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Risk, Migration, and Rural Financial Markets: Evidence from Earthquakes in El Salvador

TWO FACTS MOTIVATE THIS STUDY.[1] FIRST, LIFE IN RURAL AREAS IN developing countries is prone to many kinds of risk, such as illness or the mortality of household members, crop or other income loss due to natural disasters (weather, insect infestations, or fire, for example), and civil conflict. Second, international migration is substantial and growing: between 1975 and 2000, the number of people worldwide living outside their countries of birth more than doubled to 175 million, or 2.9 percent of world population (United Nations 2002).[2] For example, migration from El Salvador to the United States has grown rapidly: between 1990 and 2001, the number of Salvadoran-born individuals in the United States grew 69 percent, from 469,000 to 790,000.[3] These large migrant inflows in recent decades have become major public policy issues in migrants' destination countries.

This paper concerns the intersection of two subject areas in economics: research on the causes of international migration and research on the ways households in developing countries cope with different types of risk. What connections, if any, are there between the pervasiveness of rural risk in developing countries and these substantial outmigration flows? I shed light on this question by examining how migration from El Salvador responds to economic shocks. The key finding of the paper is that the impact of shocks on outmigration is actually quite nuanced, and perhaps unexpected: the impact of a shock on migration by family members depends on whether the shock is *idiosyncratic* (specific to the household) or *aggregate* (shared with other households in the local area).

Salvadoran households become differentially more likely to have close relatives who are migrants in the year following an idiosyncratic shock (a death in the family), compared to households not experiencing such shocks. By contrast, aggregate shocks (proximity to the massive 2001 earthquakes) lead to differential *declines* in whether a household has migrant relatives.

Migration typically requires that a substantial fixed cost be paid up front. If credit or assistance from others are important methods of financing migration's fixed cost, in theory the impact of economic shocks on migration will depend on whether such shocks also affect access to these financing mechanisms. When shocks are *idiosyncratic* or uncorrelated with shocks experienced by others, shocks are likely to raise migration: they should make families more willing to send members away for higher-wage work, and there should be no effect on mechanisms of migration finance. But *aggregate* shocks may actually lead to *less* migration, if such shared shocks make it more difficult or costly to access credit or interhousehold assistance networks that normally facilitate migration. (A simple model that formalizes this idea is available from the author on request.)

Declines in migration are associated mainly with being located in a quake-affected *area* (rather than the extent of the individual household's earthquake damage), suggesting that the explanation for the differential decline in migration lies in changes in general local conditions. The evidence is strongly suggestive that the decline in migration in the areas closest to the quakes is due to increased difficulty in obtaining financing for migration, via formal and informal credit in particular. Differential declines in migration in quake-affected areas are accompanied by substantial declines in households' granted credit (both informal and formal).

I also present empirical evidence against alternative explanations for the differential decline in migration in the areas closest to the quakes. It is not likely to be because of an increase in the demand for family unity when negative shocks occur, as deaths in the family (which presumably would also raise the desire for family unity) *do* lead to differentially more migration. External disaster assistance to quake-affected areas would not explain the differential migration response, as receipt of outside assistance depends on households experiencing household *damage*, rather than merely being in a quake-affected area. Increased demand for family labor to rebuild damaged households cannot explain the quake-related migration patterns either, as the differential migration changes are more strongly associated with *location* in quake-affected areas than with household damage. Finally, the differential decline in migration in quake-affected areas is not likely to be due to increases in income opportunities in the most quake-affected areas: per worker income and total household income both decline differentially in quake-affected areas.

Numerous studies have examined the mechanisms with which households cope with risk in developing countries. Among others, Townsend (1994), Udry (1994), Ligon, Thomas, and Worall (2002), and Fafchamps and Lund (2003) have documented risk-pooling arrangements among rural households in developing countries intended to smooth consumption in response to shocks. Households may also autonomously build up savings or other assets in good times and draw down these assets in hard times (Paxson, 1992; Rosenzweig and Wolpin, 1993; Udry, 1995), increase their labor supply when shocks occur (Kochar, 1999), or take steps (such as crop and plot diversification) to reduce the variation in their incomes (Morduch, 1993).

A contribution of this paper is to examine a mechanism for coping with shocks ex post on which previous studies have not focused: migration by family members (to both international and domestic destinations). In addition, I shed light on the circumstances under which migration succeeds and fails in this ex post risk-coping function. I emphasize the difficulties in using risk-coping mechanisms when shocks are shared by many households in a locality, so this paper is reminiscent of difficulties in smoothing consumption through asset sales when shocks are aggregate, because other households simultaneously seek to sell their assets, driving down asset prices (Rosenzweig and Wolpin, 1993; Fafchamps, Udry, and Czukas, 1998; and Lim and Townsend, 1998).

Rich countries with large migrant inflows from developing countries have a direct interest in understanding the impact of sending-country economic shocks on international migration. One approach has been to examine the relationship between economic conditions and outmigration using aggregate (country-level) data—for example, Hanson and Spilimbergo (1999), Hatton and Williamson (2003), and Mayda (2003)—generally finding that higher sending-country incomes or wages (relative to those in rich countries) are associated with less outmigration. While suggestive, these findings cannot be interpreted as the impact of sending-country incomes or wages per se, since many other economic conditions tend to change alongside income or wages. For example, macroeconomic reform in sending countries may raise sending-country incomes and also lead to increased credit access. If higher incomes reduce migration, but access to credit facilitates migration, the estimated impact of income on migration will be biased upward. Moreover, none of these studies have highlighted the possibility that shocks in sending countries could actually *reduce* migration.

In contrast to existing research on economic conditions and migration, this paper studies the impact of economic shocks on migration using household-level data.[4] An advantage of this approach is that it is possible to separate the impact of household-level economic shocks from the impact of aggregate economic conditions. More fundamentally, with household-level data it is possible to explore in detail the channels (such as the credit market) through which shocks have their effects.

Halliday (2006) also examines the impact of the 2001 earthquakes on migration from El Salvador, and highlights the negative relationship between a household's quake damage and increases in migration. He argues that the earthquake causes the marginal returns to a potential migrant's labor at home to rise (migrants are needed to help in household reconstruction). In the empirical analysis below I rule out this explanation: the decline in migration is more strongly related with a household's *location* with respect to the two quakes rather than the actual damage a household experiences.

This paper differs from the few household-level migration studies by emphasizing credible identification of the effect of economic conditions on migration. Existing household-level studies are cross-sectional, and do not have plausibly exogenous variation in the causal economic conditions of interest.[5] For example, negative shocks or persistent poverty may induce migration, leading to a negative relationship between household income and migration. But productive investments funded by migrant remittances can raise household income. Therefore, the estimated impact of household income and migration is likely to be severely biased in cross-sectional data, and in a direction that is not obvious *a priori*. Even if reverse causation from migration to income in source households was not a problem, it would be difficult to separate the cross-sectional relationship between income and migration from the influence of unobserved third factors affecting both income and migration (an example of an omitted variable might be the entrepreneurial spirit of household members).

Two aspects of the empirical strategy are key in resolving these identification problems. First, I examine shocks—earthquakes and deaths in the family—that are credibly exogenous, so that bias due to reverse causation is not a concern.[6] But the estimated impact of economic shocks in *cross-sectional* data is still likely to be biased, because the *likelihood* of experiencing a shock may be correlated with time-invariant household characteristics (in other words, omitted variables are still a concern). For example, if shocks occur more frequently in poorer areas, and there is in general more migration from poor areas, estimates of the impact of shocks on migration will be biased upward.

So the second crucial aspect of this paper is its use of panel data, so that estimates of the impact of shocks can be purged of the influence of unobserved time-invariant household characteristics that are jointly related with migration and the likelihood of experiencing a shock. Estimation of the impact of shocks focuses on how shocks are related to *changes* in migration rather than the *level* of migration. To minimize initial differences between shocked and unshocked households, identification of the impact of the quakes relies on assessing how changes in migration are associated with exposure to the quakes among households within the same geographic region (within El Salvador's 14 administrative departments).

EVIDENCE FROM RURAL EL SALVADOR

This section documents that migration from rural areas in El Salvador rises in response to idiosyncratic shocks (death in the family), and declines in response to aggregate shocks.

The evidence is strongly suggestive that the differential decline in migration in areas closest to the quake has to do with increased difficulty in obtaining informal and formal credit. Differential declines in migration in quake-affected areas are accompanied by substantial declines in households' formal and informal granted credit. I find evidence against alternative hypotheses for the differential decline in migration, such as increases in income opportunities or external aid, or an increase in the demand for family unity in the areas closest to quakes.

The size of the ongoing migration flow and the importance of remittances in the economy make the Salvadoran case an important one for research on migration. Few countries surpass El Salvador in terms of recent migrant outflows as a share of the national population. Substantial outflows from El Salvador began with the start of the country's civil war in 1980, and the vast majority of migrants have been destined for the United States and Canada. In 2001, there were roughly 790,000 Salvadoran-born individuals in the United States,[7] a striking figure compared with the total population of El Salvador itself, 6.3 million. By most accounts, the bulk of migration to the United States is illegal, involving a land crossing through Guatemala, across the length of Mexico, and over the US-Mexican border.[8]

Salvadoran migration is also pervasive from the point of view of households remaining in El Salvador.[9] In the year 2000, 16 percent of rural households and 14 percent of urban households reported having one or more household members living overseas.[10]

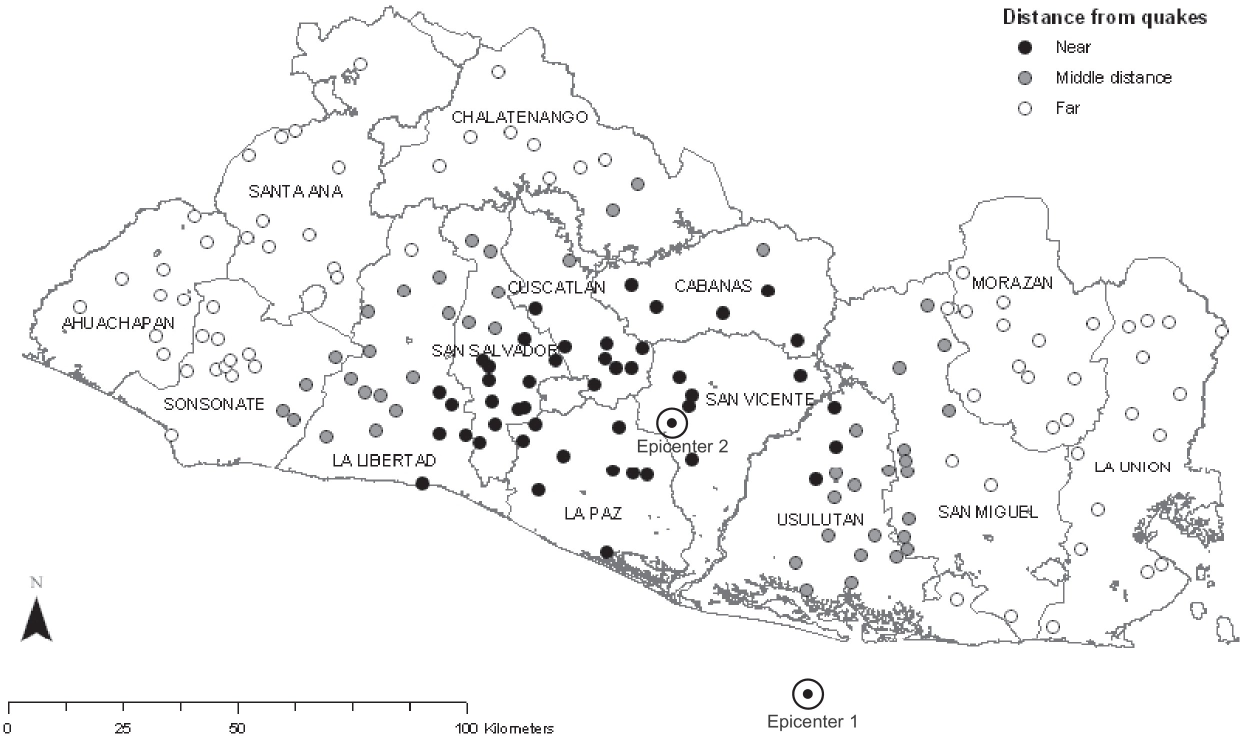
DATA AND SUMMARY STATISTICS

As discussed in the introduction, panel data is useful for evaluating the impact of shocks on migration so that estimates can be purged of bias due to unobserved time-invariant heterogeneity through the inclusion of household fixed effects.[11] This study primarily uses a high-quality panel dataset of rural households distributed across El Salvador, the FUSADES/BASIS El Salvador Rural Household Survey. This dataset tracks nearly 700 households in four biennial rounds: 1996, 1998, 2000, and 2002. The empirical work of this paper focuses on the latter two rounds of the survey, 2000 and 2002.[12] In a detailed section on migration, the survey collects information on any close relatives who are either internal or overseas migrants.

An indicator for whether a household reports having any migrant relatives will be the main outcome of interest in the empirical analysis. As such, I examine the extent to which shocks affect the propensity for *extended family groups* to send migrants away, as opposed to more narrowly defined households.[13]

In addition, the survey collected information on various unusual events in the past year. The idiosyncratic shock I focus on is an indicator for whether the household reports that any close relative (not exclusively those who live in the same household) died in the past year (the variable "death in family"). Because such shocks may have lagged effects on family groups, I examine how changes in migration between 2000 and 2002 are affected by deaths in the family in 2001 and 1999 (reported at the beginning of 2002 and 2000, respectively). The survey also contains rich detail on savings, credit, and transfers to other households that will be useful in examining the impact of the earthquakes on formal and informal financial instruments in these areas.

Figure 1. Salvadoran Municipal Halls and Epicenters of 2001 Earthquakes



Note: Municipal halls "near" quakes are those within 100 kilometers of first (Jan. 13, 2001) epicenter and 50 kilometers of second (Feb. 13, 2001) epicenter. Those in "middle distance" to quakes are those within 125 kilometers of first epicenter and 75 kilometers of second epicenter (but not in "near" area). All other municipal halls are defined as "far" from quakes.

The measure of the aggregate shock is a household's proximity to the area most highly affected by two massive earthquakes. In January and February 2001, two large earthquakes (measuring 7.8 and 6.6 on the Richter scale, respectively) struck El Salvador, leaving over 1,000 dead and tens of thousands homeless, and causing an estimated $1.6 billion in direct and indirect damage (CEPAL, 2001).

The two epicenters were only about 75 kilometers from one another, so the households most highly affected by the earthquakes were in areas close to *both* epicenters. As measures of how affected a household was by the earthquakes, I construct simple indicator variables of whether a household was initially located (prior to the quakes, in year 2000) in the most highly affected area, and in an area of intermediate distance from both quakes. The household's location is known at the level of the municipality, and geographic coordinates of municipal halls and earthquake epicenters are available from the Salvadoran government's Servicio Nacional de Estudios Territoriales (SNET).

I calculate distances to epicenters as great circle distances from a household's municipal city hall. I then define an indicator variable ("Near quakes") for a household being within 100 kilometers of the first (January 13, 2001) epicenter and within 50 kilometers of the second (February 13, 2001) epicenter.[14] A second variable ("Middle distance to quakes") indicates the household was less than 125 kilometers from the first epicenter and less than 75 kilometers of the second epicenter, but not in the "Near quakes" area. These distance thresholds for defining the earthquake shock indicators are somewhat arbitrary, but were chosen to classify roughly one-quarter of the sample households into each of the two closest quake distance categories, leaving the remaining one-half of sample households outside these two categories.

Figure 1 displays the municipal halls of households included in the sample. Black circles indicate municipal halls in the "Near quakes" area, grey circles those in the "Middle distance," and white circles those outside these two areas. Table 1 presents summary statistics for the 671 sample households.

Table 1. Household Summary Statistics (Values are for year 2000 unless otherwise indicated)

	Mean	Std. dev.	Median
Shocks			
Near quakes	0.27		
Middle distance to quakes	0.25		
Death in family (2001)	0.07		
Death in family (1999)	0.07		
Any earthquake damage (2001)	0.61		
Cost of earthquake damage (2001)	4,254	11,908	500
Household variables used as controls in empirical analysis			
Head has some primary schooling	0.40		
Head has completed primary or more schooling	0.23		
In 2nd quartile of per capita household income	0.24		
In 3rd quartile of per capita household income	0.25		
In 4th quartile of per capita household income	0.25		
Owns a vehicle	0.08		
Owns a refrigerator	0.33		
Owns a television	0.60		
Owns a cooking stove	0.34		
Has indoor plumbing	0.29		
Has electric lighting	0.69		
Number of household members	5.98	2.62	6
Has a migrant relative	0.40		
Has any savings	0.25		
Has informal credit	0.13		
Has formal credit	0.13		
Made interhousehold transfer(s)	0.04		
Member of organization	0.33		
Addenda:			
Distance from 1st (Jan. 13, 2001) epicenter (kms.)	103.7	35.0	100.5
Distance from 2nd (Feb. 13, 2001) epicenter (kms.)	63.6	31.8	65.1
Has an overseas migrant relative	0.32		
Has an internal (domestic) migrant relative	0.12		

continued

Table 1, continued

Income per capita	705	812	461
Income per worker	941	1,113	617
Amount of savings	1,008	4,559	0
Amount of informal credit	349	2,279	0
Amount of formal credit	1,291	7,841	0
Amount of interhousehold transfers	56	429	0
Has a migrant relative (2002)	0.38		
Has an overseas migrant relative (2002)	0.31		
Has an internal (domestic) migrant relative (2002)	0.10		
Has any savings (2002)	0.25		
Has informal credit (2002)	0.23		
Has formal credit (2002)	0.20		
Made interhousehold transfer(s) (2002)	0.06		
Received any aid	0.38		
Amount of aid received	850	2,652	0

Notes: Household characteristics data are from FUSADES/BASIS El Salvador Rural Household Survey (2000 data unless otherwise indicated). Geographic coordinates of municipal city halls and earthquake epicenters are from Servicio Nacional de Estudios Territoriales (SNET), government of El Salvador. The 671 sample households are those observed in both 2000 and 2002 of BASIS survey (24 households dropped out between the two years, and are not included in analysis).

Summary statistics are values for 2000 (prior to shocks). Variables without reported standard errors in table are indicators (0 or 1). Distances to epicenters are great circle distances from household's municipal hall. "Near quakes" means household was within 100 kilometers of first (January 13, 2001) epicenter and within 50 kilometers of second (February 13, 2001) epicenter. "Middle distance to quakes" means household was within 125 kilometers of first epicenter and 75 kilometers of second epicenter, but not in the "Near quakes" area. "Death in family" means a relative (not necessarily living in same household) died in given year.

"Has any savings" means household currently has nonzero savings in a formal savings institution (missing savings assumed to be zero in 36 households). "Has informal credit" means household currently has credit from informal source such as a local lender, friend, relative, store, etc. "Has formal credit" means household currently has credit from a commercial bank, development institution, or other commercial source. "Made interhousehold transfer(s)" means household made nonzero transfers (in cash or kind) to other household(s). "Member of organization" means household was a member of some community group. "Received any aid" means household received assistance from any source outside the household due to the earthquakes or some other event. Levels of income, savings, credit, transfers, and aid are in current US dollars.

EMPIRICAL STRATEGY

Examining the impact of year 2001 shocks on changes between 2000 and 2002 makes it natural to specify the outcome variables in first differences.[15] The most-inclusive regression equation I estimate is the following (for a household *i* in municipality *k* in department *j*):

$$\Delta Y_{ikj} = \alpha + \beta_1 NEAR_k + \beta_2 MID_k + \gamma_1 DEATH01_{ikj} + \gamma_2 DEATH99_{ikj} + \zeta_1 DAMQ1_{ikj} + \zeta_2 DAMQ2_{ikj} + \zeta_3 DAMQ3_{ikj} + \zeta_4 DAMQ4_{ikj} + \theta_j + \varphi' X_{ikj} + \varepsilon_{ikj}$$

The dependent variable is the change in an outcome variable (the migration indicator in most of the analysis) between 2000 and 2002 surveys. The constant term α captures the mean change across all households. The earthquake indicators are essentially in first differences already, because no quakes occurred in 1999 or 2000. $NEAR_k$ is the "Near quakes" indicator, and MID_k is the "Middle distance to quakes" indicator.[16]

I do not specify the death indicator in first differences. Instead, I enter deaths in 2001 and 1999 separately into the regression $DEATH01_{ikj}$ and $DEATH99_{ikj}$ respectively. Using the *change* in the death indicator as the idiosyncratic shock variable instead would impose the restrictions that the impact of death in 1999 and the impact of death in 2001 on the dependent variable are of equal and opposite signs, and that experiencing deaths in *both* years has no effect on the dependent variable (because then the change would be zero). Entering deaths in 1999 and 2001 into the regression separately relaxes these restrictions. In any case, only three households had a death in the family in both 2001 and 1999.

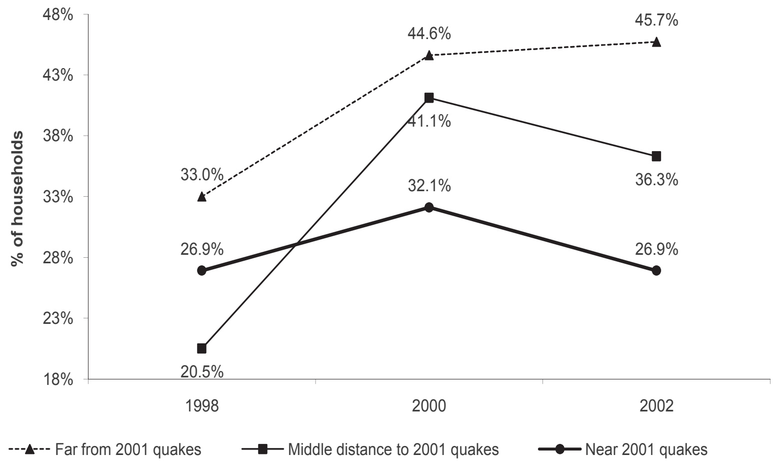
The regression also includes indicators for whether a household's reported damage fell into each of four quartiles of the distribution of damage in the dataset (in US dollars): $DAMQ1_{ikj}$ through $DAMQ4_{ikj}$. (Quartiles are defined excluding the zero values, and all four damage indicators are zero for households reporting zero damage.) The variables related to earthquake damage suffered in 2001 are useful to separate the *direct* impact of the earthquake on migration (via the household's property damage) from the *indirect* impact (for example, via changes in the local credit market). If the earthquake's impacts on migration are primarily indirect, controlling for a household's own earthquake damage should have little effect on the coefficients on the quake distance indicators.

A potential concern is that even though the *timing* of the shocks might have been unexpected, households with certain characteristics might have been more prone to shocks in general. If households with these characteristics also have different ongoing migration trends, such differences could bias the estimated impact of the earthquake shock on migration. For example, if earthquakes typically occur in places with relatively low education levels, and less-educated households have higher ongoing migration growth, then the estimated impact of the earthquake on migration will be biased upwards.

θ_j is a fixed effect for a household's administrative department (of which there are 14 in El Salvador). Including department fixed effects in a first-differenced equation controls for department-specific time trends (this is equivalent to a two-period panel regression in levels, and including department fixed effects interacted with an indicator for the second period.) When department fixed effects are included in the equation, the impact of the shock variables should therefore be interpreted as the impact of shocks on a household's *deviation from the mean change within its department*. The coefficients on the quake indicators will then only derive from the eight departments with internal variation in the quake indicators (see Figure 1).[17]

It is possible that differential time trends may be occurring within departments as well. But it is not possible to control for time trends at the next lower administrative level, the municipality, because the variation in the earthquake shock variables occurs at that level. If any differential time trends occurring within departments are correlated with initial household characteristics *and* with a household's shock variables, the inclusion of a vector of control variables for initial household characteristics in the equation can further help purge estimates of bias. X_{ikj} is a vector of initial (year 2000) characteristics of the household (listed in the middle panel of table 1).

Figure 2: Impact of Earthquake on Migration (Overseas and Internal)
Percentage of households with close relatives who are migrants



Notes: Data source is FUSADES/BASIS El Salvador Rural Household Survey (1998, 2000 and 2002 rounds). Sample includes 572 households that appear in all three rounds. Both overseas and internal (domestic) migrants are counted. See Table 1 for definitions of quake distance variables.

ε_{ikj} is a mean-zero error term. Standard errors are clustered to account for spatial correlation within municipality.

The coefficients of interest are, first, the coefficients β_1 and β_2 on the indicator variables for proximity to the earthquakes. The identification assumption is that if the earthquakes had not occurred, then changes in the outcome variables would not have varied for households located in the earthquake-affected area, compared with households further away (after controlling for department fixed effects and initial household characteristics). An advantage of focusing on earthquake shocks is that reverse causation is not a worry. First-differencing controls for any time-invariant (levels) differences between households that are shocked and not shocked.

The coefficients γ_1 and γ_2 on deaths in the family will also be of interest in order to compare the impact of these idiosyncratic shocks with the aggregate earthquake shocks. The department fixed effects θ_j and the vector of household characteristics X_{ikj} help account for heterogeneity in migration trends potentially correlated with the shock.

THE IMPACT OF SHOCKS ON MIGRATION

As a first step, I confirm that proximity to the 2001 earthquakes was indeed strongly related to whether a household experienced earthquake damage in the past year. Then I show that households closer to the 2001 earthquakes became differentially less likely to have close relatives who are migrants. By contrast, households experiencing deaths of family members in 2001 become more likely to have migrant relatives.

Regression estimates with department fixed effects (available from the author on request) confirm that closeness to the quakes was associated with higher quake damage for households. Being in the earthquake-affected areas makes a household more likely to experience earthquake damage, and raises the reported cost of earthquake damage: the coefficients on the "Near quakes" and "Middle distance to quakes" indicators are both positive and statistically significant. As one might expect, the households closest to the quakes suffer the most damage (the coefficients on the "Near quakes" indicator are always larger in magnitude than those on the "Middle distance" indicator). The likelihood of earthquake damage among households in the area closest to the quakes was on average 35 percentage points higher than for households in the same department but in areas further away.

The negative impact of the earthquake shock on migration is readily apparent in raw data. Figure 2 tracks the percentage of households in the FUSADES/BASIS dataset reporting they have close relatives who are migrants (both overseas and internal), for households of the three different distances from the quakes, in 1998, 2000, and 2002. The percentage of households with migrant relatives rises in all areas from 1998 to 2000, prior to the quakes. Between 2000 and 2002, the more affected and less affected areas diverge: the percentage of households with migrant relatives falls in the two areas nearer to the quakes, but actually rises slightly in the area furthest from the quakes.

These patterns are confirmed (and in fact magnified) in a regression analysis. Table 2 presents results from regressing the change (between 2000 and 2002) in an indicator for whether a household has any close relatives who are migrants on the shock variables and

Table 2. Impact of Shocks on Migration from Rural Areas, 2000-2002. Ordinary Least-Squares First-Differenced Estimates

Dependent variable: Change in household migration indicator, 2000-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Type of migration indicated in dep.variable:	Internal and overseas	Internal and overseas	Internal and overseas	Internal and overseas	Internal and overseas	Overseas	Internal
Near quakes	-0.056 (0.054)	-0.153 (0.051)***	-0.147 (0.054)***	-0.343 (0.074)***	-0.376 (0.073)***	-0.224 (0.069)***	-0.193 (0.101)*
Middle distance to quakes	-0.065 (0.054)	-0.091 (0.047)*	-0.097 (0.049)**	-0.201 (0.049)***	-0.205 (0.052)***	-0.120 (0.048)**	-0.130 (0.081)
Death in family (2001)	-0.025 (0.085)	0.096 (0.065)	0.097 (0.064)	0.107 (0.063)*	0.136 (0.061)**	0.226 (0.085)***	-0.073 (0.056)
Death in family (1999)	0.018 (0.079)	0.017 (0.068)	0.006 (0.069)	-0.002 (0.065)	-0.011 (0.073)	-0.003 (0.064)	0.037 (0.056)
Has migrant relative in 2000		-0.645 (0.040)***	-0.653 (0.041)***	-0.689 (0.040)***	-0.691 (0.039)***	-0.456 (0.042)***	-0.277 (0.041)***
Earthquake damage:			0.064	0.047	0.051	0.070	0.018
Bottom quartile			(0.057)	(0.055)	(0.055)	(0.050)	(0.045)
Earthquake damage:			-0.112	-0.102	-0.104	-0.071	-0.025
2nd quartile			(0.055)**	(0.055)*	(0.056)*	(0.049)	(0.057)

Earthquake damage: 3rd quartile			-0.050 (0.053)	-0.043 (0.052)	-0.026 (0.053)	0.006 (0.051)	0.010 (0.040)
Earthquake damage: Top quartile			0.032 (0.058)	0.027 (0.056)	0.008 (0.059)	-0.026 (0.057)	0.059 (0.050)
Constant	0.013 (0.033)	0.297 (0.038)***	0.311 (0.041)***	0.405 (0.045)***	0.345 (0.082)***	0.254 (0.076)***	0.083 (0.084)
Department fixed effects	--	--	--	Y	Y	Y	Y
Controls for initial household characteristics	--	--	--	--	Y	Y	Y
Observations	671	671	671	671	671	671	671
R-squared	0.00	0.33	0.34	0.39	0.39	0.43	0.28

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Standard errors in parentheses, clustered by 166 municipalities. Unit of observation is a household. Dependent variable is change between 2000-2002 in an indicator for whether household has given type of migrant relative at time of survey (takes on values of -1, 0, and 1). See Table 1 for variable definitions. Fixed effects are for 14 administrative departments. Regression coefficients on initial household-level characteristics reported in Table 3b. Household characteristics variables are values in year 2000. Initial household characteristics controls are: indicators for head's level of completed schooling (primary, secondary); indicators for household per capita income quartile;
indicators for ownership of vehicle, refrigerator, television, stove, indoor plumbing, and electric lighting; number of household members; indicators for having any savings, any informal credit, and informal credit; indicator for having made any interhousehold transfers; indicator for being member of an organization.

an increasingly inclusive set of control variables and department fixed effects. Column 1 simply regresses the change in the migration indicator on the earthquake shock indicators and the death in family indicators, with no other right-hand-side variables. The coefficients on the quake distance indicators are both negative, but not statistically significantly different from zero. The coefficients on the death in family indicators are both close to zero and statistically insignificant.

The migration changes turn out to be very different for households with and without migrants in the initial year (2000). When an indicator for having a migrant relative in 2000 is added to the regression (column 2), it enters negatively and is highly statistically significantly different from zero. The quake distance variables have now become larger in absolute value (more negative), and are now statistically significantly different from zero (indicating that households closer to the quakes were less likely to have migrant relatives initially). The 2001 death in family indicator has become positive and is approaching conventional levels of statistical significance.

In column 3, the earthquake damage indicators are added to the regression. The coefficient on the indicator for the second quartile of earthquake damage is negative and statistically significantly different from zero, while the coefficients on the other damage indicators variables are smaller in magnitude and are not statistically significantly different from zero. A possible explanation is as follows. Small amounts of quake damage (specifically, the first quartile of reported losses) have little effect on individuals' migration decisions. Intermediate amounts of quake damage (the second quartile of reported losses) lead potential migrants to forestall migration to help in reconstruction (via supplying their own labor).[18] However, when households experience large amounts of quake damage (the third and fourth quartile of reported losses), households have a greater need for migrant *remittances* to help pay for reconstruction (and potentially replace lost income, if productive assets were damaged). This increased incentive for migration on average offsets the desire to have migrants stay home to provide reconstruction labor, so that the highest amounts of quake damage are not correlated with migration changes.

The inclusion of the quake damage indicators has little effect on the coefficients on the quake distance indicators in column 3. This suggests that the impact of the earthquakes on migration has a large *indirect* component (due to living in an earthquake-affected *area*), in addition to any *direct* impact (due to sustaining earthquake damage).

When department fixed effects are included as right-hand-side regressors (column 4), the estimated impact of quake distance on migration derives primarily from differences in the quake distance indicators among different households *within the same department*. As discussed above, this helps control for possible ongoing department-level trends that may be correlated with departmental exposure to the quakes.

Figure 1 depicts the municipal halls of surveyed households (whose locations are used to determine household distances to epicenters), and indicates to which quake distance category they are assigned. In Ahuachapan, Santa Ana, Morazan, and La Union, there are no surveyed households in the two areas closest to the quakes. In La Paz and San Vicente departments, all surveyed households are in the "Near quakes" area. These departments where all households are in the same distance categories do not contribute directly to the estimation of the effects of the "Near quakes" and "Middle distance to quakes" variables (except through their contributions to estimating the other regression coefficients).[19]

With the inclusion of department fixed effects, the differential changes in migration between households nearer and farther from the quakes are magnified: the coefficients on the quake distance indicators become considerably more negative (larger in absolute value) and remain highly statistically significantly different from zero.

What is likely to be happening here? *Without* the inclusion of department fixed effects, the comparison between the departments in the central part of the country (La Paz and San Vicente, where all households are in the "Near quakes" area) with the extreme eastern and western departments (Ahuachapan, Santa Ana, Morazan, and La

Union, where all households are outside the most quake-affected areas) apparently *attenuates* the estimated impact of the quakes on migration. One possible explanation might be that earthquake assistance was disproportionately allocated to La Paz and San Vicente departments, allowing credit markets to continue to function well in the wake of the disaster, so that potential migrants could continue to obtain financing for migration's fixed cost. Including department fixed effects in the analysis keeps households in La Paz and San Vicente from contributing directly to the estimation of the quakes' effect on migration.

Column 5 includes the quake damage variables and all the initial household characteristics controls. These make little difference for the coefficients on the quake distance variables, indicating that the department fixed effects and the indicator for whether a household initially has a migrant relative are effective at controlling for underlying trends in migration across households of different distances from the quakes.

The death in family (2001) indicator becomes larger in absolute value in column 5 when initial household characteristics are included in the regression (compared with column 4), and is now statistically significantly different from zero at the 5 percent level. Deaths in the family may in fact be predictable by family members (as discussed above), and so controlling for year 2000 household observables helps eliminate some of the downward bias induced by (pre-2000) migration *in anticipation* of a family member's death (including year 2000 household characteristics in the regression helps isolate the *unpredictable* portion of a year 2001 death in the family.)

The death in family (1999) indicator is small in magnitude and not statistically significantly different from zero in any regression, providing no evidence of a lagged migration responses to deaths in the family.

Are these migration responses to shocks reflecting overseas or internal migration? The last two columns of the table report coefficient estimates from regressions similar to column 5, but where the household migration indicator is defined for overseas and internal migrants separately. In column 6, the dependent variable is the change in whether a household has any overseas migrant relatives, and in column 7 it is the change in whether a household has any internal migrant relatives.

Columns 6 and 7 indicate that proximity to the quakes has a negative and statistically significant impact on overseas and domestic migration separately. The coefficient on the 2001 death in family indicator is substantially larger in column 6 than in column 5 and is highly statistically significant. In column 7, the coefficient is actually negative and is not statistically significantly different from zero. It seems that when deaths occur, relatives substitute towards overseas migration and away from domestic migration.

In all regressions where the two quake distance indicators are statistically significantly different from zero (columns 2-7), the coefficient on the "Near quakes" indicator is larger in absolute value than the coefficient on the "Middle distance to quakes" indicator.[20] This is sensible: the negative impact of the quake should be largest for households in the most-affected area.

The coefficient estimates in column 5 indicate that being in the area nearest the 2001 quakes reduced the likelihood that a household had a migrant relative (either internal or overseas) differentially by 38 percentage points, with respect to households outside the two most-affected areas. For households in the middle distance to the quakes, the corresponding differential decline is 21 percentage points.

The coefficient on the 2001 death in family indicator indicates that a 2001 death in the family differentially raises the likelihood of having a migrant relative by 14 percentage points, compared with households where no relative died in the past year. This is the net effect of an increase in overseas migration and a reduction in internal migration: the coefficient estimate in column 6 (where the dependent variable refers to only overseas migration) indicates that a 2001 death in the family differentially increased the likelihood that a household had an overseas migrant relative by 23 percentage points, compared with households not experiencing such deaths.

Checking for Pre-existing Trends among Shocked Households ("A False Experiment")

The crucial identification assumption in the empirical analysis is that, in the absence of the earthquake shocks, changes between 2000 and 2002 in whether a household had migrant relatives would have been identical across households of different distances from the quake (as defined by the quake distance indicators). Because data on FUSADES/BASIS households was also collected in 1998, it is possible to conduct a partial test of this identification assumption. I conduct a "false experiment," and ask whether the 2001 shocks can predict the change in the indicator for having a migrant relative between 1998 and 2000 (*prior* to the shocks' occurrence). (Results are not reported here, but are available from the author on request.) There is no evidence that the parallel-trend identification assumption is violated for the earthquake shocks when department fixed effects are included in the regression. Causal inference is therefore likely to be most secure in the regression specification with department fixed effects.

POTENTIAL EXPLANATIONS FOR NEGATIVE IMPACT OF EARTHQUAKES ON MIGRATION

In this section I present empirical evidence for various explanations for the observed negative impact of the 2001 earthquakes on changes in migration between 2000 and 2002. I consider five hypotheses. The hypotheses are that the differential decline in migration occurred because the most quake-affected areas experienced:

1. increased difficulty accessing financial instruments to finance migration;
2. increased demand for family unity;
3. increased aid
4. increased need for family labor in reconstruction;
5. increased income opportunities.

The evidence is strongest for the first hypothesis: that the differential decline in migration was caused by increased difficulty in accessing methods of migration finance in areas closest to the quakes (in particular informal and formal credit).

By contrast, there is empirical evidence against alternative explanations for the differential decline in migration in the areas closest to the quakes. It is not likely to be because of an increase in the demand for family unity when negative shocks occur, as deaths in the family (which presumably would also raise the desire for family unity) *do* lead to differentially more migration. External disaster assistance to quake-affected areas would not explain the differential migration response, as receipt of outside assistance is dependent on households experiencing household *damage*, rather than merely being in a quake-affected area. Increased demand for family labor to rebuild damaged households cannot explain the quake-related migration patterns either, as the differential migration changes are more strongly associated with *location* in quake-affected areas than with household damage. Finally, the differential decline in migration in quake-affected areas is not likely to be due to increases in income opportunities in the most quake-affected areas: per-worker income and total household income both decline differentially in quake-affected areas.

Hypothesis 1: Increased difficulty accessing financial instruments

Two findings so far suggest that general equilibrium phenomena (the effect of aggregate shocks on aspects of a locality as a whole) may better explain the differential decline in migration from the most quake-affected areas. First, idiosyncratic shocks (deaths in the family) increase migration, but aggregate shocks (closeness to the quakes) reduce migration. Second, the impact of the quake on migration depends primarily on being in an earthquake-affected *area*, more than on actual damage from the quake.

I document here that changes in households' use of the instruments that finance migration, and the dependence of the quake's impact on households' *initial* use of these instruments (particularly informal credit) provide strongly suggestive evidence that breakdowns in these financial instruments are behind the decline in migration from areas closest to the quakes.

The dataset contains information on the manner in which households' migrant relatives who left between 1995 and 2000 obtained the funds to pay for migration, as reported in the year 2000 (prior to the shocks), for overseas migrants, internal migrants, and all migrants together.[21] The most common financing source for overseas migration is money sent by other relatives, at 46.4 percent. Savings (19.3 percent) and loans (17.5 percent) make up the next most common financing sources. Households report that internal migration is financed quite differently, with 59.5 percent of migrants relying on savings and none on loans.

There is evidence that some of these financing methods break down when aggregate shocks occur. Table 3 presents regression estimates of the main regression equation, but where the outcome variables are changes in a household's participation in four types of financial transactions: savings, informal credit, formal credit, and transfers to other households (which may reflect participation in mutual help or insurance arrangements). There are two regressions for each type of financial transaction. The credit variables (separately for informal and formal credit) are indicators for whether the household was granted any credit in the past year, and the log amount of credit granted. (Informal credit is from a local lender, friend, relative, store, etc. Formal credit is from a commercial bank, development institution, or other commercial source.) The savings variables are an indicator for the household's having a savings account in a formal financial institution, and the log amount of savings. The transfer variables are an indicator for making any transfers, and the log amount of transfers in the past year.[22]

For all the financial transactions considered, proximity to the earthquakes is associated with declines in use: the coefficients on the quake distance indicators are nearly all negative in sign in table 3. In all four regressions for formal and informal credit (columns 1-4), the "Near quake" indicators are negative and statistically significantly different from zero, and in the informal credit regressions the coefficients on the middle distance indicator are negative and statistically significantly different from zero as well. Households in the area closest to the quakes experienced differential declines in their likelihood of having credit of 24 percentage points (for informal credit) and 17 percentage points (for formal credit).

In addition, households in the areas closer to the quake saw differential declines in their likelihood of having savings greater than $500 (column 5); households may have needed to draw down their savings to smooth consumption in the face of lower incomes. The decline in savings may also help explain the decline in migration from the quake-affected areas. (Surprisingly, experiencing the top quartile of earthquake damage is associated with an *increased* likelihood of having savings greater than $500 and with *increased* log savings (columns 5 and 6). This may reflect the impact of aid flows to quake-affected areas, which could have overshot households' actual needs in some cases.)

Deaths in the family in 2001 do not have statistically significant relationships with changes in financial transactions generally, except (very tentatively) an increase in the likelihood of making an interhousehold transfer. A death in the family in 1999 is associated with a statistically significant decline in the interhousehold transfers indicator and in log transfers between 2000-2002 (columns 7 and 8). Because the deaths in question are of relatives who are not necessarily *coresident*, these results may arise because households make transfers to the households of dying or deceased relatives.[23]

The fact that use of financial instruments (particularly credit, but also savings) declines in areas closest to the quakes is suggestive that increased difficulty in accessing these instruments may be behind the concurrent decline in migration. This reasoning would receive further support if the impact of the quakes on migration was more negative for households that *initially* (in 2000, prior to the shocks) were using the said instruments. Initial use of an instrument is a proxy measure of a household's general access to an instrument. Increased difficulty in using a particular instrument should not have much effect if a household had no access to the instrument in the first place.

Table 4 presents regression results for estimation of the main regression equation, but now including interaction terms between the

Table 3. Impact of Shocks on Credit, Savings, and Interhousehold Transfers, 2000-2002

Ordinary least-squares first-differenced estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Change in informal credit indicator	Change in log (amount of informal credit)	Change in formal credit indicator	Change in log (amount of formal credit)	Change in indicator for savings >$500	Change in log (amount of savings)	Change in interhousehold transfers indicator	Change in log (amount of interhousehold transfers)
Near quakes	-0.244 (0.109)**	-1.461 (0.704)**	-0.170 (0.075)**	-1.243 (0.621)**	-0.148 (0.076)*	-0.599 (0.593)	-0.019 (0.042)	-0.170 (0.277)
Middle distance to quakes	-0.182 (0.084)**	-1.204 (0.563)**	-0.027 (0.055)	-0.121 (0.410)	-0.095 (0.047)**	-0.294 (0.349)	-0.022 (0.028)	-0.257 (0.180)
Death in family (2001)	-0.012 (0.069)	0.154 (0.509)	-0.034 (0.058)	-0.291 (0.445)	-0.051 (0.083)	-0.043 (0.616)	0.063 (0.049)	0.331 (0.310)
Death in family (1999)	0.045 (0.076)	0.014 (0.477)	0.039 (0.068)	0.267 (0.514)	0.059 (0.065)	0.179 (0.539)	-0.066 (0.014)***	-0.417 (0.089)***
Earthquake damage: Bottom quartile	0.073 (0.052)	0.405 (0.336)	-0.031 (0.051)	-0.432 (0.379)	0.010 (0.057)	-0.013 (0.438)	0.005 (0.028)	-0.046 (0.176)
Earthquake damage: 2nd quartile	-0.009 (0.040)	-0.082 (0.262)	0.032 (0.035)	0.292 (0.265)	0.000 (0.036)	-0.045 (0.276)	-0.015 (0.018)	-0.100 (0.122)
Earthquake damage: 3rd quartile	0.043 (0.055)	0.171 (0.358)	0.019 (0.041)	0.229 (0.323)	0.068 (0.050)	0.568 (0.382)	0.017 (0.024)	0.123 (0.164)

Earthquake damage: Top quartile	0.009 (0.056)	0.075 (0.357)	-0.026 (0.036)	-0.211 (0.282)	0.059 (0.031)*	0.442 (0.255)*	-0.002 (0.025)	-0.031 (0.166)
Department fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Controls for initial household characteristics	Y	Y	Y	Y	Y	Y	Y	Y
Observations	671	671	671	671	671	671	671	671
R-squared	0.39	0.41	0.32	0.33	0.22	0.23	0.45	0.45

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Standard errors in parentheses, clustered by 166 municipalities. Unit of observation is a household. Dependent variables are changes between 2000 and 2002. See table 1 for variable definitions. Fixed effects are for 14 administrative departments. Household characteristics variables are values in year 2000 (coefficients not shown). Variables in logs taken to be zero if variable was zero before taking logs.

Table 4. Interactions between Shock Indicators and Initial Credit, Savings, and Interhousehold Transfers, 2000-2002

Ordinary least-squares first-differenced estimates

	(1)	(2)	(3)
Type of migration indicated in dependent variable:	Internal/ Overseas	Overseas	Internal
Near quakes	-0.329 (0.078)***	-0.178 (0.072)**	-0.196 (0.101)*
Near quakes * Had informal credit (2000)	-0.188 (0.108)*	-0.192 (0.103)*	-0.046 (0.116)
Near quakes * Had formal credit (2000)	0.058 (0.102)	0.094 (0.129)	-0.080 (0.107)
Near quakes * Had savings (2000)	-0.146 (0.092)	-0.167 (0.104)	0.040 (0.076)
Near quakes * Made interhousehold transfers (2000)	0.018 (0.176)	0.049 (0.247)	0.060 (0.191)
Middle distance to quakes	-0.199 (0.061)***	-0.117 (0.057)**	-0.139 (0.081)*
Middle distance to quakes * Had informal credit (2000)	0.012 (0.116)	-0.039 (0.135)	0.103 (0.079)
Middle distance to quakes * Had formal credit (2000)	0.259 (0.132)**	0.123 (0.121)	0.101 (0.126)
Middle distance to quakes * Had savings (2000)	-0.139 (0.110)	-0.072 (0.106)	-0.039 (0.082)
Middle distance to quakes * Made inter-household transfers (2000)	-0.107 (0.201)	0.004 (0.370)	-0.107 (0.217)
Death in family (2001)	0.274 (0.078)***	0.410 (0.103)***	-0.072 (0.073)

continued

Table 4, continued

Death in family (2001) * Had informal credit (2000)	-0.052 (0.130)	-0.032 (0.194)	-0.175 (0.149)
Death in family (2001) * Had formal credit (2000)	-0.554 (0.112)***	-0.481 (0.186)***	-0.075 (0.183)
Death in family (2001) * Had savings (2000)	-0.208 (0.134)	-0.469 (0.149)***	0.203 (0.121)*
Death in family (2001) * Made interhousehold transfers (2000)	0.178 (0.203)	0.440 (0.456)	-0.161 (0.320)
Death in family (1999)	-0.015 (0.075)	-0.006 (0.067)	0.028 (0.057)
Department fixed effects	Y	Y	Y
Controls for initial household characteristics	Y	Y	Y
Observations	671	671	671
R-squared	0.45	0.30	0.18

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Dependent variable is the change in household migration indicator, 2000-2002. Standard errors in parentheses, clustered by 166 municipalities. Unit of observation is a household. Dependent variables are changes between 2000 and 2002. See Table 1 for variable definitions. Fixed effects are for 14 administrative departments. Household characteristics variables are values in year 2000 (coefficients not shown). Controls for quake damage quartile also included in regressions (coefficients not shown).

shocks (quake distance indicators and the 2001 death indicator) and indicators for having initially had informal credit, had formal credit, had savings, and made interhousehold transfers. In column 1 (where the dependent variable includes both overseas and internal migration), the interaction term between "Near quakes" and the "Had informal credit" indicator is negative and statistically significantly different from zero. The coefficient on the ("Near quakes" * "Had savings") indicator is also negative and marginally statistically significantly different from zero. Both these results also hold in column 2, when the dependent variable refers to overseas migration alone. The impact of being in the area closest to the earthquakes on the likelihood of having migrant relatives is more negative for households that initially had informal credit (by 19 percentage points in column 1) and that initially had savings (by 15 percentage points in column 1).[24]

Table 4 also indicates that the positive impact of a 2001 death in the family on the change in migration appears primarily in households that do not have formal credit or savings in the year 2000. In columns 1 and 2, the ("Death in family (2001)" * "Had formal credit (2000)") and ("Death in family (2001)" * "Had savings (2000)") interaction terms are negative and roughly equal in size to the coefficient on the "Death in family (2001)" main effect, so that the effect of 2001 deaths on the change in migration is close to zero for households that had either formal credit or savings in 2000. This is also to be expected: if consumption smoothing motivations are behind the responsiveness of migration to deaths, then households with savings and access to credit have less need for migration when deaths occur.

Taken together, the additional results in tables 3 and 4 provide strongly suggestive evidence that the decline in migration in areas closest to the quakes is at least in part due to concurrent declines in households' use of various financial instruments (particularly informal credit and savings). Potential migrants in the most quake-affected areas found it more difficult to obtain financing for migration, causing migration to decline differentially in those areas.

Hypothesis 2: Increased demand for family unity

An unlikely explanation is that the earthquake increases the value placed on family unity: in times of increased stress family members may try to keep the clan together (say, for mutual emotional support). As a result, potential migrants from the most quake-affected areas do not migrate in the period immediately after the quakes. But the demand for family unity should also rise when a family member dies, and migration (overseas migration in particular) responds *positively* to family deaths (table 2). It is not clear why deaths of family members should qualitatively be very different from an earthquake in raising the demand for family unity.

Hypothesis 3: Increased aid to quake-affected areas

An alternative explanation could be that aid to quake-affected areas was so large in magnitude that it made migration unnecessary. If this were the case, we should observe receipt of aid to be highly correlated with location in the quake-affected areas. I tested this hypothesis by estimating the main regression equation where the dependent variable is an indicator for receiving nonzero aid from sources outside the household due to the earthquakes or other negative events in 2001. The variation in aid receipt within departments does not seem highly correlated with location in the two areas most affected by the quakes: when including department fixed effects in the regression, the coefficients on the quake distance indicators are not statistically significantly different from zero. By contrast, within departments, actual damage suffered is predictive of aid. These same conclusions hold when replacing the dependent variable with the amount of aid received and the logarithm of aid received. (Regressions not reported due to space constraints, but available from the author on request.)

Within-department variation in aid receipt depends on actual damage suffered, and not merely location in the two areas closest to the quakes. Therefore, variation in aid receipt cannot explain why households in the two most quake-affected areas experienced differential declines in outmigration.

Hypothesis 4: Need for family labor in reconstruction

The fourth alternative explanation is that potential migrants in quake-affected areas stayed home to help in reconstruction, as suggested by Halliday (2006). There is suggestive evidence that this may be going on in part: in table 2, the coefficient on the second-quartile earthquake damage indicator is negative and statistically significant (although the lack of a relationship between migration changes and the other quartiles of earthquake damage is something of a puzzle).

More important, table 2 indicates that inclusion of the quake damage indicators (in column 3) has negligible effect on the coefficients on the quake location variables, which remain negative and highly statistically significant. The differential migration changes are more strongly associated with *location* in quake-affected areas than with household damage suffered. Therefore, increased need for family labor in reconstruction cannot explain the differential decline in migration in quake-affected areas.

Hypothesis 5: Increased income opportunities in quake-affected areas

The final unlikely explanation is that income opportunities actually improved differentially in quake-affected areas (in comparison to areas farther away), and so potential migrants in those areas stayed home instead of migrating. I test this hypothesis by estimating the main regression equation where the dependent variable is the change in the log of household income per worker in the sample households from 2000 to 2002. (Regressions are not reported due to space constraints, but available from the author on request.)

When department fixed effects are included in the regression, the coefficients on the quake distance indicators are negative (and not statistically significantly different from zero). There is therefore no evidence that within-department improvements in log income per worker are associated with being in the areas most affected by the quakes. The same conclusion holds when the regression controls for initial household characteristics and when the log of total household income is the dependent variable.

CONCLUSION

In theory, when financial markets are imperfect and when migration involves a fixed cost, the impact of economic shocks on migration can depend on the extent to which shocks are common across households. When shocks are *idiosyncratic*, they are likely to raise migration, as households send members away to replace lost income or meet increased consumption needs. But *aggregate* shocks can actually lead to *less* migration if such shared shocks lead to breakdowns in the local financial markets that typically finance migration.

This paper presents empirical evidence from a rural household panel in El Salvador that idiosyncratic and aggregate shocks do have opposite effects on migration. When households experience idiosyncratic shocks (a death of family member), they become more likely to have close relatives who are migrants. The net effect of the death of family members on migration is the sum of a large increase in overseas migration and a slight decline in internal (domestic) migration.

But when households are more exposed to aggregate shocks (when they are closer to the epicenters of the massive 2001 earthquakes), they become less likely to have migrant relatives. Analysis of a nationally representative cross-sectional household survey conducted by the government of El Salvador finds similar results: the fraction of households with members who are overseas migrants falls differentially in areas closer to the quake epicenters. To minimize initial differences between shocked and unshocked households, identification of the impact of the quakes relies on assessing how changes in migration are associated with exposure to the quakes among households within the same geographic region (within El Salvador's 14 administrative departments). The estimated negative relationship almost certainly reflects the causal impact of the earthquakes: among households located in the same department, no corresponding migration changes occur in the pre-shock period, and households closer to the quakes do not differ on average from those farther from the quakes in important initial household characteristics.

The evidence is strongly suggestive that the differential decline in migration in areas closest to the quake is in part explained by breakdowns in the various methods by which migration is financed, in particular informal and formal loans. Differential declines in migration in quake-affected areas are accompanied by substantial declines in households' formal and informal granted credit. By contrast, I present empirical evidence that the differential decline in migration in the most quake-affected areas cannot be explained by increases in the demand for family unity, aid to affected areas, the need for family labor in reconstruction, or income opportunities.

To the extent that residents of developed countries are concerned that natural disasters, civil war, or other aggregate shocks in developing countries will lead to increased migrant flows to the rich world, this paper provides evidence that may alleviate such fears: increased difficulty in obtaining migration finance is likely to blunt the impact of such shocks on outmigration. The other side of the coin, of course, is that economic development in poor countries could actually *raise* outmigration in some cases, if economic development is accompanied by the expansion of credit instruments that finance migration.

NOTES

1. I have benefited from discussions with Becky Blank, John DiNardo, Ricardo Hausmann, Jim Levinsohn, Sharon Maccini, Justin McCrary, Kaivan Munshi, Una Okonkwo Osili, and Anna Paulson, and several participants in seminars. Jose Berrospide and Joshua Congdon-Martin have provided excellent research assistance. I am extremely grateful to the staff at the Department of Economic and Social Studies, FUSADES (especially Anabella de Palomo, Margarita Sanfeliu and Mauricio Shi) for their invaluable assistance.
2. By contrast, total world population has grown only 49 percent over the same period.
3. Author's estimates from the year 2001 round of U.S. government's Census 2000 Supplementary Survey (C2SS), and 1990 U.S. Census (IPUMS 1 percent sample). Both these figures are likely to be biased downwards due to under-reporting of illegal migrants.
4. Existing research does suggest that *internal* (domestic) migration plays a role in pooling risk within extended families. Rosenzweig and Stark (1989) argue that village-to-village migration in rural India serves an insurance function, as households with more spatially distributed daughters have smoother consumption. Paulson and Miller (2000)

find in a cross-section of Thai households that remittance receipts from internal migrants are larger in areas where rainfall is currently below the local average. No study in this vein has used data on cross-border migration.

5. For example, Hoddinott (1994) and Adams (1993).
6. As I discuss in the empirical section, using deaths in the family as an idiosyncratic shock is not immune from econometric problems. In particular, some deaths may be anticipated (and so would not truly be shocks), and remittances sent by migrants can keep ill or dying people alive (reverse causation). Both these factors should lead to downward bias, so that the estimated impact of estimated impact of deaths on migration is a *lower bound* of the true causal impact.
7. Author's calculation from the year 2001 round of US government's Census 2000 Supplementary Survey (C2SS).
8. From anecdotal sources, the going rate for hiring a *coyote* to arrange one's journey to the United States prior to the 2001 terrorist attacks was approximately $3,000, and has since roughly doubled.
9. Internal (domestic) migration is considerably less well-documented. The rural household dataset used in the empirical analysis (described below) is not designed to be nationally representative, but it does indicate that internal migration is less common than overseas migration: 12 percent of households in early 2000 reported having close relatives (but not necessarily household members) who were internal migrants; by comparison, 32 percent reported having close relatives overseas.
10. These figures are from the government of El Salvador's Encuesta de Hogares de Propositos Multiples (EHPM).
11. Or, equivalently when the panel consists of just two time periods, estimation using first-differenced variables.
12. The survey does a careful job of following households that move internally within El Salvador, reducing attrition dramatically: only 24 out of 696 households drop out of the sample between these two survey years. One additional household is not included in the analysis because its municipality code (0214) is misrecorded: it does not corre-

spond with any municipality in El Salvador. This leaves a sample size of 671 households.

13. Because surveyed households are typically some distance from one another, there is likely to be little double-counting of migrants.
14. I use a smaller radius for distance to the second earthquake, because it was less powerful than the first one.
15. This will be equivalent to estimating a panel regression with two periods and including household-level fixed effects and year effects.
16. The quake distance indicators only vary at the municipality level, because distances to epicenters are measured from a household's municipal city hall.
17. The departments with internal variation in the quake indicators are Sonsonate, Chalatenango, La Libertad, San Salvador, Cuscatlan, Cabanas, Usulutan, and San Miguel. It will turn out to be important to identify the quake's impact from *within*-department variation, since there were *between*-department trends in the pre-period (1998-2000) analogous to those found in the study period (2000-2002).
18. As argued by Halliday (2006) in this same context.
19. In Ahuachapan, Santa Ana, Morazan, and La Union, there are no surveyed households in the two areas closest to the quakes. In La Paz and San Vicente departments, all surveyed households are in the "Near quakes" area.
20. In columns 4, 5, and 6, these differences are statistically significantly different from zero at conventional levels.
21. Figures can add up to more than 100 percent within columns because migrants can have used more than one source of financing.
22. The log of a variable is taken to be zero when the value of the variable is zero before taking logs. Missing values of the savings variable were replaced with zero in 36 households.
23. If a noncoresident relative dies in 1999, a household may make transfers to that relative's household (and report it in the 2000 survey), but then might not make transfers afterwards. This would generate a negative relationship between 1999 deaths and the change in reported transfers between the 2000 and 2002 surveys.

24. A concern might be that the interactions with indicators for initial use of financial instruments might simply reflect the impact of omitted variables (such as socioeconomic status) rather than initial access to financial markets. But the coefficients on the interaction terms in table 3 remain similar in size and statistical significance when additional interaction terms are included between the shocks and a set of indicators for the household's initial per capita income quartile and head's education.

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