Migration responses to adverse household shocks:

Do family relationships and types of shocks matter?

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Abstract

This paper estimates how family relationships between migrants and their households affect migration and remittance responses to three different household shocks: an earthquake, the death of a family member, and livestock death. Using agricultural household panel data from El Salvador we find that migrant responses to negative shocks change across family relationships and the type of shock. Sisters of the household head return home after an earthquake while sons and brothers migrate away after livestock deaths, and household heads migrate away after the death of a family member. We also find that remittances received by the household significantly fall in response to earthquakes.

Keywords: household panel data, Central America, El Salvador, international migration, remittances, family relationships.

1. Introduction

Remittances from international migrants are an important income source for many households in the developing world. There is evidence that men and women behave differently when remitting to their origin household because of differing gender roles. Yet how migration and migrant remittances respond to negative economic shocks remains an open empirical question, especially across migrants' gender and their family relationship to the household. El Salvador makes a good case study given its extensive migrant network and consistently high remittance flows. In 2000, approximately 1 in every 8 Salvadorans resided in the United States, representing about 13 percent of the total Salvadoran population. El Salvador received a total of over $US 1.7 billion in remittances from abroad during the same year. Further, in 2001, El Salvador experienced two large earthquakes within weeks of each other causing widespread structural damage, injuries, and fatalities[2]. This paper uses a household panel data set from El Salvador to examine the ways in which different migrants respond to three different kinds of household shocks, namely damage from an earthquake, death of a household member (not due to the earthquakes), and death of multiple livestock.

The new economics of labor migration (NELM) suggests that migration is a household decision and a response to missing credit and insurance markets (Stark, 1991; Stark & Bloom, 1985). As noted by Yang (2005), migrants are often implicitly expected to buffer economic shocks in the migrants' home country[3]. It is well established in the literature that negative income shocks may induce both migration and remittance flows to households. Rosenzweig and Stark (1989) demonstrate this for the case of agricultural producers who experience negative

[2] On January 13, 2001 at least 944 people were killed, 5,565 injured, 108,261 houses destroyed, 169,692 houses damaged, and more than 150,000 buildings were damaged. On February 13, 2001, 315 people were killed, 3,399 were injured, 44,750 houses were destroyed and 16,752 houses were damaged. ("2001 El Salvador earthquakes", 2011).

[3] Another example of this research is Ratha (2003).

agricultural shocks in India. These findings are corroborated by Lambert (1994) in the Ivory Coast, Stark and Lucas (1988) in Botswana, and Gubert (2002) in western Mali. A number of other studies have confirmed a similar relationship between negative income shocks and increased intra-familial transfers (Caldwell, Reddy & Caldwell, 1986; Cox, Eser & Jimenez ,1998; ; Cox & Jimenez, 1998; Rosenzweig, 1988).

To our knowledge, there is limited research on gendered differences of migration patterns, however there have been studies on gender differences and remittances. These studies fail to reach a consensus on the motivating factors behind these differences (de la Briere, Sadoulet, Janvry & Lambert, 2002; Niimi & Reilly, 2008; Vanwey, 2004) This lack of consensus is likely due to differing social norms for male and female migrants across cultural contexts. For example, de la Briere et al. (2002) find that, in Jamaica, only when the male is the sole migrant do males send remittances as insurance to smooth income for the sending household. For international migrants, sending remittances motivated by future bequests is done equally by males and females. Vanwey (2004) concludes that women and men behave both contractually and altruistically in Vietnam; female migrants from poorer households behave more altruistically and remit more because of cultural and religious reasons, while male migrants from richer households behave contractually. Also in Vietnam, Niimi and Reilly (2008) find that women are more likely to remit, however when men do remit, the amount is larger than that of women. They conclude that this finding has little to do with gender differences in remitting and much more to do with endowment differences related to family relationships and labor market earnings.

Several studies (Halliday, 2006; Halliday, 2012; Yang, 2008) use the same data as we do to examine migration responses to earthquakes in El Salvador and find that migration decreases after the earthquakes. Halliday (2006) suggests that households reduced migration rates in order

to have more family members available to help in the aftermath of the disaster. In contrast, Yang (2008) argues that the earthquake shocks affect all households in a region and reduce the capacity of informal financial markets needed to finance migration. Further, Halliday (2012) finds a decline in female migrants sent abroad after the earthquakes, arguing that females chose to supply labor locally instead.

Few papers have considered how migration and remittance patterns differ across family relationships and across different types of adverse shocks[4]. Our study uses detailed data on the migrant's gender and relation to the household head (son, daughter, brother, sister, or household head) to determine whether migration and remittances differ by gender and/or by family relationships in response to negative shocks. Further, since Niimi and Reilly (2008) suggest much of the difference in gendered remitting behavior is due to differences in endowments and the migrant's labor market conditions, we control for wage and unemployment rates of males and females in the U.S.

The paper proceeds in the following way. Section 2 provides a discussion of theoretical considerations, section 3 describes the data, section 4 explains the empirical model and methods, section 5 discusses the results, and section 6 provides some concluding comments.

2. Theoretical discussion

We begin by assuming that the migration decision is a household, not individual, decision and that the term *household* refers to the migrant's household of origin. Migrant refers to the household member who is separated from the household. Consider a two period framework. In period one, the household can choose to either send a family member to a different labor market,

[4] One exception that we are aware of is Gubert (2002) who uses a cross section analysis to look at remittance response to income shocks and does consider family relationships. Here, only migrants who were brothers or sons of the household head were considered (along with the head themself); brothers were found to be a positive determinant of remittances.

or bring a family member back home. In period two, if the migrant has migrated away from the household, he or she determines how much to remit back to the sending household.

This model helps to frame two questions. First, how do the household decision about migration and the migrant's decision to remit vary by exogenous shocks? Second, how does the migrant's response to a shock vary by gender and family relationships? We assume there is an implicit relationship or agreement between the existing or potential migrant and the household. The form of this relationship (*s*) is a key determinant of migration and remittance choices and outcomes. Since the cost to send a migrant is significant, the household's decision to send a family member to a different labor market may depend on the household's expectation of receiving future remittances. The form of this relationship (*s*) may increase or decrease the likelihood that a specific family member is sent. For example, a household may not pay migration costs for a distant cousin, who has weaker family ties, to migrate since the likelihood of receiving future remittances may be low. Alternatively, it is possible that the family may be more likely to send less "central" family members if they are considered less important to the daily business of the household. The term "form of the relationship" or (*s*) is intentionally vague, because the household's relationship with a migrant may be defined by unobservable roles of different family members that differ by gender or family relationship.

To better understand the motivation behind the household's choice in period one, we work backward, starting with the migrant's choice to remit in period two. In period two, given both the migrant *j* in household *i* has been chosen (M_{ij}) and the form of the relationship between migrant *j* and household *i* has been determined (s_{ij}), we assume that this migrant is spatially separated from the household and now faces an individual utility optimization problem. The utility maximization problem for migrant *j* in household *i* is

$$\max_{C_{ij}^M, R_{ij}} U\left(C_{ij}^M, R_{ij}(s_{ij})\right) \quad (1)$$

subject to:

$$p_1 C_{ij}^M \leq Y_{ij}^M(w_{ij}) - R_{ij}(s_{ij});\ 0 \leq s_{ij} \quad (2)$$

where the migrant maximizes his or her utility, subject to a budget constraint, given s_{ij}, by choosing their own consumption C_{ij}^M, and the remittances sent to household *i* by the migrant *j* or R_{ij}. In the budget constraint, migrant consumption is determined by their income minus remittances sent to the household where p_1 is a vector of consumption good prices in the migrant's labor market and Y_{ij}^M is income as a function of migrant wages, w_{ij}. Solving for R_{ij} leads to a simple remittances supply function:

$$R_{ij} = f(w_{ij}, s_{ij,} p_1) \quad (3)$$

Pfeiffer et al. (2006) point out that empirical models which pool male and female migrants are adequate if parameters do not vary by gender. We argue that it is not only gender which may affect the parameters, but a migrant's family relationship to the sending household and thus we must further disaggregate estimates by migrant family relationships. Thus we expect s_{ij} to vary by gender (g_{ij}) and family relationships (f_{ij}). Further, while the form of the relationship (s_{ij}) is unobservable, it is influenced by observable migrant and household characteristics, and whether the household has been affected by an exogenous shock. These additional variables include: household size (η_i), education level of household head (E_i), and number of migrants in the household (ρ_i), and an economic shock (Q_i). It is also influenced by unobservable migrant ability (α_{ij}) and motivation (τ_{ij}). Household size is included to account for the possibility that larger households have larger needs for migrants/remittances to support more dependents in the household or simply larger households may have more labor available to migrate. Therefore, the

form of the relationship will differ from that of smaller households. The education of the household head could also potentially affect the form of the relationship as better educated household heads may make different choices about sending a particular household member, given the cost associated with sending. Acosta (2006) points out that sending a migrant away requires investment and only wealthy households can afford this. Better educated household heads may also be wealthier, and help capture this point. Finally, the strength of the relationship may also be a function of the number of other migrants in the household. For example, if a household has many migrants, each migrant may be responsible for only a portion of the household remittance, or may be expected to remit only under certain circumstances. Thus we can write:

$$s_{ij} = s_{ij}{}^{*}\left(g_{ij}, f_{ij}\eta_i, E_i, \rho_i, Q_i; \alpha_{ij}, \tau_{ij}\right) \quad (4)$$

Then the remittance supply function can be written as:

$$R_{ij} = f\left(w_{ij}, g_{ij}, f_{ij}, \eta_i, E_i, \rho_i, Q_i, p_1; \alpha_{ij}, \tau_{ij,}\right) \quad (5)$$

Now, turn to the migration choice of household (*i*) in period one. The problem of interest is which family member (*j*) will migrate (or alternatively come home). The household utility maximization problem in period one is:

$$\max_{C_i^h, M_{ij}} U\left(C_i^h, M_{ij}\right) \quad (6)$$

subject to:

$$p_2 C_i^h \leq Y_i^h + E(R_{ij}) - p_3\left(M_{ij}\right); 0 \leq s_{ij}, \quad (7)$$

$$R_{ij} = R\left(w_{ij}, s_{ij}, P_1\right) \quad (8)$$

where the household maximizes their utility by choosing household consumption C_i^h and a specific migrant to supply M_{ij}, subject to s_{ij} and the household budget constraint which includes: p_2 as a vector of consumption good prices, household income Y_i^h, the household's expected

remittances received from migrant $E(R_{ij})$, and the cost to send or return a migrant ($p_3(M_{ij})$); where p_3 represents the financial cost to send each migrant M_{ij}. Note, the expectation of the remittances term allows for the possibility that the household has no expectation for remittances. Solving for M_{ij} leads to a simple migration supply function:

$$M_{ij} = f(w_{ij}, s_{ij}, p_1, p_2, p_3) \quad (9)$$

Substituting for s_{ij}, we have the migration supply function for migrant *j* in household *i* can be written as:

$$M_{ij} = f\left(w_{ij}, g_{ij}, f_{ij}\,\eta_i, E_i, \rho_i, Q_i, p_1, p_2, p_3; \alpha_{ij}, \tau_{ij}\right) \quad (10)$$

The following empirical analysis will use expressions (5) and (10) as guiding equations for estimation. Our null hypothesis is that s_{ij} , which is a function of Q_i does not vary across relationships such that $\frac{\partial M_{ij}}{\partial Q_i} = 0$ for all *j*. In the following sections we use data from El Salvador to empirically test this hypothesis.

3. Data and descriptive statistics

Description of data

For the empirical analysis we employ a four year panel dataset collected in El Salvador in 1996, 1998, 2000, and 2002 by the Salvadoran Foundation for Economic and Social Development[5] (FUSADES) and Ohio State University (OSU) under the Broadening Access and Strengthening Input Markets System (BASIS) program in El Salvador (Pleitez-Chavez, 2004). We use the 2000 and 2002 rounds of this survey which capture migration and remittance changes as a response to the two earthquakes that occurred in January and February of 2001 as well as changes due to household family deaths and livestock deaths.

Both rounds include detailed data on migration, received remittances, socioeconomic, and

5 In Spanish: Fundación Salvadoreña para el Desarrollo Económico y Social

demographic status of the households. The 2002 round includes information on how the households were affected, if at all, by the two earthquakes in 2001. In particular, the survey includes details on whether households experienced structural damage to the home, loss of work or employment, injury or deaths to the family, and loss or damage of assets that directly resulted from earthquake damage. We use a 0/1 dummy variable collected in the 2002 survey to indicate whether a household was negatively affected by the earthquakes. Further, using global positioning coordinates collected for each household, the Euclidean distance between the household and each earthquake epicentre was calculated for each household by the authors. The "distance" variables are used as instruments to control for possible endogeneity of earthquake damage with migration and remittances. The data also include detailed information on family deaths as well as changes in livestock holdings due to unexpected livestock deaths. Both household deaths and livestock deaths are measured as dichotomous variables, such that if a household experienced either a family or livestock death in year *y*, they are assigned a 1 for that year and a 0 otherwise. Wage and unemployment rates in U.S. cities are calculated from the U.S. Current Population Survey using only non-resident Latino workers in the migrant's destination city to control for labor market conditions faced by migrants in the United States[6].

Descriptive statistics

Table 1 shows descriptive statistics for the number of migrants per household and remittances received per household. Table 2 shows descriptive statistics for our explanatory variables. Our sample includes 291 households that had an international migrant in either 2000 or 2002. Each household may have multiple migrants (or none) in a year and each migrant may be of a different family relation to the household head (i.e., son, daughter, sister, brother, or

[6] We use non-resident Latino workers to capture the most accurate wage rate faced by Salvadoran immigrants to the U.S.

household head).

[Table 1 about here]

To begin, consider the household's initial stock of migrants in 2000. As shown in table 1, in 2000, the average number of migrants per household was 1.53. We consider the number of migrants for each household by their relation to the household head. Migrant who are sons of the household head are the most likely to migrate with the average household having .45 migrant sons, whereas daughters are second with an average of .26 per household. Interestingly households have an average of .95 female migrants compared with .58 male migrants per household. Next consider the change in number of migrants between 2000 and 2002. Overall, the number of migrants per household rose slightly between 2000 and 2002, but the households' stock of migrants who are sisters or brothers of the household head, or household heads fell. The number of migrants who were sons and daughters increased. The number of female migrants rose, but the number of male migrants fell.

Table 1 also shows that over time the average remittances received by households rose by $371.56. Unfortunately, we do not have data on which migrant in a household sent remittances; we only have data on the total remittances received by each household.

[Table 2 about here]

Table 2 shows descriptive statistics for our three explanatory variables of interest and for our control variables. We see that over half of our sample (.56) was affected by the 2001 earthquakes. A much smaller number of households experienced more human deaths in 2002 than in 2000, only 4%, whereas 16% experienced more small livestock deaths[7] in 2002 than in 2000.

[7] We split livestock into small stock (chickens, goats, ducks etc) and large stock (cows, horses, oxen) and examined the deaths of each separately. For small stock we only indicated that a household experienced small livestock death

Our analysis first controls for the migrant's labor market conditions in the United States. It is possible that changes in migration and remittance levels can be partially explained by changes in the migrant's labor market conditions in the United States. We see that average weekly wages in the United States for non-resident Latino workers increased between 2000 and 2002 represented by a positive change in the wage variable. A decrease in the unemployment rate for non-resident Latino workers of .03 percentage points is observed and could also partly explain a change in migration (and remittance) levels.

We also control for the size of the sending household (excluding the migrant(s)). In 2000, there were an average 5.81 people per household; the size fell slightly by 2002[8]. The education level of the household head could also potentially affect migration patterns and remittance levels if less educated household heads were somehow more vulnerable or contributed to unmeasured migrant characteristics that could affect remittance levels. The education level of the household head may also influence the wealth of the household or the ability of the household to identify financing for migration. Education of the household head is 2.32 years on average.

Following Yang (2008) we also include a variable for each household's number of migrants in 2000 to control for the possibility that households' migration patterns differed by region across El Salvador, which was 1.53 per household (table 1).

4. Empirical model

Following recent work by Yang (2008) we examine the impact of the household shocks on changes in migration patterns and remittances between the years 2000 and 2002 using a first difference approach. We disaggregate migrants to examine the role of family relationships in

shock if they lost more than 10 small stock in a year. The results for large livestock deaths were consistently insignificant and thus dropped from analysis.

[8] We also considered using data on number of dependents in the household, but these results were always insignificant across all regressions and thus dropped from the analysis.

migration and remittance responses to a household shock. First, we consider an empirical specification of equation (9) where M_{ij} is migrant type j, where j could represent gender or family relation. The following is a reduced form equation for migrant stock (M_{ij}) for migrant relation j in household i between 2000 and 2002. Given repeated observations on household i in years 2000 and 2002 we can write an equation explaining the number of migrants as:

$$M_{ijt} = \beta_0 + \delta_0 T_t + \beta_1 Q_{it} + \gamma_1 X_{it} + \gamma_2 L_{ijt} + \alpha_i + u_{it}, \;\; t = 2000{,}2002 \qquad (11)$$

Here, T_t is a dummy variable for 2002 and α_i is an unobserved household effect that might affect the household's stock of migrants but does not change over time, such as prices in equations (5) and (10). Q_{it} indicates the household's exposure to a shock between 2000 and 2002. X_{it} is a set of observed household level control variables, L_{ijt} is a vector of variables to control for labor market conditions in the United States and u_{it} is the time-varying error that represents unobserved factors that affect the household's stock of migrants that may change over time. Differencing equation (11) across time yields

$$\Delta M_{ji} = \delta_0 + \beta_1 \Delta Q_i + \gamma_1 X_{i,2000} + \gamma_2 \Delta L_{ji} + \Delta u_i \qquad (12)$$

Here, ΔM_{ji} is now the change in the number of migrants in household i from 2000 to 2002; $\Delta M_{ji} > 0$ means the household experienced migration away from the household and $\Delta M_{ji} < 0$ means the household experienced a migrant returning home. Our explanatory variables are also differenced to be the change in the value from 2000 to 2002[9]. The variable ΔQ_i measures the change in the households shock exposure; for the case of the earthquake shock, we use the household's report of impact in 2002 ($Q_{i,2002}$). We also replace the differenced control variables in the vector X_i with the initial 2000 levels to control for differing demographic characteristics across households.

[9] Note that the specifications shown below examine changes in number of migrants at the household level, aggregating all migrants. All variables are measures at the household level *i*.

One potential concern is whether Δu_i is still correlated with $Q_{i,2002}$ for the case of the earthquakes. It is possible that an unobservable characteristic about the household, that changes over time, is correlated with both how the household was affected by the earthquake ($Q_{i,2002}$) and a household's number of migrants. Reverse causality between earthquake damage and migration is also a concern. For example, if previous migration strengthened and broadened a household's social network or improved the information a household has at its disposal, the severity of the earthquake's impact on the household would be affected by the previous behavior of the household's migrant. Thus, we may have a potential endogeneity problem with Q_i.

A standard approach in this case is to find an instrument vector (z_i) that is correlated with $Q_{i,2002}$, ($Cov(Q_i,z_i) \neq 0$), but not correlated with Δu_i, ($Cov(\Delta u_i,z_i) = 0$). One potential instrument is the geographic distance from each household to the epicenter of each earthquake. Since there were two earthquakes, we have two instruments $Z1_i$ and $Z2_i$. Most certainly, the distances from each household to the epicenter would be strongly correlated with a measured impact of the earthquakes on each household. Households located closer to the epicenter would be more likely to experience structural damage to the home, injuries, and loss of work than those further away[10]. It follows that a set of appropriate excluded instruments for $Q_{i,2002}$ are the two variables that measure the distance between epicenters 1 and 2 ($Z1_i$ and $Z2_i$) and the location of the household. It is also possible that there is a non-linear relationship between the earthquake's impact on the household and the distance to the epicenter. To account for this possibility we included and tested squared distances for both Z1 and Z2. As a final step, we cluster the standard errors at the municipal level. The first stage of the two-staged least squares specification is:

$$Q_{i,2002} = \omega_0 + \omega_1 Z1_i + \omega_2 Z2_i + \omega_3 Z1_i^2 + \omega_2 Z2_i^2 + \theta_1 X_{i,2000} + \theta_2 \Delta L_{ji} + \Delta\epsilon_{ji} \quad (13)$$

[10] At the same time there is no reason to believe that a household's distance to an epicenter of a random, natural event would be correlated with unobservable household characteristics that have changed over time.

Second, we consider an empirical specification of the migrant remittance supply equation (5) for migrant *j* in household *i*. Since we only have data on remittances received by the household *i* (not on which migrant *j* supplied the remittances), we write the following differenced equation for remittances received by household *i*:

$$\Delta R_i = \delta_0 + \beta_1 \Delta Q_i + \gamma_1 X_{i,2000} + \gamma_2 \Delta L_{ji} + \Delta u_i \quad (14)$$

where R_i is the average remittance received by household *i*. Again, we apply the same instrumental variable technique as described above for the earthquake shock case.

5. Results

In this section we estimate equations (12) and (14) using OLS with standard errors clustered at the municipal level for all three household shocks. In cases where the shock (Q_i) refers to the earthquakes, we also estimate (12) and (14) using two-stage least squares.

Impact of economic shock on overall household migration

In table 3, we examine the parameter estimates for equation (12) to better understand how the household's total stock of migrants is affected by household shocks. Column 1 of table 3 displays results for a naive OLS estimation for equation (12), where we regress the earthquake impact variable on the change in the household's total number of migrants between 2000 and 2002. The coefficient on the earthquake variable is negative, but not significant. These results are consistent with Yang (2008) and Halliday (2006), who also find the number of households who choose to send a migrant falls in response to the earthquake.

[Table 3 about here]

We also include household demographic control variables to account for heterogeneity across households as well as the change in the U.S. wage and unemployment rates in migrant destination cities. First, the controls for changes in labor market conditions are statistically

significant with expected signs. Households send migrants to the U.S. when U.S. wages are higher and U.S. unemployment is lower. Second, we include the number of household members in 2000 (excluding the migrant(s)) and find no significant impact on the household's stock of migrants. Third, we include the 2000 level of education for the household head. The results show a negative relationship between education of the household head in 2000 and change in migrant stock; families with a more highly educated household head saw migrants return after the earthquake. Finally, the initial number of migrants in the household has a negative effect on migrant change, meaning that there were more migrants in 2000 than in 2002.

Since the earthquake damage variable may be endogenous with migration decisions, we present two-stage least squares results using *Z1* and *Z2* and their squared terms as excluded instruments. In doing so, column (2) shows that the size of the coefficient on the earthquake impact variable becomes larger in magnitude but is still insignificant[11].

Columns (3) and (4) in table 3 examine two other household shocks and their effect on migration decisions. Column (3) estimates a household's migration response to a change in the deaths experienced by a household and column (4) estimates the migration response to a group of small livestock deaths. Interestingly we see that these two shocks have different signs on the aggregate change in the number of migrants, however in both cases the standard errors are large.

Impact of economic shock on household migration by migrants' relation to household head

Here we explore how the family relationship between the migrant and the household affects migrant behavior and how this behavior differs across different kinds of shocks. Previous

[11] All IV regressions also report test statistics for over-identification and under-identification. First, the Hanson j-statistic provides a test of over-identification, where the joint null hypothesis is that the instruments are valid instruments, meaning they are uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Since the p-value is .08, one can reject the valid instruments only at the 8% level. Also reported is the Kleibergen_Paap LM test statistic for under-identification of whether the equation is identified, meaning the excluded instruments are correlated with "earthquake impact". The statistic is significant at the .01% level, thus the equation is identified. Finally, we report the Wald F statistic for weak identification.

studies have examined the way male and female migrants respond differently to household shocks (e.g. de la Briere et. al, 2002). We further hypothesize that after controlling for labor market conditions, which may vary by gender, family relationships play an important role in determining how migrants respond to household shocks.

[Table 4 about here]

Indeed, we see evidence of heterogeneous responses across migrant relationships to earthquake damage. In table 4 we present estimates of the IV model of equation (12) again, but now consider the change in migrant stock by the migrant's relation to the household head[12]. The results suggest that households' migration decisions in the face of a shock, like earthquake damage, is more nuanced than a simple gender story. There is a negative and significant relationship between earthquake damage and the change in the household's stock of migrants for only sisters of the household head. Specifically, if a household experienced earthquake damage there is a reduction of .516 sister migrants; likewise the results also show that female migrants return home in response to the earthquake (see column 6). The finding of gender patterns in response to the quake is consistent with Yang (2008). This change represents a negative net change in migrants which could indicate that some households simply did not send women, particularly sisters of the household head. Household heads show no reverse migration tendencies when the household experiences earthquake damage, likely due to the important remitting role that these household heads play; while the coefficient associated with the household head is positive, it is insignificant.

Table 5 examines how different relationships respond to the death of small livestock,

[12] Again, all IV regressions also report test statistics including: Hanson j-statistic for over-identification, Kleibergen _Paap LM test statistic for under-identification and the Wald F statistic. Here, the results show that all instruments are valid, except for column 7 where the p-value for the Hanson j-statistic is 0.05.

using OLS[13]. Here we see a different behavior than we observed in the case of earthquake damage. In general, there is a tendency for family members to migrate away from home when a significant number of small livestock die. We see that sons and brothers of the household head, and not surprisingly men, are the most likely to leave. The coefficient on both sons and brothers (columns (1) and (4)) are positive and significant, however it seems that sons leave with greater frequency than brothers since the coefficient estimate on sons is much larger than that for brothers. These results correspond to the finding that there is significant out-migration by males after an adverse agricultural shock like livestock death (column 7), which makes sense since many agricultural responsibilities including livestock are attended to primarily by men.

[Table 6 about here]

Finally, Table 6 shows that, when a household experiences a death of a family member (not due to the earthquakes), migrants respond differently according to their relationship to the household head. In particular it seems that the household head is more likely to migrate away from home, possibly to cover funeral expenses or to compensate for the lost family member's income; the coefficient is positive and significant. We see negative coefficients associated with children of the household head, however the standard errors are large and the estimates are insignificant.

The results presented above in tables 4, 5, and 6 suggest that households employ different migration strategies according to the type of shock a household experiences. While the major earthquakes in 2001 tended to induce negative net migration for women (sisters of household head), death of livestock tends to induce migration primarily of men (brothers and sons of household head), whereas death of a family member may have a mixed effect on migration

[13] Small livestock refers to the death of 10 or more small livestock, such as chickens, turkeys, goats, etc. Large livestock were also considered but results were insignificant.

strategies depending on family relations, but we see some evidence that household heads return home. ***Impact of economic shock on household remittances received from migrant.***

Here in table 7 we turn to estimates of equation (14) to examine the change in the amount of household remittances received from migrant(s) in response to these shock variables. We control for changes in labor market conditions, the number of household members (excluding migrant(s)) in 2000, education level of the household head in 2000, remittances received in 2000 and changes in the household's stock of migrants between 2000 and 2002. In the OLS results presented in column (1), the coefficient on the earthquake impact variable is negative and significant, indicating a fall in remittances received in response to the earthquakes. This is consistent with migration patterns observed in table 3 which suggests migrants return home after the earthquakes (though insignificant). As expected, an increase in U.S. wage and U.S. unemployment had a significant positive and negative effect on remittances, respectively. Remittances were also significant and positively related to education level of the household head, but significant and negatively related to remittances received in 2000. We also controlled for the change in the number of migrants and found that remittances received rose with increased outmigration.

[Table 7 about here]

In columns (2)-(4) we present two-stage least squares results using *Z1* and *Z2* and their squared terms as excluded instruments[14]. The coefficient on the earthquake variable is still negative but no longer significant.

Recall, we do not have data on which migrant in the household sent remittances, but we

[14] Again, all IV regressions also report test statistics including: Hanson j-statistic for over-identification, Kleibergen _Paap LM test statistic for under-identification and the Wald F statistic. Here, the results shows all instruments are valid.

can consider how the total remittances received by household vary by migration flows by migrant family relationship. Column (4) includes dummy variables to indicate whether a specific migrant, by family relation to the household head, migrated away ($\Delta M_{ji} > 0$). Column (5) includes dummy variables to indicate whether a specific migrant returned home after the quake ($\Delta M_{ji} < 0$). In both columns, the coefficient on the earthquake impact is negative and significant; controlling for migration flow by family type, household remittances fell in response to the earthquakes. In column (4), remittances significantly rise when the migrant is the son of the household head, daughter of the household head or household head themselves. Not surprisingly, in column (5), remittances significantly fall when the returning migrant is the son or daughter of the household head. Finally, we see no significant changes in remittances after the loss of a family member or loss of livestock.

6. Conclusions

This paper examines the differential responses of migrants to negative household shocks, including the 2001 Salvadoran earthquakes, death of a family member, and loss of livestock particularly looking at how migration responses to these shocks changes across family relationships to the household head. There is a growing literature examining gendered responses of migrants to household shocks, but there has been little consensus on the actual gendered response of remittances and even fewer on how migration patterns differ by the migrant's family relationship to the household head. This paper addresses this divergent literature by suggesting that it is the migrant's relation to the household head that is more important in terms migration behavior rather than gender alone and that household migration strategies differ according to the type of shock experienced.

Our results are consistent with both Yang (2008) and Halliday (2006) in that we see

migrants returning (or fewer sent) in response to the earthquake. Specifically, it is sisters of the household head who change their migration patterns (return home) in response to earthquakes. We also find that it is sons and brothers of the household head who are more likely to migrate after significant livestock death, whereas household heads are more likely to migrate in the case of a family member's death.

Similar to Halliday (2006) we see evidence of a reduction in remittances in response to the earthquakes when controlling for migration flow by the migrant's relation to the household head. When sons or daughters of the household head or the household head themselves migrate, there is a positive impact of remittances received, but when sons or daughters of the household head return home, there is a negative impact on the remittances received.

One implication of our paper is that perhaps the reason for the mixed results regarding gender trends is that migration and remittance patterns are grounded more strongly in the migrants' familial relation to the household head rather than gender alone and highly dependent on the type of shock experienced. Given the data, it is difficult to speculate at this point why different family members migrant and remit in response to different shocks. Yet this finding more interestingly suggests that future research should continue to disaggregate migration behavior at the level of household member's relation to that of the household head.

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Table 1. Descriptive statistics for number of migrants per household.

	2000			2002			Change	
Variable	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.
Total Number of Migrants	291	1.53	1.64	291	1.57	1.66	291	0.04	2.03
Migrant Sons	291	0.45	0.88	291	0.59	0.99	291	0.13	0.95
Migrant Daughters	291	0.26	0.71	291	0.34	0.81	291	0.08	0.62
Migrant Household Heads	291	0.12	0.40	291	0.08	0.27	291	-0.05	0.61
Migrant Brothers	291	0.20	0.58	291	0.14	0.50	291	-0.08	0.55
Migrant Sisters	291	0.16	0.54	291	0.08	0.32	291	-0.04	0.39
Migrant Males	291	0.58	0.98	291	0.57	0.93	291	-0.01	1.06
Migrant Females	291	0.95	1.15	291	0.99	1.13	291	0.04	1.36
Remittances Received	291	974.34	1799.35	291	1303.39	1986.18	290	371.56	2010.40

Table 2. Descriptive statistics for control variables.

	2000			2002			Change	
Variable	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.
Impacted by Earth Quake				291	0.56	0.50			
Household Death	291	0.06	0.23	291	0.100	0.300	291	0.04	0.38
Small Livestock Death	291	0.11	0.32	291	0.275	0.447	291	0.16	0.53
US Unemployment Rate	217	0.09	0.02	215	0.047	0.014	291	-0.03	0.05
US Weekly Pay Rate	217	337.64	30.94	215	360.180	30.027	291	14.34	249.83
Household Size (excluding migrant)	291	5.81	2.51	291	5.625	2.641	291	-0.19	1.77
Education of Household Head	291	2.32	2.62	289	2.612	3.327	291	-0.28	2.46

Table 3. Impact of shocks on change in household stock of migrants.

VARIABLES	(1) OLS	(2) IV	(3) OLS	(4) OLS
Impacted by Earthquake	-0.224	-0.704		
	(0.173)	(0.434)		
Change death			-0.213	
			(0.218)	
Change small livestock death				0.182
				(0.132)
Change in US wage	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Change in US unemployment rate	-8.258***	-8.583***	-8.050***	-8.615***
	(2.746)	(2.749)	(2.760)	(2.759)
Number of household members, 2000 (excluding migrants)	-0.001	-0.010	0.004	-0.000
	(0.031)	(0.034)	(0.030)	(0.031)
Education of household head, 2000	-0.070***	-0.060**	-0.073***	-0.0700***
	(0.024)	(0.024)	(0.024)	(0.024)
Number of household migrants, 2000	-0.572***	-0.582***	-0.568***	-0.573***
	(0.137)	(0.137)	(0.135)	(0.133)
Constant	0.862***	1.164***	0.724***	0.693**
	(0.308)	(0.390)	(0.271)	(0.274)
Observations	291	291	291	291
R-squared	0.564	0.551	0.563	0.563
mean	.			
Hanson j statistic		6.728		
p-value		0.081		
Kleibergen-Paap LM statistic		28.360		
p-value		1.05e-05		
Wald F statistic for weak identification		13.95		

Note: Dependent variable measures the change in the number of household migrants between 2000 and 2002.
Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1, ^ p<.15.

Table 4. Impact of earthquake shock on change in household stock of migrants, by migrant's relation to household head, IV estimates.

VARIABLES	(1) Son	(2) Daughter	(3) HH Head	(4) Brother	(5) Sister	(6) Female	(7) Male
Impacted by Earthquake	-0.112	-0.195	0.130	-0.131	-0.516**	-0.712**	-0.086
	(0.266)	(0.171)	(0.142)	(0.173)	(0.232)	(0.321)	(0.277)
Change in US wage	0.002***	0.0004**	2.45e-06	0.001***	0.0003	0.002***	0.004***
	(0.0004)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Change in US unemployment rate	-1.476	0.419	0.914	-2.646**	-0.169	-2.271	-6.581***
	(1.784)	(1.014)	(0.745)	(1.295)	(1.312)	(1.984)	(2.016)
Number of household members, 2000 (excluding migrants)	0.019	0.0301**	0.0117*	-0.005	-0.037***	-0.010	-0.013
	(0.020)	(0.014)	(0.007)	(0.014)	(0.014)	(0.021)	(0.022)
Education of household head, 2000	0.005	-0.003	-0.008	-0.0361**	-0.006	-0.034	-0.022
	(0.016)	(0.012)	(0.009)	(0.018)	(0.015)	(0.023)	(0.018)
Number of household migrants, 2000	-0.042	-0.018	-0.014	-0.065**	-0.093***	-0.249***	-0.333***
	(0.054)	(0.033)	(0.017)	(0.029)	(0.032)	(0.060)	(0.091)
Constant	0.065	0.059	-0.109	0.129	0.567***	0.810***	0.457*
	(0.228)	(0.137)	(0.105)	(0.136)	(0.197)	(0.264)	(0.262)
Observations	291	291	291	291	291	291	291
R-squared	0.137	0.080	0.006	0.130	-0.055	0.241	0.478
Hanson j statistic	3.976	0.884	4.212	5.697	2.974	0.557	8.016
p-value	0.264	0.829	0.239	0.127	0.396	0.906	0.046
Kleibergen-Paap LM statistic	28.360	28.360	28.360	28.360	28.360	28.360	28.360
p-value	1.05e-05	1.05e-05	1.05e-05	1.05e-05	1.05e-05	1.05e-05	1.05e-05
Wald F statistic for weak identification	13.950	13.950	13.950	13.950	13.950	13.950	13.950

Note: Dependent variable measures the change in the number of household migrants between 2000 and 2002. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1, ^ p<.15.

Table 5. Impact of change in death of small livestock on change in household stock of migrants, by migrant's relation to household head, OLS estimates.

VARIABLES	(1) Son	(2) Daughter	(3) HH Head	(4) Brother	(5) Sister	(6) Female	(7) Male
Change small livestock death	0.166*	0.067	0.029	0.076*	-0.041	-0.011	0.203**
	(0.091)	(0.060)	(0.035)	(0.045)	(0.072)	(0.091)	(0.102)
Change in US wage	0.002***	0.0004**	2.14e-05	0.001***	0.0002	0.002***	0.004***
	(0.0004)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Change in US unemployment rate	-1.864	0.363	0.746	-2.769**	0.296	-1.757	-7.088***
	(1.932)	(1.048)	(0.708)	(1.339)	(1.292)	(1.983)	(2.161)
Number of household members, 2000 (excluding migrants)	0.018	0.032**	0.009	-0.004	-0.026***	0.004	-0.016
	(0.020)	(0.015)	(0.007)	(0.015)	(0.010)	(0.019)	(0.022)
Education of household head, 2000	0.007	-0.005	-0.004	-0.037**	-0.018	-0.050**	-0.019
	(0.017)	(0.012)	(0.009)	(0.016)	(0.013)	(0.021)	(0.018)
Number of household migrants, 2000	-0.045	-0.016	-0.018	-0.064**	-0.081***	-0.233***	-0.338***
	(0.055)	(0.034)	(0.019)	(0.029)	(0.027)	(0.060)	(0.091)
Constant	-0.030	-0.074	-0.031	0.035	0.248***	0.363**	0.372*
	(0.157)	(0.108)	(0.056)	(0.088)	(0.094)	(0.142)	(0.204)
Observations	291	291	291	291	291	291	291
R-squared	0.143	0.083	0.036	0.141	0.132	0.317	0.482

Note: Dependent variable measures the change in the number of household migrants between 2000 and 2002. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1, ^ p<.15.

Table 6. Impact of change in death of family member on change in household stock of migrants, by migrant's relation to household head, OLS estimates.

VARIABLES	(1) Son	(2) Daughter	(3) HH Head	(4) Brother	(5) Sister	(6) Female	(7) Male
Change death	-0.168	-0.113	0.101*	-0.056	0.091	-0.008	-0.202
	(0.108)	(0.084)	(0.057)	(0.066)	(0.071)	(0.132)	(0.146)
Change in US wage	0.002***	0.0004*	1.49e-05	0.001***	0.0003	0.002***	0.004***
	(0.0004)	(0.0002)	(0.0001)	(0.0003)	(0.0002)	(0.0004)	(0.0004)
Change in US unemployment rate	-1.356	0.581	0.799	-2.543*	0.157	-1.787	-6.469***
	(1.866)	(1.058)	(0.705)	(1.306)	(1.223)	(1.950)	(2.077)
Number of household members, 2000 (excluding migrants)	0.022	0.034**	0.009	-0.003	-0.027***	0.004	-0.011
	(0.020)	(0.015)	(0.006)	(0.014)	(0.010)	(0.020)	(0.022)
Education of household head, 2000	0.004	-0.006	-0.006	-0.038**	-0.018	-0.049**	-0.023
	(0.017)	(0.012)	(0.009)	(0.016)	(0.013)	(0.021)	(0.018)
Number of household migrants, 2000	-0.040	-0.015	-0.017	-0.062**	-0.082***	-0.234***	-0.332***
	(0.055)	(0.034)	(0.018)	(0.029)	(0.028)	(0.059)	(0.091)
Constant	-0.002	-0.062	-0.029	0.048	0.240***	0.361***	0.406**
	(0.157)	(0.108)	(0.055)	(0.089)	(0.090)	(0.137)	(0.203)
Observations	291	291	291	291	291	291	291
R-squared	0.139	0.085	0.044	0.138	0.134	0.317	0.479

Note: Dependent variable measures the change in the number of household migrants between 2000 and 2002. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1, ^ p<.15.

Table 7. Impact of shocks on change in remittances received by household.

VARIABLES	(1) OLS	(2) IV	(3) IV	(4) IV	(5) OLS	(6) OLS
Impacted by Earthquake	-591.2***	-611.3	-1,033**	-987.6*		
	(224.4)	(588.3)	(455.4)	(531.8)		
Change household death					-364.2	
					(255.7)	
Change small livestock death						280.0
						(279.5)
Change in US wage	3.720***	3.723***	3.087***	3.220***	3.642***	3.706***
	(0.927)	(0.933)	(0.915)	(1.041)	(0.939)	(0.945)
Change in US unemployment rate	-14,065***	-14,077***	-11,269***	-10,115**	-13,638***	-14,388***
	(4,528)	(4,537)	(4,016)	(4,520)	(4,469)	(4,671)
Number of household members, 2000 (excluding migrants)	33.91	33.57	69.22*	53.48	45.51	38.63
	(35.35)	(33.19)	(40.88)	(42.58)	(37.00)	(34.94)
Education of household head, 2000	97.49**	97.89**	110.6***	80.43**	88.24**	92.33**
	(38.26)	(39.34)	(40.15)	(40.68)	(38.18)	(36.58)
Remittances received 2000	-0.527***	-0.527***	-0.521***	-0.474***	-0.520***	-0.516***
	(0.104)	(0.100)	(0.108)	(0.130)	(0.110)	(0.108)
Change in household migrant stock	150.1**	149.9**			153.1**	155.8**
	(69.55)	(68.81)			(70.79)	(71.07)
Son migrates away			638.9**			
			(290.9)			
Daughter migrates away			608.5*			
			(333.2)			
Brother migrates away			-303.7			
			(525.4)			
Sister migrates away			638.5			
			(700.9)			
Household head migrates away			2,464***			
			(403.7)			
Son returns home				-584.9**		
				(273.7)		
Daughter returns home				-557.1**		
				(247.2)		

Brother returns home				-46.47		
				(341.3)		
Sister returns home				-179.7		
				(339.9)		
Household head returns home				-528.7		
				(422.2)		
Constant	245.4	257.7	-102.2	515.6	-108.8	-167.7
	(267.7)	(340.9)	(363.9)	(370.3)	(290.1)	(307.5)
Observations	290	290	229	229	290	290
R-squared	0.308	0.308	0.398	0.323	0.292	0.292
Hanson j statistic		4.062	0.671	2.235		
p-value		0.255	0.880	0.525		
Kleibergen-Paap LM statistic		26.97	19.67	22.08		
p-value		2.02e-05	0.0006	0.0002		
Wald F statistic for weak identification		12.80	8.486	11.06		

Note: Dependent variable measures the change in the remittances received between 2000 and 2002. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1, ^ p<.15.