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The Impact of International Remittances on Investment in Education in Caltimacán, Hidalgo

El impacto de las remesas internacionales sobre la inversión en educación en la localidad de Caltimacán, Hidalgo

Yesenia García Nájera[1] & Alfredo Cuecuecha Mendoza[2]

ABSTRACT

This article presents the results of a study about the impact of international remittances on investment in education in the Mexican town of Caltimacán, Hidalgo, Mexico, a community that is characterized by legal migration through temporary labor contracts. The estimations apply instrumental variables based on job creation in the American states were migrants worked between 2010 and 2016. The results show that the proportion of expenditure spent on education is higher among households that receive remittances than among households that do not receive them. However, this effect vanishes when household expenditure and wealth are introduced in the model. These results confirm that the investments in the education of the inhabitants of Caltimacán face credit constraints, which in turn are diminish by the reception of remittances.

Keywords: 1. remittances, 2. education investment, 3. credit constraints, 4. Caltimacán, 5. Hidalgo.

RESUMEN

Este artículo presenta resultados de una investigación que analiza el impacto de las remesas internacionales sobre la inversión en educación en Caltimacán, estado de Hidalgo, México, una comunidad que se caracteriza por ser de alta migración basada en contratos temporales de trabajo. Para resolver los problemas de sesgo originados por la simultaneidad existente entre la recepción de remesas y las inversiones en educación, así como por la existencia de variables no observadas que determinan a ambas variables, se utiliza el Método de las Variables Instrumentales, utilizando para dicho fin a las tasas de creación de empleo en los Estados de la Unión Americana en los cuales trabajaban los migrantes durante el periodo comprendido entre el 2010 y el 2011. Los resultados muestran que las remesas aumentan cuando hay una mayor creación de empleo en la Unión Americana, lo que a su vez genera una mayor inversión en educación en hogares receptores de remesas, en comparación a hogares no receptores de remesas. Sin embargo, este impacto desaparece al incluir en el modelo el gasto de los hogares y el nivel de riqueza de los mismos. Estos resultados confirman que la inversión en educación en Caltimacán se ve sujeta a restricciones de acceso a crédito, mismas que son suavizadas por la llegada de remesas.

Palabras clave: 1. remesas, 2. inversión en educación, 3. restricciones crediticias. 4. Caltimacán 5. estado Hidalgo.

[1]El Colegio de Tlaxcala, Mexico, yesenia.garcianj@gmail.com,
[2]Research Center for Business Intelligence, UPAEP, Mexico, alfredo.cuecuecha@upaep.mx,
https://orcid.org/0000-0003-2828-0473

INTRODUCTION

In 2017, remittances reached the record level of US $618 billion in the United States (World Bank Group, 2018). In Mexico, in the same period, remittances reached an historical record of US $28.7 billion (Banco de Mexico, BANXICO, 2018). The economic and social effects of these extraordinary cash flows at macroeconomic and microeconomic levels have resulted in debates in the literature on the subject (Adams & Cuecuecha, 2010, 2013; Buvinic & Gupta, 1997; Cuecuecha & Adams, 2016; Kandell & Massey, 2002; Levitt, 1998; Sawyer, 2015; Stark & Bloom, 1985). This paper aims at expanding the knowledge regarding the relationship between remittances and education expenditure at the microeconomic level in Caltimacán, Hidalgo, Mexico.

On a theoretical level, remittances can have three types of effects on household investments in education:

1) No effect: remittances are perfectly fungible and only replace lost resources due to the migration of a family member; migration does not generate changes in the way the household operates;

2) Positive effect: remittances are perceived as a temporary resource that must be invested while it lasts;

3) Negative effect: remittances are seen as an increase in permanent income, and the household decides to increase its consumption and reduce its investment levels (Adams & Cuecuecha, 2010).

Remittances can also have a positive impact if insurance and credit markets are incomplete or missing. The strategy of sending migrants and receiving remittances helps to make investments that the household did not make before due to not having access to loans (Stark & Bloom, 1985). Remittances can also impact by changing the structure of the household, because if household members who migrate to the United States and send remittances are male, then a female may become the head of the household and the investments may increase (Buvinic & Gupta, 1997). Finally, consumption habits can also be modified in households that receive remittances if the members who live abroad influence their consumption habits when visiting relatives in Mexico (Levitt, 1998).

Empirical studies conducted for Guatemala (Adams & Cuecuecha, 2010), Ghana (Adams & Cuecuecha, 2013), Indonesia (Cuecuecha & Adams, 2016) and the community of San Miguel Tlacotepec, in Oaxaca, Mexico (Sawyer, 2015), report the positive impact of remittances on household investment in education. Kandell and Massey (2002) report positive and negative results, depending on the sample studied; they recommend studies at the local level in order to try and understand these specific cases.

Consequently, this paper chooses to study the case of Caltimacán, in the state of Hidalgo, characterized by high migration and high reception of remittances; as well as because its

migrants have temporary employment contracts in the United States. This study, at the local level, allows to measure in detail elements that have not been included in other studies, such as risk aversion and measures of subjective well-being. In order to identify the impact of remittances at the household level, advantage is taken of the fact that our survey allows us to identify the place of residence of migrants who send remittances from the United States.

This information was used to design an instrument that measures job creation at the place of residence of migrants in the United States. The Instrumental Variables Method allows to find the causal effect of a variable, conditioning on a set of specific observed variables of the households included in the sample (Wooldridge, 2013, p. 514).

This study shows that an increase in employment in the United States increases in turn the remittances sent to Mexico, which translates into greater investment in education. The foregoing would show that remittances are perceived as temporary, as has also been reported for other countries (Adams & Cuecuecha, 2010, 2013). Nevertheless, the aforementioned effect is mainly explained by the greater presence of wealth and income in these households.

This result would confirm that remittances help make investments that the household would otherwise not make due to the lack of access to loans (Stark & Bloom, 1985), because by including two factors in the model, associated with access to credit, such as income and wealth (Ray, 1998, p. 268), the positive impact of remittances disappears. The result also implies that households that receive remittances spend on education in the same measure as households with equivalent incomes that do not receive remittances. It is noteworthy that due to the representativeness of the sample, the estimated coefficient is valid for communities whose households have similar characteristics to those of Caltimacán, Hidalgo (Deaton, 1997).

There are other studies that have focused on other dimensions of performance indicators associated with education, such as school drop-out rates (Cox Edwards & Ureta, 2003), participation in higher education (Yang, 2008), school attendance (McKenzie & Rapoport, 2006; Hanson & Woodroff, 2003), illiteracy (López Cordova, 2005), school aspirations (Pérez Gañán & Pesántez Calle, 2017) and student engagement (Acosta Rangel & Caamal Olvera, 2017).

Cox Edwards and Ureta (2003) estimate the possibilities of dropping-out from school in El Salvador, finding that, unlike what happens in rural areas, remittances reduce school drop-out rates in urban areas. Yang (2008) studied the case of the Philippines, finding that young people (aged 17 to 21) increase their participation in higher education. Pérez Gañán and Pesántez Calle (2017) point out that when remittances are received, the school aspirations of young Ecuadorians improve.

In the case of Mexico, McKenzie and Rapoport (2006), as well as Hanson and Woodroff (2003) found that remittances improve school attendance among young people, aged 13 to 15, particularly girls; on the other hand, López Córdova (2005) did find that illiteracy

decreased in children aged 6 to 14 in Mexican municipalities that receive more remittances. Acosta Rangel and Caamal Olvera (2017) recently analyzed the effect of remittances on student engagement in Mexico using the synthetic panels technique, with data from the 2004 and 2008 ENIGH; through their study, they conclude that student engagement is to remain strong as long as the proportion of remittances is high, since these additional resources allow to continue investing in education, especially in highly marginalized homes.

Other works have tried to directly address the relationship between education and remittances, by studying the impact of migration on the education of migrant households, compared to households without migrants. Some authors report a positive relationship (Hanson, Robertson, & Spilimbergo, 2002; McKenzie & Rapoport, 2006), while others report a negative one (Bryant, Giorguli Saucedo, & Hernández Padilla, 2016).

The article is organized as follows: the first part describes the location of the study, the survey carried out, and the main results of the latter; the second part shows the empirical model estimated in the study which sets out the main results; the last part presents the conclusions of the study.

LOCATION OF THE STUDY, INSTRUMENT USED AND CHARACTERIZATION OF HOUSEHOLDS RECEIVING REMITTANCES IN CALTIMACÁN, HIDALGO

The community of Caltimacán, in Hidalgo, belongs to the municipality of Tasquillo, and is currently considered a source of high migration to the United States. Migration in this region even precedes the Bracero program from the 40s of the 20th century, which benefitted all of Mexico (Massey, 2016; Durand, 2016). Also, migration here grew exponentially in the early eighties of the last century.

According to Quezada Ramírez (2008), in the beginning the migrant population of Caltimacán mainly included men from 18 to 59 years old, who worked in different states of the United States, especially in construction, gardening and fieldwork activities. Typically, these are works carried out from February to November, and under contract. Over time, the population of Caltimacán has spread to 17 states of the United States; Texas occupies the first place, with 45.63% of migrants settled there; Indiana is second place, with 9.71%; Kansas is third place, with 5.83%; California is the fourth, with 4.85%; in fifth place are North Carolina, Florida, Tennessee and Virginia, with 3.88%; the rest of Caltimacán migrants are distributed, in order of importance, in Arizona, Chicago, Missouri, Pennsylvania, Arkansas, North Dakota, Maryland, Oklahoma, and Utah.

Quezada Ramírez (2008) argues that migration impacted the local economy in a positive way, by increasing the number of houses being built and, in general, has managed for Caltimacán (in Hidalgo) to reach only moderate rates of marginalization, below the state and national average (Quezada Ramírez, 2008). García Nájera (2017) shows that international

remittances have had different effects on households, mainly on the subjective well-being of the families of the locality we studied.

This study makes use of the International Remittance Reception in Caltimacán Hidalgo Survey (ERRICH, for its acronym in Spanish), which obtains information about migration, remittances and other social, economic and demographic characteristics of that population's households (García Nájera, 2017). The sample size of the ERRICH was calculated using the methodology proposed by Valdivieso Castellón and Valdivieso Taborga (2011) for proportions, which estimates the number of observations needed to have a representative sample. The survey must be conducted in a way that it can accurately represent the population receiving the remittances, contextualized for the studied location. To understand this argument, it should suffice to say that in 2017, 4.8% of households at the national level received remittances (Fundación BBVA, 2017), while in Caltimacán, that proportion was approximately 92% in 2010 (CONAPO, 2010). Given a 95% confidence interval and 10% sampling error, the sample size is 102 homes.

The questionnaire collected information regarding having relatives living in the United States, and about specific aspects of receiving remittances; subjects were asked: a) type of migrant in the home (recent migrant, circular migrant or definitive return migrant), b) if the migrant was the head of the household, c) number of migrants in the home, d) Remittance reception frequency (weekly, biweekly, monthly and bimonthly), and e) Total amount of the remittances received (less than $100 to more than $200 USD).

In the case of a *recent migrant*, they are defined as those who migrated 5 years before the survey (INEGI, 2010); for *circular migrants*, this is defined as migrants who somehow legally manage to come and go between the two countries (Alaminos, López Fernández, López Monzalve, Perea Crespo, & Santacreu, 2009); and in the case of *definitive return migrants*, they are the ones with international migrant experience who have permanently returned to Mexico.

The questionnaire also collected information on the expenses of families, containing household expenditure in seven items: a) food (food items), b) health (medicines and treatments), c) tuition fees, d) other expenses related to education (teaching materials and transportation to school), e) recreation and entertainment, f) housing maintenance (construction, gardening, plumbing and others), and g) helping relatives; the information on all these expenses was provided as a monthly expenditure sum in national currency.

This instrument captured information not only from households that receive international remittances, but also from those that do not have this income; it should be noted that the data collected for this study was provided by the person who was available at the time that the survey was conducted, although we mostly tried to interview the wives of the household heads. These are cross-sectional data collected between May 30, 2016 and July 28, 2016.

Table 1 shows statistical information on Caltimacán households, presenting some characteristics of households and classifying them according to the reception of remittances. The reception of international remittances in Caltimacán is important since, of all households, 81.6% receive this economic resource.

Caltimacán households have an average monthly expenditure of $8,300 MXN (Mexican pesos); households with remittances have an expenditure of $9,218 MXN, and households without remittances have an expenditure of $4,291 MXN; the difference between both variables is significant, at 1%. The average expenditure on education in Caltimacán is $1,911 MXN per month; households with remittances spend $2,239 MXN per month, while households without remittances spend $480 MXN per month; the difference is significant, at 5%. Table 1 shows that households spend 17% of their total expenditure on education. Households that receive remittances have a 19% expenditure on education; while households that do not receive remittances have an education expenditure of 8%. This difference is significant, at 5%. It is noteworthy that these differences only represent a positive association between education expenditures and remittances, because to determine a causal effect it is necessary to control by observed variables, as well as for other possible biases that exist when studying remittances (Adams, 2011).

Table 1. Descriptive Statistics, Caltimacán, Hidalgo, 2016

Variable	Total homes in Caltimacán	Households that receive remittances (1)	Households that do not receive remittances (2)	Significance level of the difference (1) and (2)
% of home remittances	81	100	0	NA
Total monthly household expenditure	8300.04 [5353.29]	9218 [5485]	4291 [1699]	1%
Monthly expenditure on education	1911.30 [3067.17]	2239 [3271]	480 [1181]	5%
% of expenditure on education	17 [0.21]	19 [0.21]	8 [0.2]	5%
Non-poverty index	0.92 [0.11]	0.94 [0.01]	0.81 [0.08]	1%
Risk aversion	0.47 [0.50]	0.43 [0.50]	0.63 [0.50]	NS
Life satisfaction	0.62 [0.49]	0.64 [0.48]	0.53 [0.51]	NS
Members	3.88 [1.26]	3.89 [1.20]	3.84 [1.54]	NS
% under 5 years old	20 [0.40]	14 [0.35]	42 [0.51]	1%
% children over 5 years old	43	47	26	NS

	[0.50]	[0.50]	[0.45]	
Household head's age	50.42	50.78	48.84	
	[17.54]	[16.54]	[21.83]	NS
Mother's age	38.25	39.80	31.53	
	[20.34]	[19.59]	[22.67]	NS
Household head's education	8.08	7.89	8.89	
	[3.50]	[3.58]	[3.07]	NS
Mother's education	7.91	8.10	7.11	
	[4.96]	[4.95]	[5.09]	NS
N	102	83	19	

Notes: N=102 homes. All values are weighted; standard error in parentheses.
Total household expenditure and education expenditure is measured in MXN (Mexican pesos). NA: Not applicable. NS: Not significant.
Source: Own elaboration based on data from ERRICH-2016.

Table 1 presents other characteristics of Caltimacán households, although not all of them can be applied for statistical analysis due to the number of observations; however, they are presented descriptively to achieve a better characterization of remittance-receiving households in Caltimacán, Hidalgo.

The non-poverty index, which is an indicator of the wealth of families and, therefore, of their objective well-being, marks that on average the families of Caltimacán have an index of 0.92 units; households that receive remittances have an index of 0.94 units; while households without remittances have an index of 0.81 units; the difference is statistically significant, at 1%. It should be noted that this result shows us that in Caltimacán remittance-receiving households are relatively richer than households that do not receive remittances.

The above clearly shows us a stage of the migration process in which households that have historically migrated to the United States under temporary migration contracts, clearly exceed in their wealth index those households that have not participated in the migration process. Table 1 also shows that the percentage of households with 5-year-old children is 20% in Caltimacán; the rate is 14% in households receiving remittances, and 42% in households not receiving remittances; this difference is significant, at 1%.

On the contrary, there are different variables in which no significant differences were observed. These variables are the risk aversion index, the life satisfaction index (INEGI, 2012), the average number of members in a household, the percentage of households with children over 5 years, the household head's age, the age of the mother, the household head's education, and the mother's education.

Table 2 shows a possible explanation on why education expenditures in households that receive remittances are higher than in households that do not receive remittances. Private education is more prevalent among households that receive remittances than in households that do not receive them. The data shows that households that receive remittances have higher enrollment rate in education at the three levels: elementary, high school and

university. Households that do not receive remittances only reported a single case of private high school education.

Table 2. Number of Students According to Level of Education
and Type of School in Caltimacán, Hidalgo, 2016

Education level	Public Do not receive remittances	Receive remittances	Private Do not receive remittances	Receive remittances
Elementary	5	32	0	13
High school	0	18	1	6
University	1	8	0	8
Total	6	58	1	27

Source: Own elaboration based on data from ERRICH-2016.

The survey asked only the amounts of remittances and their frequency of reception in the form of ranges, as presented in Table 3. Most households reported receiving weekly remittances, while the second frequency shows biweekly reception.

For all frequency groups, the common reception amount is more than $180 USD, except for the group that receives biweekly remittances for whom it is normal to receive between $105 and $170 USD. By means of the frequencies and amounts received, an average remittance of $450 USD per month was estimated. These remittance amounts are below the ones estimated by BANXICO (2018). To reduce the possible measurement error of the amount of remittances, the variable that defines whether or not households receive remittances is used.

Table 3. Frequency and Amounts of Remittances, Caltimacán,
Hidalgo, 2016

Amounts/Frequency	Weekly	Biweekly	Monthly	Bimonthly
50 to 75	2%	2%	0	0
80 to 100	5%	5%	22%	0
105 to 175	41%	58%	22%	0
More than 180	51%	32%	55%	100%
N	39	34	9	1

Source: Own elaboration based on data from ERRICH-2016.

EMPIRICAL MODEL AND RESULTS

In the empirical model, the dependent variable is the proportion of total education expenditure; it is proposed as a function of receiving remittances and a set of variables that seek to control by the ability to generate income at home, as well as other characteristics that can help determine the tastes, preferences and needs of education expenditure that exist.

There are variables that directly measure the impact of investment in education such as student engagement, school attendance or school performance of household members, among others. In this study, the proportion of expenditure on education is measured, which is considered as an indirect measure of household investment in human capital, because it measures the intention of households to increase their knowledge (Fermoso, 1997), and/or accumulate more investment in education (Bendfelt, 1992), and/or increase the productivity/quality of their children (Becker, Murphy, & Tamura, 1990), and/or increase their quality of life (Bustamante, 2003; Martínez, 2006) to the extent that education is associated with the level of subjective well-being (Watanabe & Yasuko, 2005).

This estimation seeks to find an Engel equation, without having information on prices and in which it is desired to reduce the possible endogeneity and inverse causality that can occur when including income (Adams & Cuecuecha, 2010). No attempt is made to estimate the marginal proportions of income that are proposed to be estimated in Adams and Cuecuecha (2010), because the number of observations necessary to establish an estimate as a system of equations is not available. Specifically, we estimated the following equation:

$$lped_i = b_0 + b_1 rem_i + b_2 jefeduc_i + b_3 indnocar_i + b_4 mayor5_i + b_5 riesgo_i + b_6 actitud_i + v_i$$

$$(1)$$

Where the logarithm of the proportion of expenditure at the household level is *lped*; *rem* is 1 if the household receives remittances, 0 otherwise; the *jefeduc* variable is the school level of the head of the household, and is included in order to measure the ability of the household to generate income (Becker, 1964), as well as to measure the possible knowledge, attitudes and expectations that parents may have in terms of educating their children (Sawyer, 2015). The *mayor5* variable measures the number of children older than 5 years old and younger than 14 years old in the family; it is included to establish if the family has children of school age. It is used both to record the family's needs to spend on education, and to record the decisions of quantity (number of children) versus quality (education expenditure) made in the household (Becker, 1983).

The *indnocar* variable is a non-poverty index that seeks to measure the objective well-being of the family, in order to measure the relationship that human capital has with the quality of life (Becker, Murphy, & Tamura, 1990; Bustamante, 2003; Martínez, 2006). It was considered that by including a measurement of non-poverty in the household, it would

be possible to measure part of the objective well-being of families; for this, the criteria for the multidimensional measurement of poverty in Mexico were followed (CONEVAL, 2009).

The *actitud* variable measures the attitude towards life, which seeks to measure the degree of satisfaction of families, associating it with the levels of happiness for achievements in life, which are associated with subjective well-being (Watanabe & Yasuko, 2005); this variable is related to the state of health, economic situation, sociodemographic aspects and intergenerational progress, as measured by the Self-Regulated Welfare Module, Subjective Well-being (INEGI, 2012). Finally, the model contemplates the *riesgo* variable intended to measure the risk aversion of families, which is known to be a factor that can affect the investment decisions of families.

It is important to mention that the coefficient of interest in this estimation is the parameter b_1, as it represents the effect of remittances on investment in education. Since the equation of the proportion of expenditure on education is in logarithms, the coefficients of the equation can be interpreted as elasticities. This will be done throughout the explanation of results.

The estimation of this parameter faces different challenges; the first is the number of observations in the sample, which in turn limits the number of variables to be used and makes certain econometric methodologies unfeasible (Adams & Cuecuecha, 2010). The second refers to the studies conducted on remittances with cross-sectional data, such as (Adams, 2011):

1) The simultaneity that exists between the decision to migrate and the decision to send remittances, as well as with other decisions such as investing in education, and fertility;

2) Self-selection of migrants and remittance recipients since not all families send migrants or receive remittances;

3) The reverse causality that may exist between the decision to invest in education and the reception of remittances, and

4) The occurrence of an omitted variable bias due to the complexity of the decisions that households make. Among the omitted variables are the expectations parents have about the education of their children, the investment in non-monetary expenditure parents make in their children, such as reading time or help with homework.

The third problem is the truncation caused by the fact that households that no longer have school-age children have no expenditure in education. A fourth problem is the potential measurement bias, which has to do with the fact that the survey was mostly answered by whoever was at home, most of them women, which can generate a bias if they do not know factual information.[3]

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[3]The authors thank an anonymous arbitrator for highlighting this potential measurement bias.

To solve the problems of endogeneity, possible inverse causality, omitted variables, and measurement error, the *instrument variables* represent a solution to the extent that it finds one or more variables correlated with the reception of remittances, but not with those not observable in the equation. Achieving the above requires an empirical strategy, which is presented below.

As explained, each household in Caltimacán was interviewed and specifically asked for the geographical location where their relatives work in the United States of America. With this information, we obtained the level of employment, as well as the job creation rate in that state from 2010 to 2016. For households without migrants, the average job creation was calculated in the 17 states of the United States, where the population of Caltimacán is working, which were specified in the first section of this article. Given that the above results in the instruments being equal for two observations, households that do not have family members in the United States, and households in which migrants are located in the same state of the United States, employment variables are multiplied by the square of the age of the household head. Information on employment was obtained from the *United States Department of Labor, Bureau of Labor Statistics* (2016).

The existence of a statistically significant correlation between employment in the U.S. labor market and the reception of remittances is explained by the fact that labor activity in this market can increase the amount of population from Caltimacán that is working in the United States, the hours they work, as well as the hourly wage, which probably means that migrants have more resources to send in the form of remittances. This link between sending remittances to Mexico and the labor market in the United States comes from the relationship between the labor market in the United States and the migration of Mexicans to that country, which has been demonstrated in the literature available on the subject (Rendón & Cuecuecha, 2010; Cuecuecha & Rendón, 2012).

To ensure that employment in the United States only influences the receipt of remittances, and not the education expenditure equation, it is proposed to follow the strategy of Adams and Cuecuecha (2010, 2013). This identification strategy is based on the one used to identify dynamic panel data models (Arellano & Bond, 1988).

This technique is based on assuming that the impact of employment in the United States on the education expenditure equation only lasts four years; however, the impact of employment in the United States on the reception of remittances lasts at least six years. To determine the number of lags to be included in the equation, the principle of seeking the highest Cragg-Donald statistic was followed, as well as the specification respecting the Anderson and Sargan statistical tests (Adams & Cuecuecha, 2010).

The Cragg-Donald test allows to verify that the instruments are not weak, which implies that the bias generated by using an instrument is less than the reduction in bias that is achieved by solving the problem of endogeneity (Cragg & Donald, 1993). The Anderson

statistic allows verifying that the estimated model is not under-identified; that is, the matrix of instruments is of greater range than the number of equations that we want to estimate, in our case, an equation. Hansen's J statistic makes it possible to determine if the lags included as surplus instruments are in fact orthogonal to the residuals in the expenditure equation. Statistical tests and estimation with linear instruments were performed using a routine developed by Baum, Schaffer, and Stillman (2007).

By choosing the instrument combination obtained by the highest Cragg-Donald, the use of the instrument subspace that generates the most information related to the estimation bias inherent to the use of instruments is guaranteed, which in turn also guarantees that such subspace is a valid set of instruments and identifies the expenditure equation (Cragg & Donald, 1993).

The model to be estimated with instrument variables is presented in the equation (2):

$$
\begin{aligned}
lped_i = b_0 &+ b_1 rem_i + b_2 jefeduc_i + b_3 indnocar_i + b_4 mayor5_i + b_5 riesgo_i \\
&+ b_6 actitud_i + b_7 empEU_{2013} + b_8 empEU_{2014} + b_9 empEU_{2015} \\
&+ b_{10} empEU_{2016} + \sigma E[v_i|\ lped_i > 0] + u_i
\end{aligned}
$$

$$(2)$$

Equation (2) includes the $\sigma E[v_i|\ lped_i > 0]$ element that corrects for the truncation of equation (1). Similarly, the $empEU_{2016}$ and $empEU_{2013}$ variables are included, which are associated with the job creation rate the United States from 2013 to 2016. They were introduced under the argument that by conditioning the rates of job creation in the U.S. in 2010, the square of job creation in 2010 and the square of job creation in 2011 function as instruments for the reception of remittances at home.

In exploratory estimations made by the authors, the level of employment in the U.S. in 2012 was introduced. However, the Cragg-Donald statistic reduced its value and therefore it was decided to exclude said variable from both the set of instruments and the set of control variables. The explicit assumption mentioned above is illustrated in the equation (3):

$$
cov\ (empEU_{2010}, v_{2016}\ |\ empEU_{2016}, \dots, empEU_{2013}, x) = 0
$$

$$(3)$$

A similar assumption is made for the other two instrument variables. This equation does not include macroeconomic information for Mexico because all observations belong to the same locality and therefore all of them are subject to the same national shocks. On the contrary, the fact that each household has family members in different parts of the United States implies that each household is exposed to different regional shocks in the United States. The equation used to estimate the reception of remittances is then the following:

$$rem_i = \alpha_0 + \alpha_1 jefeduc_i + \alpha_2 indnocar_i + \alpha_3 mayor5_i + \alpha_4 riesgo_i + \alpha_5 actitud_i$$
$$+ \alpha_6 empEU_{2010} + \alpha_7 empEU_{2010}{}^2 + \alpha_8 empEU_{2011}{}^2 + \alpha_9 empEU_{2013}$$
$$+ \alpha_{10} empEU_{2014} + \alpha_{11} empEU_{2015} + \alpha_{12} empEU_{2016} + \varepsilon_i$$

(4)

Where the included lags, as well as the decision to include them linear or quadratic, was made following the principle of achieving the highest Cragg-Donald statistic.

To address the problem of possible simultaneity in the household head's education, it was decided to make estimations in which said variable is replaced by the mother's education, as well as estimations in which the household head's education is excluded. Likewise, it was decided to estimate specifications excluding the variable related to the presence of children older than 5 years ($mayor5$), since non-linear models (Tobit) showed that this variable reduces the validity of the instruments, which is evidence that the presence of children older than 5 years is a very likely endogenous variable.

Finally, estimations were made in which the logarithm of household expenditure was included. This allows identifying if investment in education is modified proportionally with income —which occurs in expenditure functions derived from demand functions with grade one homogeneity in income—, or if the proportion of expenditure does not vary proportionally to income. This situation can arise if, as income increases, individuals spend proportionally more on education (education is a luxury good), or if, as income increases, education expenditure grows less than proportionally to income (education is an inelastic good with respect to income).

RESULTS

Table 4 shows the results of estimating a simplified version of *equation* 1, as well as different versions of *equation* 2. A relationship is raised between the logarithm of the education expenditure fraction and the reception of remittances, controlled by education, risk aversion and life satisfaction. Column 1 of Table 4 presents the model of ordinary least squares (OLS) including only the variable remittances at home. A positive association is found between remittances and the education expenditure fraction. In particular, the result implies that households that receive remittances have a 0.81% expenditure fraction greater than the expenditure fraction of households without remittances.

Column 2 of Table 4, presents the same estimate using the Tobit model, which controls the fact that not all households have education expenditure. The positive association is maintained, and it is estimated that households that receive remittances have a 0.30% higher education expenditure ratio than households without them. Column 3 of Table 4 includes in the estimation the variables of risk aversion and life satisfaction, obtaining qualitatively

similar results. This implies that the effect found cannot be explained by elements of risk aversion or subjective well-being.

Table 4. Estimates for the Logarithm of Education Expenditure, Caltimacán Hidalgo, 2016

Variable	OLS	Tobit	Tobit	Tobit	Tobit
Household Remittances	0.810* [0.437]	0.299** [0.136]	0.272** [0.140]	0.315** [0.147]	0.251* [0.148]
Household head's education				0.029** [0.014]	
Mother's education					0.020** [0.011]
Risk aversion			-0.157 [0.110]	-0.130 [0.115]	-0.172 [0.118]
Life satisfaction			-0.026 [0.110]	-0.025 [0.114]	-0.038 [0.119]
Constant	-2.336*** [0.423]	NA	NA	NA	NA
N	63	102	102	102	102
Adjusted R^2	8.9%	NA	NA	NA	NA
Pseudo R^2	NA	1.73%	2.9%	3.7%	3.7%

Notes: Standard errors in square brackets. ***Significant at 1% **Significant at 5%. * Significant at 10%. NA: Not applicable.
Source: Own elaboration based on data from ERRICH-2016.

Similarly, columns 4 and 5 include in the estimate the household head's education and the mother's education, without qualitatively altering the results, since a positive association between remittances and the education expenditure fraction is obtained, with a marginal effect between 0.25% and 0.32%. In column 4 of Table 4 it can be seen that the father's education turns out to be statistically significant, and implies that 1% increase in the father's education generates a 0.03% increase in the education expenditure fraction.

Column 5 of Table 4 shows that the mother's education is statistically significant, and implies that 1% increase in the mother's education increases the education expenditure fraction by 0.02%. In all cases shown in Table 4, the variance explained by the models is small, ranging between 1.7% and 8.9%.

Table 5 presents estimates of the model in its Tobit version. It includes one by one the variables found in the analysis, which can explain the association observed between remittances and the education expenditure fraction. Column 1 of Table 5 includes, in relation to column 5 of Table 4, the non-poverty index. By including this variable, all variables become non-significant, but the degree of variance explained is maintained at the levels reported in Table 4. This suggests that the non-poverty index has a high correlation with the rest of the variables included in the regression.

In column 2 of Table 5, in relation to the fifth column of Table 4, only the logarithm of expenditure is added. This also causes the association between remittances and the fraction of household expenditure to become non-significant. Household expenditure is significant at 1% and implies that a 1% growth in household expenditure generates a 0.56% increase in the education expenditure fraction.

Column 3 of Table 5 includes, in relation to column 5 of Table 4, the children older than 5 years variable. The result is that the association between remittances and the education expenditure fraction is also lost. Households that have children older than 5 years have an education expenditure fraction 0.56% higher than households without children older than 5 years. In both columns, it is possible to explain about 10% of the variance observed.

Column 4 of Table 5 presents the estimate with all the variables presented in equation 3. The result that there is no association between remittances and the fraction of household expenditure is maintained, as well as the statistical significance of the logarithm of expenditure and the children older than 5 years variable.

These results have several implications. The first is that there are restrictions on access to credit in Caltimacán, Hidalgo, which are expressed by the fact that having school-age children forces families to spend more on education. Remittances help to reduce these credit restrictions, allowing Caltimacán households to pay their education expenses, as expected by the New Economics of Labor Migration (Stark & Bloom, 1985).

This result is verified, since the inclusion in the estimation of household income and a variable associated with wealth also explains the association observed between remittances and the fraction of expenditure on education. A second implication is that access to credit is most likely associated with total household expenditure, as it verifies that when the expenditure variable is present, there is no significant coefficient for the non-poverty index variable. This result is probably explained by the fact that formal financial services in Caltimacán are scarce. Although, most likely, the existing credit available to the population operates through informal mechanisms based on the observation of the expenditure levels of Caltimacán households.

Table 5. Marginal Effects for the Logarithm of Education Expenditure, Tobit Models

Variable	With wealth	With logarithm of expenditure	With fertility	With wealth, expenditure and fertility
Home Remittances	0.206 [0.144]	-0.032 [0.171]	0.238 [0.149]	-0.123 [0.178]
Children over 5 years old			0.560*** [0.107]	0.616*** [0.109]

Total household expenditure		0.487***		0.544***
		[0.115]		[0.157]
Non-poverty index	Yes	No	No	Yes
Risk aversion and life satisfaction	Yes	Yes	Yes	Yes
Pseudo R^2	2.7%	8.6%	10.7%	17.6%

***Significant at 1%. **Significant at 5%. *Significant at 10%.
Source: Own calculations based on ERRICHH-2016.

It is just as important to note that the result contrasts with that found by Adams and Cuecuecha (2010), which shows that in Guatemala there is a positive impact of remittances on the education expenditure fraction. This result may be associated with the nature of the Caltimacán migration, as many of the migrants work abroad for many years under temporary employment contracts, allowing them to see increases in the household income as permanent.

Likewise, temporary employment contracts allow migrants to keep permanent contact with Caltimacán's society; in this way, their expenditure patterns simply adjust to their current level of income, and observationally maintain expenditure patterns similar to households that do not receive remittances and that have similar income levels to them. This would explain why, from a theoretical point of view, remittances are fungible with the rest of the income in Caltimacán, Hidalgo.

Table 6 shows the estimate of the remittance equation (equation 4) under two versions and two types of models. First, the estimate is presented by means of linear models and Tobit models. A version of equation 4 is presented, in which the logarithm variables of expenditure, non-poverty index and children older than 5 years are excluded from the estimation. In the second version, all variables are included for the linear model, except for children older than 5 years; this is because the validity analysis of instruments for the Tobit model rejects the fact that the children older than 5 years variable can be included in the equation. For consistency, in the linear model, it was decided to present the estimate excluding said variable. It is important to mention that this demonstrates that in Caltimacán children older than 5 years are already at risk of migrating to the United States, to the point that their presence in Caltimacán is associated with labor market movements in the United States.

The first column of Table 6 excludes the variables of education, wealth and expenditure. This column shows that all instruments —employment in the U.S. in 2010, the employment square in the U.S. in 2010 and the employment square in the U.S. in 2011— are statistically significant, at 1%. The employment variables that allow us to control for the contemporary correlation between the education expenditure fraction and employment in the U.S. —

employment in the U.S. in 2013, employment in the U.S. in 2014, employment in the U.S. in 2015, and employment in the U.S. in 2016— are statistically significant, at 1%, with the exception of employment in the United States in 2016, which is not statistically significant. The first stage model can explain 73% of the variation observed in the reception of remittances in Caltimacán.

The previous result is very important because in preliminary analyses it was found that there is a high correlation between employment variables in the U.S., above 0.9%. This data does not prove multicollinearity, because in multivariate models the simple correlation is no longer informative (Klein, 1962). The multicollinearity problem is characterized by generating a matrix of covariances with a high condition value, as well as by generating a biased variance estimate (Maddala, 1996). This generates a high R^2 but many small Student t coefficients.

However, it is important to mention that the Stata 15 package was used, which is characterized by algorithms that are robust to multicollinearity. The fact that highly significant parameters and a high R^2 are obtained in the estimate shows that the estimates are not affected by the multicollinearity problem.[4]

Table 6 also shows us that the instruments identify the remittance equation, since the Anderson test is rejected at 1%; it shows us that the instruments that over identify the remittance equation are exogenous in relation to the errors of the education expenditure fraction equation, as Hansen's J test does not reject the hypothesis of exogeneity of instruments. Finally, Table 6 also shows us that the instruments are not weak, because the Cragg-Donald test indicates that the coefficients have a relative maximum bias of 5% and a maximum bias of 10% (Stock & Yogo, 2005). The second column of Table 6 shows the results of equation 4 when including the variables of household head's education, the mother's education, the logarithm of expenditure and the non-poverty index.

The instruments are all statistically significant and the model manages to explain a 76% variation in the remittance equation; Anderson's test rejects that the remittance equation is under identified; Hansen's J test shows that the equation is over identified; and the Cragg-Donald test shows that there is a relative maximum bias of 5%. The only change in relation to column 1 of the same table is that the Cragg-Donald test is below the value that indicates a maximum bias of 10%. This implies that this equation may have a maximum bias slightly greater than 10%.

The third column shows the results of estimating the model using a Tobit and the instruments, as well as excluding education, logarithm of expenditure and wealth. All

[4]We would like to thank an anonymous evaluator, who warned us about the need to evaluate the possible presence of multicollinearity. Results on correlations between employment variables are available and can be requested to the authors.

employment variables in the U.S. are significant, at 1%, except for employment in the U.S. in 2016, which is significant at 10%. For this nonlinear model, the tests that are appropriate to use (Finlay & Magnusson, 2009) are the conditional likelihood-ratio (CLR), the Anderson-Rubin's statistic, the Lagrange Multiplier (LM) and the LM-J's statistic. In all cases, the null hypothesis that the bias generated by the use of instruments is zero is tested. Column 3 of Table 6 shows that in all cases the null hypothesis is not rejected, and so the strength of the instruments is confirmed. The fourth column of Table 6 shows the estimate of equation 4, including all the variables of the model. All results are qualitatively similar to those mentioned in the third column of the same table.

Table 6. First Stage Results, Reception of Remittances in Households

Variable	Excludes education, wealth and expenditure	With education, wealth and expenditure	Excludes education, wealth and expenditure	With education, wealth and expenditure
Risk aversion and life satisfaction	Yes	Yes	Yes	Yes
Employment creation in the U.S. in 2010	2.90E-06***	3.25E-06**	4.65E-06***	4.81E-06***
	[1.12E-06]	[1.37E-06]	[8.20E-07]	[9.59E-07]
Employment creation in the U.S. in 2010 ^ 2	-1.51E-12***	-1.45E-12***	-1.59E-12***	-1.53E-12***
	[2.63E-13]	[2.86E-13]	[1.42E-13]	[1.61E-13]
Employment creation in the U.S. in 2011 ^ 2	1.48E-12***	1.41E-12***	1.56E-12***	1.50E-12***
	[2.55E-13]	[2.78E-13]	[1.38E-13]	[1.57E-13]
Employment creation in the U.S. in 2013	1.68E-05***	1.45E-05**	1.17E-05***	1.03E-05***
	[5.12E-06]	[5.56E-06]	[2.80E-06]	[3.04E-06]
Employment creation in the U.S. in 2014	-4.33E-05***	-3.97E-05***	-3.89E-05***	-3.68E-05***
	[1.06E-05]	[1.18E-05]	[6.24E-06]	[6.71E-06]
Employment creation in the U.S. in 2015	2.54E-05***	2.37E-05***	2.46E-05***	2.40E-05***
	[6.94E-06]	[8.13E-06]	[4.78E-06]	[5.27E-06]
Employment creation in the U.S. in 2016	-6.81E-07	-6.27E-07	-7.56E-07*	-8.25E-07*
	[4.78E-07]	[6.25E-07]	[4.12E-07]	[4.66E-07]
Constant	1.167***	0.487	1.298***	0.875*
	[0.110]	[0.718]	[0.106]	[0.469]
Model	Linear	Linear	Tobit	Tobit
R^2 centered	73.7%	76.5%	NA	NA
Anderson Chi^2(3)	81.2***	52.1***	NA	NA
Cragg-Donald F test	46.4[a]	21.01[a]	NA	NA
Hansen J Chi^2 (2)	0.71	0.37	NA	NA

Conditional Likelihood-Ratio (CLR)	NA	NA	0.17	1.43
Anderson-Rubin	NA	NA	0.17	1.43
Likelihood Multiplier (LM)	NA	NA	0.17	1.43
LM-J statistic	NA	NA	NR 5%	NR 5%

***Significant at 1%. **Significant at 5%. *Significant at 10%. ª5% value for maximum relative bias 13.91; 10% value for maximum bias 22.30 (Stock & Yogo, 2005). NA: Not applicable. NR: Hypothesis not rejected at 5%.
Source: Own calculations based on ERRICHH-2016.

Table 7 shows the results for the logarithm equation of the education expenditure fraction, that is, the instrumented results. The first column of Table 7 presents the results of the linear model. Remittances are statistically significant and remittance-receiving households have an education expenditure fraction 1.04% higher than that of households without remittances. This coefficient is greater than that found in the linear model and in the Tobit model. The model can explain 14% of the variation observed in the data.

The second column of Table 7 shows the estimate of equation 4 including all variables. The impact of remittances disappears and it is found that the mother's education and household expenditure are the only statistically significant variables. A 1% increase in the mother's education generates a 0.05% increase in the education expenditure fraction. A 1% increase in household expenditure increases the education expenditure fraction by 0.60%.

The third column of Table 7 shows the estimate excluding education, wealth and expenditure. Again, the results show that households that receive remittances have an education expenditure fraction that is 0.36% higher than that of households with no remittances. This parameter is less than the estimate using linear models, but greater than the estimate without instruments. This implies that the truncation in the data generates an upward bias in the estimated parameter, while the non-instrumentation generates a downward bias in the estimated parameter. The model is statistically significant, at 1%.

Table 7. Linear Models (Coefficients) and Tobit Models (Marginal Effects)
for Education Expenditure

Variable	Excludes education, wealth and expenditure	With education, wealth and expenditure	Excludes education, wealth and expenditure	With education, wealth and expenditure
Household Remittances	1.040** [0.453]	0.313 [0.525]	0.364*** [0.137]	0.049 [0.230]
Father's education		-0.030 [0.032]		-0.002 [0.020]
Mother's education		0.046* [0.028]		0.022 [0.015]
Total household expenditure		0.602**		0.473***

		[0.290]		[0.121]
Includes non-poverty index	No	Yes	No	Yes
Includes risk aversion and life satisfaction	Yes	Yes	Yes	Yes
Employment creation in the U.S. from 2013 to 2016	Yes	Yes	Yes	Yes
Constant	-3.014**	-7.609***		
	[0.543]	[2.311]	NA	NA
Model	Linear	Linear	Tobit	Tobit
R^2 centered	13.8%	25.7%	NA	NA
Wald Chi^2	NA	NA	12.3*	42.9***
N	63	63	100	100

***Significant at 1%. **Significant at 5%.

Source: Own calculations based on ERRICHH-2016.

The fourth column of Table 7 shows the estimate of equation 4 without including the children older than 5 years variable. Again, the impact of remittances disappears and only household expenditure is statistically significant. In particular, it is found that a 1% increase in household expenditure generates a 0.47% increase in the education expenditure fraction. The model is significant at 1%. These results confirm that the effect of remittances is associated with credit restrictions, which remittances help to reduce (Stark & Bloom, 1985). Similarly, they show that Caltimacán households that receive remittances adjust their spending patterns to levels similar to those of households with similar incomes, regardless of whether the income comes from remittances or not.

CONCLUSIONS

The results show that households that receive remittances have a higher proportion of expenditure on education; however, the above is explained by the greater existence of children older than 5 years in remittance-receiving households, which shows that there are credit restrictions in the studied community, since having school-age children can explain the differences in expenditure between households with and without remittances. In addition, it is found that the effect of remittances can also be explained by the non-poverty index; that is, the wealth of families, as well as the logarithm of household expenditure by the level of household income.

This confirms that there are credit restrictions in Caltimacán, Hidalgo, and allows us to see that access to credit is linked to income levels, and not to wealth levels, since by introducing both variables of wealth and expenditure at home, only the second maintains its statistical significance.

These results imply that the reception of remittances works as a strategy to avoid credit restrictions (Stark & Bloom, 1985) and that they can probably generate inequality issues in

the community since the reception of remittances increases the levels of income and access to credit in the community. Likewise, the results also support the hypothesis that education expenditure varies in proportion to income; and so, remittances, beyond increasing income, have no further additional effect, which would come to show that household income is fungible.

This result may be due to the nature of migration in the studied community, which is primarily legal via temporary contracts, as well as the maturity of migration in the locality, since almost all the inhabitants have relatives in the United States. These facts cause Caltimacán's population to assume their income increases as permanent, and then simply adjust their levels of education expenditure according to their income levels. This result contrasts with what was found in other studies (Adams & Cuecuecha, 2010; Sawyer, 2015) and confirms what was found by Kandell and Massey (2002) about the importance of the particular context being studied.

This study has other important implications that resulted from being a local level study. The first is the identification of the places where migrants work in the United States, which allowed the construction of instruments with a variation at the household level and not at the community level, as in other studies (Adams & Cuecuecha, 2010). The second is that it shows the relevance of the specific characteristics of migration in the studied locality, necessary to understand the effects of remittances. The third is to demonstrate the importance of specific studies at a local level with a sufficient number of observations to make quantitative estimates. One of the limitations of the present study is that it is not a longitudinal database, which would be advisable given the dynamic nature of the migration process, and the investment in education.

Finally, it is important to mention that having more knowledge about the effort made by the population of Caltimacán in migrating and maintaining the investment in education, allows us to recognize the contribution of migrants in the improvement of human capital, well-being and quality of life in their country of origin.

Translator: Fernando Llanas

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