Migration, Risk, and Liquidity Constraints in El Salvador

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I. Introduction

There is a vast literature in development economics that has investigated how households in less developed countries (LDCs) cope with exogenous economic shocks in the face of imperfect insurance markets.[1] This literature has two strands. In the first, researchers have looked at informal means of allocating risk across space in which households within a group such as a village insure each other via state-contingent transfers.[2] In the second strand, researchers have looked at the household's use of asset accumulation and depletion, in autarky, as a means of self-insurance.[3] This article adds to this part of the literature by treating the

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[1] For a more thorough overview of the literature on savings, credit, and insurance arrangements in developing countries, see Besley (1995).

[2] For example, Udry (1994a) looks at the role that state-contingent credit contracts play in risk management for households in northern Nigeria. He finds that repayment depends not only on shocks to the borrower but also on shocks to the lender. This result is not consistent with a standard model of loan contracting; rather, it has more in common with a model of cross-sectional risk pooling. In a related work, Townsend (1994) uses the ICRISAT data set to look at villages in India and concludes that idiosyncratic risk matters relatively little for household consumption once one controls for village-level risk. Despite finding evidence of cross-sectional risk sharing, both papers reject the null of efficient risk sharing, although Townsend concludes that the Complete Markets Paradigm fares reasonably well in the ICRISAT data. However, Ravallion and Chaudhuri (1997) provide a comment to Townsend's work. Their work indicates that a particular form of measurement error in Townsend's consumption data may have been a potentially important factor that biased some of Townsend's results toward the null of efficient risk sharing. Their work lends credence to Deaton (1992), who claims that the comovements in consumption that are observed in the ICRISAT data may be rationalized by an autarkic model of savings in which different households receive common signals concerning future income.

[3] In one example, Udry (1994b) looks at a sample of rural dwellers from northern Nigeria and finds that grain inventories grow more slowly upon the receipt of adverse shocks. In a similar piece, Paxson (1992) tests the Permanent Income Hypothesis with a sample of rural farmers in Thailand, using rainfall data. She finds that farm households save a significantly larger portion of transitory income than permanent income, thereby suggesting that savings is used to smooth consumption

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number of migrants within a household as a productive asset and investigating how and why various exogenous economic shocks affect its movement.

There has been substantial work on the use of migration as a means of mitigating risk prior to the occurrence of a shock, or as an ex ante risk management strategy (Rosenzweig and Stark 1989; Paulson 2000). However, there has been surprisingly little work done on the use of migration as a means of mitigating risk after the occurrence of a shock, or as an ex post risk management strategy. Helping to fill this void is this article's main objective.

To accomplish this, I use a panel of rural households from El Salvador. The data that I employ in this article cover the years 1997, 1999, and 2001. They contain information on the number of migrants per household. Because I have a panel, I am able to measure the household's migrant flow through the difference in migrant stocks across two time periods. Since my data come from El Salvador and not the United States, I am better able to account for illegal as well as legal migration. In addition, I have good data on exogenous events that affect the household in El Salvador. These events come from two sources. The first source is agricultural conditions that caused livestock loss and/or harvest loss during the years 1999 and 2001. The second source is damage sustained by the household due to the 2001 earthquakes. Because my final survey was fielded at the beginning of 2002 and the earthquakes occurred in the beginning of 2001, this provides me with a good measurement of the earthquake's effects.

El Salvador provides an excellent laboratory for this work due to the high volume of migration in the country. While Salvadoran migration to the United States was somewhat common prior to 1980, it gained momentum in the eighties, primarily due to the civil war that was fought during that decade. Upon the signing of the peace accords in 1992 by the government and the FMLN (Frente Farbundo Martí para la Liberación Nacional), the umbrella group for the opposition during the war, now a political party, many expected that these migrant flows would abate. However, this has proven not to be the case. Indeed, according to the 2000 U.S. Census, the number of Salvadorans in the United States was estimated to be 784,700.[4] In contrast, the 1990 census estimate was 418,800 (Ruggles et al. 2003).[5]

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from transitory income fluctuations. In another study, Rosenzweig and Wolpin (1993) show that farmers in India are more apt to sell bullocks when they experience low profits.

[4] Of course, due to the difficulty of counting undocumented workers, it is likely that this number provides us with a lower bound of the actual number of Salvadorans residing in the United States. Indeed, many estimate that the actual number is now well above 1 million (PNUD 2001). In a country of just over 6 million people, this has astounding implications for the number of Salvadorans residing abroad.

[5] In addition, the high prevalence of Salvadorans in the United States has had significant impli-

My results indicate that these large migrant flows are, in part, affected by the economic conditions that prevail in El Salvador. I find that adverse agricultural shocks, such as harvest and livestock loss, have large and positive effects on the household's probability of sending members to the United States. In particular, in the absence of any agricultural shocks, on average, the probability that a household sent members to the United States would have dropped by 24.26%. I also find that households that experience adverse agricultural conditions also experience increases in remittances that are on the order of 40%–60%.

In contrast, my results indicate that the dollar amount of damage due to the earthquakes is associated with a substantial decrease in net migration to the United States. A one standard deviation increase in damage lowers the probability of migration to the United States by 37.11%. One explanation for this finding is that the earthquakes created exigencies in El Salvador that increased the incentives for families to retain labor at home. This explanation states that the labor of potential and existing migrants was used to buffer the effects of the earthquakes. Another explanation for this result is that Salvadoran households are liquidity constrained and that the earthquakes disrupted migration financing either through depleting savings or restricting access to credit.

To investigate the role that liquidity constraints play, I looked into the relationship between household wealth, migration, and the earthquakes. The basic idea behind this exercise is that wealthier households are less likely to be credit constrained and, hence, should be better able to finance migration. As expected, if households are liquidity constrained, I find that higher levels of wealth are associated with a higher probability of migration. However, I also find that the earthquakes stunted migration to the United States at all wealth levels. Thus, the earthquakes appear to have had as much of an effect on wealthier households, which are less likely to be liquidity constrained, as they had on poorer households, which are more likely to be liquidity constrained. Accordingly, the evidence in this study does not support the hypothesis that the earthquakes stunted migration as a consequence of the disruption of migration financing.

The remainder of this article is organized as follows. In Section II, I describe the data. Section III examines the impact of exogenous shocks on migration and remittances. Section IV explores alternative explanations for the results of

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cations for the volume of money remitted to El Salvador from the United States each year. In fact, the Salvadoran government estimates that remittances contributed US$1.75 billion to the Salvadoran GNP in 2000 (MRE 2001; PNUD 2001). This amount accounted for 13% of the Salvadoran GNP in 2000.

TABLE 1
VARIABLES

Variable	Definition	Mean
Migrants*	Number of household members residing in the United States	.55 (1.23)
Remittances*,†	Total amount remitted by all migrants in the household (in 1992 US$)	303.29 (974.22)
Land 1*	Total landholdings (in *manzanas*) of the household that has either a title or documents indicating the power of transfer	1.69 (5.38)
Land 2*	Total landholdings (in *manzanas*) of the household that has a title, documents indicating the power of transfer, or no official documents	1.82 (5.59)
Land 3*	Total landholdings in (*manzanas*) of the household that has a title	1.63 (5.39)
Harvest loss‡	Dummy indicating income loss due to harvest loss	.19 (.39)
Livestock loss‡	Dummy indicating income loss due to livestock loss	.11 (.31)
Earthquake damage†,§	Cost of all household damage due to the 2001 earthquakes (in 1992 US$, in levels)	3,261.15 (9,127.22)
Household head's education‖	Years of education for the household's head	2.78 (3.14)

Note. Standard deviations are in parentheses.
* This descriptive statistic corresponds to the years 1997, 1999, and 2001.
† This variable was deflated using the Salvadoran CPI.
‡ This descriptive statistic corresponds to the years 1999 and 2001.
§ This descriptive statistic only corresponds to 2001.
‖ This descriptive statistic corresponds to 1997 and 1999.

Section III. In Section V, I extend the analysis of Section III and examine the role that liquidity constraints play. Section VI concludes.

II. The Data

The data that I employ come from the BASIS research program in El Salvador at Ohio State University. The data set is a panel of rural households in El Salvador.[6] I employ data on migration, remittances, demographic characteristics, and wealth from the 1997, 1999, and 2001 waves of the survey, as well as data on exogenous shocks from the 1999 and 2001 waves. The data contain household identifiers, so it is possible to track households across time. Variable definitions and summary statistics are provided in table 1. Table 2 reports sample sizes by year.

[6] El Salvador is divided into 14 departments, which, in turn, are divided into *municipios*, which are further subdivided into *cantones*. A household is defined to be rural if the members live in a *cantón* that is not the capital of the *municipio*. Several *cantones* within the *municipio* of San Salvador were not classified as rural due to the expansion of the capital city.

TABLE 2
SAMPLE SIZES BY YEAR

	Number of Households
Households present in 2001:	689
Present in 1999 and present in 1997	572
Present in 1999 and absent in 1997	100
Absent in 1999 and present in 1997	1
Absent in 1999 and absent in 1997	16
Households present in 1999:	696
Present in 2001 and present in 1997	572
Present in 2001 and absent in 1997	100
Absent in 2001 and present in 1997	21
Absent in 2001 and absent in 1997	3
Households present in 1997:	623
Present in 2001 and present in 1999	572
Present in 2001 and absent in 1999	1
Absent in 2001 and present in 1999	21
Absent in 2001 and absent in 1999	29

A. Migration

The primary migration variables that we work with are migrants and remittances. I define a migrant to be anyone in the household who, at the time of the survey year, was residing in the United States or Canada.[7] The average number of migrants per household in my data is 0.55; 26.44% of all households report having at least one migrant. Among the households who report having migrants, the average number of migrants per household is 2.08. Remittances is a measure of the total amount of money sent back from the United States to the household in El Salvador in a given time period. The average remittance level per household is $303.29. However, conditional on having at least one migrant residing in the United States, the average remittance level rises to $1,110.98.

B. Shocks

Shocks come from two sources. The first source is household-specific agricultural conditions that prevailed during the years 1999 and 2001. The second source is the earthquakes of 2001.

1. Agricultural Shocks

Measures of household-specific agricultural shocks come from two events: live-

[7] A person is defined to be a household member if he or she is tied to the household either by blood by or by marriage. While it is not possible to know whether or not the migrant is residing in the United States or Canada, it is reasonable to assume that the vast majority of migrants reside in the United States. For this reason, throughout the remainder of the article, I refer to all migrants as residing in the United States.

TABLE 3
DISTRIBUTION OF AGRICULTURAL SHOCKS

Agricultural Shock	Both Years	1999	2001
Number of shocks:			
0	1,025	580	445
	(74.01)	(83.33)	(64.59)
1	314	102	212
	(22.67)	(14.66)	(30.77)
2	46	14	32
	(3.32)	(2.01)	(4.64)
Harvest loss:			
0	1,128	613	515
	(81.44)	(88.07)	(74.75)
1	257	83	174
	(18.56)	(11.93)	(25.25)
Livestock loss:			
0	1,236	649	587
	(89.24)	(93.25)	(85.20)
1	149	47	102
	(10.76)	(6.75)	(14.80)

Note. This table reports the frequency of adverse agricultural events. The top part shows the distribution of households sustaining either harvest loss, livestock loss, or both. The middle part shows the distribution of households sustaining harvest loss. The bottom part shows the distribution of households sustaining livestock loss. In each data cell, the top number is the number of households sustaining the shock and the bottom number (in parentheses) is the percentage of households sustaining the shock.

stock loss and harvest loss. In the 2001 and 1999 panels, the enumerators solicited information concerning whether or not the household experienced income loss due to either event. If the household indicated that they did lose income as a consequence of either of these events, then harvest loss or livestock loss equals one; otherwise, it equals zero. Similar self-reported shocks have been used by Udry (1994a, 1994b) in his work on risk management in Nigeria.[8]

I report the distribution of agricultural shocks in table 3. Combining the 2001 and 1999 data, 25.99% of all households experienced at least one agricultural shock. The prevalence of shocks was substantially higher in the 2001 panel. The percentage of households experiencing shocks rose from 16.67% in 1999 to 35.41% in 2001. One possible reason for this dramatic increase

[8] Because the survey designs differed slightly across 1999 and 2001, the construction of the harvest loss variable warrants some more exposition. In 1999, the household was defined to have experienced a harvest loss if they reported that they had lost all or part of their harvest and that this event had caused them to lose income. In 2001, the household was defined to have experienced a harvest loss if they reported that the value of their harvest was less than normal as a consequence of a drought that occurred in 2001. Unfortunately, the 1999 survey did not solicit the actual cause of the harvest loss; hence, it is not possible to have comparable measures of harvest losses in 1999 and 2001. To address this issue, I estimated my models separately for 1999 and 2001 to ensure that the results were comparable in the 2 years. They were.

TABLE 4
SUMMARY OF EARTHQUAKE DAMAGE

Type of Damage	Average Cost ($)	Households Affected (%)
House destroyed	868.94	10.3
House uninhabitable	767.92	6.7
Major house damage	777.79	14.6
Minor house damage	279.11	28.0
Other edifices	134.76	3.8
Land	143.82	1.7
Furniture	61.00	8.0
Appliances	193.12	11.0
Tools used for agricultural production	1.71	.01
Machines used for agricultural production	.68	.001
Tools used for nonagricultural production	2.27	.01
Machines used for nonagricultural production	20.21	.01
Merchandise meant to be sold	11.19	.02
Stored grains	11.74	.02

Note. All cost figures have been deflated using the Salvadoran CPI with 1992 as the base year. All figures are in US$.

was the drought of 2001.[9] Finally, the majority of households that experienced agricultural shocks did so due to harvest loss; however, a nontrivial number of households, 149 or 10.76% of all households present in 1999 and 2001, also experienced livestock losses.

2. Earthquake Shocks

The earthquakes of 2001 provide us with a second shock. The earthquakes occurred on January 13 and February 13 of 2001. The first earthquake registered 7.6 on the Richter scale and killed a total of 844 people. The second earthquake registered 6.6 on the Richter scale and killed an additional 315 people. Out of El Salvador's approximately 6 million people, it is estimated that over 1 million people were left without adequate shelter by the middle of February 2001 (Nicolás and Olson 2001).

Earthquake damage, our second shock, is an index that measures the extent to which the dwelling of a household was affected by the 2001 earthquakes. It is equal to the log of the total cost of the damage sustained. Damage came from numerous sources. Table 4 describes in detail all of the sources of damage from the earthquakes that were used to construct the index. As can be seen in the table, home damage was the principal source of damage. In the data of this study, the dwellings of 59.6% of households were affected in some way

[9] In El Salvador, the rainy season occurs between May and October. During the months of June and July, there is a dry period called the *canicula*. Droughts typically occur when the *canicula* is longer than normal.

by the earthquakes; 31.6% of households reported that they sustained at least major damage to their homes; 17% of households reported having their homes destroyed or rendered uninhabitable. This number coincides with the estimate that approximately one out of six Salvadorans was left without adequate housing in the wake of the disaster, thereby suggesting that my measure of the earthquake shock is good.[10] Finally, the average cost of damage among households who actually sustained damage was $5,202.12. Figure 1 displays the density of earthquake damage for each of El Salvador's 14 departments.

C. Demographic Characteristics

I also use demographic controls. To control for household composition, I construct measures of the number of household members residing at home in El Salvador within certain age and gender brackets for all home dwellers. In my analysis, I only focus on the demographic composition of the household at home in El Salvador, since I am primarily interested in controlling for the effects of young children and elderly household members on migration decisions.[11] Table 5 reports the descriptive statistics for my household demographic variables. I report the mean and standard deviations for the number of household members within each age/gender bracket.[12] In addition, I also employed data on the education of the household head; those descriptive statistics are reported in table 1.

D. Wealth

I employ data on the household's total landholdings; these are measured in *manzanas* (1 *manzana* = 6,988 square meters) as a proxy for wealth.[13] I use three land measures, which are defined in table 1. The first measure, land 1, includes all the holdings of the household for which there is either a title or

[10] It was not possible for the statistics from this study to be constructed from BASIS data, since the study was released in mid-2001 and the BASIS survey was fielded in 2002.

[11] The age brackets that I employ are < 6 years, 6–10 years, 11–15 years, 16–20 years, 21–40 years, 41–60 years, and > 60 years.

[12] Interestingly, there are no significant differences in the gender composition of the household for household members ≤ 20 years of age. However, we do observe significant differences in household composition across gender for household members >20 years. In particular, we observe that there are significantly fewer male household members residing in El Salvador who are ages 21–60. The reason for this is that there is a relative abundance of men between these ages residing in the United States. What is not clear, however, is why there are significantly more men over the age of 60. Presumably, this reflects a weakness in my data.

[13] An alternative proxy for wealth in the BASIS data is savings. However, only about 20% of households have positive savings in our data in the years 1999 and 2001, whereas roughly 50%–60% of households have positive landholdings in these years, depending on which measure I use. Consequently, I felt that landholdings was a more comprehensive proxy of wealth for our sample.

documents indicating the power of transfer.[14] The second measure, land 2, is land 1 plus any land that the household may be using with no proper legal documentation.[15] The third measure, land 3, is the least inclusive. It only includes land that has a title. Our preferred measure is land 1, as it is comprehensive but not so comprehensive that it includes land that households would have difficulty selling. However, I also use the other measures as a robustness check.

E. Attrition in the BASIS Panel

An important issue to consider when working with panel data is attrition, particularly whether or not it occurs randomly. Table 2 provided some insights into attrition in the BASIS data. The table showed that roughly 92% of the original households in 1997 survived until 2001, so that attrition was about 8% over a 4-year period.[16] Between 1999 and 2001, attrition was less than 4%.[17]

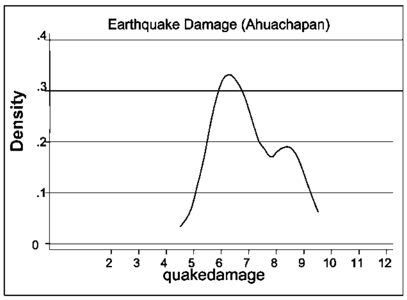
A useful exercise when thinking about the potential impact that attrition may have on estimation is to regress variables indicating survival in the panel on baseline household characteristics. This is a common exercise in the literature on panel attrition. For more information, I refer the reader to Gottschalk,

[14] Specifically, the survey asks the household whether or not they have a *título* or an *acta de transferencia de dominio*. The latter does not have the same legal guarantees as a title but can used as a means for obtaining a title. However, due to reasons associated with poverty and lack of education, many people with the *acta de transferencia* do not take the necessary steps to obtain a title. I thank Alvaro Trigueros of FUSADES for clarifying this point. In my data, 2.8% of the households had land with an *acta de transferencia* but no title; 49.7% of the households had land with a title.

[15] In my data, 11.6% of the households had land with no proper documentation.

[16] Unfortunately, we do not know whether households left the survey because they migrated, died, or refused to respond. However, according to economists at FUSADES, a policy-oriented think tank in El Salvador, which shared responsibilities for administering the survey along with Ohio State University, there is a common belief that migration was the primary cause of attrition. This accords well with Thomas, Frankenberg, and Smith (2001), who provide direct evidence that migration was the primary cause of attrition in the Indonesian Family Life Survey (IFLS).

[17] It is informative to compare attrition in the BASIS data with that of other more commonly used panels. In the IFLS, for example, there were three waves in 1993, 1997, and 1998. Between 1993 and 1997, attrition was 6%. Interestingly, between 1993 and 1998, attrition was actually lower at 5%. This low rate of attrition is quite remarkable given that attrition in panels from developing countries is notoriously high. It is also remarkable given that attrition in some commonly used American panels is substantially higher. For example, in the Panel Study of Income Dynamics, attrition was about 12% between 1968 and 1969—a 1-year time period. In a more current survey, the Health and Retirement Survey, attrition was about 9% between 1991 and 1993. Thomas et al. (2001) credit a conscientious effort at tracking movers for the low rate of attrition in the IFLS. Indeed, it is reassuring that attrition in the BASIS data is lower than that of many panels from the developing world, and even some from the developed world, although it is substantially higher than the IFLS.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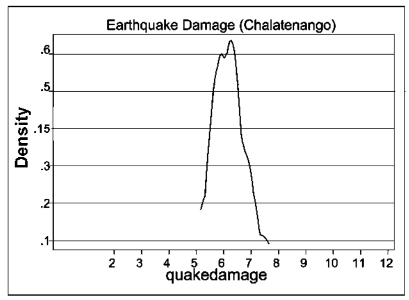
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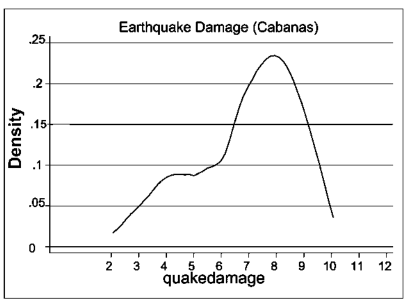
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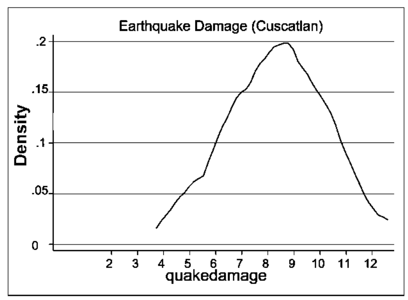
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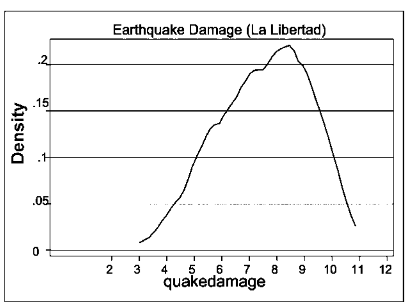
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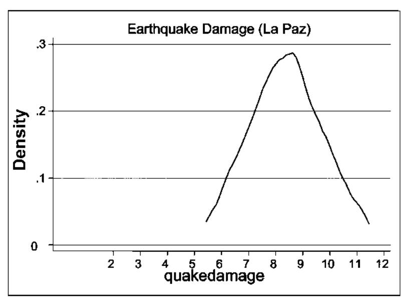
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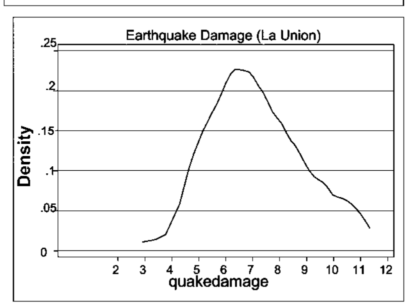
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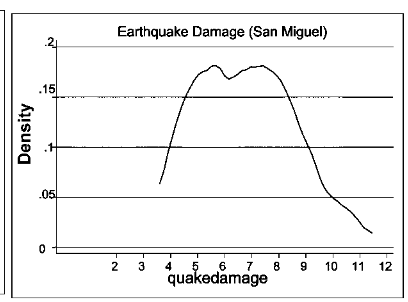
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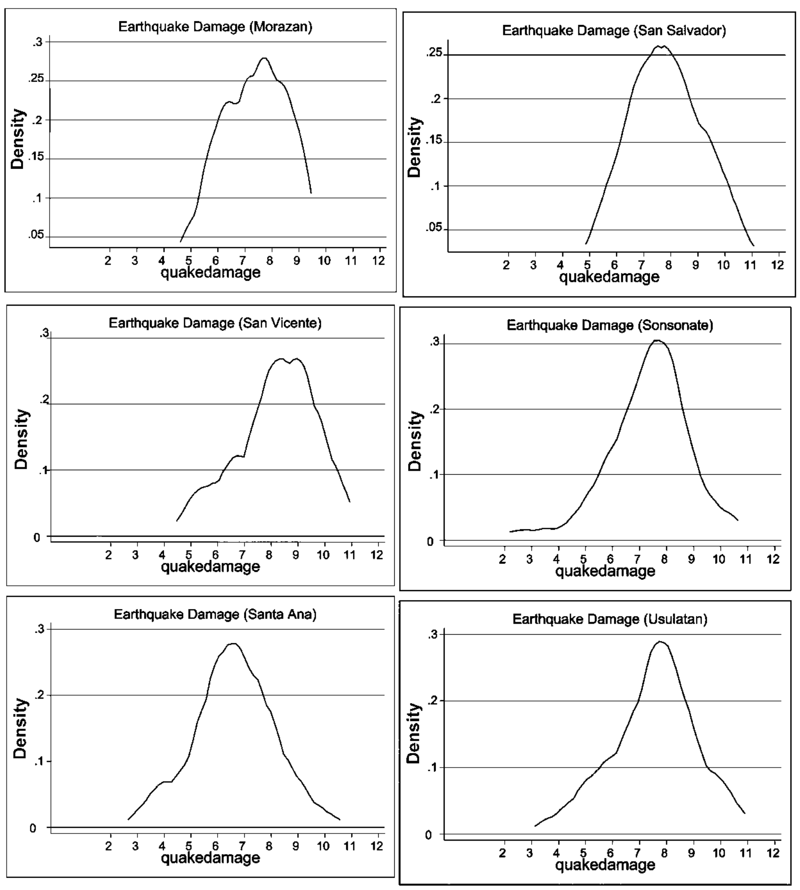

Figure 1. Earthquake damage densities by department

TABLE 5
DEMOGRAPHIC CHARACTERISTICS: AGE AND GENDER

Age Bracket	Men	Women	Test of Equality
<6	.38	.38	.02
	(.67)	(.68)	[.900]
6–10	.43	.45	.60
	(.69)	(.69)	[.437]
11–15	.41	.41	.00
	(.67)	(.67)	[.981]
16–20	.38	.37	.64
	(.65)	(.63)	[.423]
21–40	.63	.75	31.38
	(.75)	(.69)	[.000]
41–60	.45	.48	3.34
	(.52)	(.51)	[.068]
>60	.28	.19	66.59
	(.47)	(.41)	[.000]

Note. This table reports descriptive statistics for number of household members at home in El Salvador within certain age and gender brackets for the years 1997, 1999, and 2001. Standard errors are reported in parentheses. Test of equality reports an *F*-test of the equality of means for men and women; *p*-values are reported in brackets for each *F*-statistic.

Fitzgerald, and Moffit (1998) and Thomas et al. (2001). I report the results of this exercise in table 6.[18]

I have been careful to include variables indicating how prone the household is to shocks. In the first, second, and third columns, I included the percentage of households in a *municipio* in 1999 and 2001 that experienced harvest and livestock loss. In column 3, I simply included the harvest loss and livestock loss variables from 1999. Also, I included the mean of earthquake damage within *municipios* in all four columns. The logic behind this is that if proneness to shocks is correlated with survival, then this could generate potentially serious biases in the estimation of the impact of shocks on migration, particularly since the attrition literature has shown that panel survival is negatively correlated with migration.[19]

The results do not reveal many significant predictors of attrition. Land-

[18] Right-hand-side variables include baseline characteristics such as landholdings, a dummy indicating positive landholdings, the number of migrants, the head's education, a dummy indicating that the household size is one, household size, the demographic variables described in Sec. II.C, and department dummies.

[19] Ideally, if I had had shocks from all of the baselines, I would have looked at whether or not households that received shocks were also more likely to leave the panel. This type of exercise was only possible using 1999 as the baseline with the agricultural shocks; it was not possible with 1997 as the baseline, since the survey did not solicit information on shocks in that year. Consequently, I used *municipio*-level aggregates.

TABLE 6
PANEL ATTRITION

	Survival 1997–2001	Survival 1997–2001	Survival 1999–2001	Survival 1997–1999
Land	.003	.003	.001	.002
	(2.16)	(2.25)	(1.75)	(1.45)
Dummy land > 0	.02	.02	.03	.02
	(.74)	(.61)	(1.91)	(.90)
Migrants	−.01	−.01	−.01	−.01
	(−.67)	(−.50)	(−1.99)	(−.94)
Head's education	.00	.00	.00	.00
	(.52)	(.69)	(.53)	(.87)
Harvest loss in 1999			−.01	
			(−.40)	
Livestock loss in 1999			.01	
			(.59)	
% Harvest losses in *municipio**	−.07	−.03		.05
	(−.90)	(−.32)		(.82)
% Livestock losses in *municipio**	.14	.15		−.02
	(1.01)	(1.06)		(−.14)
Mean earthquake damage in *municipio**	.01	.01	.00	.01
	(1.50)	(.88)	(.11)	(1.52)
Single household dummy?	−.21	−.22	−.09	−.07
	(−1.25)	(−1.24)	(−.91)	(−.63)
Household size	−.00			
	(−.68)			
Demographics included?†	No	Yes	Yes	Yes
Department dummies?	No	Yes	No	Yes
F-test on agriculture shocks	.73	.56	.33	.36
	[.484]	[.574]	[.722]	[.702]
F-test on all shocks	1.25	.63	.26	.98
	[.295]	[.595]	[.853]	[.406]
R^2	.0177	.0546	.041	.0580
Households	623	623	696	623

Note. The first two columns estimate the probability of surviving from 1997 to 2001. The third column estimates the probability of surviving from 1999 to 2001, and the fourth column estimates the probability of surviving from 1997 to 1999. In the first, second, and fourth columns, baseline characteristics are from the 1997 survey. In the third column, which looks into survival from 1999 to 2001, the baseline characteristics come from the 1999 survey. All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*. The *p*-values for the *F*-statistics are in brackets.
* For details concerning the construction of these variables, see Sec. II.E.
† For details concerning the construction of these variables, see Sec. II.C or the note to table 7.

holdings is by far the most important, with households with more land being more likely to survive. This is not surprising, given that households with more land are, presumably, less mobile and, hence, easier to track across survey years. In terms of the coming estimation, this is not of tremendous concern, as any potential bias that this might cause can be mitigated by controlling for landholdings. Turning to the shock variables, we see that the tests of joint significance on the agricultural shocks are all soundly rejected, both with and without the department dummies. There is some evidence, however, in the first and last columns of table 6, that proneness to earthquake damage is weakly correlated with survival. This is potentially problematic, and I will address this issue in Section IV.

III. Migration, Remittances, and Risk

A. The Impact of Shocks on Migration

I begin by estimating the response of the household's migration decision to shocks in El Salvador. Let $M_{h,t}$ denote the migrant stock of household h at time t. Let $\Delta M_{h,t}$ denote the change in the household's migrant stock across survey years. Let $\omega_{h,t}$ denote a vector of exogenous events that affect the household at time t that includes harvest loss, livestock loss, and earthquake damage. Next, I let $Z_{h,t}$ denote the vector of household demographic variables that were described in Section II.C.[20] Finally, I let $X_{h,t}$ denote other control variables such as location dummies and time dummies. This notation is held throughout the balance of the article.

To assess the impact of shocks on migration, I estimate the ordered response model

$$1(\Delta M_{h,t} = n) = 1(\alpha_{n-1} \leq \delta_1 \omega_{h,t} + \delta_2 X_{h,t} + \delta_3 Z_{h,t-1} + \varepsilon_{h,t} < \alpha_n) \quad \text{for } n \in \{\ldots, -1, 0, 1, \ldots\}, \tag{1}$$

where α_n denotes the nth ancillary parameter. I assume that $\varepsilon_{h,t}$ is independent of the vector $(\omega_{h,t}, X_{h,t}, Z_{h,t-1})$ and that it follows a logistic distribution. The advantage of the ordered-response model in equation (1) is that the additional ancillary parameters allow us to handle $\Delta M_{h,t}$ in a flexible manner. I am careful to include lags of the household's demographic characteristics. I do this since migration decisions today will affect the household's demographic composition in the present period.

Table 7 presents the results.[21] In all five columns, we see that adverse

[20] In this section, I do not address the effects of household wealth on migration. The reason for this is that wealth has a positive effect on both northward migration (i.e., $\Delta M_{h,t} > 0$) and southward migration (i.e., $\Delta M_{h,t} < 0$) in my data, and the parsimonious econometric model that I work with in this section does not allow for such nonmonotonicity. I reserve a discussion of the effects of wealth on migration for Sec. V, when I address the role that liquidity constraints play in migration decisions.

[21] The standard errors in this table (and in all of the tables in the coming analysis) allow for clustering within *municipios*. I do so for two reasons. The first is that I often work with the same household observed across multiple time periods. The second is that I expect many of my variables, particularly the shocks, to be spatially correlated. Accordingly, standard errors that assume that the data are independent and identically distributed will be incorrect. For a more thorough discussion of clustering, I refer the reader to Deaton (1997). However, it is important to state that while the asymptotic justification for this procedure is clear in linear models, this justification is

TABLE 7

MIGRATORY RESPONSES TO ADVERSE SHOCKS (NUMBER OF HOUSEHOLDS = 1,265)

	(1)	(2)	(3)	(4)	(5)
Harvest loss	.31	.31	.33	.27	.24
	(1.89)	(1.87)	(1.99)	(1.62)	(1.20)
Livestock loss	.36	.36	.37	.38	.46
	(1.84)	(1.86)	(1.94)	(1.95)	(2.26)
Earthquake damage	−.05		−.04	−.03	−.04
	(−2.15)		(−1.80)	(−1.33)	(−1.44)
Earthquake damage dummy		−.26			
		(−1.54)			
2001 dummy	−.28	−.33	−.29	−.33	−.31
	(−1.55)	(−1.76)	(−1.58)	(−1.74)	(−1.44)
Demographic variables?*	No	No	Yes	Yes	Yes
Municipio dummies?	No	No	No	No	Yes
Department dummies?	No	No	No	Yes	No
F-test on agricultural shocks	8.32	8.29	9.55	8.46	8.00
	[.016]	[.016]	[.008]	[.014]	[.018]
F-test on all shocks	12.18	9.52	12.25	10.02	10.24
	[.007]	[.023]	[.007]	[.018]	[.017]
Pseudo-R^2	.0078	.0072	.0137	.0177	.0599

Note. This table contains estimates from an ordered logit model where the dependent variable is migration. All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*. The *p*-values for the *F*-statistics are in brackets.

* The demographic controls that were used are indicators for the number of household members at home within certain age and gender brackets. Details are in Sec. II.C.

agricultural conditions in El Salvador had a positive effect on migration and, thus, tended to push people out of the country.[22] The variables livestock loss and harvest loss are all positive and individually significant at the 10% level, and they are jointly significant at the 5% level.[23] These results are consistent with Munshi (2003), who shows that low rainfall in Mexico has a positive impact on migration to the United States.

less clear in nonlinear models as it would seem that correlated unobservables would fundamentally alter the likelihood function. Nevertheless, I admonish the reader to view this clustering procedure as a "down and dirty" solution to the problem of spatial correlation.

[22] I also have a version of the results in this table using the Inverse Probability Weighting (IPW) Scheme developed by Moffitt, Fitzgerald, and Gottschalk (1999). This procedure corrects for a particular form of attrition bias that occurs when the attrition is affected by observable characteristics in the first time period but is unaffected by outcomes that occur in subsequent time periods. The results are very similar and are available upon request. Despite this, however, it is important not to place too much stock in the IPW results, as attrition in the current case is often being caused by migration and this type of attrition cannot be accommodated by IPW.

[23] I also estimated these models individually using only single years of the panel. While, not surprisingly, the estimates are less precise, they still paint the same picture as table 7. What is interesting about this exercise is that I know that the primary cause of agricultural shocks in 2001 was a drought. Moreover, I know for certain that every harvest loss in my data in 2001 was reported as a consequence of this drought. This then casts serious doubt on an alternative story of reverse causality in which the shock resulted as a consequence of less effort being expended on the household's farm after the departure of a family member.

The relationship between agricultural shocks and migration suggests that households that experienced agricultural losses anticipated low expected returns to their labor at home for the foreseeable future and thus a widened north-south wage gap. Consequently, the shocks may have created additional incentives to send household members to the United States and disincentives for existing migrants to return to El Salvador. In addition, as we will see, there is some evidence that the effects of the agricultural shocks on migration are accompanied by rises in remittances.

In contrast, table 7 shows that the earthquakes had a negative impact on migration. The earthquake damage index is negative and significant in columns 1 and 3. In column 2, I include a dummy variable indicating whether or not the household was affected by the disaster (in lieu of the index). The dummy variable, which tells us the average impact of the earthquakes, is negative and moderately significant. In columns 4 and 5, I include 14 department dummies and 167 *municipio* dummies. We see that the standard error on earthquake damage is larger but that the point estimate is similar to what it was in column 3.[24]

Excluding stories involving nonrandom assignment of the shocks (which we consider later), the finding that the earthquakes had a negative impact on migration is consistent with two explanations. The first is that the earthquakes created exigencies that caused households to retain members at home or to bring members back from the United States in order to help the family recover from the disaster's effects. The second explanation is that the earthquakes were an enormous burden on the household's financial resources and that this prohibited the household from putting up the capital necessary to send members abroad.[25] In Section V, I investigate the role that liquidity constraints play in the household's migration decisions and in doing so attempt to disentangle these explanations from one another.

[24] It is important to address the pros and cons of the location dummies. First, using *municipio* dummies creates an efficiency loss, since their inclusion relies on variation in shocks within *municipios*. All variation in the shocks across *municipios* gets absorbed by the location dummies. This is desirable as it addresses any concerns about correlations between shocks and location effects. However, it is undesirable since variation that occurs across *municipios* is potentially useful information that does not get utilized, and this results in an efficiency loss. This is particularly undesirable as efficiency is not something that is relatively abundant in shorts panels with small sample sizes and noisy data. Indeed, it may be the case that the cure is worse than the sickness. Second, El Salvador is roughly the size of Massachusetts. El Salvador is divided into 14 departments, and Massachusetts is divided into 14 counties. Consequently, I believe that it is reasonable to expect that department dummies may adequately control for location effects without incurring the same efficiency costs as the *municipio* dummies.

[25] "Illegal" migration to the United States from El Salvador typically requires payments to smugglers or *coyotes*; this can exceed $1,500 (Menjívar 2000).

TABLE 8
MARGINAL IMPACT OF SHOCKS

	Northward Migration*	Southward Migration†
Agriculture shocks:		
Actual distribution‡	.2650	.0914
Absence of shocks§	.2007	.1262
% Change between rows 1 and 2	24.26	38.07
Earthquakes:§		
Actual distribution‡	.2328	.1073
1 SD increase‖	.1464	.1682
% Change between rows 1 and 2	37.11	56.76

Note. These are fitted probabilities calculated using estimates of eq. (1). Further detail concerning the calculations can be found in the appendix.
* Northward migration corresponds to the probability of $\Delta M_{h,t} > 0$.
† Southward migration corresponds to the probability of $\Delta M_{h,t} < 0$.
‡ These probabilities were calculated using the actual distribution of shocks.
§ These calculations only use the fitted probabilities from 2001.
‖ These probabilities were calculated assuming that there were no agricultural shocks. A 1 SD increase refers to the level (not the log) of damage.

To give the reader some notion of the magnitude of these shocks, I calculate their marginal impacts. The results are in table 8. Detail concerning how the marginal effects were calculated can be found in the appendix. We see that, in the absence of any agricultural shocks, the probability of sending members abroad in both years (northward migration) decreases from 0.2650 to 0.2007—a 24.26% decrease. The probability of receiving members (southward migration) increases from 0.0914 to 0.1262—a 38.07% increase. Turning to the earthquakes, we see that a one standard deviation increase in the level of damage lowers the probability of northward migration in 2001 from 0.2328 to 0.1464—a 37.11% change. In contrast, the probability of southward migration goes from 0.1073 to 0.1682—a 56.76% increase.

B. The Impact of Shocks on Remittances

We now turn to the effects of exogenous shocks in El Salvador on migrant remittances. Let $r_{h,t}$ denote the amount remitted by all migrants in household h at time t in logs, and let $R_{h,t}$ denote remittances in levels. Using the notation from above for the other variables, I estimate the simple linear models

$$r_{h,t} = \beta_0 + \beta_1 \omega_{h,t} + \beta_2 X_{h,t} + \beta_3 Z_{h,t-1} + u_{h,t}, \qquad (2)$$

$$\log\left(\frac{R_{h,t}}{M_{h,t}}\right) = \gamma_0 + \gamma_1 \omega_{h,t} + \gamma_2 X_{h,t} + \gamma_3 Z_{h,t-1} + v_{h,t}, \qquad (3)$$

to identify the effects of exogenous shocks on migrant remittances. Equation (2) tells us the impact of shocks on total migrant remittances, and equation

(3) tells us the impact of shocks on remittances per migrant. Equation (3) is of interest, as it is informative of cross-sectional risk sharing within spatially diversified households. In other words, it is suggestive of whether or not a given migrant remits more when his or her family at home experiences adversity.[26]

Table 9 reports the results. In the first column, we see—consistent with table 7—that agricultural shocks are associated with higher remittances. However, the inclusion of the department and *municipio* dummies attenuates the impact of livestock loss and takes away the impact of harvest loss. My estimates indicate that a livestock loss results in an increase in migrant remittances that is on the order of 40%–60%, whereas the first column suggests that households that experienced a harvest loss witnessed an increase in remittances on the order of 40%.[27] In addition, we see that the earthquakes are associated with decreases in the total amount remitted from the United States. The elasticities of total migrant remittances with respect to earthquake damage in the first three columns are −0.11, −0.06, and −0.04, respectively. Finally, the effects of the earthquakes shown in table 9 remain significant after the department dummies are added, suggesting that the marginally significant estimates in the last two columns of table 7 were most likely the consequence of increased imprecision due to the addition of location effects.

The basic lesson that we learn in the first three columns of table 9 is that shocks affect total migrant remittances the same way that they affect migration—although the results do become more imprecise with the addition of location effects. Agricultural shocks pushed people to the United States and increased remittances, whereas the earthquakes pulled people back and decreased remittances. In this sense, the results in table 9 reinforce those in table 7.

The last two columns of table 9 report the results of estimating equation (3). In both columns, we see that the agricultural shocks had positive impacts on remittances per migrant, although, when I include the department dummies, harvest loss is no longer significant. This is suggestive, but by no means conclusive, that not only do households self-insure against agriculture shocks via migration (i.e., changes in their migrant stocks across time) but households hit by agricultural shocks insure themselves via increases in intrahousehold transfers (i.e., changes in the amount remitted per migrant).

[26] I also estimated the remittance equation using a standard tobit model. The results are similar to the OLS results. In order to save space, the results are not reported, but they are available upon request. I attempted to use the Censored Least Absolute Deviations model of Powell (1984) but was unsuccessful as the remittance data contain too much censoring.

[27] See n. 24 for a discussion of the pros and cons of location effects.

TABLE 9
RESPONSE OF HOUSEHOLD REMITTANCES TO ADVERSE SHOCKS

	Dependent Variable = Remittances			Dependent Variable = Remittances per Migrant	
	(1)	(2)	(3)	(4)	(5)
Harvest loss	.39	.16	.05	.30	.09
	(1.66)	(.71)	(.18)	(1.44)	(.44)
Livestock loss	.61	.43	.40	.56	.40
	(2.33)	(1.76)	(1.48)	(2.30)	(1.79)
Earthquake damage	−.11	−.06	−.04	−.10	−.06
	(−3.31)	(−1.77)	(−1.17)	(−3.25)	(−2.05)
2001 dummy	.82	.62	.58	.71	.56
	(3.79)	(2.92)	(2.61)	(3.45)	(2.81)
Demographic variables?*	No	Yes	Yes	No	Yes
Municipio dummies?	No	No	Yes	No	No
Department dummies?	No	Yes	No	No	Yes
F-test on agricultural shocks	4.09	1.93	1.11	3.63	1.78
	[.018]	[.149]	[.332]	[.029]	[.172]
F-test on all shocks	6.73	2.33	1.20	6.22	2.49
	[.000]	[.076]	[.311]	[.001]	[.062]
R^2	.0210	.1457	.3442	.0194	.1319
Number of households	1,385	1,265	1,265	1,385	1,265

Note. This table contains results from OLS regressions where the dependent variable is remittances; the *t*-statistics are in parentheses. The *p*-values for the *Z*-statistics are in brackets.
* The demographic controls that were used are indicators for the number of household members at home within certain age and gender brackets. Details are given in Sec. II.C.

Turning to the effects of the earthquakes, we see negative and significant effects on remittances per migrant. This is interesting as it does not suggest that existing migrants remitted more in order to insure their families against the disaster's consequences, as one would expect if the household were engaging in cross-sectional risk sharing through state-contingent transfers. One explanation for this coefficient is that households that were hit by the earthquakes valued the labor of potential and existing migrants more than they valued their remittances. However, a more plausible explanation is that households that were more likely to be affected by the earthquakes also received fewer remittances per migrant from abroad prior to their occurrence. In other words, earthquake damage may have been nonrandomly assigned to households that were less likely to receive remittances. The next section discusses the implications of this for the core results of table 7. It provides evidence that earthquake damage was most likely assigned nonrandomly, but it also demonstrates that this was probably not responsible for the results in table 7.

This discussion highlights some of the pitfalls of OLS estimation of equations (2) and (3) to identify the impact of shocks on remittances. The first concerns potential correlation between the shocks and omitted household characteristics resulting from nonrandom assignment. One seemingly sensible remedy for this would be fixed effects estimation. However, while it is true that fixed effects estimation does address many problems concerning omitted variables, it comes with considerable efficiency loss.[28] Consequently, given my data, I believe that the costs of fixed effects estimation greatly outweigh its benefits.[29] Another pitfall associated with estimation of the remittance equations concerns measurement error in remittances. While it is true that measurement error in dependent variables will only result in asymptotic biases if it is correlated with right-hand-side variables, in finite samples it may still be problematic as it adds additional noise to our estimator that is only zero in a large sample.

IV. Alternative Explanations

In this section, I explore some alternative explanations for the previous section's results. I consider the possibility that migration is used to hedge risk ex ante as opposed to ex post, as well as the possibility that the shocks were assigned nonrandomly to households with varying wealth levels and/or ties to the United States. I also investigate the possibility that the previous section's results were, at least in part, the consequence of nonrandom attrition. I now discuss these competing hypotheses.

Ex ante risk management. It is conceivable that the previous section's effects of the agricultural shocks are capturing the use of migration as an ex-ante risk coping strategy. The reason for this is that households that are engaged in risky agricultural activities may also engage in migration as a means of hedging against risk prior to the occurrence of any shocks. This suggests that agricultural shocks were more likely to be assigned to households that engage in migration as opposed to households actually migrating in response to the shock.

Nonrandom assignment to households with weak ties to the United States. The effects of the earthquakes on migration may be the consequence of the earthquakes disproportionately affecting households with weaker ties to the United States as opposed to families utilizing household labor to buffer their effects. One might expect this to happen since much research has shown that migrant

[28] As pointed out by Deaton (1995), addressing unobserved heterogeneity is not free. For example, one important issue concerns the role that serial correlation in the agricultural shocks plays. If there is positive serial correlation (which there is in my data), demeaning results in a substantial loss of variation and thus greater imprecision. A second issue concerns the role of measurement error. Generally, demeaning will exacerbate the role of measurement error, which, in the case of the agricultural shocks, should bias the estimates toward zero (see Aigner [1973] for a discussion of measurement error with binary regressors). These caveats are especially important to bear in mind given my small sample size and my short panel.

[29] I do have a set of fixed effects results, which are available upon request. These results, not surprisingly, are less precise. Nevertheless, they still paint a picture similar to what we have been seeing throughout this article.

networks play important roles in the household's migration decision in the sense that households with migrants already residing in the United States are more likely to send additional members abroad (see Massey et al. [1987] for a discussion).[30]

Nonrandom assignment to poorer households. A concern similar to the previous one is that the earthquakes hit poorer households.[31] This is potentially problematic if households are liquidity constrained, especially given the large cost of migration. As a result, it could be the case that households that were hit by the earthquakes would not have migrated irrespective of whether or not they were affected by the earthquakes.[32] While the exercises in this section shed some light on this issue, I provide a more thorough investigation in Section V.

Nonrandom attrition. Attrition can also play a pernicious role in the estimation. For the agricultural shocks, we would not expect much of a bias, since the results of Section II.E did not reveal any relationship between the agricultural shocks and attrition. However, I did find some evidence that households that resided in areas that were hit hard by the earthquakes were also more likely to survive in the panel. This is worrisome given that Thomas et al. (2001) provide evidence that migration was a major cause of attrition in the Indonesian Family Life Survey. Taken together, this suggests that survivors were more likely to be hit by the earthquakes and, at the same time, less likely to migrate. This implies that my estimates of the impact of the earthquakes may be negatively biased due to nonrandom attrition.[33]

All of these explanations have to do with nonrandom assignment of the shocks. Consequently, investigating the plausibility of these alternative theories will involve testing whether or not the shocks were, in fact, randomly assigned. In addition, I can gauge the plausibility of these alternative stories by seeing if households that were affected by the shocks also had unobservable characteristics that made them more or less disposed to migration even in the absence of any shocks.

To start investigating these issues, I begin by looking into whether or not

[30] Similar arguments can be made for the agricultural shocks with harvest and livestock losses being more likely to hit households with stronger network ties.

[31] This does appear to be the case in my data.

[32] Once again, similar arguments can be made for the agricultural shocks.

[33] To see this formally within the context of a linear model that is analogous to eq. (1), let $s_{h,t} \in \{0, 1\}$ be an indicator for whether or not a household has survived in the panel from $t-1$ to t. A value of unity denotes survival. The direction of bias in the estimates of eq. (1) will depend on the sign of $E[s_{h,t}\omega_{h,t}\varepsilon_{h,t}]$. For the reasons stated above, I do not expect there to be much of a bias for the components of this expectation, which correspond to the agricultural shocks. However, for earthquake damage, which I denote by $Q_{h,t}$, I expect to see $E[s_{h,t}Q_{h,t}\varepsilon_{h,t}] < 0$.

TABLE 10
BASELINE HOUSEHOLD CHARACTERISTICS IN 1997 AND SHOCKS

	Harvest Loss	Livestock Loss	Earthquake Damage
Migrants in 1997	.009	.013	−.161
	(.80)	(1.16)	(−2.14)
Household size in 1997	.007	.003	−.004
	(1.54)	(.94)	(−.15)
Land in 1997	.000	−.001	−.029
	(.12)	(−.30)	(−2.71)
Head's education in 1997	−.003	−.006	.027
	(−.93)	(−1.99)	(1.05)
Department dummies?	Yes	Yes	Yes
Number of households	1,166	1,166	1,166

Note. All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*.

shocks are predicted by baseline household characteristics. In table 10, I regress each of the three shocks on baseline characteristics from the 1997 survey. The characteristics that I use are the household's migrant level, landholdings, household size, and the head's education. As we can see, the only significant predictor of harvest loss is household size, with larger households being more likely to experience subsequent losses. However, the robustness of the agricultural shocks to demographic controls in the previous section suggests that this is of little concern. In the second column, we see that livestock loss is only predicted by the head's education, with more educated households being less likely to experience livestock loss. It is important to emphasize that subsequent agricultural shocks are not predicted by the baseline number of migrants in the household, as would be expected if households that were engaged in risky agricultural activities also engaged in migration to hedge against risk ex ante. In addition, this casts doubt on the alternative story, where the agricultural shocks affected households with stronger ties to the United States. Turning to the earthquakes, we see that households with fewer migrants abroad and with less land were more likely to be severely hit by the earthquakes. This raises some concern that households that were hit by the earthquakes would have been less likely to migrate irrespective of the disaster, due to either the networks story or the liquidity constraints story.[34]

In table 11, I further investigate the possibility that the results of the previous section are confounded by these alternative stories by looking at the relationship between "counterfactual" shocks and trends in migration and remittances. The counterfactual shocks that I employ are the 2001 shocks

[34] In the next section, I include all of the significant predictors of shocks in our regressions to ensure that our results are robust to nonrandom assignment. They are.

TABLE 11
COUNTERFACTUAL SHOCKS

	Number of Migrants Difference (Ordered Logit) (1)	With Counterfactual Shocks: Dependent Variable = Number of Migrants Difference (Ordered Logit) (2)	Dependent Variable = Remittance Difference (OLS) (3)	Dependent Variable = Remittance per Migrant Difference (OLS) (4)
Harvest loss	.31	−.23	−.15	−.25
	(1.89)	(−1.33)	(−.63)	(−1.10)
Livestock loss	.36	−.00	.11	.06
	(1.84)	(−.02)	(.45)	(.27)
Earthquake damage	−.05	.00	.00	.00
	(−2.15)	(.02)	(.02)	(.05)
2001 dummy	−.28	−.40	−.23	−.26
	(−1.55)	(−2.05)	(−.87)	(−1.06)
F-test on agricultural shocks	8.32	1.78	.23	.61
	[.016]	[.411]	[.796]	[.546]
F-test on all shocks	12.18	1.79	.15	.41
	[.007]	[.616]	[.923]	[.746]
Number of households	1,265	1,244	1,244	1,244

Note. Counterfactual shocks are the 2001 shocks merged into the 1999 data and the 1999 shocks merged into the 2001 data. All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*. The *p*-values for the *F*-statistics are in brackets.

merged into the 1999 data and the 1999 shocks merged into the 2001 data. I do not use the actual shocks. In this exercise, I wish to test whether or not the shocks were assigned to households that would have made the same migration decision even if they had not been hit by the shock.

The first column of the table restates the results from the second column of table 7 as a benchmark. The second column is identical to the first except that now we use the counterfactual shocks. As can be seen, nothing is significant at conventional levels, and thus there is no evidence in favor of the competing theories. The last two columns look at trends in remittances and remittances per migrant. The counterfactual shocks do not have an impact on either trends in remittances or trends in remittances per migrant. The results of this table do not suggest that the core results in table 7 are the consequence of nonrandom assignment of shocks.

V. Migration, Liquidity Constraints, and Earthquakes

The purpose of this section is twofold. My primary objective is to further explore the role that liquidity constraints play in the household's migration decision. My secondary objective is to provide additional robustness checks that are facilitated by this section's empirical framework.

Specifically, there are three concerns. The first and primary concern of this section is to better understand to what extent the 2001 earthquakes stunted migration as a consequence of the disruption of migration financing. Second, I want to ensure that the effects of the earthquakes on migration are not driven by the earthquakes disproportionately affecting poorer households that may have had a harder time financing migration. Finally, I also include all other regressors from table 10 that significantly predicted shocks to ensure that the results of table 7 are not being driven by nonrandom assignment.[35]

I work with a modification of equation (1). As discussed earlier, one of the drawbacks of the ordered model is that it assumes that a covariate that has a positive effect on northward migration must have a negative effect on southward migration. This is an undesirable trait if a covariate of interest, such as landholdings, which serves as a proxy for household wealth, has a positive effect on northward as well as southward migration. To address this issue, I break the variable $\Delta M_{h,t}$ into two components, one that measures northward migration and one that measures southward migration. Formally, I define these two components as

$$\Delta M^N_{h,t} = \Delta M_{h,t} \times 1(\Delta M_{h,t} \geq 0),$$

$$\Delta M^S_{h,t} = \Delta M_{h,t} \times 1(\Delta M_{h,t} \leq 0).$$

I then estimate the models

$$\begin{aligned} 1(\Delta M^S_{h,t} = n) = 1\big[\alpha^S_{n-1} &\leq \delta^S_1 \omega_{h,t} + \delta^S_2 X_{h,t} \\ &+ \delta^S_3 Z_{h,t-1} + \delta^S_4 T_{h,t-1} + \delta^S_5 T^2_{h,t-1} \\ &+ (\delta^S_6 T_{h,t-1} \times Q_{h,t}) + \varepsilon^S_{h,t} < \alpha^S_n\big] \\ &\text{for } n \in \{\dots, -1, 0\}, \end{aligned} \tag{4}$$

$$\begin{aligned} 1(\Delta M^N_{h,t} = n) = 1\big[\alpha^N_{n-1} &\leq \delta^N_1 \omega_{h,t} + \delta^N_2 X_{h,t} \\ &+ \delta^N_3 Z_{h,t-1} + \delta^N_4 T_{h,t-1} + \delta^N_5 T^2_{h,t-1} \\ &+ (\delta^N_6 T_{h,t-1} \times Q_{h,t}) + \varepsilon^N_{h,t} < \alpha^N_n\big] \\ &\text{for } n \in \{0, 1, \dots\}, \end{aligned} \tag{5}$$

where $T_{h,t}$ is the total landholdings of the household and $Q_{h,t}$ is the earthquake damage index.[36] The land variable that I use is land 1, although at the end

[35] It will become apparent to the reader why I could not have done this with the empirical model in Sec. III.

[36] It is important to note that these models estimate the impact of shocks on net northward or southward migration.

of this section I also check to ensure that my results are robust to alternative measures. Here $\omega_{h,t}$ is defined as in Section III. I use lags of the household's landholdings to account for the fact that migration today may have a contemporaneous impact on land transactions. In some of the specifications, I also include the household's migrant stock and the education of the household head from the 1997 data (both of which significantly predicted some of the shocks in table10) as a final robustness check.[37] Table 12 reports the results for southward migration, and table 13 reports the results for northward migration.

The coefficients δ_4^j and δ_5^j for $j \in \{S, N\}$ warrant some discussion. They are informative regarding the impact of wealth on the household's migration decision. If migration is more common among wealthier households, then we will see that $\delta_4^N > 0$ and $\delta_4^S < 0$.[38] While this would be consistent with the presence of liquidity constraints, there are certainly alternative reasons for a positive relationship between landholdings and migration.[39] Consequently, a positive relationship between wealth and migration should be interpreted as suggestive, but by no means conclusive, evidence that liquidity constraints matter. The coefficients δ_5^j for $j \in \{S, N\}$ allow for nonlinearities in the relationship between wealth and migration.

The coefficients δ_6^j for $j \in \{S, N\}$ allow the impact of an earthquake shock of a given size to vary with the household's wealth level. This interaction is important because the presence of liquidity constraints implies that, for example, \$500 worth of damage will have a much greater impact on a household's ability to finance migration when they have no assets than when they have \$10,000 worth of assets. Thus, if the earthquakes disrupted migration because they affected migration financing, then we would expect to see that $\delta_6^N > 0$ since this would mean that the earthquakes would have stunted migration for poorer households, who are more likely to face liquidity constraints, more than they stunted migration for richer households, who are less likely to face liquidity constraints. Turning to equation (4), if the household in El Salvador finances the migrant's return trip and if the earthquakes stunted migration as a consequence of liquidity constraints, then we would expect to see that

[37] The impact of the 1997 migrant stock on migration in 1999 and 2001 is similar to the impact of landholdings, in the sense that it has a positive impact on northward migration and a negative impact on southward migration. Accordingly, to assess the impact of the migrant stock, it is essential to break the migration variable into northward and southward components.

[38] When the dependent variable is southward migration, a positive (negative) coefficient means that the variable has a negative (positive) effect on southward migration.

[39] For example, households with large landholdings may also be more likely to be engaged in risky agricultural activities and, hence, more likely to use migration (either ex post or ex ante) to mitigate the impact of income shocks.

TABLE 12
MIGRATORY RESPONSES TO ADVERSE SHOCKS: SOUTHWARD MIGRATION

	(1)	(2)	(3)	(4)	(5)
Harvest loss	.16	.08	.23	.17	.25
	(.65)	(.31)	(.90)	(.67)	(1.03)
Livestock loss	.26	.20	.28	.27	.26
	(.84)	(.61)	(.89)	(.84)	(.81)
Earthquake damage	.01	−.05	.01	.01	−.00
	(.45)	(−1.96)	(.37)	(.21)	(−.11)
Earthquake damage × land				.002	.005
				(.34)	(1.10)
Land			−.07	−.02	−.09
			(−2.85)	(−1.70)	(−2.76)
Land squared			.001		.002
			(1.78)		(1.63)
2001 dummy	−.78		−.76	−.76	−.72
	(−3.58)		(−3.43)	(−3.38)	(−3.11)
Demographic variables?*	No	No	No	No	Yes
F-test on agricultural shocks	1.08	.45	1.49	1.11	1.56
	[.583]	[.797]	[.476]	[.574]	[.459]
F-test on all shocks	1.41	3.94	1.72	1.20	1.56
	[.704]	[.268]	[.632]	[.754]	[.667]
Pseudo-R^2	.0124	.0033	.0173	.0148	.0336
Number of households	1,265	1,265	1,265	1,265	1,265

Note. This table contains estimates from an ordered logit model where the dependent variable is southward migration. These results use land 1 as the land variable. All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*. The *p*-values for the *F*-statistics are in brackets.
* The demographic controls that were used are indicators for the number of household members at home within certain age and gender brackets. Details are in Sec. II.C.

$\delta_6^S < 0$ since poorer households that were affected by the earthquakes would have been less able to pay the migration costs to bring household members back from the United States. However, since, anecdotally, we would expect the migrant, and not the family back home, to finance return migration, we do not expect δ_6^S to be that informative of the interaction between liquidity constraints and the earthquakes.

In table 12, we see that household wealth, as proxied by landholdings, is positively associated with southward migration. The estimates of δ_4^S are negative and highly significant. So, we see that wealthier households are more apt to have members migrate back from the United States.[40] In columns 3 and 5 of table 12, we see substantial evidence of nonlinearities in the wealth-migration relationship, as shown by the positive and significant estimates of δ_5^S.[41] This

[40] If I use household savings in lieu of land, we see that savings is also positively associated with southward migration.

[41] The positive effects of landholdings on migration that we observe in this section are consistent with empirical results in Hoddinott (1994) in his analysis of migration in Kenya.

TABLE 13

MIGRATORY RESPONSES TO ADVERSE SHOCKS: NORTHWARD MIGRATION

	(1)	(2)	(3)	(4)	(5)
Harvest loss	.38	.35	.40	.44	.46
	(1.96)	(1.78)	(2.02)	(2.09)	(2.15)
Livestock loss	.38	.37	.43	.31	.32
	(1.83)	(1.78)	(2.10)	(1.27)	(1.32)
Earthquake damage	−.09	−.08	−.07	−.07	−.07
	(−3.24)	(−3.17)	(−2.54)	(−2.26)	(−2.32)
Earthquake damage × land			−.002	−.004	−.004
			(−.45)	(−.76)	(−.72)
Land		.05	.03	.03	.03
		(2.33)	(2.97)	(2.74)	(2.71)
Land squared		−.001			
		(−1.20)			
2001 dummy	−.00	−.04	−.09	−.09	−.09
	(−.02)	(−.21)	(−.47)	(−.44)	(−.41)
Migrants in 1997				.22	.22
				(2.65)	(2.66)
Head's education in 1997					.03
					(1.23)
Demographic variables?*	No	No	Yes	Yes	Yes
F-test on agricultural shocks	8.90	8.01	11.67	8.59	9.11
	[.011]	[.018]	[.003]	[.014]	[.011]
F-test on all shocks	16.88	15.70	15.83	12.44	12.84
	[.001]	[.001]	[.001]	[.006]	[.005]
Pseudo-R^2	.0115	.0156	.0286	.0340	.0350
Number of households	1,265	1,265	1,265	1,165	1,165

Note. This table contains estimates from an ordered logit model where the dependent variable is southward migration. These results use land 1 as the land variable.All *t*-statistics (presented in parentheses) are calculated with standard errors that allow for clustering within *municipios*. The *p*-values for the *F*-statistics are in brackets.

* The demographic controls that were used are indicators for the number of household members at home within certain age and gender brackets. Details are in Sec. II.C.

may be suggestive that sufficiently wealthy households do not need to rely on migration for supplemental income or informal insurance.

Table 12 does not provide evidence that any of the shocks directly affect southward migration. However, it is interesting to note that, in column 2, when I exclude the year dummy, the earthquakes do have a significant effect on southward migration. Because southward migration is not that frequent in our data, this may reflect a difficulty disentangling the effects of the earthquakes from the year effect.[42]

The estimate of δ_6^S in table 12 is essentially zero in column 4 but is positive

[42] A total of 141 households experienced southward migration in either 1999 or 2001; of these, 95 households experienced southward migration in 2001. Of these 95 households, 56 experienced some earthquake damage. I believe that it is reasonable to expect that this small number makes it difficult to disentangle the earthquakes from the year effect in table 12.

with a *t*-statistic of unity in column 5 once I allow for a quadratic in landholdings. This is interesting for two reasons. First, as argued above, if the earthquakes stunted migration as a consequence of liquidity constraints and if the household in El Salvador finances return migration (a big "if"), then we would expect to see a negative estimate, which we do not see. Second, the positive (but imprecise) estimate of the interaction suggests that southward migration as a consequence of the earthquakes was more likely for poorer households than for richer households. What this suggests is that wealthier households may have had alternative means at their disposal for buffering the shock of the earthquakes other than bringing back family members from the United States. Finally, this provides additional evidence that the earthquakes may have induced southward migration, although these effects appear to be concentrated among the poor.[43]

We now turn to table 13 and look at the effects of landholdings on northward migration. In the table, we see that the estimates of δ_4^N are all positive and highly significant, so that more wealth is associated with northward migration.[44] Once again, the results suggest that liquidity constraints may be an important determinant of households' ability to send members abroad. However, I must stress once again that a positive relationship between migration and landholdings is only suggestive of the presence of liquidity constraints. Completely analogous to table 12, the estimates of δ_5^N are all negative and significant, suggesting nonlinearities in the migration/wealth relationship. Finally, the estimates of δ_6^N in columns 3, 4, and 5 are very close to zero and not significant. As argued above, this is not what we would have expected to see if the earthquakes stunted migration as a consequence of liquidity constraints.[45]

In addition, table 13 shows that the effects of exogenous shocks on northward

[43] The fact that I find some, albeit tenuous, evidence of southward migration due to the earthquakes sheds an interesting light on whether the earthquakes stunted migration as a consequence of credit constraints or increased demand for labor at home. The reason for this is that, if the only effect of the earthquakes was to disrupt migration financing, then we would not expect to see any evidence of reverse migration due to earthquake damage.

[44] If I use savings in lieu of landholdings, we see that savings has a positive effect on northward migration.

[45] An important issue concerning our tests for the importance of liquidity constraints is the presence of measurement error in both landholdings and damage. In a linear model, the classical measurement error will result in attenuation bias, with the degree of attenuation increasing with the R^2 of the short regression of the interaction term on the remaining covariates. However, in my case, the estimate of δ_6^S is negative, which is not consistent with attenuation bias due to classical measurement errors. Nevertheless, the assumptions of classical measurement error are quite restrictive, and it is conceivable that a more complex form of measurement is operating in my estimation. Unfortunately, it is difficult to assess the plausibility of this scenario without alternative measures of earthquake damage, as well as all three land measures.

migration are broadly consistent with the results in table 7. We see that households that received adverse agricultural shocks were more likely to experience northward migration. In addition, the table shows that households that were severely affected by the earthquakes were less apt to send members to the United States. The fact that the earthquakes are robust to the inclusion of landholdings is important, because it addresses a concern of Section IV, in which landholdings predicted earthquake damage.

Another concern that was raised in Section IV was that baseline migrants also predicted earthquake damage and that baseline education predicted livestock loss. To address this, the fourth and fifth columns of the table add baseline migrants and education as controls. In column 4, I add baseline migrants. We see that, while there is a positive relationship between the household's migrant stock in 1997 and subsequent migration, which we would expect if networks matter, the point estimate on earthquake damage remains unchanged and significant. Overall, this table does not lend any support to the alternative explanations concerning migrant networks that were raised in Section IV. In column 5, I include both baseline migrants and baseline education. While it is true that livestock loss is no longer significant, it was also not significant in column 4 when baseline education was not included. Consequently, the lower point estimate on livestock loss in columns 4 and 5 probably has more to do with the sample size being reduced by 100 observations than with the inclusion of baseline education.[46]

Finally, in table 14, I ensure that my results are robust to different measures of landholdings. I report the coefficients on land, land squared, and the interaction of land and earthquake damage using the three measures of land that are described in Section II. As can be seen in the table, my conclusions are not affected in any way by my choice of land measure.

VI. Conclusions

This article investigated the relationship between idiosyncratic economic shocks in El Salvador and migrant flows to the United States. To accomplish this, I utilized panel data from El Salvador that contained good measures of

[46] The results in table 12 suggested that earthquake damage may not have been randomly assigned to households. One of my strategies to address this concern was to add the significant predictors of damage as controls and check if damage was still significant. This technique comes from the literature on treatment effects. The idea is that, provided that the outcome (migration) is independent of the treatment (damage) conditional on a set of covariates that predict treatment, the econometrician can identify the true impact of the treatment on the outcome by regressing the outcome on the treatment and all covariates that predict the treatment. This is what Wooldridge (2000) refers to as a "kitchen sink regression." For an excellent overview of treatment effects using binary treatments, see Wooldridge (2000).

TABLE 14
SOUTHWARD AND NORTHWARD MIGRATION RESULTS WITH ALTERNATIVE LAND MEASURES

	Land 1		Land 2		Land 3	
	(1)	(2)	(3)	(4)	(5)	(6)
Southward migration:						
Earthquake damage × land		.002		−.000		.002
		(.34)		(−.09)		(.39)
Land	−.07	−.02	−.08	−.02	−.07	−.03
	(−2.85)	(−1.70)	(−2.77)	(−1.38)	(−2.97)	(−1.78)
Land squared	.001		.001		.001	
	(1.78)		(1.45)		(1.74)	
Northward migration:						
Earthquake damage × land		−.001		−.001		−.001
		(−.22)		(−.31)		(−.18)
Land	.05	.03	.06	.03	.06	.03
	(2.33)	(2.38)	(3.15)	(1.98)	(2.48)	(2.45)
Land squared	−.001		−.001		−.001	
	(−1.20)		(−1.84)		(−1.28)	

Note. This table contains regressions like those in tables 12 and 13, except that alternative land measures have been used. Each regression includes the listed variables as well as the shock variables and the year dummy. All standard errors allow for clustering within *municipios*; the *t*-statistics are in parentheses.

economic shocks and migrant flows. My results indicate that migration to the United States is, in part, determined by the economic conditions that prevail in El Salvador. Overall, this article paints a picture in which Salvadoran households use migration as an ex post risk management strategy.

I showed that adverse agricultural conditions in El Salvador tended to push household members to the United States. In the absence of any shocks, the average probability that a household sends members abroad decreases by 24.26%. In addition, I provided evidence that the effects of agricultural shocks on migration are accompanied by increases in remittances that are on the order of 40%–60%.

In contrast, I showed that households that were affected by the 2001 earthquakes tended to retain members at home. A one standard deviation increase in earthquake damage lowers the average probability that a household sends someone to the United States by 37.11%. One explanation for this is that households retained labor at home to deal with the aftermath of the disaster. This explanation states that the labor of household members was used to buffer the earthquake's effects. Another explanation for this result is that Salvadoran households are liquidity constrained and that the earthquakes disrupted household finances that would have otherwise been used to finance migration.

To disentangle these two explanations from one another, I investigated the nexus of migration, wealth, and the earthquakes. First, I showed that migration is more likely for wealthier households, suggesting that liquidity constraints are important. However, I also showed that the earthquakes were just as likely to stunt migration for wealthier households as they were for poorer households, which is not consistent with the story in which the earthquakes stunted migration because they disrupted migration financing.

Finally, an important topic that warrants additional work concerns the degree of cross-sectional risk sharing that occurs between migrants and home dwellers via remittances. This topic is challenging, as it is very difficult to identify the direct effect that adverse shocks will have on remittances. The reason is that shocks will affect remittances both directly and indirectly. The direct effect corresponds to cross-sectional risk pooling. The indirect effect corresponds to households using migration as a self-insurance mechanism, which is the focus of this article. In the absence of the stringent distributional assumptions that would be imposed by a complicated structural model, identification would entail using instruments that affect migration but do not affect remittances. Finding valid instruments is likely to be difficult, if not impossible. Hence, progress on this front most likely will need to rely on alternative methods such as structural modeling and, of course, better data. Another reason why this topic is challenging concerns the role that imperfect information would play in risk pooling arrangements. As discussed by Rosenzweig (1988), the large distances that can separate migrants from their families are likely to amplify the role that asymmetric information will play in intrafamily risk-sharing arrangements.

Appendix

Calculating the Marginal Impact of Shocks

I now provide the details concerning the calculation of the marginal effects in table 9. Let $\omega_{h,t}$ denote the shock vector as defined in Section III. Let $\omega^{A}_{h,t}$ have the same values for the earthquake shocks as in $\omega_{h,t}$ but have no agricultural disturbances. So harvest loss and livestock loss always equal zero in $\omega^{A}_{h,t}$. Alternatively, let $\omega^{Q}_{h,t}$ have the same values for the agricultural shocks as $\omega_{h,t}$ but have a one standard deviation increase in the level of earthquake damage. I then computed the fitted probabilities from equation (1) using the specification in column 2 of table 7 using $\omega_{h,t}$,$\omega^{A}_{h,t}$ and $\omega^{Q}_{h,t}$. Let $p_{h,t}(\Delta M_{h,t} = n|x)$ for $x \in \{\omega_{h,t}, \omega^{A}_{h,t}, \omega^{Q}_{h,t}\}$ denote the estimated probability that net migration in household h at time t equals n evaluated at $\omega_{h,t}, \omega^{A}_{h,t}$, or $\omega^{Q}_{h,t}$. Then the probability of northward migration (out-migration) for a household is given by

$$p_{h,t}(\Delta M_{h,t} > 0|x) = \sum_{n>0} p(\Delta M_{h,t} = n|x), \quad \text{for } x \in \{\omega_{h,t}, \omega^{A}_{h,t}, \omega^{Q}_{h,t}\}, \tag{A1}$$

and the probability of southward migration (in-migration) is given by

$$p_{h,t}(\Delta M_{h,t} < 0|x) = \sum_{n<0} p(\Delta M_{h,t} = n|x),$$

$$\text{for } x \in \{\omega_{h,t}, \omega^{A}_{h,t}, \omega^{Q}_{h,t}\}. \quad \text{(A2)}$$

The average probability of out-migration is then given by

$$p(\Delta M_{h,t} > 0|x) = (HT)^{-1} \sum_{h,t} p_{h,t}(\Delta M_{h,t} > 0|x), \quad \text{(A3)}$$

and the average probability of in-migration is then given by

$$p(\Delta M_{h,t} < 0|x) = (HT)^{-1} \sum_{h,t} p_{h,t}(\Delta M_{h,t} < 0|x). \quad \text{(A4)}$$

To calculate the marginal impact of the agricultural shocks, I then computed the average probabilities in (A3) and (A4) for all households who experienced either a harvest loss or a livestock loss evaluated at $\omega_{h,t}$. I then calculated these probabilities again for the same households under the assumption that they did not experience any agricultural shocks, that is, using $\omega^{A}_{h,t}$. To calculate the marginal impact of the earthquakes, I computed (A3) and (A4) for all households in 2001 using $\omega_{h,t}$ and then again using $\omega^{Q}_{h,t}$.

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