51	1.64	1.87	52.60
2	YES	1,664	9.83	4.81	3.61	1.66	1.95	51.94
Diff			***	***				
3	NO	1,726	9.73	5.40	3.51	1.66	1.84	52.65
3	YES	1,875	10.36	4.95	3.26	1.39	1.88	54.97
Diff			***	***		***		**
4	NO	1,887	10.19	5.03	3.35	1.64	1.70	52.13
4	YES	2,171	10.84	4.34	3.10	1.35	1.75	56.09
Diff		**	***	***		***		***
5	NO	2,260	10.41	3.96	3	1.54	1.46	51.57
5	YES	2,595	11.05	3.18	2.68	1.27	1.42	54.34
Diff		***	***	***	*	***		**
Total	NO	1,822	9.77	5.03	3.45	1.66	1.79	51.18
	YES	2,152	10.60	4.23	3.07	1.39	1.68	53.61
Diff		***	***	***	***	***		***

Source: prepared by the authors based on the 2019 ENCOVI.

Appendix 3. Results of OLS estimations

Variable	Calories		Diversity		Access Lim.	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Household receives remittances	331.150*** (53.078)	148.352*** (42.374)	0.823*** (0.067)	0.374*** (0.058)	-0.956*** (0.084)	-0.359*** (0.074)
Sex of head of household: male		78.917*** (23.381)		0.006 (0.044)		-0.088* (0.047)
Number of members in household		-376.112*** (9,347)		0.061*** (0.016)		0.105*** (0.018)
Households with children under age 5		103.297*** (22,432)		0.146* (0.060)		-0.135* (0.065)
Age of head of household Reference value: under 30						
Age of head of household (31-40)		39.097 (40.094)		-0.039 (0.084)		0.086 (0.090)
Age of head of household (41-50)		73.990* (40.820)		-0.029 (0.084)		0.212* (0.092)
Age of head of household (over 50)		26.120 (38.393)		-0.140* (0.079)		0.414*** (0.086)
Maximum level of education of household, reference value: basic primary education						
Secondary education		-149.723*** (42.344)		0.156* (0.069)		-0.123* (0.073)
Post-secondary education		-166.744*** (43.768)		0.253*** (0.072)		-0.373*** (0.079)
Household receives CLAP bag		58.447 (47.591)		0.356*** (0.086)		0.462*** (0.086)
Access to PAE		-100.434*** (20.173)		0.090* (0.052)		0.038 (0.057)
Household income quintiles reference values: income quintile 1						
Household income quintile = 2		12.818 (32.154)		0.184* (0.075)		-0.146* (0.075)
Household income quintile = 3		70.202* (34.105)		0.485*** (0.074)		-0.286*** (0.075)
Household income quintile = 4		156.339*** (34.267)		0.794*** (0.074)		-0.625*** (0.078)
Household income quintile = 5		442.149*** (41.258)		0.951*** (0.077)		-1.320*** (0.083)
Has own house		3.061 (29.583)		-0.011 (0.055)		-0.144* (0.062)
Has car		48.517 (37.850)		0.207*** (0.068)		-0.470*** (0.078)
Has appliances and other utilities						

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Variable	Calories		Diversity		Access Lim.	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Has a refrigerator		-1.940		0.207***		-0.308***
		(32.211)		(0.066)		(0.067)
Has a washing machine		26.932		0.180***		-0.324***
		(23.712)		(0.047)		(0.052)
Has a drying machine		174.738***		0.216*		-0.075
		(48.478)		(0.085)		(0.095)
Has a computer		37.333		0.073		-0.085
		(31.595)		(0.062)		(0.072)
Has internet		100.520***		0.072		-0.506***
		(38.033)		(0.070)		(0.082)
Has a television		6.542		0.011		-0.261***
		(35.776)		(0.074)		(0.071)
Has a radio		109.299***		0.251***		-0.118*
		(21.995)		(0.043)		(0.047)
Has water heater		166.851*		-0.167		-0.402***
		(70.626)		(0,113)		(0,120)
Has air conditioning		81.518***		0.176***		-0.339***
		(26.675)		(0.052)		(0.057)
Has cable TV		111.694***		0.377***		-0.294***
		(24.030)		(0.048)		(0.054)
Has a microwave oven		108.540***		0.183***		-0.520***
		(39.447)		(0.068)		(0.078)
Has a landline		-53.269		0.033		-0.060
		(33.623)		(0,060)		(0,069)
Impact on food prices (increase)		31.677		0.552***		0.609***
		(24.841)		(0.049)		(0.053)
Constant	1,829.356***	2,905.451***	9.655***	7.787***	5.149***	5.252***
	(14.107)	(116.774)	(0.027)	(0.218)	(0.028)	(0.259)
Geographical controls at the entities level	No	Yes	No	Yes	No	Yes
Observations	9,480	9,047	9,480	9,047	9,480	9,047
R-squared	0.006	0.400	0.012	0.329	0.014	0.314

Source: prepared by the authors based on the 2019 ENCOVI. **Notes:** Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix 4. Instrumental variables estimations

Variable	Receives remittances *(First stage)*	Calories per capita *(Second stage)*	Diversity (*Second stage*)	Access Lim. *(Second stage)*
Household receives remittances		312.1***	0.839***	-0.471***
		(84.34)	(0.159)	(0.172)
Number of members in household	-0.009***	-373.7***	0.0677***	0.104***
	(0.002)	(8.081)	(0.0152)	(0.0165)
Sex of head of household: male	-0.028***	84.78***	0.0223	-0.0923*
	(0.006)	(23.17)	(0.0437)	(0.0472)
There are children under age 5 in the household	0.026***	98.11***	0.131*	-0.132*
	(0.009)	(32.49)	(0.0613)	(0.0662)
Age of head of household reference value: under 30				
Age of head of household (31-40)	-0.002	40.90	-0.0340	0.0847
	(0.012)	(44.01)	(0.0830)	(0.0897)
Age of head of household (41-50)	0.004	71.99	-0.0346	0.213*
	(0.012)	(44.07)	(0.0831)	(0.0898)
Age of head of household (over 50)	0.016	18.98	-0.161*	0.419***
	(0.011)	(41.36)	(0.0780)	(0.0843)
Maximum level of education of household, reference value: basic primary education				
Secondary education	-0.001	-150.1***	0.155*	-0.122*
	(0.010)	(35.48)	(0.0669)	(0.0723)
Post-secondary education	-0.009	-164.9***	0.258***	-0.375***
	(0.010)	(37.75)	(0.0712)	(0.0769)
Household receives CLAP bag	-0.020*	61.14	0.364***	0.460***
	(0.012)	(42.78)	(0.0807)	(0.0872)
Access to PAE program	0.025***	-106.8***	0.0718	0.0427
	(0.008)	(28.22)	(0.0532)	(0.0575)
Household income quintiles Reference value: income quintile 1				
Household income quintile = 2	0.016	11.08	0.179*	-0.145*
	(0.010)	(37.43)	(0.0706)	(0.0763)
Household income quintile = 3	0.032***	65.68*	0.472***	-0.283***
	(0.010)	(37.66)	(0.0710)	(0.0767)
Household income quintile = 4	0.045***	148.8***	0.773***	-0.620***
	(0.010)	(38.31)	(0.0722)	(0.0781)
Household income quintile = 5	0.055***	433.9***	0.928***	-1.314***
	(0.011)	(39.94)	(0.0753)	(0.0814)
Has own house	-0.008	3,559	-0.00934	-0.144*
	(0.008)	(30.03)	(0.0566)	(0.0612)
Has car	-0.003	47.79	0.205***	-0.470***
	(0.010)	(36.92)	(0.0696)	(0.0752)
Has appliances and other utilities				
Has a refrigerator	0.004	-2.885	0.205***	-0.308***
	(0.009)	(33.14)	(0.0625)	(0.0675)
Has a washing machine	0.022***	22.55	0.168***	-0.321***

Variable	Receives remittances *(First stage)*	Calories per capita *(Second stage)*	Diversity *(Second stage)*	Access Lim. *(Second stage)*
	(0.007)	(25.47)	(0.0480)	(0.0519)
Has a drying machine	0.011	174.5***	0.215*	-0.0752
	(0.012)	(45.48)	(0.0857)	(0.0927)
Has a computer	0.009	34.75	0.0657	-0.0836
	(0.009)	(34.37)	(0.0648)	(0.0700)
Has internet	0.013	97.15*	0.0620	-0.504***
	(0.010)	(38.55)	(0.0727)	(0.0785)
Has a television	-0.003	6,786	0.0115	-0.261***
	(0.010)	(36.35)	(0.0685)	(0.0741)
Has a radio	-0.008	110.7***	0.255***	-0.119*
	(0.006)	(23.33)	(0.0440)	(0.0475)
Has a water heater	0.018	163.2***	-0.177	-0.400***
	(0.016)	(58.11)	(0.110)	(0.118)
Has air conditioning	0.004	80.06***	0.172***	-0.338***
	(0.007)	(27.34)	(0.0515)	(0.0557)
Has cable TV	0.005	108.3***	0.367***	-0.292***
	(0.007)	(25.83)	(0.0487)	(0.0526)
Has a microwave oven	0.025***	102.8***	0.166*	-0.516***
	(0.010)	(36.27)	(0.0684)	(0.0739)
Has a landline	0	-54.15*	0.0305	-0.0597
	(0.009)	(32.52)	(0.0613)	(0.0663)
Impact of food prices (increase)	0.026***	26.57	0.537***	0.613***
	(0.007)	(26.35)	(0.0497)	(0.0537)
Geographical controls at the entity level	YES	YES	YES	YES
Instruments				
Household has members who are migrants	0.233***			
	(0.022)			
Migrant's destination country, reference value: Other countries				
Migrant's destination country: Colombia	-0.028			
	(0.018)			
Migrant's destination country: Ecuador	0.012			
	(0.026)			
Migrant's destination country: Chile	0.059*			
	(0.025)			
Migrant's destination country: Peru	-0.037*			
	(0.020)			
Year of migration, reference value: prior to 2017 (2016, 2015, 2014)				
Year migrated: 2017	0.072***			
	(0.020)			
Year migrated: 2018	0.075***			
	(0.018)			
Year migrated: 2019	0.013			
	(0.018)			
Year migrated: 2020	-0.195***			
	(0.037)			

Variable	Receives remittances *(First stage)*	Calories per capita *(Second stage)*	Diversity *(Second stage)*	Access Lim. *(Second stage)*
Migrant has post-secondary education	0.060***			
	(0.015)			
Sex of migrant: male	0.061***			
	(0.015)			
Constant	0.025	2,898***	7.765***	5.257***
	(0.029)	(109.2)	(0.206)	(0.223)
Observations	9,047	9,047	9,047	9,047
R-squared	0.235	0.398	0.325	0.314
IV F-stat		175.7	175.7	175.7
Wooldridge (p-value)		0.0321	0.00123	0.470
Wu-Hausman (p-value)		0.0326	0.0013	0.4715
Sargan (p-value)		0.0511	0.077	0.0808
Basmann (p-value)		0.0525	0.079	0.0828

Source: Prepared by the authors based on the 2019 ENCOVI. **Notes:** Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$