DISCUSSION PAPER SERIES

IZA

IZA DP No. 9494

Regional Migration, Insurance and Economic Shocks: Evidence from Nicaragua

Teresa Molina Millán

November 2015

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Regional Migration, Insurance and Economic Shocks: Evidence from Nicaragua

Teresa Molina Millán
Universidade Nova de Lisboa
and IZA

Discussion Paper No. 9494
November 2015

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 9494
November 2015

ABSTRACT

Regional Migration, Insurance and Economic Shocks: Evidence from Nicaragua*

To test whether transfers sent and received by regional migrants serve an insurance role, this paper estimates the causal impact of income shocks at a migrant's origin and destination location on the bilateral transfer of funds. Using rainfall shocks in rural Nicaragua, I find that migrants aged 15-21 years provide unilateral insurance to their origin household. Distinguishing by destination and economic activity I show that the level of insurance increases when migrants and households are exposed to less correlated shocks. In addition, I find evidence of bilateral insurance among rural migrants exposed to rainfall shocks with low levels of correlation with respect to shocks occurring at origin.

JEL Classification: O12, O15, F24, R23

Keywords: internal migration, remittances, risk, insurance, inter-households transfers, weather shocks

Corresponding author:

Teresa Molina Millán
NOVA School of Business and Economics
Universidade Nova de Lisboa
Campus de Campolide
1099-032 Lisboa
Portugal
E-mail: teresa.molina@novasbe.pt

* I am grateful to Karen Macours for her insightful suggestions on this project. I will also like to thank John Maluccio, Luc Behaghel, Joachim De Weerdt, Hillel Rapoport, Kalle Hirvonen, Tania Barham and participants at XX Lacea Annual Meetings, PhD Workshop on the Economics of Migration at Southampton, Northeast Universities Development Conference 2014, Oxford University Development Workshop, and at the Paris School of Economics workshops for their comments. I am thankful to Thomas W. Dickinson for all his support and assistance in GIS. I gratefully acknowledge the financial support of DIMeco Ile-de-France, of the Inter American Development Bank, Initiative for International Impact Evaluation (3ie: OW2.216), and National Science Foundation (SES 11239945 and 1123993) for data collection and preparation. All errors are my own.

1 Introduction

Rural households in developing countries are exposed to many kinds of risk. In a context characterized by limited access to credit and insurance markets, households have developed a range of different strategies to cope with and manage adverse economic shocks (Rosenzweig and Wolpin, 1993; Morduch, 1995; De Weerdt and Dercon, 2006). But, some of these strategies offer little protection in case of shocks affecting almost everybody in a local area, as it happens with weather shocks. Moreover, adverse weather events in developing countries are predicted to increase due to climate change (WorldBank, 2013), increasing households' exposure to covariate shocks. In order to handle this type of shocks, households may rely on a network of relatives extended beyond the borders of their community or village.

To investigate whether the transfer of funds between long-term migrants and their origin households has an insurance role, this paper estimates the causal impact of income shocks on transfers from the migrant to the household of origin (henceforth, "remittances") as well as transfers from the origin household to the migrant (henceforth, "transfers") in rural Nicaragua. While the recent literature has focused on the insurance role of remittances from international migrants, this paper looks at regional migration. Regional migration, understood as the sum of domestic and south to south migration, includes rural and urban migrants and is more common than international migration in poor-rural areas, especially among young adults. While international migration to developed countries, is expensive and risky (de Brauw and Carletto, 2012), young adults frequently move regionally, to close and distant locations for work or family reasons.

This paper uses data on migrant's location to simultaneously examine exogenous income shocks at origin and destination and to look at the efficiency of the insurance mechanism at different levels of income correlation. I use a two-agent risk-sharing model to show that inter-household transfers are a function of income uncertainty at both locations. While risk-pooling will be more efficient when a network's income is less correlated, large distances among network members may increase information and enforcement cost.

Under the assumption that migrants and their origin households are risk averse but incur different risks at different times, the New Economics of Labor Migration (NELM) predicts that remittances should be highest when recipients are exposed to income shocks. This hypothesis has been tested in several studies (Lucas and Stark, 1985; De la Briere et al., 2002; Cox et al., 1998; Gubert, 2002), which rely on household data and on regional proxy for the identification of income shocks rather than data on exogenous shocks.[1] In the last decade, a strand of the new experimental literature on migration has focused on understanding the role of remittances as an instrument to cope with economic shocks. These studies focus on exogenous shocks which have a credible impact on household income to estimate adjustment on the flow of remittances. Clarke and Wallsten (2003) and Yang and Choi (2007) find that international remittances increase when households in the country of origin are exposed to adverse weather events. At the country level, Yang (2008a) finds that for the poorest developing countries hurricanes lead to increases in migrants' remittances, which account for 20 percent of experienced damages. Looking at long-distance internal migration, Gröger and Zylberberg (2015) provide evidence on the insurance role of internal remittances from labor migrants in the aftermath of a strong typhoon in Vietnam.

These studies are focused on how remittances, usually from oversea, adjust to income shocks at migrants' original community, while few studies look at how remittances are affected by exogenous shocks at destination. Yang and Martínez (2005) and Yang (2008b) analyze how outcomes in non-migrating household members in Philippines react to different variations of international exchange rates. They find that exogenous increases in migrant resources have positive effects on investment outcomes in the household of origin, suggesting a positive income effect on the amount of remittances sent.

This paper contributes to this literature by looking at a different pool of migrants and by analyzing the presence of bilateral insurance arrangements between migrants and their origin households. The empirical strategy breaks down the net effect of rainfall shocks on the flow of transfers, into an income and an insurance component, and identifies the mechanisms behind the insurance agreement. This paper also relates to De Weerdt and

[1] See Docquier and Rapoport (2006) for a model on the remittance sending decision and Yang (2011) for a review of the literature on remittances dimensions.

Hirvonen (2013) who examine how income shocks and household consumption co-vary across linked households in Tanzania. They find that internal migrants share about 2.7 percent of their consumption growth by insuring family members at their original location, but they do not find evidence of bilateral insurance. My analysis differs by focusing on the actual flows of transfers between households and migrants, which allows me to understand the mechanism behind the risk-sharing arrangement.

To test the insurance role of transfers this paper uses two rounds of data from a household survey implemented in rural communities in Nicaragua (2000 and 2010) in which regional migration is large [2] and rain-fed agriculture is the main income source among non-migrating households. The analysis is focused on young migrants aged 15-21 in 2010. This cohort comprises the ages in which important life transitions -finishing school, beginning work, getting married, leaving home- occur in developing countries. The realization of this transition may bring with it some risks and uncertainties which affect the economic relationship with other household members. Even if it represents a young cohort, around 85 percent of the migrants in this cohort is working in 2010 and 50 percent has an off farm income source.

The sample of migrants were long-term household members prior to migration and they were intensively tracked during the follow-up survey in 2010 and interviewed at their new location. To analyze whether the effect varies over the life cycle I extend the analysis to older migrants, 22 to 30 years old, from whom I have reported information by the origin household on migrant's location. The sample of migrants is divided into local and non-local migrants, being local migrants those exposed to the same weather shock as their origin household, while non-local migrants those exposed to different ones.

The results show that while transfers between local migrants and their origin household do not adjust in face of rainfall shock, remittances received from non-local migrant compensate for 10 percent of the reduction in household agricultural income. This amount is far from full insurance, but it shows the prevalence of informal risk-sharing arrangements beyond the community level in line with the findings in the literature focused on

[2] Fifty percent of the households in the original communities have at least one long-term migrant in 2010 and only 2.5 percent of those are international migrants

international remittances. By type of destination, this paper finds that urban migrants unilaterally insure their household of origin, while average rural migrants neither provide nor receive such insurance. The lack of insurance among rural migrants is explained by high levels of correlation between shocks at origin and at destination. When the difference between the intensity of rainfall shocks increases, rural migrants provide insurance to their origin household. Moreover, they also receive insurance from their origin household, although as differences in rainfall intensity between locations increase the implementation of such an insurance mechanism weakens. This result points to the existence of a bilateral insurance arrangement, but it also indicates a trade-off between the level of correlation among rainfall shocks and the access to information on migrants' economic situation. Finally, this paper finds that exogenous reductions in income coming from rainfall shocks at origin reduce transfers receipts by non-local migrants. This income effect on migrants' transfer receipts occurs regardless of migrants' characteristics and destination, suggesting that is not correlated with the insurance mechanism.

This paper contributes to the literature on risk management by highlighting the role of regional migrants on informal insurance arrangements. A strand of this literature has focused on the study of informal insurance by reciprocal transfers and gifts from friends and relatives (Townsend, 1994; Fafchamps and Lund, 2003; De Weerdt and Hirvonen, 2013; Jack and Suri, 2014). With the exception of De Weerdt and Hirvonen (2013) and Jack and Suri (2014), this literature has focused on the flow of transfers at the community or village level. It has argued that information and enforcement problems are likely to be small between the members of a community creating an adequate environment. This paper shows that regional migrants and their origin households participate in insurance arrangements in the context of weather shocks and that this arrangement is asymmetric.

Understanding of the role of regional migration for insurance against shocks has important implications for policy. Indeed, while there has been significant interest in policies targeting international and seasonal migration, there has been less policy attention to domestic and regional migration. [3] Looking at seasonal migrants, Bryan et al. (2014) show

[3]Recent policy experiments on international migrants have shown that migrants remit and save more when they have higher control over their bank accounts in their country of origin (Aycinena et al., 2010;

that small incentives to seasonal migration lead to an increase in the number of seasonal migrants, to an improvement in terms of consumption, and to an increased rate of seasonal migrants in the following years. Policies targeting long-term domestic and regional migration have received less attention, with the exception of studies focused on the impact of mobile money on risk-sharing strategies (Blumenstock and Fafchamps, 2013; Jack and Suri, 2014).

The remainder of the paper is set out as follows. Section 2 presents the insurance model from which reduced forms are derived. Section 3 summarizes the data, describes the sample of migrants and the remittance behavior. Section 4 presents the weather shocks. In Section 5, I present the specification strategy, and in Section 6 I discuss the results and the mechanism driving the main results. Section 7 investigates other risk coping mechanisms and Section 8 concludes.

2 Conceptual Framework

Among the several motives for why remittances may occur, the literature usually distinguishes four groups: self interest, pure altruism, exchange and insurance. Nevertheless, remittances may combine any of these, making it difficult to distinguish empirically between different motives (Lucas and Stark, 1985). Even if it is difficult to correctly identify the motive behind the decision to remit, it is possible to test whether remittances and transfers play an insurance role. To do so, I follow the literature on risk sharing and I set up a simple model to derive the reduced form equations to test the insurance hypothesis. This section builds on Fafchamps and Lund (2003) and Yang and Choi (2007).[4]

Risk-sharing theory states that if there is a Pareto-efficient allocation of risk across network members, consumption should not be affected by individual income shocks. About 75 percent of original households in the sample have only one migrant in this age cohort, therefore the risk-sharing model is simplified to a two-individuals model. Consider two risk-averse members coming from a former household: the household head (h) who has

Ashraf et al., 2015) or when they face lower monitoring cost over the use of remittances at origin (Batista and Narciso, 2013).

[4] See also (Mace, 1991; Altonji et al., 1992; Townsend, 1994).

stayed in the community of origin (o) and a young migrant (m) who was formally a member of the household and is currently living in a different location (d). I assume that all members have identical preferences and that they cannot borrow or save. I take the decision to migrate as a given, and focus on the decisions to transfer.

Individuals have an uncertain income $y^i_{s^g}$, where $s^g \in S$ stands for the state of nature in location g ($g \in G = \{o, d\}$), and $i = \{h, m\}$. They consume $c^i_{s^g}$ and derive instantaneous utility $U_i(c^i_{s^g})$. Utility is separable and it's twice differentiable, with $U'_i > 0$ and $U''_i < 0$. Both type of individuals work and able to actively participate in an insurance contract by sending transfers back and forth to each other. Pareto efficiency requires the ratio of marginal utilities between network members to be constant in any state of nature:

$$\frac{U'_h(c^h_{s^o})}{U'_m(c^m_{s^d})} = \frac{U'_h(c^h_{s^{o'}})}{U'_m(c^m_{s^{d'}})} = \frac{\omega_m}{\omega_h} \tag{1}$$

with the planner's weights ω_i satisfying $0 < \omega_i < 1$ and $\omega_h + \omega_m = 1$. Let individual utility take the form of a constant absolute risk aversion function with all individuals having the same coefficient of absolute risk aversion θ,

$$U_i(c^i_{s^g}) = -\frac{1}{\theta} e^{-\theta c^i_{s^g}} \tag{2}$$

Because I am interested in the flows between two individuals, I can equalize the marginal utilities by each individual. Taking logs and rearranging, I get $\frac{1}{\theta}(\ln \omega_m - \ln \omega_h) = c^m_{s^d} - c^h_{s^o}$, where planner's weights do not depend on the state of nature, thus they are constant, and individual consumption depends on the realization of consumption of the other network's member. I follow Fafchamps and Lund (2003) and Yang and Choi (2007) and define the budget constraint for each individual i as, $c^i_{s^g} = y^i_{s^g} + NTr^i_j$ where NTr^i_j accounts for the net value of transfers received by individual i and sent by individual j. Notice that NTr^i_j enters individual i's budget constraint positive but individuals j's budget constraint negatively. Individual income $y^i_{s^g}$ is decomposed into a permanent component ($\tilde{y}^i$) and a transitory component ($y'^i_{s^g}$), such that $y^i_{s^g} = \tilde{y}^i + y'^i_{s^g}$. Rearranging, I get the equation for the net value of transfers received by the migrant:

$$NTr_h^m = \frac{1}{2}\{(\tilde{y}^h_{s^o} - \tilde{y}^m_{s^d}) + (y'^h_{s^o} - y'^m_{s^d}) + \frac{1}{\theta}(\ln \omega_m - \ln \omega_h)\} \tag{3}$$

Given that rain-fed agriculture is the main economic activity in the communities of origin, transitory income is going to depend on observed agricultural shocks- rainfall shocks- which can be represented by $z^i_{s^g}$, such that $\frac{\partial y'^i_{s^g}}{\partial z^i_g} < 0$. The model allows differences in productivity across different economic areas in Nicaragua and Costa Rica, that is, income response to rainfall shocks are not homogeneous across locations. The model also assumes that the state of nature is heterogeneous across space, $s^g \neq s^{g'}$, a reasonable assumption in the case of Nicaragua,which is a small mountainous country with multiple micro-climates (Macours et al., 2012). Under this set of assumptions, equation 3 becomes:

$$NTr_h^m(s^o, s^d) = \alpha + \beta_o z^h_o + \beta_d z^m_d + \gamma X_{mh} + \epsilon_m \tag{4}$$

Where ϵ is a mean-zero error term. The function of Pareto weights and the permanent income component $\tilde{y}_i$ for the migrant and for the origin household is captured by a vector of individual and household characteristics X_{ij}.[5] In this framework, β_o may differ from β_d as the impact of rainfall shocks on agricultural income could differ among locations, also, the model does not impose any assumption on the income response to shocks among households living in the same location (g). When income shocks experienced by both agents are exactly the same, there would be no adjustment on the net amount of funds transferred. I test this result using migrants who experienced the same rainfall shock that the origin household did. If the impact of the rainfall shock is larger on one side than the other, I should observe an adjustment in the net value of transfers.

Equation 4 tests whether NTr received by the migrant varies with shocks at origin and at destination. Negative income shocks affecting the origin household are expected to reduce migrant's net value of transfers received through two mechanisms. First, the

[5]In risk sharing literature the term average consumption is replaced by village or network shocks, Yang and Choi (2007) replace it by time effects. In this paper permanent income from the origin household is proxy by initial assets, location and household members, and the transitory component of income at origin is captured by the agricultural shock at origin.

amount of transfers received by the migrant (in-flow) is reduced as a consequence of a drop in income at origin (income effect). Second, the amount of remittances sent by the migrant (out-flow) increases to compensate the income lost at origin (insurance mechanism). To test both effects, equation 4 is split into two equations, one for transfers (transfers sent from the origin household to the migrant) and the other for remittances (transfers sent from the migrant to the origin household).

$$Tr_h^m(s^o, s^d) = \alpha^{Tr} + \beta_o^{Tr} z_{s^o}^h + \beta_d^{Tr} z_{s^d}^m + \gamma^{Tr} X_{mh} + \epsilon_m^{Tr} \tag{5}$$

$$R_h^m(s^o, s^d) = \alpha^{R} + \beta_o^{R} z_{s^o}^h + \beta_d^{R} z_{s^d}^m + \gamma^{R} X_{mh} + \epsilon_m^{R} \tag{6}$$

Where Tr_h^m accounts for migrants' inflow of transfers and R_h^m for migrants' outflow of transfers (remittances). This paper tests whether $\beta_d^{Tr} > 0$ and $\beta_o^R > 0$, that is, whether transfers receipts increase when the recipient is exposed to an exogenous negative income shock. This paper also estimates the impact of income shocks at the sender's location on the outflow of transfers, captured by β_d^R and β_o^T. Given that these households are liquidity constrained, I expect the negative income shock at sender's location to reduce the amount of transfers sent. The size of β_d^{Tr} relative to β_o^R provides some insight on whether the insurance contract is symmetric or asymmetric. Still, the difference between coefficients might be driven also by differences on the vulnerability to weather shocks at either location.

3 Data

I use two years of panel data from a household survey conducted in rural Nicaragua. These data were collected to evaluate a Conditional Cash Transfer (CCT) program, *Red de Protección Social*, which was implemented starting in 2000 using a randomized phase-in process. I use data from a baseline census collected in May 2000 and a long-term follow-up survey conduced between November 2009 and November 2011 (henceforth, 2010 survey).

Data in 2010 was collected making a significant effort to track individuals to reduce as much as possible attrition due to migration and household split-off. Households and individuals in the target group[6] were tracked across Nicaragua and to Costa Rica. Multiple visits to the original communities reduced attrition in the sample due to seasonal migration. At the household level the attrition rate is below 8 percent. The target sample included 2,711 original households; during the follow-up the survey team interviewed 2,505 original households and 1,375 new households.

At the individual level, the sample is restricted to respondents between the ages of 15 and 21 in 2010 (see Figure A1 in appendix A), and it contains 3,995 young adults among whom 3,540 were surveyed in 2010. [7] The attrition rate for this age group is 11.4 percent, extremely low for such a mobile cohort. Leaving out household migration and 10 migrants from whom the original household was never found, the sample is reduced to 945 migrants. Figure 1 shows the geographical distribution of young migrants in Nicaragua and Costa Rica. The map shows three flows of migration: migrants staying in their municipalities of origin (dashed regions) or in neighboring municipalities, migrants moving to the agricultural frontier (north-east) or to other remote rural areas, and finally migrants moving to the Pacific Coast and around Managua and San José (Costa Rica). This third flow is formed mainly by urban migrants, while the first two are rural migrants and migrants moving to small urban areas. The distribution of rural migrants across space allows me to exploit the space-variation of local income shocks at destination.

The household survey and tracking records provide data on current location of attritors, which allow me to conduct a robustness check by adding to the analysis migrants who were not found in 2010 (see Section 6.3). These data is also available for migrants older than 21 years old, who were living at the household of origin in 2010 but were not part of the tracking protocol. In Section 6.4 migrants between the ages of 22 and 30 are incorporated to the analysis. Using this group of migrants I analyze whether the results hold along the life cycle or are driven by particularly strong links between migrants and the household of origin at the first stages of the adulthood. Nevertheless, results from

[6]The target group includes all households that have split-off and that contain the main caregiver, an original panel household member under 21 (in 2010), or a child (under 21 in 2010) of an original household member.

[7]This number does not include the deceased, 11 girls and 21 boys.

this cohort should be taken cautiously as using proxy data on destination introduces measurement error in migrants' shocks. Even if the household knows migrants' current community it could be not enough to locate him or her, and therefore the shocks at destination would be assigned using information at the municipality level. This procedure also introduces sample selection bias, as migrants moving to communities where other migrants have moved, and have been tracked, are more likely to be traceable and to be assigned to a more precise shock at destination than migrants moving to other localities.

3.1 Migration from the sampled communities

This paper analyzes the insurance role of transfers between migrants and their origin household regardless of the motivations behind the decision to migrate. Migrants in the sample were members of their origin household when the baseline survey was conducted in 2000. Ten years later, when the follow-up survey was implemented in 2010, they were part of a new household. The decision to migrate is taken as given, and the decisions to send transfers and remittances is analyzed conditional on being a migrant. While the identification strategy allows me to estimate the causal impact of income shocks on remittances and transfers adjustments, the self-selection process of migrants restricts me from drawing any inference on the impact of migration on individual and household outcomes. [8]

Migrants are split into local and non-local migrants using as a reference the rainfall data cell in which each household is contained. The rainfall data comes in the form of grids of approximately 8 km; local migrants are defined as those who live in the same rainfall grid as their origin household. Non-local migrants live in a different rainfall grid so I can measure any difference in rainfall between the non-local migrant and the origin household. This group of migrants contains 430 individuals and will be the center of the analysis. The average (median) distance between the household of origin and the migrant

[8] Tables B1- B3 in Appendix B show that the decision to migrate is neither correlated with rainfall shocks in 2009 or with the dispersion of accumulated rainfall over the previous ten years. I find that conditional on being a migrant, rainfall shocks at origin reduce slightly the probability to migrate to rural areas. The point estimate is small and significant at 10 percentage level. I discuss the implications of this result in Section 5.

destination is 900 meters (400 meters) for local migrants and around 40 kilometers (16 kilometers) for non-local migrants.

Theoretical and applied literature on migration suggest that rural and urban migration are motivated by different factors. To exploit this fact, I distinguish between migrants to urban and rural locations. I link the household database to DMSP-OLS Nighttime Lights (Defence Meteorological Satellite Program-Operational Linescan System) [9] to get accurate measures of urban areas. The images obtained identify lights from cities, towns, and other sites with persistent lighting. I define urban areas as those locations where the level of light intensity at night is above a threshold of 7 (of the 6-bit 0-63.0 range of the DSMP-OLS city lights produce). This process gives an objective measure of urbanization in Costa Rica and Nicaragua. The level of light intensity is highly correlated with urban development,[10] in the case of Nicaragua, I use a threshold of seven based on urban sites observed using Google Maps and data collected in the household survey. Migrants not located in these areas are considered rural migrants.

The sample is restricted to long-term migrants, defined as those absent for more than nine months in the last 12, or as those that have left more recently but have no plans of returning in the short run, independently of the distance between the location of origin and of destination. [11] Surveyed migrants in my sample represent 39.3 percent of female young adults and 15.3 percent of male young adults. These rates are in line with the fact that in Nicaraguan rural society young men are more likely to stay at their parents' house once they are married, while young women moved to their husbands' communities. Eighty percent of the migrants moved to rural areas while 18 percent migrated to urban areas and 2 percent to Costa Rica. Given the small number of international migrants,the analysis on domestic migrants and migrants to Costa Rica is conducted together. In general, the sample analyzed presents high levels of extreme poverty and low levels of

[9]The DMSP is a Department of Defense (DoD) program run by the U.S. Air Force Space and Missile Systems Center (SMC).

[10]Elvidge et al. (1997); Henderson et al. (2011) show that light density at night is a robust proxy of economic activity. These studies establish a strong within-country correlation between light density at night and GDP levels and growth rates.

[11]The survey also has information on household migration, which occurs when all members migrate to the same location.

education (household head had on average two years of education in 2000). The main economic activity at the communities of origin is rain-fed agriculture and only 16 percent of households had livestock at baseline. Differences on baseline characteristics between migrants and non-migrants are driven by urban migrants who on average come from wealthier households and had more years of education than stayers and rural migrants (see Table A1 in appendix A).

Table 1 shows that those who migrated are more likely to be married in 2010 or to be the household head or his/her spouse than those who stayed. These differences are especially large for local and rural non-local migrants. Almost all young adults in the sample are working at the date of the interview, and only 36 percent still at school. Even though one third of the sample is enrolled, 92 percent of them are working, which suggests that this cohort is old enough to be actively participating in economic transactions. Non-working migrants and those attending school are more likely to live in urban areas than in rural areas. The difference between these and the rest of the sample is driven by women who are married but are not working. In terms of education, local migrants have fewer years of education than non-local migrants, and the difference is driven again by urban migrants who have on average two more years of education. Around 60 percent of local migrants and rural non-local migrants have moved to get married (mainly women), while migrants to urban areas are more heterogeneous and move also to study, work or to find a better economic situation.

3.2 Remittances

The data contains information on the value of remittances sent and transfers received for 90 percent of the sample of migrants. The data on remittances and transfers on each migrant is reported by a member in the origin household (usually the household head) and not by the migrant. As a result, even when the migrant was found and interviewed later than the origin household, I have information on his or her transactions at the date when the origin household was surveyed.[12] The data refer to transfers of funds done during the

[12]Ninety six percent of households at origin were interviewed before the start of the first crop season of 2010.

12 months prior to the survey in 2010, including monetary and in kind transfers.

One third of the total sample of migrants received transfers and/or send remittances (34 percent and 33 percent respectively). Table 1 shows that at the extensive margin the rates of migrants sending and receiving remittances are not significantly different among destinations. At the intensive margin, urban migrants send more remittances (annual values) than rural migrants and local migrants. Rural non-local migrants received on average fewer transfers from their origin household than other migrants (local and urban migrants). Among urban migrants, both married and non-married received transfers from their original communities, although such transfers are more common among those who are still studying. Intuitively this makes sense: households are still investing in the education of their children, who on average have one more year of education that those who did not receive transfers in 2010.

Urban migrants send total remittances for the value of 110 USD on average. Rural migrants are net contributors although the difference is very small. Finally, local migrants receive around 15 USD more than what they contribute. In relative terms with respect to the level of consumption in senders' households, urban migrants send remittances that account for 6 percent of expenditures on total consumption in destination, and they receive transfers for the value of 11.5 percent of total expenditures in origin. These percentages are smaller among rural migrants in local and non-local areas.

In general, those who remit are the child of the head of the origin household, and they come from nuclear households with fewer young adult members. Those receiving transfers from their origin household are similar in baseline characteristics to those sending remittances, which supports the hypothesis of a cooperative contract in which both parties are actively involved.

4 Weather and Agricultural Outcomes

4.1 Weather Shocks

The historical rainfall data are taken from the "Gridded Analysis of Meteorological Variables in Nicaragua" (Uribe, 2011) and are available from 1979 to 2009. The data are available for a grid of 0.075° (approximately every 8km) and are interpolated from existing weather stations (from the Nicaraguan Institute of Territorial Studies, INETER) and satellite data measured at a resolution of 0.1875° (approximately every 20km) from NARR (the North American Regional Reanalysis) (Macours et al., 2012).[13] For households at origin I use data from 53 nodes, and for the sample of migrants the data comes from 127 nodes. Rainfall variables are constructed separately by nodes, and households are assigned the rainfall data for the node geographically closest to their locations of origin and destination using GPS coordinates.

Drought events are important for agricultural output in Nicaragua. Insufficient rainfall over an extended period has particularly negative consequences for yields. In 2009, Nicaragua experienced a intensive drought driven by *El Niño*; INETER recorded deficit rainfall ranging between -14 and -50 percent over the rainy season. The direct consequences were felt in the production of basic grain, especially in the Dry Corridor where losses of basic grains reached 50 percent of production (FAO, 2010). The drought was especially intense from the end of June to the beginning of October, delaying the start of the second season by 15 days.[14] The analysis is focused on the first agriculture season of 2009, from May to August, as data collection for the household follow-up survey started at the beginning of November 2009 and therefore data on agricultural outputs for the second season is incomplete. Data from the community questionnaire shows that 93% of the community leaders who completed the survey reported experiencing a drought in the

[13] The small size of the cells in the gridded analyses database used in this paper allows me to capture Nicaraguan micro-climates and identify local rainfall shocks. The network of weather stations used for the interpolation is large (205 stations), and the spatial distribution of stations across Nicaragua is relatively homogeneous (the national average is approximately 23 rain stations per average departments' size (6,755 km^2)).

[14] In Nicaragua there are two growing seasons: from May to the end of August (*Primera*) and from the end of August to November (*Postrera*). Between both seasons there is a dry period, known as *canícula* which marks the change of the season.

previous 12 months.

The agronomy literature indicates that the large losses of grain yields are caused by water deficits during the flowering season (Calvache et al., 1997), which depending of the crop variety occurs 48-60 days after sowing (corn) and 31-38 days after sowing (beans). This paper follows Macours et al. (2012) and focuses on water deficits during critical windows in the growth cycles. In particular it looks at accumulated rain between June and July for the first growing season. The measure of rainfall shocks is defined as deviations of accumulated rain during the growing season from the historical mean[15] divided by the standard deviation for each node (z-scores).

For households in the municipalities of origin the first growing season in 2009 was dryer than normal; Figure 2 shows the distribution of rainfall in standard deviation units for households of origin and for migrants who were found. Both figures show that very few households and only slightly more migrants experienced positive deviations on accumulated rain for this period. While almost 37 percent of the total households of origin experienced positive rainfall deviations, only 6 percent of the total sample actually experienced accumulated rainfall above 0.5 standard deviations from the historical mean. On the other hand, almost 17 percent of households of origin were exposed to rainfall deficits one standard deviation or more below the historical mean.

4.2 Agricultural outcomes and rainfall shocks

The most common activity in this sample is farming: 89 percent of the household heads were involved in agricultural activities in 2000 and 90 percent of the land cultivated was used to grow temporal crops, basically beans and maize, while only 10 percent was allocated to permanent crops.[16]

Given that most households depend principally on the cultivation of rain-fed crops, I

[15] Macours et al. (2012) provides evidence that drought shocks became more frequent after Hurricane Mitch in 1998. Post-1998 rainfall is lower during the first growing season and during the last months of the second growing season. I follow their specification and compute the historical mean using data from 1979 to 1998. The results are robust to computing the historical mean using data from 1979 to 2008.

[16] Statistics from The National Agricultural Census in 2001 show that in these regions 79 percent of land used is allocated to grow basic grains (36 percent to maize and 30 percent to beans) and 15 percent is used to grow coffee

expect weather fluctuations to drive changes in consumption or trigger risk-coping mechanisms. Table 2 shows the effect of rainfall fluctuations on food production and harvest outcomes among households at origin with and without migrants.[17] The first column presents the estimated coefficients on rainfall z-scores on the subsample of households with regional migrants in the specific cohort and the second column presents results on the subsample of households with children in the cohort of interest but who are not regional migrants. One standard deviation decrease in accumulated rainfall reduces annual food production by 36 percent in both samples. This decline is driven by a drop in the production of basic grains, and is confirmed by an increase in the amount of grains bought. One standard deviation decrease in rainfall reduces the probability to sell grains by 10 percent among households with migrants and by 12 percent among households with no migrants. Consumption of grains produced at home declines by 7 percent, while the likelihood to lose the harvest increases. These results highlight the importance of the first growing season in food production and provide evidence of the direct effects of rainfall deficits on the agricultural production for the region regardless on whether a household has or has not regional migrants.

The top panel of Table 3 shows the impact of rainfall fluctuations on household agricultural income and total income. Weather shocks have a large effect on agricultural income, one standard deviation increase in rainfall deficit decreases household agricultural per capita income for households with non-local migrants by 64 percent (55 percent in households without migrants in this cohort). While the effect of rainfall shocks is similar in both types of household, income from other economic sources in households with migrants is less exposed to rainfall fluctuations, indicating that households may have different strategies to cope and manage economic shocks. One standard deviation increase in rainfall deficit decreases total household income by 20 percent in households without non-local migrants, while among households with migrant income falls by 12 percent (p-value 0.16). Bottom panel of Table 3 shows that on average households smooth consumption

[17]Given the timing of the survey, I focus on the impact of weather shocks among households at the community of origin. I restrict the sample to the original households of all the individuals in the age cohort of interest (15-21 years old). Including all households in the communities of origin do not change the results.

in face of rainfall fluctuations, indicating that they manage to protect themselves against shocks even when an important source of income is jeopardized.

5 Empirical Specification

To test whether transfers act as an insurance mechanism I estimate the causal effect of income shocks at migrants' location of origin and of destination on the inflow, outflow and net value of transfers. The previous section shows that rainfall deficits represent credible income shocks among households in rural areas. For urban migrants I assume rainfall shocks equal to zero, as their income is less affected by changes in seasonal rain.[18]

I estimate equations 4-6 derived in Section 2. Rainfall shocks, z^h_{so} and z^m_{sd} are measured as negative standardized deviations of accumulated rainfall during the first growing season (positive deviations account for periods with rainfall deficits compared to the historical mean). The coefficients of interest are β_o and β_d, they capture the impact of a decrease of one standard deviation in seasonal rainfall at origin and at destination on the outcome variables. Given that my empirical strategy is focused on the impact of exogenous rainfall shocks -that have a large impact on household income- reverse causation between transfers and income is not a problem. Still, estimates could be biased if the likelihood to be exposed to a rainfall shock is correlated with time-invariant household characteristics. For example if the decision to migrate is determined by the intensity of rainfall fluctuations at each location or if shocks are more likely to occur in poor areas in which migration and remittances inflows are high. In this case the estimates of the impact of the shocks on transfers sent will be overestimated. Covariates in X_{mh} help to reduce this bias, and tables B1- B3 in Appendix B show that the decision to migrate is not correlated with rainfall shocks. On the other hand, one standard deviation increase in rainfall deficit decreases the probability to migrate to rural areas conditional on being a migrant (p-value 0.08) (Table B2). Hence, $\hat{\beta^R_{orig}} < \beta^R_{orig}$ indicating that my specification could underestimate the impact of shocks at origin on the level of remittances ("insurance effects") and overestimate the

[18]Rainfall may affect food prices at the local level, but it is very unlikely to affect market prices in Managua and San José. There is only a migrant in non-urban areas in Costa Rica, I assign him the shock of the nearest location in Nicaragua, the results do not change if I drop him from the sample.

impact of rainfall shocks at origin on the amount of transfers received ("income effect"). Selection into rural migration may threat the estimates of the income effect but not the presence of an insurance mechanism through remittances, which if anything, would be underestimated.

Equations 4-6 are estimated by OLS, with standard errors adjusted for clustering at origin *comarca* level.[19] [20] Where X_{mh} includes regional fixed effects at origin and at destination, location variables including altitude, vegetation index, distance to school and level of urbanization in 2000, and a set of baseline control variables at the household and at the individual level; T_h^m accounts for the probability of receiving transfers (column 1) from the origin household and for the annual amount of transfers received (column 3), R_h^m accounts for the probability to remit (column 2) and for the annual amount of remittances sent by the migrant (column 4), and NTr_h^m accounts for migrants' net value of transfers received ($Tr_h^m - R_h^m$).

6 Results

6.1 Main Results

Table 4 shows the estimated coefficients for non-local migrants.[21] The last column shows the impact of shocks at origin and at destination on the net value of transfers received by the migrant. Both coefficients (β_o^{NTr} and β_d^{NTr}) have the expected sign, meaning those exposed to negative income shocks are net recipients of funds. One standard deviation decrease in rainfall at origin reduces the net value of transfers received by the migrant by 22.21 USD, indicating that the net contribution of the migrant increases. Conversely, when migrants are exposed to negative shocks at destination their net benefits increase. In this case the adjustment is smaller, 11 USD, and it accounts for less than half of the

[19]Census *comarcas* are administrative areas within municipalities based on the 1995 National Population and Housing Census that, on average, included 10 small communities for a total of approximately 250 households.

[20]Estimates are robust to clustering at rainfall grids at origin.

[21]The decision to migrate and the choice of destination may differ by gender. Women migrate to get married wile the main motivation behind the decision to migrate by male is labor. To capture whether there are gender differences in shock responses I test for heterogeneous gender effects in the main specification, and find no differential effects by migrant's gender.

change observed when shocks occur at origin.

Regarding the insurance effect, results show that one standard deviation decrease in rainfall at origin raises the amount of remittances sent by the migrant by 16.5 USD, indicating that migrants provide insurance to their origin household. On the other hand, rainfall shocks at destination do not have any impact on the amount of transfer receipts, suggesting that migrants are not insured by their origin household. Table 4 shows that both flows of funds (transfers and remittances) are adjusted by shocks happening on sender's location. The impact of shocks at destination on remittances is large, though not significant at the 10 percent level. A drop in household income due to rainfall shocks reduces the amount of transfers and remittances sent, suggesting that households and migrants in this environment are liquidity constrained, specially households of origin. This result is in line with the findings by Yang (2008b) in Philippines, who finds that exogenous increases in senders' resource have positive effects on the amount of funds transferred.[22]

The last row of Table 4 contains the p-value for testing whether a rainfall shock at origin is the additive inverse of one at destination, that is $\beta_o + \beta_d = 0$. First, I cannot reject the hypothesis that the coefficients are equal in magnitude (opposite-signed) in neither the equation of remittances or of transfers. In net values, the effect of rainfall shocks at origin and at destination is different in magnitude indicating that the insurance contract is not symmetric (p-value 0.102). Table 1 shows that the rate and the value of transfers and remittances between migrants and their origin household are very similar. One possible explanation of this asymmetric result, is the presence of asymmetric information concerning income shocks at either location. Migrants may have reliable information on income realizations at home, due to social networks and return visits during holiday periods, while it would be harder for households at origin to have perfect information on weather and income conditions at destination. In this case, asymmetric information on

[22]It is difficult to test whether this income effect responds to an altruistic motive, is part of the insurance contract, or is driven by other purposes. For example, in a exchange model, migrants would be providing loans that would be repaid when the household experiences an income surplus. In that case, the income effect (β_o^{Tr}) and the insurance effect (β_o^{R}) should be observed together. Results among different pool of migrants (married, new household head, students, rural) suggest that the income effect is present even when migrants do not provide insurance. Results available upon request.

shocks would hamper the presence of bilateral insurance.

The lack of impact of rainfall shocks on the probability to remit and to receive transfers indicates that the adjustments on the annual amount of remittances and transfers is coming from migrants who were already participating in economic transactions (around 34 percent of the sample of non-local migrants). The magnitude of the effect on this sample is about three times the size of the coefficients estimates in Table 4.[23] At the intensive margin, one standard deviation decrease in rainfall at origin raises the amount of remittances sent by 64 USD (p-value 0.034) and decreases the amount of transfers received by the migrant by 16.8 USD (p-value 0.061). The impact of shocks at destination also are larger, one standard deviation decrease in rainfall reduces the amount of remittances sent by 63.7 USD (p-value 0.026). These estimates are more suggestive as they rely on the assumption that there is no selection on the extensive margin.

How large is the unilateral insurance provided by the migrant? One standard deviation decrease of accumulated rainfall decreases household agricultural income by 171 USD (total income by 228 USD (p-value 0.025). Remittances from this pool of migrants compensate for 10 percent of the reduction in household agricultural income (7.3 percent of the reduction in total income). Although small, this level of insurance is relatively large when compared to the average annual value of remittances in the sample. [24]

Overall, these results confirm that households in poor, rural areas exploit the spatial distribution of members of their extended network, in this case young migrants, to face agricultural shocks. The rest of this section focuses on understanding the mechanisms behind the insurance contract and the trade-offs between correlated shocks and asymmetric information.

[23]Appendix A replicates the main results under different specifications: inverse hyperbolic sine transformations, square root of annual values and quantile regression for the top percentiles of the transfers distribution.

[24]Migrants between the ages of 18 and 21 are more likely to be economically independent, but they may have less ties to their household at origin. The impact effect of rainfall shocks on the amount of remittances (18.67 USD, p-value 0.094) and transfers (-8.48 USD, p-value 0.018) it is slightly larger in this sub-group than in the benchmark cohort. These results are consistent with the findings in the full sample, and confirm that the income effect on transfers receipts is not driven exclusively by the youngest group of migrants (15-17 years old).

6.2 Interpretation and Mechanisms

Equation 3 suggests than when income shocks at origin and at destination are exactly the same, there would be no adjustments on the net amount of funds transferred. Table 5 shows the results for all young local migrants, that is, migrants laying in the same rainfall grid than their origin household. While the rate of migrants involved in inter-household transfers is similar to the rate among non-local migrants (one third), rainfall shocks do not have any impact on the amount of funds transfered from or towards local migrants. As has been pointed out in the literature (Dercon and Krishnan, 2000; Duflo and Udry, 2004), high correlated income shocks are difficult to insure at the local level. Both sides may be suffering equally the deficits of rainfall, indicating that income response to rainfall shocks may be homogeneous among households living in the same location, even is very likely that migrants who are living very close to the household of origin are also participating in the very same agricultural activity or using the same plots of land. To analyze how correlation between income shocks affects the insurance role of remittances and transfers, I look at different levels of correlation between shocks, first by destination and second by economic activity.

Spatial Distribution of Migrants: urban versus rural migrants

As mentioned in Section 3 urban and rural migrants to no-local areas differ from each other. The pool of migrants moving to urban areas come from wealthier households and have more years of education than other migrants. Their income is less vulnerable to rainfall fluctuations and therefore less correlated to income shocks occurring at their location of origin.[25] On the other hand, around 60 percent of non-local migrants moved to rural areas where they work mainly in agricultural activities, making this group highly vulnerable to rainfall shocks.

Table 6 shows the estimated coefficients by non-local migrants' current location. The top panel shows the results for urban migrants and gives strong evidence on the unilateral

[25] Tables A2 and A3 in Appendix A shows no impact of rainfall deficits neither on agricultural or on total household income indicating that urban migrants are less exposed to rainfall shocks. Still, rainfall deficits could have impacted individuals in urban areas through an increase in food prices. See Appendix C for a discussion on the impact of rainfall shocks on non-local prices.

insurance mechanism by which origin household are insured by young migrants. One standard deviation decrease in rainfall at origin raises the amount in remittances sent by the migrant by about 28.44 USD, almost twice the effect found in Table 4. Remittances from young urban migrants compensate for 17 percent of the reduction in household agricultural income. The income effect is also strong and large; migrants' transfer receipts decrease by 13 USD in face of negative shocks at origin.[26]

The bottom panel presents the results for non-local rural migrants. Coefficients are neither significant for remittances nor for transfers,there is no evidence of any insurance mechanism functioning between the average rural migrant and the household at origin. The estimated coefficient on the net value of transfers received shows that rural migrants receive fewer transfers when their origin household is exposed to negative rainfall shocks. Differences between the two types of migrants could be explained by migrants' characteristics, for example urban migrants may be less liquidity constrained than their rural counterparts (Table 1). Still, the lack of insurance provided by the average rural migrant could also be explained by the fact that they and their origin household might be exposed to highly correlated weather shocks. If that is the case, it is reasonable to expect that rural migrants will not insure their household of origin in the face of weather shocks and vice-versa. Using the rainfall grid to distinguish local and non-local migrants has the inconvenience that rural non-local migrants may still be living very close to their communities of origin and therefore remain exposed to highly correlated shocks.

Spatial Distribution of Migrants: rural migrants with more or less covariate shocks

To analyze whether high levels of correlation between rainfall fluctuations at origin and destination are driving the results for rural migrants, I compute the absolute value of the difference between rainfall deviations at each location and, based on the result, construct different samples of migrants. This strategy allows me to reduce spatial correlation without imposing any assumption on the income effect of rainfall fluctuations at each location

[26]Table A6 in Appendix A show the results including rainfall shocks at destination. The estimated coefficients on shocks at origin are not affected while none of the coefficients on rainfall shocks at destination are significantly different from zero.

(z_{s^o}, z_{s^d}), as the absolute value of the difference does not capture whom is exposed to the larger shock. Given that I do not have self-reported data on the intensity of shocks, I do not know whose income is more vulnerable to rainfall deviations, and therefore I cannot establish whether the origin household or the migrant are better or worse off.

Figures 3 and 4 show the results for equations 5-6 on various samples of migrants. The vertical axis shows the coefficients capturing the insurance role of transfers and remittances, values in the horizontal axis represent the minimum difference in absolute values between rainfall deviations at origin and destination in each sample ($\delta_{abs} = |z_{s^o} - z_{s^d}|$).

Both graphs show a positive relation between the absolute difference in shocks intensity and the level of insurance. Rural migrants living in areas exposed to shocks at least 0.45 points bigger or smaller than their household of origin adjust their remittances by almost 10 USD, which accounts for two thirds of the impact observed among urban migrants. Figure 4 shows that when the correlation between rainfall shocks shrinks, rural migrants provide insurance to their origin household. This result is important as it indicates that even migrants with low levels of education (around five years of schooling in 2010), working in agricultural activities (85 percent of them works only in agriculture), and who are married and economically independent (77 percent are married and 62 percent are household heads in 2010) are still providing insurance to their origin household. Are they also receiving insurance? Figure 3 shows that the level of insurance increases as shocks between locations are less correlated but it decreases again when differences between shocks increase. The peak of insurance gets as far as 6 USD when the absolute difference between shocks is between 0.2 and 0.3 points. Although small, this result suggests that households of origin may provide some insurance to migrants exposed to negative rainfall shocks The figure also shows that as distance between locations increases, the implementation of such an insurance mechanism aimed to protect the migrant weakens. The reduction on the insurance effect as the difference between shocks increases is consistent with the presence of some information or enforcement costs that are likely to increase with distance.

All together, these results point to the presence of bilateral insurance informal arrangements, in which households receive higher levels of protection.The estimated coefficients on the net value of transfers show that taking into account the income effect does not change this result: households of origin are net beneficiaries when they are exposed to negative shocks. [27]

Household Strategy: labor diversification?

Households of origin and migrants might also be exposed to less covariate shocks when they are active in different types of economic activities. Even if the decision to migrate and the choice of destination are not correlated with rainfall fluctuations at origin and destination, migration to a specific location could be motivated by the accessibility to different jobs or economic sectors. While 85 percent of the household heads at origin work exclusively on agriculture activities (basically growing grains crops), only 30 percent of rural migrants' household heads work in the farming sector. The main activities for rural migrants are livestock farming (40 percent) and self-employed agriculture (31 percent). Migrants only involved in agricultural activities, without including livestock farming, are less likely to diversify their income portfolio and therefore more likely to be vulnerable to rainfall shocks (Macours et al., 2012), moreover, their income may be more correlated to their origin household's income.

To test whether migrants participating in other economic activities are more likely to provide insurance to their household of origin, I focus on rural migrants working on livestock farming. Table 7 presents the results from equations 4-6 including interaction effects for migrants involved on livestock farming in 2009.

Table 7 confirms that among rural migrants those providing insurance to their household of origin (β_o^R) are involved in livestock farming and less vulnerable to rainfall shocks. One standard deviation decrease in accumulated rainfall raises the annual amount of remittances by 12.51 USD and the probability to remit increases by 28 percentage points. This result is in line with the hypothesis that households rely on remittances sent from

[27] Tables A4 and A5 in Appendix A shows that agricultural production and household income among rural migrants are affected by rainfall shocks, but less than among households at origin.

migrants whose income is less vulnerable to rainfall shocks, which at the same time explains the lack of a bilateral insurance contracts as these migrants are more likely to be able to protect themselves by diversifying their economic activities.

The results above point out that risk-sharing arrangements between migrants and their households of origin are heterogeneous by destination and economic activity. As expected, those who are exposed to less correlated shocks are more likely to participate in an insurance arrangement. The effect of rainfall shocks in the net value of transfers received by non-local migrants differ in magnitude depending on the location of the shock, indicating that the economic contract is not symmetric and is especially beneficial to households in the communities of origin.

In the following section I analyze whether this economic arrangement holds for a group of migrants for whom the information between households and migrants is likely to be imperfect. In particular, I include migrants in the cohort of interest (15-21 years old) who were traced but not found during 2010 follow-up survey, i.e. the attritors.

6.3 Attrition

During the 2010 follow-up survey the research team made a great effort on minimizing attrition at the household and individual level. As a result, attrition rates for the cohort of interest are about 11 percent over a period of 10 years. Among them 20 percent moved with their entire households, 29.4 percent were untraceable (the survey team could not obtain any information regarding their destination) and less than 1 percent refused to be surveyed. The rest were individual migrants (49.9 percent) for whom a proxy destination was obtained, even if the migrants were subsequently not found at that destination. This latter group can be added to the previous analysis using information reported by other household members who were found during the tracking protocol.[28] This group is not included in the analysis from the beginning because, in order to look at shocks at destination, I have to rely on proxy information on migrant's location. Adding the

[28] The data on transfers and remittances come from the questionnaire filled by the household of origin, and the sample is restricted to those for whom household of origin was interviewed before the harvest of the first season in 2010.

sample of attritors increase the sample size, but it also introduce noise in the regression, as the shocks at destination are less precise.[29]

Of the 227 individual migrants not found but traceable, 161 were assigned to a micro-region,[30] 27 to a municipality and 39 were reported to be living in another country (64 percent of them in Costa Rica). Depending on the level of information available, different strategies are used to merge the sample of non-found migrants to the rainfall data: at the micro-region level I compute the geographic centroid of each micro-region and assign them to the nearest rainfall grid; at the municipality level I assign them the shock of the most common micro-region destination of migrants in each municipality, and in case they were the only ones moving to a municipality they are assigned municipality average rainfall shocks. The rate of migrants not found sending remittances to their household of origin is almost the same as among those found (31 percent versus 33 percent respectively), but the rate of those receiving transfers is much smaller (17 percent versus 34 percent).

Top panel in Table 8 presents the results for non-local migrants found and not found inside Nicaragua. Including those not found in Costa Rica does not change the results but it introduces more measurement error, as I do not have information on the region in which they are living within Costa Rica. A one standard deviation fall in accumulated rainfall at origin decreases transfer receipts by 4.53 USD and increases remittances sent by 7.72 USD (only the coefficient estimated on transfer receipts is significantly different from zero). This result indicates that there is a decrease in the size of the insurance effect on remittances and especially on the income effect on transfers compared to those found. The coefficient on the impact of shocks at destination on transfer receipts is very small, supporting the hypothesis that the lack of information on the migrant's situation may explain the lack of insurance provided by the household of origin. These results should be taken cautiously as they might be driven by measurement errors on the weather shocks at destination.

Among urban migrants (bottom panel), the bias due to measurement error is smaller

[29] Also, the fact that these migrants were not found during the tracking protocol could be in part because the enumerator team did not get the correct information on their location to start with.

[30] A micro-region is an administrative area smaller than a municipality and bigger than a *comarca*,and represents geographic areas similar in socio-economic outcomes and micro-climates.

as I rely only on rainfall fluctuations at origin. The estimated coefficients are very close to the estimates on the restricted sample of surveyed migrants. One standard deviation fall in accumulated rainfall at origin decreases the annual value of transfers receipts by 9.6 USD and increases the annual value of remittances sent by 23.6 USD.

These results support the findings among migrants who were found and who are well connected to the household at origin, however, there is a remaining question on whether the insurance contract is permanent or temporary. It is reasonable to believe that the observed flow of transfers may be driven by a life cycle component. During good seasons, households help young adults leave the nest and settle elsewhere; during lean seasons, they reduce their transfers. The insurance provided by the migrant could be also temporary and be observed among young migrants during the period of life transition. To test this hypothesis, next section tests the insurance and income effect among migrants in the next age cohort (22-30 years old).

6.4 Older cohort

Section 3 has shown that migrants aged 15-21 are working, economically independent, and they are likely to be recent migrants and to have tight links with the household at origin. To test whether the previous findings can be applied to other adults I include in the analysis migrants under 30 who were household members in 2000.

The attrition rate in this group is about 49 percent, and 31 percent of the migrants who were found were living in a non-local area. Because this cohort was not part of the tracking sample, the sub-sample of migrants found are those who were living with a younger member of the origin household (77.7 percent) or were living in a community where someone from the target population was living.

To have a representative sample of the older cohort of migrants I rely on proxy information on migrants' current location reported at the household of origin and replicate the steps followed in Section 6.3. Among those not found, I have proxy information on destination for 64 percent of attritors.

Table 9 presents the results for migrants aged 22-30 years living within Nicaragua. A one standard deviation decrease in rainfall at origin increases the amount of remittances sent by almost 6.43 USD and it has no effect on the level of transfers received by the migrant. Almost 30 percent of non-local migrants in this cohort are receiving transfers from the household of origin, but the decision to send transfers or the amount sent is not affected by income shocks, neither at origin or at destination. Compared to the results for the youngest cohort (Table 8), the annual value of remittances and the proportion of migrants sending remittances suggest that migrants are still transferring funds to their household at origin, although the insurance effect is smaller.

The bottom panel shows the results on the sample of migrants in urban areas. A one standard deviation decrease in rainfall increases the amount of remittances sent by 20.6 USD. This number is closer to the observed in the youngest cohort of migrants (23 USD). Among rural migrants, the point estimate on the amount of remittances for shocks occurring at origin is almost zero, reducing the level of correlation between shocks at origin and at destination does not change the result. Although the relation between migrants and their household of origin, as an insurance mechanism, weakens over time, older migrants still sending remittances to their original households in response to negative rainfall shocks, suggesting the presence of a long term insurance contract. On the other hand, the income effect seems to respond to a life cycle model in which the household of origin transfers funds to young migrants during ages of life transition.

7 Other risk-coping mechanisms

Table 3 shows that households smooth consumption even if their income has shrunk. Although results among households with and without migrants are not comparable as these households may be extremely different, the estimates on household food production and on agricultural income show that while rainfall shocks have an impact in both types of household, households may have different strategies to manage and cope with economic shocks. In particular, total income per capita in households with migrants seems to be less vulnerable to rainfall shocks than income in households with no migrants.

Previous studies on risk management in rural areas have looked at changes on asset levels to buffer against income shocks, among them, livestock has been considered a key asset that households may use to cope with economic risks (Rosenzweig and Wolpin, 1993; Fafchamps et al., 1998). Two first panels in Table 10 display the impact of weather shocks on the level of assets and on livestock by type of household.[31] The estimates show that households use durable assets and livestock as buffer stock in face of rainfall deficits. These results are mainly driven by households without non-local migrants. Even if the estimated coefficients are not large, they highlight that households with non-local migrants might be less likely to deplete their asset stock when shocks hit. Bottom panel in Table 10 shows the impact of rainfall shocks on the number of household members in 2010. A one standard deviation decreases in rainfall decreases the total number of household members by 0.47 members. This impact is mainly driven by a reduction on the number of kids and teenagers (children between 0-14)[32] and older members, and is only observed on households with at least one non-local migrant. At the same time, there is an increase in the number of adults (31-60 years old), but overall the impact on the total number of household members is negative, and suggest a change in the composition of the household towards productive members. Still, the change in household composition does not explained the lack of effect on consumption per capita, but suggests that households with non-local migrants may count with a reliable network not exposed to the same economic shocks. Looking at other coping strategies, I find no impact of shocks on seasonal migration, but some evidence of labor diversification, indicating that households substitute sales of food products and services with sales of other manufacturing products.

These results should be interpreted with caution as the two types of households, with and without migrants, are not really comparable. Migrants come from households with different observable characteristics, which could be correlated with the decision to migrate, with the choice of destination, and with the implementation of an insurance mechanism, also households characteristics determine the degree of vulnerability of each

[31] The list of productive assets includes owing a pumping machine, draft animals, corn grinder machine, sewing machine, while the list of all assets also includes television, radio, small tools, and oven.

[32] In particular, there is a fall in the number of teenagers whose parents do not live anymore at the household

household. Overall, changes in household composition and the increase on remittances received are the main coping strategies identified among households with non-local migrants. Among households without non-local migrants I find evidence of assets depletion and labor diversification. Aggregates on remittances received from any migrant who was living at the household in 2000 suggest that these households do not receive transfers from other migrants neither.

8 Conclusion

Domestic migration represents almost 75 percent of an estimated 1 billion migrants worldwide (UNDP, 2009). In rural areas with no access to credit or insurance markets, remittances from these migrants represent an important source of income and a plausible mechanism to cope with income shocks. In the case of Nicaragua, international migration is coming basically from urban areas, in 2010 46 percent of migrants to the USA came from Managua urban area, while only 13 percent of migrants to Costa Rica came from this location (Europea, 2013). The potential impact of internal migrants is intensified by the fact that internal remittances, though smaller in terms of individual transfers, tend to be redistributed back to the poorest sectors of society in greater and more regular amounts than international remittances (Deshingkar and Grimm, 2004; Hickey et al., 2013). Using household survey data on poor-rural communities this paper has examined how transfers between migrants and their household of origin are adjusted in face of income shocks , indicating that regional migration serves as insurance mechanism against income shocks.

For households with regional migrants, a one standard deviation decrease in accumulated rainfall at origin increases remittance receipts by 16.5 USD. This increases to 27 USD for migrants whose household of origin works only on the agricultural sector and is thus especially vulnerable to rainfall shocks. The adjustment on the amount of remittances is especially large among migrants who might be exposed to different economic shocks than their origin household. For instance, urban migrants and migrants diversifying economic activities provide a larger level of insurance. Among rural migrants, the transfer of fund increases as the correlation between rainfall fluctuations at origin and destination decreases. There is weak evidence of the presence of a bilateral insurance mechanism in which both parties are insured. This bilateral insurance agreement is observed among rural migrants when the correlation between shocks is reduced.

Beside the insurance mechanism, households also adjust their flows of transfers when they are the ones experiencing rainfall shocks. The sign of the causal effect indicates that the outflow of transfers decreases with negative rainfall shocks. Estimates on a sample which includes older migrants (22-30 years old) show that while the income effect is not permanent, the insurance effect prevails over time. In contrast, the size of migrant's contribution may be correlated with the links between the migrant and the household of origin, including migrants who were not found during the tracking protocol in 2010 but from whom I have data on transfers and destination reduces the insurance effect by half.

While the paper shows significant evidence of an insurance effect, the magnitude is modest. For the average migrant, the economic value of the exchange is not large and households not receiving remittances in my sample are able to smooth consumption using other risk-coping strategies. On average, remittances received from non-local migrants compensate for 10 percent of the reduction in household agricultural income due to a one standard deviation decrease of accumulated rainfall at origin. Taking into account other sources of income, the remittances per migrant in the specific cohort compensates for 7.3 percent of the total income lost. Among households with regional migrants in this cohort the average number of migrants of this type is 1.3, which would raise the level of total income insured to 9.5 percent. If the household also have a regional migrant in the previous cohort (58 percent of households at origin) remittances compensate for 10 percent of total household income lost. Insurance increases as migrants are less exposed to similar economic shocks, one urban migrant between the ages 15 and 21 compensates for 12 percent of total income lost. Smoothing is considerable when taking into account that transfers and remittances are only small percentage of consumption per capita. A remaining question is whether households who actively keep networks across space are better off than other households, and even, how are these links affecting migrants' outcomes. I analyze other mechanisms that households may use to face income shocks and smooth consumption. The results indicate that adverse rainfall shocks lead to a reduction in assets and livestock especially among households with no young regional migrants, which could lead to poverty traps in the long run through asset depletion.

References

Altonji, J. G., F. Hayashi, and L. J. Kotlikoff (1992). Is the extended family altruistically linked? direct tests using micro data. The American Economic Review 82(5), pp. 1177–1198.

Ashraf, N., D. Aycinena, C. Martínez A, and D. Yang (2015). Savings in transnational households: a field experiment among migrants from el salvador. Review of Economics and Statistics 97(2), 332–351.

Aycinena, D., C. Martínez, and D. Yang (2010). The impact of remittance fees on remittance flows: Evidence from a field experiment among salvadoran migrants. Mimeo.

Batista, C. and G. Narciso (2013). Migrant remittances and information flows: Evidence from a field experiment. IZA Discussion Paper No. 7839.

Blumenstock, J. and M. Fafchamps (2013). Motives for mobile phone-based giving: Evidence in the aftermath of natural disasters. Unpublished.

Bryan, G., S. Chowdhury, and A. M. Mobarak (2014). Underinvestment in a profitable technology: The case of seasonal migration in bangladesh. Econometrica 82(5), 1671–1748.

Calvache, M., K. Reichardt, O. Bacchi, and D. Dourado-Neto (1997). Deficit irrigation at different growth stages of the common bean (phaseolus vulgaris l., cv. imbabello). Scientia Agricola 54(SPE), pp. 1–16.

Clarke, G. and S. Wallsten (2003). Do remittances act like insurance? evidence from a natural disaster in jamaica. Development Research Group, The World Bank. Mimeo.

Cox, D., Z. Eser, and E. Jimenez (1998). Motives for private transfers over the life cycle: An analytical framework and evidence for peru. Journal of Development Economics 55(1), pp. 57–80.

de Brauw, A. and C. Carletto (2012). Improving the measurement and policy relevance of migration information in multi-topic household surveys. Living Standards Measurement Study Working Paper 14.

De la Briere, B., E. Sadoulet, A. De Janvry, and S. Lambert (2002). The roles of destination, gender, and household composition in explaining remittances: an analysis for the dominican sierra. Journal of Development Economics 68(2), pp. 309–328.

De Weerdt, J. and S. Dercon (2006). Risk-sharing networks and insurance against illness. Journal of Development Economics 81(2), pp. 337–356.

De Weerdt, J. and K. Hirvonen (2013). Risk sharing and internal migration. World Bank Policy Research Working Paper (6429).

Dercon, S. and P. Krishnan (2000). Vulnerability, seasonality and poverty in ethiopia. The Journal of Development Studies 36(6), pp. 25–53.

Deshingkar, P. and S. Grimm (2004). Voluntary internal migration: an update. Paper commissioned by the Urban and Rural Change Team and the Migration Team, Policy Division, DFID. ODI. September 2004.

Docquier, F. and H. Rapoport (2006). The economics of migrants' remittances. Handbook of the economics of giving, altruism and reciprocity 2, pp. 1135–1198.

Duflo, E. and C. Udry (2004). Intrahousehold resource allocation in cote d'ivoire: Social norms, separate accounts and consumption choices. NBER Working Papers (10498).

Elvidge, C. D., K. E. Baugh, E. A. Kihn, H. W. Kroehl, and E. R. Davis (1997). Mapping city lights with nighttime data from the dmsp operational linescan system. Photogrammetric Engineering and Remote Sensing 63(6), pp. 727–734.

Europea, U. (2013). Perfil migratorio de nicaragua 2012.

Fafchamps, M. and S. Lund (2003). Risk-sharing networks in rural philippines. Journal of development Economics 71(2), pp. 261–287.

Fafchamps, M., C. Udry, and K. Czukas (1998). Drought and saving in west africa: are livestock a buffer stock? Journal of Development economics 55(2), pp. 273–305.

FAO (2010). Evaluación rápida de seguridad alimentaria y nutricional en 23 municipios del corredor seco de nicaragua. Technical report.

Gröger, A. and Y. Zylberberg (2015). Internal labor migration as a shock-coping strategy: evidence from a typhoon. American Economic Journal: Applied Economics. Forthcoming.

Gubert, F. (2002). Do migrants insure those who stay behind? evidence from the kayes area (western mali). Oxford Development Studies 30(3), pp. 267–287.

Henderson, V., A. Storeygard, and D. N. Weil (2011). A bright idea for measuring economic growth. The American Economic Review 101(3), pp. 194–199.

Hickey, M., P. Narendra, and K. Rainwater (2013). A review of internal and regional migration policy in southeast asia. Migrating Out of Poverty Working Paper 8.

Jack, W. and T. Suri (2014). Risk sharing and transactions costs: Evidence from kenya's mobile money revolution. The American Economic Review 104(1), pp. 183–223.

Lucas, R. E. and O. Stark (1985). Motivations to remit: Evidence from botswana. The Journal of Political Economy 93(5), pp. 901.

Mace, B. J. (1991). Full insurance in the presence of aggregate uncertainty. Journal of Political Economy 99(5), pp. 928–956.

Macours, K., P. Premand, and R. Vakis (2012). Transfers, diversification and household risk strategies : experimental evidence with lessons for climate change adaptation. World Bank Policy Research Working Paper (6053).

Morduch, J. (1995). Income smoothing and consumption smoothing. The Journal of Economic Perspectives 9(3), pp. 103–114.

Rosenzweig, M. R. and K. I. Wolpin (1993). Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: Investments in bullocks in india. Journal of political economy 101(2), pp. 223–244.

Townsend, R. M. (1994). Risk and insurance in village india. Econometrica 62(3), pp. 539–591.

UNDP (2009). Human Development Report: Overcoming Barriers: Human Mobility and Development. 2009. United Nations Development Programme.

Uribe, A. E. M. (2011). Gridded analysis of meteorological variables in nicaragua. The World Bank. Mimeo.

WorldBank (2013). World development report 2014: Risk and opportunity-managing risk for development. Washington, DC: World Bank.

Yang, D. (2008a). Coping with disaster: The impact of hurricanes on international financial flows, 1970-2002. The BE Journal of Economic Analysis & Policy 8(1).

Yang, D. (2008b). International migration, remittances and household investment: Evidence from philippine migrants' exchange rate shocks*. The Economic Journal 118(528), pp. 591–630.

Yang, D. (2011). Migrant remittances. The Journal of Economic Perspectives 25(3), pp. 129–151.

Yang, D. and H. Choi (2007). Are remittances insurance? evidence from rainfall shocks in the philippines. The World Bank Economic Review 21(2), pp. 219–248.

Yang, D. and A. Martínez (2005). Remittances and poverty in migrants' home areas: Evidence from the philippines. In International Migration, Remittances and the Brain Drain, pp. 81–123. Washington DC, World Bank.

Tables and Figures

Figure 1: Migrants by Destination. Cohort 15-21 years old in 2010

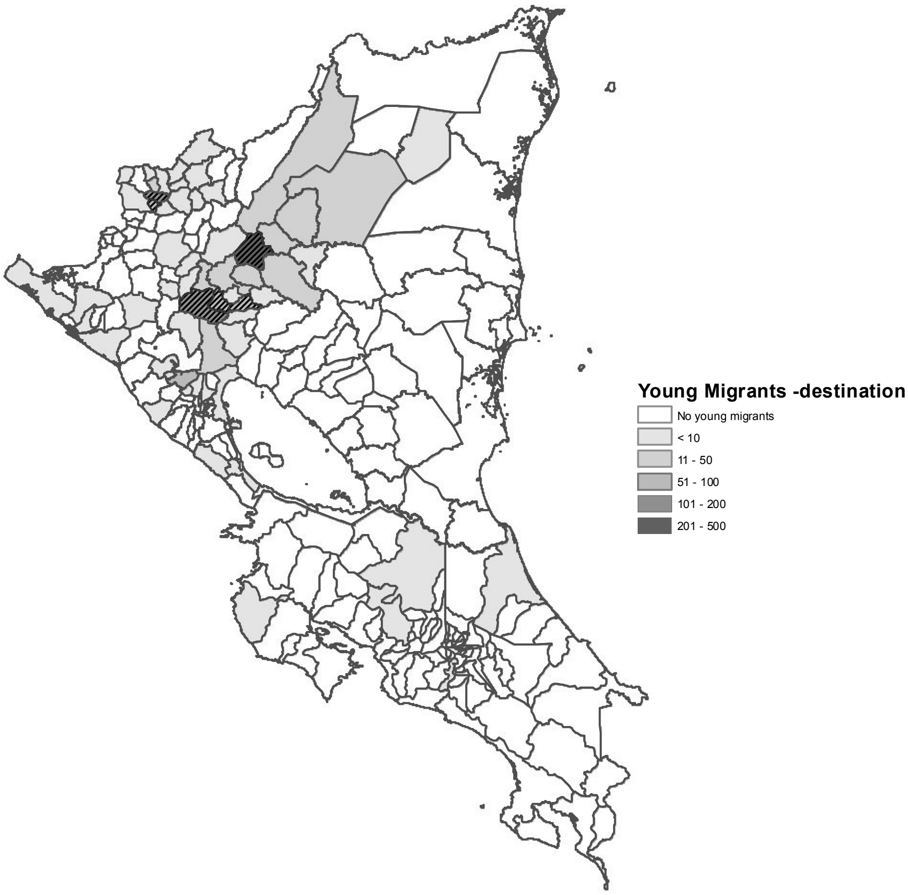


Table 1: Individual Characteristics-2010 by destination. Cohort 15-21 years old in 2010.

				Non-Local Migrants	
	Complete Sample	**Local Migrants**	**Non-Local Migrants**	**Rural Migrants**	**Urban Migrants**
Age (Jan, 1st 2010)	18.03	0.01	-0.02	-0.01	-0.04
		(0.02)	(0.02)	(0.02)	(0.02)
Marry	0.25	0.54***	0.38***	0.50***	0.13**
		(0.03)	(0.03)	(0.04)	(0.06)
Hh head or Spouse	0.14	0.41***	0.40***	0.41***	0.32***
		(0.03)	(0.03)	(0.04)	(0.04)
Years of school	6.08	-0.60***	0.65***	-0.27	1.94***
		(0.14)	(0.24)	(0.25)	(0.34)
Enrolled	0.36	-0.14***	-0.04	-0.14***	0.10*
		(0.02)	(0.04)	(0.04)	(0.06)
Working	0.92	0.02	-0.10***	-0.03	-0.18***
		(0.02)	(0.03)	(0.02)	(0.04)
Transfers and Remittances					
Probability to remit	0.33	-0.02	0.02	-0.02	0.07
		(0.03)	(0.03)	(0.03)	(0.04)
Probability to receive transfers	0.33	-0.02	0.02	0.00	0.03
		(0.03)	(0.03)	(0.03)	(0.05)
Remit and receive transfers	0.21	0.02	-0.02	0.01	-0.05
		(0.03)	(0.03)	(0.03)	(0.04)
Annual value remittances (USD)	46.13	-29.08**	30.85**	-25.30***	73.18***
		(14.31)	(14.51)	(6.97)	(21.70)
Annual value transfers (USD)	39.47	-4.02	5.57	-15.08	28.95
		(12.46)	(12.37)	(10.48)	(18.68)
Net annual value transfers (USD)	-9.12	12.73**	-13.31**	4.93	-34.28***
		(5.46)	(5.51)	(4.77)	(10.80)
Total Annual Consumption per capita in 2010					
Consumption at origin	602.66	29.67	60.86**	12.50	124.48***
		(19.70)	(23.02)	(25.45)	(40.10)
Consumption at destination	960.25	67.86**	659.33***	184.05***	1271.01***
		(31.52)	(90.23)	(49.18)	(150.39)
Observations	945	515	430	258	172

Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01. Column 1 presents the average value for the complete sample, while Columns 2-5 report the differences in means (standard errors in parentheses) by destination with respect to the rest of the sample.

Figure 2: Distribution Rainfall Shocks (z-score)

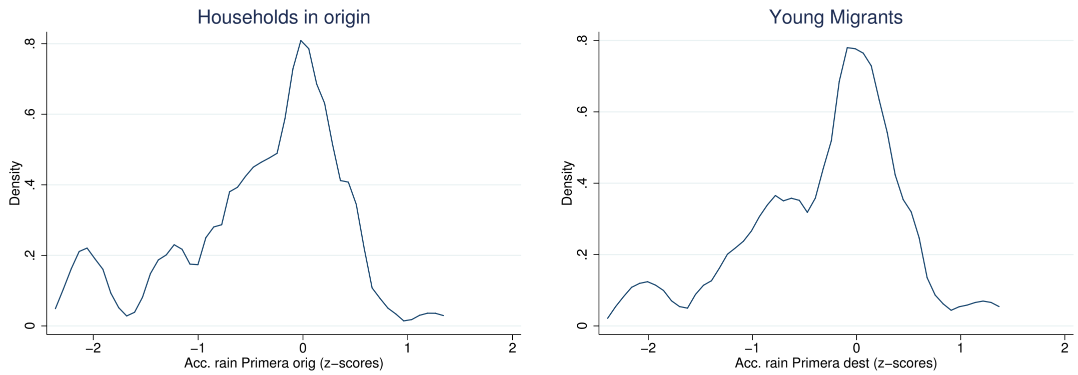


Table 2: Impact of weather shocks on household annual food production and first season harvest. Households at origin.

	Households with Young Migrants		**Households without Young Migrants**	
Outcome	**Mean**	**Rainfall Deficit Negative SD**	**Mean**	**Rainfall Deficit Negative SD**
Log Food Production	4.66	-0.369***	4.67	-0.351***
		(0.084)		(0.078)
Grains produced (USD)	2.97	-0.634**	3.08	-0.575***
		(0.24)		(0.18)
Grains bought (USD)	2.77	0.276	2.93	0.431***
		(0.21)		(0.15)
Harvest Final Outcome *Primera*:				
Sale	0.29	-0.0966**	0.28	-0.122***
		(0.040)		(0.040)
Consume	0.76	-0.0695*	0.80	-0.0735***
		(0.037)		(0.025)
Lost	0.059	0.0237	0.060	0.0484***
		(0.027)		(0.014)
Area without harvest (sq meters)	551.4	10.50	669.1	428.7**
		(233.4)		(179.9)
Obs.		438		1212

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household level controls, regional fixed effects, location controls and treatment controls.Values of grains produced and bought are trimmed for 5% outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 3: Impact of weather shocks on annual household income and annual household per capita consumption. Households at Origin

	Households with Young Migrants		Households without Young Migrants	
Outcome	**Mean**	**Rainfall Deficit Negative SD**	**Mean**	**Rainfall Deficit Negative SD**
Log Household Annual Income				
Agricultural income	3.77	-0.819***	3.60	-0.710***
		(0.15)		(0.13)
Agricultural income p.c.	2.41	-0.644***	2.14	-0.551***
		(0.14)		(0.10)
Total sources of income	6.77	-0.122	6.99	-0.221**
		(0.087)		(0.098)
Total sources of income p.c.	5.09	-0.0600	5.13	-0.203**
		(0.089)		(0.096)
Log Household Annual Consumption				
Log Total Consumption p.c.	6.25	0.0178	6.19	0.0303
		(0.046)		(0.030)
Log Food Consumption p.c.	5.76	0.0246	5.67	0.0206
		(0.048)		(0.036)
Log No-Food Consumption p.c.	5.19	-0.00261	5.17	0.0507*
		(0.055)		(0.030)
Obs.		438		1212

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household level controls, regional fixed effects, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 4: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants (15-21 years old)

	Probability to		Total Annual Value (USD)		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
Negative Rainfall SD: origin	-0.06	0.04	-6.34**	16.50*	-22.21**
	(0.05)	(0.05)	(2.39)	(8.22)	(9.65)
Negative Rainfall SD: destination	0.03	-0.04	1.84	-9.45	11.03*
	(0.05)	(0.04)	(2.88)	(6.29)	(6.54)
Outcome mean	0.35	0.34	10.69	20.96	-10.54
P-value: $\beta_o = -\beta_d$	0.698	0.993	0.255	0.188	0.102
Obs	357	348	355	347	346

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 5: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Local Migrants(15-21 years old)

	Probability to		**Total Annual Value (USD)**		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
Negative Rainfall SD: origin	-0.03	0.01	-0.45	-2.49	0.71
	(0.04)	(0.04)	(1.77)	(1.98)	(2.64)
Outcome mean	0.32	0.32	8.65	10.18	-0.36
Obs	470	445	467	442	441

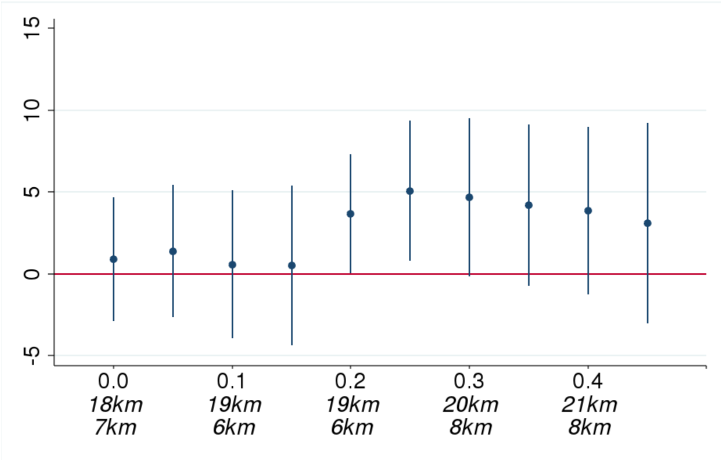
Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 6: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants by Destination (15-21 years old)

	Probability to		**Total Annual Value (USD)**		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
			Urban Non-Local Migrants		
Negative Rainfall SD: origin	-0.16**	-0.02	-13.31**	28.44**	-40.28**
	(0.07)	(0.05)	(5.69)	(13.18)	(15.36)
Outcome mean	0.36	0.39	15.99	42.48	-27.31
Obs	142	139	141	139	138
			Rural Non-Local Migrants		
Negative Rainfall SD: origin	-0.02	0.06	-4.71	1.15	-5.58*
	(0.08)	(0.07)	(3.16)	(1.76)	(3.02)
Negative Rainfall SD: destination	0.04	-0.04	0.89	-0.77	1.72
	(0.06)	(0.06)	(2.25)	(2.16)	(2.76)
Outcome mean	0.34	0.31	7.37	7.32	0.01
P-value: $\beta_o = -\beta_d$	0.773	0.749	0.246	0.855	0.222
Obs	215	209	214	208	208

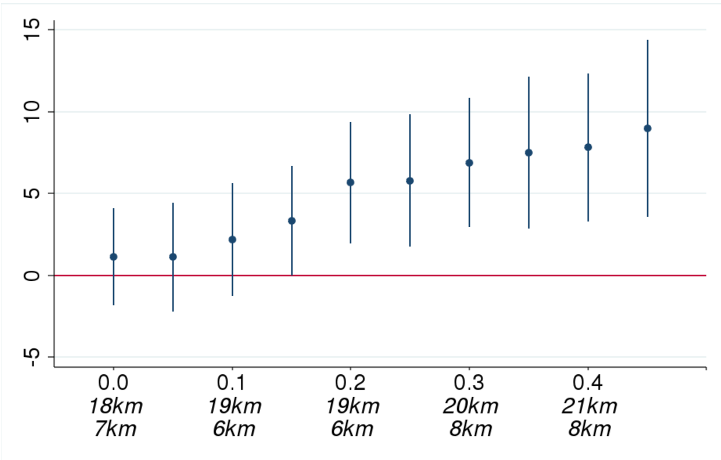
Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Figure 3: Rural Migrants (15-21 years old). Impact of Negative Rainfall SD at destination on the Value of Transfers Receipts (β^d_{Tr})



$$|z^h_o - z^m_d|$$

Figure 4: Rural Migrants (15-21 years old). Impact of Negative Rainfall SD at origin on the Value of Remittances Sent (β^o_R)



$$|z^h_o - z^m_d|$$

Notes (Figures 3 & 4): Each figure plots coefficient estimates (β^d_{Tr} and β^o_R respectively) of running Equation 5 and 6 on the pool of migrants satisfying $|z^h_o - z^m_d| > x$, where x takes values from 0 to 0.45 in 0.05 intervals. Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. Confidence Intervals are set at 90%. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca* at origin.

Table 7: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants-Livestock farming (15-21 years old)

	Probability to		**Total Annual Value (USD)**		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
Negative Rainfall SD: origin	0.00	-0.13	-5.29	-6.91	2.08
	(0.10)	(0.12)	(5.49)	(4.99)	(4.21)
Livestock*Negative Rainfall SD: origin	-0.05	0.28**	0.87	12.51*	-11.98***
	(0.15)	(0.13)	(6.68)	(6.42)	(4.18)
Negative Rainfall SD: dest	-0.01	0.04	2.12	4.55	-2.09
	(0.08)	(0.10)	(3.74)	(4.83)	(4.28)
Livestock*Negative Rainfall SD: dest	0.12	-0.12	-2.35	-9.09	6.24
	(0.12)	(0.13)	(5.65)	(5.84)	(4.99)
Livestock farming	0.06	0.12	0.81	0.87	-0.00
	(0.07)	(0.09)	(3.40)	(2.21)	(3.78)
Outcome mean	0.34	0.31	7.37	7.32	0.01
Pvalue: shock orig	0.900	0.076	0.351	0.050	0.004
Pvalue: shock dest	0.575	0.590	0.848	0.123	0.339
Obs	215	209	214	208	208

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 8: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants Found and Not Found (15-21 years old)

	Probability to		**Total Annual Value (USD)**		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
	Non-local Migrants within Nicaragua				
Negative Rainfall SD: origin	-0.05	0.03	-4.53**	7.72	-11.94
	(0.04)	(0.04)	(1.79)	(6.30)	(7.15)
Negative Rainfall SD: destination	0.04	-0.02	1.31	-4.24	5.21
	(0.03)	(0.03)	(1.87)	(4.46)	(4.27)
Outcome mean	0.30	0.34	8.85	22.67	-14.04
P-value: $\beta_o = -\beta_d$	0.830	0.683	0.276	0.405	0.207
Obs	505	488	502	487	485
	Urban Migrants within Nicaragua				
Negative Rainfall SD: origin	-0.08	0.04	-9.57**	23.59*	-32.44**
	(0.06)	(0.05)	(4.38)	(13.20)	(15.31)
Outcome mean	0.34	0.41	13.28	43.57	-30.89
Obs	189	185	188	185	184

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 9: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants (22-30 years old)

	Probability to		**Total Annual Value (USD)**		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
			Non-local Migrants within Nicaragua		
Negative Rainfall SD: origin	-0.00	-0.01	0.10	6.43*	-6.29*
	(0.03)	(0.03)	(1.11)	(3.70)	(3.51)
Negative Rainfall SD: destination	-0.02	-0.03	-0.04	-2.77	2.89
	(0.02)	(0.04)	(1.15)	(3.49)	(3.55)
Outcome mean	0.29	0.41	7.89	32.09	-23.81
P-value: $\beta_o = -\beta_d$	0.576	0.265	0.949	0.387	0.427
Obs	1020	1017	1017	1015	1013
			Urban Migrants within Nicaragua		
Negative Rainfall SD: origin	-0.03	0.08	-0.90	20.59**	-21.08**
	(0.06)	(0.06)	(2.43)	(9.22)	(9.68)
Outcome mean	0.31	0.54	9.05	61.03	-51.98
Obs	286	285	286	285	285

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean. All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls.Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table 10: Impact of weather shocks on household composition and buffer stock. Households at Original Communities.

	Households with Young Migrants		**Households without Young Migrants**	
		Rainfall Deficit		**Rainfall Deficit**
Outcome	**Mean**	Negative SD	**Mean**	Negative SD
Buffer Stock				
Assets				
Own Productive Assets (score)	1.75	-0.0332	1.79	-0.129**
		(0.090)		(0.064)
Own Assets	3.71	-0.111	3.75	-0.248**
		(0.13)		(0.097)
Livestock				
TLU Livestock: 2009	0.52	-0.00598	0.55	-0.00863
		(0.041)		(0.027)
Numb. pigs	0.91	0.0729	0.89	-0.131*
		(0.084)		(0.069)
Numb. chickens	10.2	-1.103**	10.4	-1.021
		(0.53)		(0.68)
Numb. cows	1.60	-0.399	1.93	-0.761
		(0.24)		(0.54)
Household composition				
Household Members	6.05	-0.466***	6.96	-0.0939
		(0.16)		(0.11)
Household members by age cohort				
Ages between 0-6	0.72	-0.168*	0.77	-0.00488
		(0.087)		(0.043)
Ages between 7-14	1.39	-0.289***	1.48	0.0317
		(0.079)		(0.052)
Ages between 15-21	1.21	0.0910	1.84	-0.0730
		(0.063)		(0.046)
Ages between 22-30	0.72	-0.109	0.77	-0.0318
		(0.11)		(0.041)
Ages between 31-60	1.55	0.0859**	1.71	0.000763
		(0.039)		(0.029)
Age over 61	0.42	-0.0639*	0.35	-0.0124
Obs.		438		1212

The sample in the first two columns includes households at origin with regional migrants aged between 15-21 and in the last two columns it includes households at origin for all the rest of the sample of young adults aged between 15-21 surveyed (excluding non-local migrants). The number of observations is smaller than in Table 4 as some migrants come from the same household at origin. All regressions include household level controls, regional fixed effects, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

A Appendix

Figure A1: Diagram: Young Adults 15-21 years old in 2010

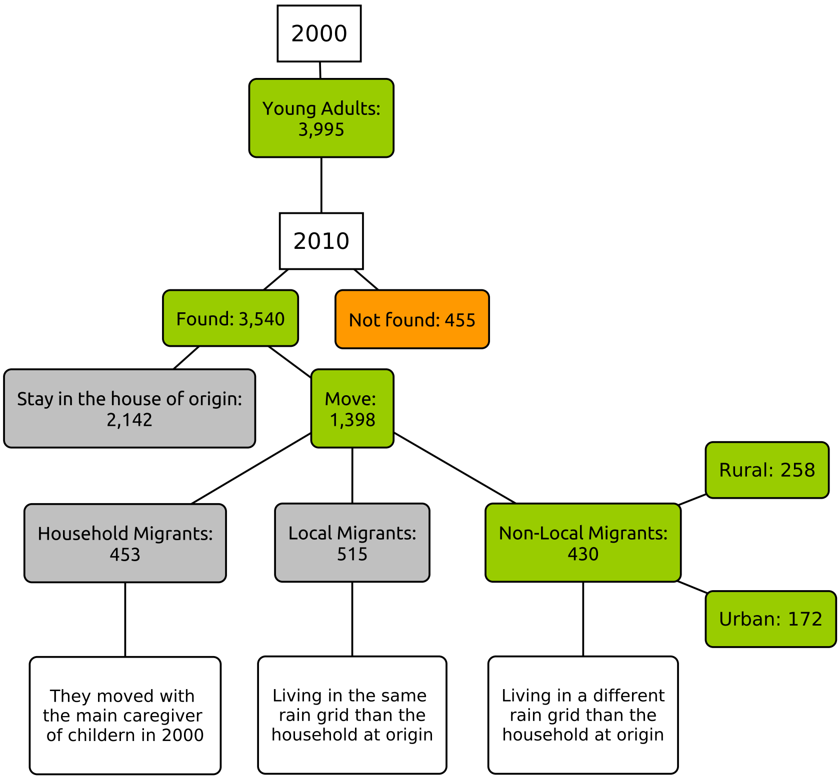


Figure A2: Map of Rainfall Shocks: distribution of Non-Local Migrants (15-21 years old)

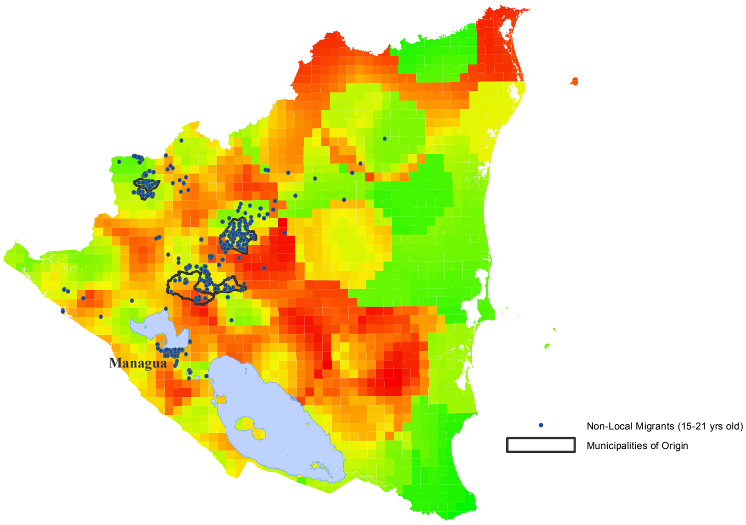


Table A1: Baseline Characteristics-2000 by destination. Cohort 15-21 years old in 2010.

	Complete Sample	Local Migrants	Non-Local Migrants	Non-Local Migrants: Rural Migrants	Non-Local Migrants: Urban Migrants
Phase I *RPS*	0.51	0.04	-0.01	0.05	-0.10
		(0.03)	(0.03)	(0.04)	(0.08)
Individual Characteristics in 2000					
Female	0.48	0.25***	0.31***	0.32***	0.25***
		(0.03)	(0.03)	(0.03)	(0.04)
Years of education	0.79	0.11*	0.37***	0.09	0.73***
		(0.06)	(0.09)	(0.09)	(0.12)
Work last week	0.08	-0.03**	-0.01	-0.01	-0.01
		(0.01)	(0.01)	(0.02)	(0.02)
Child of the hh head	0.83	-0.20***	-0.15***	-0.16***	-0.12**
		(0.03)	(0.03)	(0.03)	(0.05)
Household head Characteristics in 2000					
Female	0.11	0.03	0.02	-0.01	0.07
		(0.02)	(0.03)	(0.02)	(0.05)
Age	44.16	3.80***	2.61***	2.00**	3.15**
		(0.72)	(0.72)	(0.88)	(1.19)
Years of education	1.56	-0.35***	-0.10	-0.08	-0.12
		(0.11)	(0.12)	(0.16)	(0.18)
Agriculture activity	0.88	0.01	0.01	0.03	-0.01
		(0.01)	(0.02)	(0.02)	(0.03)
Household Characteristics					
House ownership	0.85	-0.03	0.01	-0.03	0.07*
		(0.02)	(0.02)	(0.03)	(0.04)
Land ownership	0.86	-0.02	0.05**	0.01	0.09***
		(0.02)	(0.02)	(0.03)	(0.03)
Livestock	0.16	-0.02	0.04	-0.02	0.12**
		(0.02)	(0.02)	(0.03)	(0.05)
Log Total Consumption p.c	7.72	-0.08***	0.01	-0.01	0.03
		(0.02)	(0.02)	(0.03)	(0.03)
Extreme poverty	0.54	0.09***	0.01	0.00	0.01
		(0.03)	(0.03)	(0.04)	(0.05)
Distance school (min)	25.58	1.44	-0.29	3.61	-6.12**
		(1.87)	(1.47)	(2.62)	(2.83)
Vegetation index	0.88	0.00	-0.00	0.02***	-0.03***
		(0.00)	(0.00)	(0.00)	(0.01)
Household Composition in 2000					
Household members: ages 0-4 yrs old	1.10	0.16***	-0.06	-0.00	-0.13**
		(0.05)	(0.05)	(0.07)	(0.06)
Household members: ages 5-15 yrs old	3.56	0.18**	0.08	0.08	0.08
		(0.07)	(0.07)	(0.09)	(0.15)
Household members: ages 16-30 yrs old	1.73	0.18*	0.34***	0.25**	0.43**
		(0.09)	(0.11)	(0.11)	(0.18)
Household members: ages 31-60 yrs old	1.62	0.14**	0.04	0.01	0.09
		(0.07)	(0.04)	(0.06)	(0.07)
Household members: ages over 61 yrs old	0.19	0.11***	0.07*	0.10*	0.01
		(0.03)	(0.04)	(0.06)	(0.05)

Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01
Column 1 presents the average value for the complete sample, while Columns 2-4 report the differences in means (standard errors in parentheses) by destination with respect to the rest of the sample (including those who did not move).

Table A2: Impact of weather shocks on household annual food production and first season harvest. Urban Migrants at Destination 15-21 years old.

	Urban Migrants surveyed before harvest first season 2010	
Outcome	**Mean**	**Rainfall Deficit Negative SD**
Log Food Production	0.36	-0.749*
		(0.43)
Grains produced (USD)	0.29	-1.014
		(0.83)
Grains bought (USD)	5.51	-3.219
		(4.37)
Harvest Final Outcome *Primera*:		
Sale	0.043	0.207
		(0.16)
Consume	0.12	0.293
		(0.27)
Lost	-	-
Area without harvest (sq meters)	-	-
Obs.		94

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include individual and household level controls, regional fixed effects, location controls and treatment controls.Values of grains produced and bought are trimmed for 5% outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A3: Impact of weather shocks on annual household income and annual household per capita consumption. Urban Migrants at Destination 15-21 years old.

	Urban Migrants surveyed before harvest first season 2010	
Outcome	**Mean**	**Rainfall Deficit Negative SD**
Log Household Annual Income		
Agricultural income	1.44	-0.350
		(2.12)
Agricultural income p.c.	0.42	0.341
		(1.08)
Total sources of income	8.29	-0.127
		(2.74)
Total sources of income p.c.	5.00	0.213
		(1.89)
Log Household Annual Consumption		
Log Total Consumption p.c.	7.72	-0.260
		(0.34)
Log Food Consumption p.c.	7.03	-0.0994
		(0.34)
Log No-Food Consumption p.c.	6.91	-0.263
		(0.36)
Obs.		94

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.

All regressions include individual and household level controls, regional fixed effects, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A4: Impact of weather shocks on household annual food production and first season harvest. Rural Non-Local Migrants at Destination 15-21 years old.

	Rural Migrants surveyed before harvest first season 2010			
	All		$\lvert z_o^h - z_d^m \rvert \geq 0.25$	
Outcome	**Mean**	**Rainfall Deficit Negative SD**	**Mean**	**Rainfall Deficit Negative SD**
Log Food Production	1.83	-0.105	1.68	-0.0602
		(0.091)		(0.11)
Grains produced (USD)	2.59	-0.182	2.27	0.186
		(0.43)		(0.35)
Grains bought (USD)	3.48	1.243**	3.64	1.144*
		(0.50)		(0.64)
Harvest Final Outcome *Primera*:				
Sale	0.27	-0.0140	0.28	-0.0324
		(0.059)		(0.072)
Consume	0.70	-0.171***	0.65	-0.188***
		(0.037)		(0.049)
Lost	0.024	-0.0281	0.039	-0.0366
		(0.028)		(0.047)
Area without harvest (sq meters)	194.0	65.60	319.2	106.4
		(226.9)		(341.9)
Obs.		209		127

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.

All regressions include household level controls, regional fixed effects, location controls and treatment controls.Values of grains produced and bought are trimmed for 5% outliers. Robust Standard errors, in parentheses, are clustered by *comarca*.
*p<0.1, **p<0.05, ***p< 0.01

Table A5: Impact of weather shocks on annual household income and annual household per capita consumption. Rural Non-Local Migrants at Destination 15-21 years old.

	Rural Migrants surveyed before harvest first season 2010			
	All		$\lvert z_o^h - z_d^m \rvert \geq 0.25$	
Outcome	**Mean**	**Rainfall Deficit Negative SD**	**Mean**	**Rainfall Deficit Negative SD**
Log Household Annual Income				
Agricultural income	5.76	-0.387	5.55	-0.631
		(0.30)		(0.40)
Agricultural income p.c.	2.55	-0.391	2.42	-0.535
		(0.24)		(0.36)
Total sources of income	9.02	-0.261	8.75	-0.678*
		(0.28)		(0.37)
Total sources of income p.c.	5.30	-0.228	5.14	-0.625*
		(0.24)		(0.34)
Log Household Annual Consumption				
Log Total Consumption p.c.	7.17	-0.0608	7.15	-0.0562
		(0.087)		(0.12)
Log Food Consumption p.c.	6.61	-0.0706	6.59	-0.111
		(0.095)		(0.13)
Log No-Food Consumption p.c.	6.21	-0.0670	6.19	-0.000279
		(0.089)		(0.13)
Obs.		209		127

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household level controls, regional fixed effects, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A6: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Urban Migrants (15-21 years old). Including rainfall shocks at destination.

	Probability		Total Annual Value (USD)		
	Receive Transfers	**Remit**	**Transfers**	**Remittances**	**Net Transfers**
Negative Rainfall SD: origin	-0.16**	-0.03	-13.39**	29.56**	-41.65**
	(0.06)	(0.06)	(6.04)	(13.84)	(16.46)
Negative Rainfall SD: destination	0.05	0.10	2.74	-14.08	17.24
	(0.14)	(0.20)	(10.81)	(31.37)	(35.17)
Outcome mean	0.36	0.39	15.99	42.48	-27.31
Obs	141	138	140	138	137

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Dependent values inputed max and min values for the 1% highest and lowest outliers. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A7: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants (15-21 years old)

	Log (hyperbolic transformation)			**Square Root**	
	Transfers	**Remittances**	**Net Transfers**	**Transfers**	**Remittances**
Negative Rainfall SD: origin	-0.31	0.24	-0.53**	-0.24*	0.17
	(0.20)	(0.18)	(0.26)	(0.12)	(0.11)
Negative Rainfall SD: destination	0.18	-0.32*	0.41	0.10	-0.18*
	(0.19)	(0.17)	(0.28)	(0.11)	(0.11)
Outcome mean	1.21	1.34	-0.27	0.74	0.81
P-value: $\beta_o = -\beta_d$	0.623	0.722	0.671	0.386	0.913
Obs	355	347	346	355	347

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A8: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants by Destination (15-21 years old)

	Log (hyperbolic transformation)			**Square Root**	
	Transfers	**Remittances**	**Net Transfers**	**Transfers**	**Remittances**
	Urban Non-Local Migrants				
Negative Rainfall SD: origin	-0.82**	0.07	-0.77*	-0.66**	0.09
	(0.30)	(0.22)	(0.38)	(0.27)	(0.13)
Outcome mean	1.40	1.89	-0.66	0.89	1.14
P-value: $\beta_o = -\beta_d$					
Obs	141	139	138	141	139
	Rural Non-Local Migrants				
Negative Rainfall SD: origin	-0.18	0.17	-0.42	-0.12	0.11
	(0.31)	(0.22)	(0.34)	(0.18)	(0.13)
Negative Rainfall SD: destination	0.17	-0.21	0.34	0.10	-0.11
	(0.21)	(0.20)	(0.31)	(0.12)	(0.12)
Outcome mean	1.08	1.00	-0.02	0.66	0.60
P-value: $\beta_o = -\beta_d$	0.957	0.828	0.814	0.870	0.957
Obs	214	208	208	214	208

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table A9: OLS: Impact of Weather Shocks on Remittances and Transfers Receipts. Non-Local Migrants by Destination (15-21 years old)

Quantile Regression		
	Transfers	**Remittances**
Percentile 80%		
Negative Rainfall SD: origin	-0.12	5.31
	(5.50)	(9.73)
Negative Rainfall SD: destination	2.37	-6.59
	(2.68)	(5.54)
Percentile 85%		
Negative Rainfall SD: origin	-3.38	15.86*
	(5.37)	(9.33)
Negative Rainfall SD: destination	2.82	-8.17
	(3.16)	(6.30)
Percentile 90%		
Negative Rainfall SD: origin	-8.89	39.44
	(7.54)	(27.85)
Negative Rainfall SD: destination	1.96	-4.43
	(5.77)	(9.91)
Percentile 95%		
Negative Rainfall SD: origin	-25.74	70.33**
	(26.40)	(27.65)
Negative Rainfall SD: destination	9.70	-19.24*
	(18.23)	(10.66)
Obs	355	347

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.

All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Bootstrap Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

B Appendix: Migrants Selection

Table B1: OLS: Impact of Weather Shocks on the Probability to Migrate by Destination (15-21 years old)

			Non-Local Migrants	
	Local Migrants	**Non-Local Migrants**	**Rural Migrants**	**Urban Migrants**
Negative Rainfall SD: origin	0.00	0.02	-0.06	0.00
	(0.01)	(0.08)	(0.05)	(0.00)
Negative Rainfall SD: destination		-0.05	0.04	
		(0.08)	(0.06)	
Outcome mean	0.15	0.11	0.07	0.05
Obs	3464	3464	3464	3464

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table B2: OLS: Impact of Weather Shocks on the choice of destination (15-21 years old). Conditional on being a migrant.

		Non-Local Migrants	
	Non-Local Migrants	**Rural Migrants**	**Urban Migrants**
Negative Rainfall SD: origin	-0.01	-0.08*	0.00
	(0.06)	(0.05)	(0.01)
Negative Rainfall SD: destination	-0.06	0.03	
	(0.07)	(0.05)	
Outcome mean	0.30	0.18	0.12
Obs	1364	1364	1364

Notes: Negative Rainfall SD accounts for deviations of accumulated rain between June-July in 2009 from the historical mean divided by the standard deviation for each node multiplied by minus one. Positive values represent rainfall deficits with respect to the historical mean.
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

Table B3: OLS: Impact of Rainfall Historical Variation on Probability to Migrate by Destination (15-21 years old)

			Non-Local Migrants	
	Local Migrants	**Non-Local Migrants**	**Rural Migrants**	**Urban Migrants**
Coef. Variation: orig	0.10*	0.07	-0.01	0.10
	(0.06)	(0.14)	(0.13)	(0.08)
Coef. Variation: dest		-0.00	-0.03	
		(0.15)	(0.15)	
Outcome mean	0.15	0.11	0.07	0.05
Obs	3464	3440	3440	3464

Notes: Coefficient of Variation of accumulated rain between June-July from 2000 to 2009 at migrants' location of origin and of destination.CV= $\frac{STD_{(00-09)}}{MEAN_{(00-09)}}$
All regressions include household and individual level controls, regional fixed effects at origin and at destination, location controls and treatment controls. Robust Standard errors, in parentheses, are clustered by *comarca*. *p<0.1, **p<0.05, ***p< 0.01

C Appendix: Impact of rainfall shocks in local and non-local prices

An alternative explanation of the lack of impact of rainfall fluctuations on consumption is that shocks may affect local prices forcing households to adjust their expenditures to compensate for the change in prices. Using data from a community questionnaire on the municipalities of origin and data from the household survey, I analyze whether that is the case. I construct the average price for food and non-food items at the community level, and find that an increase on accumulated rainfall is positively correlated with prices of non-food items and no correlated with the average price of food items. This effect may explain why I do not find any impact of rainfall shocks at origin on non-food consumption aggregates but it does not explain smoothing on food consumption. At the household level, I can compute prices of food products. Relative to prices at the community level, constructing prices using information from the household questionnaire allows me to investigate whether local rainfall shocks have an impact on prices at migrant destination. I construct a price index using most frequently observed products and find that consistent with the results on prices index at the community level, rainfall shocks are not correlated with household price index of food products (estimates are positive, but small and not significantly different from zero). By product, local shocks may have an impact on the prices of food products in local markets, but the sign of this effect is not clear, and overall prices do not seem to be moving in any particular direction. Regarding whether local shocks at origin affect prices at destination, I run a regression, for each food product and for the the price index, including shocks at origin and shocks at destination. I focus on migrants who are at least 8 km (size of each rainfall grid) far away from the household of origin and find that coefficients are not significantly different from zero. In addition, I test whether shocks occurring in neighboring grids have any impact on local prices and find non-significant effects.

It is difficult to disentangle, at this stage, the magnitude of the effect and the direction, as it seems that prices of different products move in different directions. Importantly, the data shows that local prices are not affected by non-local shocks. The opposite could have affected the interpretation of my results: the increase in remittances due to negative shocks at origin instead of being driven by an insurance effect could have been driven by an income effect due to the change in prices. I find that for some particular products, local prices are affected by shocks at destination, however, this happens among migrants living very close to the household of origin, for whom shocks are highly correlated. In this matter, the paper shows that for this group of migrants rainfall shocks do not affect the transfer of funds, and it clearly shows that only when migrants are living in urban communities or are exposed to shocks that are less correlated negative rainfall shocks activate the insurance mechanism.