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ABSTRACT

Temporary International Migration, Shocks and Informal Insurance: Analysis Using Panel Data*

We use panel data for rural Kyrgyzstan to examine households' international migration response when faced with shocks. Using a household fixed effects regression model, we find that while a drought shock increases the likelihood of migration, winter and earthquake shocks reduce the likelihood of migration. We use a simple theoretical framework to illustrate the trade-off between two effects of a shock for a household: loss of income and increase in the need of labor services. We show that migration increases when the former effect of a shock dominates, it reduces when the latter effect dominates. We explore these mechanisms by examining how the migration-response to shocks changes in the presence of alternate coping mechanisms and by evaluating the effect of shocks on a household's decision to send and recall a migrant member. We find that when households have easier access to informal finance the migration-response is muted only for shocks for which the adverse income effect dominates. Our findings also suggest that while shocks for which the loss of income effect dominates have a greater effect on the decision to send a migrant, shocks for which the need of labor services effect dominates only affect the decision to recall a migrant. These findings provide evidence in favor of the proposed mechanisms through which shocks affect temporary migration.

JEL Classification: J61, O15, O16

Keywords: temporary migration, shocks, insurance, informal finance, Asia, Kyrgyzstan

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1 Introduction

There is a large literature that examines the causes and consequences of international migration.[1] However, two important aspects with regards to temporary international migration have received very little attention.[2] First, except Halliday (2006), no other study distinguishes between different types of shocks faced by households that affect their temporary international migration decision. While past studies have examined the effects of agricultural shocks (Dillon et al., 2011), direct income shocks (Angelucci, 2015) and weather shocks (Gröger and Zylberberg, 2016) in isolation, they do not distinguish between the effects of various types of shocks on the migration decision. This distinction is important because the decision to migrate in response to a shock depends on the nature of the shock. For instance, households could be faced with an adverse income situation that is likely to increase migration (Morten, 2016) or they could experience an adverse labor situation leading to a decrease in migration. We fill these gaps in the literature by using a unique panel data from the Life in Kyrgyzstan (LiK) surveys which allows us to observe the dynamics of temporary migration. Second, we explore the extent to which migration is used as an insurance to buffer negative shocks. Specifically, we investigate whether access to other forms of informal insurance has an effect on the migration response of a household to shocks.

We examine the migration decision of a household using panel data from the LiK surveys. The surveys provide a nationally representative panel data comprising of about 3000 households in Kyrgyzstan. We use data from four waves of the survey (2010-2013). To our knowledge, the LiK survey data is the only panel data available for a low income source country that allows for tracking and analyzing temporary international migration

[1] See Kerr and Kerr (2011) and (Gaston and Nelson, 2013) for reviews of the literature. A large number of studies examining the determinants of migrants have used data for migrants from Mexico to the U.S. These studies include Chiquiar and Hanson (2005); Ibarraran and Lubotsky (2007); Mishra (2007); McKenzie and Rapoport (2010); Caponi (2011); Kaestner and Malamud (2014), among others.

[2] See Dustmann and Görlach (2016) for a review of the literature on temporary international migration.

decisions of households.[3] The longitudinal nature of the LiK data allows us to use a household-specific fixed effects model along with lagged values of explanatory variables to address the issue of unobserved heterogeneity in migration decisions (McKenzie et al., 2010). Further, to our knowledge, the LiK data has only been utilized by two other studies to study international migration - Chakraborty et al. (2015) and Zhunusova and Herrmann (2018). The former uses the 2010 and 2011 waves of the data to examine the consequences of migration on private transfers between households in Kyrgyzstan. The latter uses the panel between 2010 and 2013 to study the impact of migration on income in the sending community.

We use the information on whether a household was affected by one of five natural shocks - drought, rain & landslide, winter & frost, earthquake and pest in the survey-reference period. We restrict our analysis to natural shocks as they are most likely to be exogenous to a household's migration decision. Further, given that weather shocks are more likely to effect the income of rural households, we restrict our analysis to households residing in villages.

We begin our analysis by estimating the independent effect of each shock on a household's decision to have a migrant. The dependent variable is an indicator reflecting whether a household has a migrant or not. We find that while receiving a drought shock in the last period increases the likelihood of migration, winter and earthquake shocks reduce the likelihood of migration.[4] We then follow the studies analyzing the decision to migrate and control for various household characteristics in our baseline specification. Consistent with previous studies, we find that while the likelihood of migration is positively related to household size, fraction of adults and wealth of the household, fraction of elderly negatively predicts the likelihood of migration (see, for example, Kaestner and

[3]For details on the LiK survey data see Brück et al. (2014).

[4]For migrants from El Salvador to the United States, Halliday (2006) finds that adverse agricultural conditions increase net migration while earthquakes reduce net migration. Our findings for Kyrgyzstan are consistent with these results.

Malamud, 2014). Importantly, we find that the estimated coefficients for the shocks remain unaffected by the inclusion of these covariates.

We use a simple theoretical set-up to illustrate how the effect of shocks on the decision to migrate could differ depending on the nature of a shock. We consider a framework in which the migration decision is arrived at by maximizing the joint utility of all household members. In contexts where inter-generational dependence is common, migration of one member from the household affects the utility of all members residing in that household. A household will have a migrant member if the net utility from migration is higher than some reservation utility. The opportunity cost of migration includes the loss of income at home and the labor services that the migrant member could have provided at home if s/he did not migrate.

In this set up shocks play an important role in affecting the migration decision by changing the relative costs and payoffs associated with migration. We use this framework to illustrate the trade-off between two effects of a shock: loss of income and increase in the need of labor services. The shocks for which the former effect dominates, for example, drought, have a positive effect on the likelihood of migration; while the shocks for which the latter effect dominates, for example, winter, have a negative effect on the likelihood of migration. We empirically examine these mechanisms by analyzing the change in the migration-response to a shock in the presence of alternate coping mechanism and by evaluating the effect of shocks on the decisions of a household to send or recall a migrant member.

It is well established that in the absence of financial markets rural households use informal networks to insure against income shocks (Townsend, 1994).[5] Morten (2019) examines the link between informal networks and domestic migration within India and finds

[5] A large literature examines the importance of informal networks in providing insurance in rural areas, see Morten (2016) for a brief review of the literature.

that availability of informal insurance reduces migration.[6] To understand the channels through which income shocks might affect temporary international migration decisions, we examine whether access to finance can alleviate some of the effects of shocks on the decision to migrate. We find that having access to borrowing reduces the likelihood of migration for a household that experiences drought, rainfall or earthquake shocks. For households faced with a winter shock, access to borrowing has no effect on the likelihood of migration. The findings suggest that access to finance reduces the likelihood of migration only for shocks that reduce incomes of households but not for shocks that increase the demand for labor service for households.

When examining temporary migration, an important distinction is between the decision to send a migrant and to recall a migrant. The longitudinal nature of the LiK data allows for examining this dynamics of of temporary migration and evaluate whether the effect of shocks on the two decisions depends on the nature of the shock. For analyzing the effect of shocks on recalling a migrant, we compare two households who both have a migrant in the current period and study the change in migrant status in the next period. Analogously, for analyzing the effect of shocks on a household's decision to send a migrant, we compare two households who are both non-migrants in the current period and one of them switches to be a migrant in the next period. We find that a shock for which the loss of income effect dominates, for example drought shock, affects the decision to send a migrant more than the decision to recall a migrant. However, a shock for which the need for labor service dominates, severe winter, affects the decision to recall a migrant but not to send a migrant. These findings provide support for our proposed mechanisms through which shocks affect the decision to migrate.

We contribute to the existing literature in a number of ways. First, with the exception of Halliday (2006), previous studies have focused on only one shock as a determinant of

[6]Also, Kubik and Maurel (2016) shows that the effect of agricultural shocks on internal migration depend on household wealth in Tanzania.

migration (see for example Angelucci, 2015; Dillon et al., 2011; Gröger and Zylberberg, 2016). Additionally, in contrast to Halliday (2006), we examine the effects of five different shocks on the decision to migrate.[7] Second, unlike most studies we are able to account for unobserved heterogeneity at the household level that drives temporary international migration decisions.[8] Finally, we propose mechanisms for how shocks could have a positive or negative effect on the decision to migrate and empirically investigate these mechanisms. Our empirical findings provide evidence in support of the proposed mechanisms.

The rest of the paper is organized as follows. Section 2 discusses the data, provides an overview of migration and shock experiences of households and outlines the empirical specification that we use for our analysis. Section 3 reports the findings of our empirical analysis, outlines a theoretical structure to explain the mechanisms driving the findings and empirically investigates the mechanisms. Section 4 provides a brief conclusion.

2 Data and Empirical Specification

We use four waves of the Life in Kyrgyzstan (LIK) survey, a panel data collected annually between 2010 and 2013. The survey was conducted in roughly 120 communities across the country and covers all provinces of Kyrgyzstan. We study the effects of weather and other natural shocks on a housheolds decision to have a migrant member how this relationship is affected by the availability of informal finance. Weather shocks and informal finance are more likely to be relevant factors in the livelihoods of rural households predominantly employed in agriculture and related activities. Hence, we restrict our analysis to households that reside in villages. To do so, we follow Chakraborty et al. (2015) and use a variable in the data that provides information on whether a household resides in a city or village. The data consists of about 3000 households, of which about 59% reside in villages.

[7] While Morten (2019) considers income shocks, she does so only in the context of internal migration.

[8] While Halliday (2006) uses three waves of household data from El Salvador, he does not address household level unobserved heterogeneity.

We consider the decision to migrate as a joint household decision. Accordingly, our outcome variable is the migrant status of a household in a specific year. We construct this variable from the survey question that asks each household whether any of the household members lived in another country for more than one month (excluding business trips, vacations, and visits) during the last 12 months.[9] The migrant status is an indicator variable that takes on a value of 1 for households that have at least one member who lived in another country for more than one month during the last 12 months, 0 otherwise. Table 1 provides the number of migrant and non-migrant households that reside in villages in each of the four years of the survey. The last column of the Table indicates that the fraction of households with migrants has gradually increased from 15% to 21% to between 2010 and 2013.

Table 1: Migrant and Non-Migrant Households

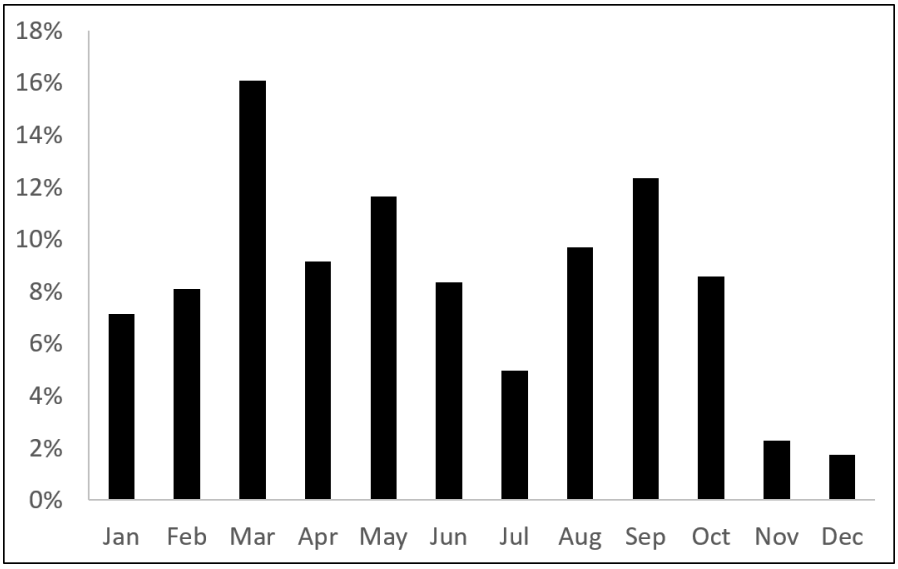
year	Non-migrant	Migrant	Fraction Migrant
2010	1513	271	0.152
2011	1446	320	0.181
2012	1438	341	0.192
2013	1329	357	0.212

Notes: Households residing in villages used in the analysis. Non-migrant refers to households who do not have any migrants in the reference period. Migrant refers to households with at least one migrant in the reference period. Fraction Migrant is the fraction of migrant-households in the reference period.

The data also provides information on the month in which a migrant leaves home to go to another country. In Figure 1 we use this information to plot the percentage of migration in each month in 2010 . The figure indicates that while migrants leave all year round, the highest percentage of migration is around the month of March (Spring) and September (Fall). In comparison, migration is very low in winter between November and February. This pattern of migration is similar for other years in the data.

[9]Based on the information available in the LiK data, more than 90% of the migrants from Kyrgyzstan go to Russia. While there were some requirements for workers to register in Russia, there was free mobility of workers between Central Asian countries and Russia over the period of our analysis.

Figure 1: Migration by Month: year 2010



While the information on migration status, in any year, is the primary outcome of interest, we also examine the dynamic nature of temporary migration decisions. To do so we construct a dynamic migration status of a household over every two consecutive years. This variable, summarized in Table 2, indicates four types of dynamic migration status of households. First, if a household was a non-migrant [migrant status=0] in the previous year and continues to be a non migrant in the current year it is indicated as (0,0) in column 1. Thus in 2011, 2012 and 2013, roughly 76%, 74% and 70%, respectively, of the households did not have a migrant and also did not have one in 2010, 2011 and 2012, respectively. Second, if a household was a non-migrant in the previous year but decides to send a migrant [migrant status=1] member in current year it is indicated by (0 to 1) in column 2. In 2011, roughly 9% of the households sent a migrant - i.e. had a migrant member in 2011 but did not have one in 2010. Third, if a household had a migrant in the previous year but recalls the migrant in the current year it is indicated by (1 to 0) in column 3. Thus in 2011, roughly 6% of the households recalled the migrant, i.e. switched to being a non-migrant household from a migrant household in 2010. Finally, if a household had a migrant in the previous year and continues to have a migrant in

the current year it is indicated as (1 to 1) in column 4. In 2011, roughly 9% of the households continued to have a migrant member from 2010. Importantly for us, there are households of all types in the data and there are substantial changes in the migration status of households over the period of our analysis. We also find that almost all of the international migration from Kyrgyzstan is temporary in nature: there are only 3% of households that have a migrant status of 1 in all four years of the data. We use these migration patterns of households in our analysis to determine the mechanisms through which shocks affect the migration decision.

Table 2: Patterns of Migration

	(1)	(2)	(3)	(4)
year	0 to 0	0 to 1	1 to 0	1 to 1
2011	0.761	0.088	0.058	0.093
2012	0.736	0.083	0.071	0.110
2013	0.699	0.107	0.090	0.105

Notes: 1 indicates migrant household; 0 indicates non-migrant household. The columns provide fraction of households that are in the four types of switches. 0 to 1 indicates households that switch from being a non-migrant in the previous year to being migrant in the current year; other switches indicated accordingly.

Our main explanatory variable of interest is the household exposure to shocks in a specific year. The survey asks each member of the household whether he/she experienced any of the listed shocks during the year preceding the day of the survey. We create a binary variable for each shock that takes a value of 1 if any member of the household indicates that they received the shock, and 0 otherwise. While the survey lists a number of shocks, for our analysis we use all the shocks in the list that are caused by nature - drought, excessive rain or flood and landslide, severe winter and frost, earthquake and pests.[10] The other shocks included in the survey are specific to a region or a household such as riots, deaths, illnesses etc., which, unlike weather shocks, are likely to be endogenous to a household's decisions. Hence we restrict our analysis to the effect of natural shocks on

[10]Given the high correlation between excessive rain and landslide and severe winter and frost, we combine these natural shocks into one shock. Of the households that reported landslide, 64% reported excessive rain; and of the households that reported frost, 75% reported severe winter.

a household's decision to migrate.

Table 3: Summary of Shocks (2010-2013)

Variable	Mean	SD	Min	Max
drought	0.232	0.422	0	1
rain&landslide	0.211	0.408	0	1
winter&frost	0.379	0.485	0	1
earthquake	0.162	0.368	0	1
pest	0.193	0.394	0	1

Table 3 provides a summary of the shocks. Given the geography of Kyrgyzstan all the five shocks are reported with high frequency.[11] Severe winter and frost is the most commonly reported shock while earthquake is the least reported. Table 4 provides the correlation between pairs of shocks for the year 2010. The low correlation between any pair of shocks suggests that the shocks are independent of each other.[12]

Table 4: Correlation between Shocks (year 2010)

	drought	rain& landslide	winter& frost	earthquake	pest
drought	1.00				
rain&landslide	0.00	1.00			
winter&frost	0.14	0.23	1.00		
earthquake	0.02	0.26	0.17	1.00	
pest	0.11	0.24	0.25	0.24	1.00

Following the literature on the socio-economic determinants of migration, in our analysis we control for household demographics, education and wealth. The demographic control variables we include are: total number of members in a household (*Household size*); gender composition of the household using the ratio of the number of male members in the household and the household size (*Male fraction*); age composition of the household using two variables: the fraction of members in the household older than 18 years of age (*Adult fraction*) and the fraction of household members older than 65 years of age (*Elderly*

[11] Kyrgyzstan is a landlocked Central Asian country with the Tien Shan mountain range and its valleys and basins comprising most of the country (https://www.cia.gov/library/publications/the-world-factbook/geos/kg.html).

[12] We find similar correlations between pairs of shocks for other years in the data.

fraction). To account for education as a determinant of migration, we construct a measure of education at the household level. We use the highest years of schooling achieved by any member within the household (*Education years*). For wealth of a household, we follow Chakraborty et al. (2015) and combine various asset indicators to create a wealth index using a principal component method that serves as a proxy for household income.[13] We then use the wealth index to construct and classify each household into wealth quintiles (*Wealth1-Wealth5*).

Table 5: Summary statistics (year 2010)

Variable	Non-migrant	Migrant
Household size	5.07	6.45
Male fraction	0.50	0.53
Adult fraction	0.65	0.72
Elderly fraction	0.07	0.03
Education years	13.35	14.50
Wealth 1	0.29	0.26
Wealth 2	0.24	0.31
Wealth 3	0.20	0.25
Wealth 4	0.16	0.12
Wealth 5	0.11	0.06

Notes: Adult fraction is the fraction of household members in the 18-65 age group; elderly fraction is the fraction of household members older than 65 years. In all regressions, fraction of children, those below 17 years of age, is the excluded category. Wealth1-wealth5 refers to quintiles of a wealth index created using principle component analysis from a range of asset indicators for a household.

Table 5 provides a summary of the data for migrant and non-migrant households for the year 2010.[14] Relative to non-migrant households, migrant households are larger in size, have more male and adult members but few elderly members and are more educated. In addition, migrant households are relatively poor - they are more likely to belong to the lower wealth quintiles (*wealth1-wealth3*) than higher quintiles.

[13]Specifically, we use a weighted average of whether the household own a house, car, refrigerator, gas-stove, microwave, washing machine, vacuum cleaner, television, computer, mobile-phone and livestock.

[14]We only present summary statistics for 2010 as household migration status changes across years. Summary statistics for migrant and non-migrant households for other years are similar to that for 2010.

2.1 Empirical Specification

We examine the relation between shocks and the decision to migrate by estimating variations of the following baseline empirical model:

$$hhmig_{i,t} = \beta_0 + \sum_{j=1}^{5} \gamma_j shock_{i,j,t-1} + X_{i,t-1}\beta + \phi_t + \eta_i + \epsilon_{i,t}, \quad (1)$$

where the dependent variable $hhmig$ represents migration status for household i in year t. It takes a value 1 for a migrant household; and a value 0 for a non-migrant household. We include each shock j separately as well as all five shocks together in the regression equations that we estimate.

As illustrated in Figure 1, while migrants leave all year round, the highest percentage of migration is around the month of March (Spring) and September (Fall) and the surveys rounds have typically been fielded between October and December. Thus when a household is surveyed in 2013, specifically between October 2013 and January 2014, the migrant would have most likely left the household between March-June 2013. This suggests that within a year shocks and migration could occur at the same time. To ensure that for a household our measure of the shock episode precedes the migration episode, we use one-period lagged values $(t-1)$ of shocks as explanatory variables.

Another significant identification challenge arises from the possibility of unobserved heterogeneity. We cannot be sure that the observed correlates of migration are not picking up the effects of other unobserved household characteristics. The longitudinal nature of our data enables us to address this issue by introducing household fixed effects (η_i). The household fixed effects exploit the changes in shock experiences, over the four waves, within the household and link them to observed migration decisions of the same household.

The one-period lagged values of control variables, $X_{i,t-1}$, included in the regression are household size, fraction of males, fraction of adults, fraction of elderly, years of education

and wealth quintile of households. We also include time fixed effects (ϕ_t) in all regressions equations.

3 Effect of Shocks on Migration

We begin by estimating a baseline specification in which we estimate the independent effect of each shock on the decision to migrate, that is, we estimate regression equation (1) separately for each shock without including any control variables. As discussed in Section 2, we consider the effect of natural shocks that are available in the data and therefore restrict our attention to households residing in villages.

Table 6: Migration and Shocks

	1	2	3	4	5	6
	b/se	b/se	b/se	b/se	b/se	b/se
drought$_{t-1}$	0.043***					0.048***
	(0.013)					(0.013)
rain&landslide$_{t-1}$		0.006				0.022
		(0.014)				(0.015)
winter&frost$_{t-1}$			-0.037***			-0.043***
			(0.013)			(0.013)
earthquake$_{t-1}$				-0.029*		-0.036**
				(0.016)		(0.016)
pest$_{t-1}$					0.012	0.007
					(0.015)	(0.015)
constant	0.180***	0.181***	0.195***	0.185***	0.180***	0.190***
	(0.006)	(0.007)	(0.008)	(0.006)	(0.007)	(0.009)
Observations	5211	5211	5211	5211	5211	5211
Households	1782	1782	1782	1782	1782	1782

Notes: Migration Decision is measured in period t. All independent variables are measured in period $t-1$. Standard errors are reported in parenthesis below the estimated coefficients. ***, **, * Significant at 0.01, 0.05, 0.10 level, respectively.

Table 6 presents the estimates for this baseline specification. In columns 1-5 an indicator for whether a household experienced each of the shocks in the previous year is introduced separately. Column 1 indicates that a drought in the previous year increases

migration for households residing in villages. On the other hand, negative coefficients in Columns 3 and 4 indicate that a household is less likely to have a migrant in the current year, if it experienced a severe winter, or earthquake, in the previous year. Excessive rain or floods (in Column 2) and pest infestation (Column 5) do not have a statistically significant effect on migration. In Column 6, we include all the shocks simultaneously and find that the estimated coefficients are similar to those in Columns 1-5. In adidtion to the low correlation observed between these shocks in Table 4, this further indicates that the occurrence of each of these shocks are independent of each other.

The estimates presented in Table 7 control for household characteristics that are established determinants of migration. We find that larger households and households that have a higher fraction of individuals in the employable age groups, 18-65, are more likely to have migrant members. On the other hand, a greater fraction of elderly, after controlling for the fraction of adults, reduces the likelihood of migration. Adults in a household are possibly deterred from migrating when there is a need to provide elderly care at home, especially in the absence of state provided elderly care. We also see that education levels and migration are inversely related, possibly indicating that majority of the migration is of low skilled labor. Finally, households in the middle of the wealth distribution seem to be the ones migrating compared to the very poor or the very rich. The decision to migrate is likely to depend both on the potential to earn a higher income as well as the ability to cover the cost of migration. Very poor families might be restricted by their ability to bear the cost of migration. On the other hand, higher income of wealthier families might make migration less attractive for them. The signs of the estimated coefficients for the control variables are similar to those reported in previous studies (see, for example, Kaestner and Malamud, 2014).

The estimated coefficients for the shocks remain unaffected by the inclusion of controls, both when shocks enter the specification individually or when shocks are introduced in the regression simultaneously. This suggests that the shocks are very likely exogenous with

respect to household characteristics. Nevertheless, in all subsequent tables we estimate the full specification that includes all the household level control variables.

Table 7: Migration and Shocks with Controls

	1	2	3	4	5	6
	b/se	b/se	b/se	b/se	b/se	b/se
drought$_{t-1}$	0.045***					0.050***
	(0.013)					(0.013)
rain&landslide$_{t-1}$		0.008				0.023
		(0.014)				(0.015)
winter&frost$_{t-1}$			-0.032**			-0.038***
			(0.013)			(0.014)
earthquake$_{t-1}$				-0.029*		-0.036**
				(0.017)		(0.017)
pest$_{t-1}$					0.012	0.006
					(0.015)	(0.015)
size	0.045***	0.045***	0.045***	0.045***	0.045***	0.044***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
malefrac	0.100	0.094	0.101	0.095	0.096	0.095
	(0.081)	(0.082)	(0.082)	(0.082)	(0.082)	(0.081)
adultfrac	0.466***	0.470***	0.461***	0.467***	0.469***	0.456***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)
elderlyfrac	-0.153*	-0.161*	-0.152*	-0.155*	-0.159*	-0.145
	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.090)
education	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
wealth2	-0.034**	-0.032**	-0.033**	-0.033**	-0.033**	-0.033**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
wealth3	-0.022	-0.019	-0.019	-0.019	-0.019	-0.020
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
wealth4	-0.032	-0.027	-0.025	-0.028	-0.026	-0.030
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
wealth5	-0.003	0.003	0.003	0.002	0.004	-0.002
	(0.029)	(0.029)	(0.028)	(0.029)	(0.029)	(0.029)
constant	-0.380***	-0.381***	-0.367***	-0.375***	-0.383***	-0.361***
	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.086)
Observations	5052	5052	5052	5052	5052	5052
Households	1781	1781	1781	1781	1781	1781

Notes: Migration Decision is measured in period t. All independent variables are measured in period $t-1$. Standard errors are reported in parenthesis below the estimated coefficients. ***, **, * Significant at 0.01, 0.05, 0.10 level, respectively.

Our empirical findings indicate that there are significant differences in the effect of

shocks on a household's migration decision. While a drought shock increases the probability of a household to have a migrant, winter and earthquake shocks reduce the probability of a household to have a migrant. To understand why some shocks might increase migration while others reduce migration, in the next section we develop a simple framework to illustrate potential underlying mechanisms.

3.1 Decision to Migrate and Shocks: Underlying Mechanisms

We use a simple theoretical set-up to explore possible explanations for our empirical findings. We start by assuming a joint utility maximization framework where the household faces the decision to send a member of the household for work abroad. In any period, the decision of a household to have a migrant member can be written as follows:

$$Migrate = \begin{cases} 1 & \text{if joint household utility from migration is} \geq \text{cost incurred from migration} \\ 0 & otherwise \end{cases}$$

To arrive at the migration decision, the household implicitly maximizes the net household utility from migration of a member. We assume that the utility from migration depends on the foreign country income earned by the migrant, the home country income foregone and the costs associated with the process of migration. Specifically, the net utility from migration is given by:

$$U(y^f - I(e, y^h)), \tag{2}$$

where y^f is returns to migration net of direct migration costs. It is the income earned abroad by the migrant member(s) of the household less the the associated costs of travel that have to be borne to be able to migrate. The function I represents the opportunity cost of migration. It depends on the contributions that the migrant member would have made to the household had s/he not migrated. These contributions can be in two forms: 1)

potential income of the migrant member had he been employed in home country (y^h); and 2) services that the migrant member could have rendered at home had s/he not migrated (e). For instance, an adult member of the household is likely to not only contribute to the household in terms of earnings but also by providing labor services at home. The extent of benefit from such labor services, and hence the opportunity cost of losing them, is likely to depend on the need for such services at home. For example, when a household has elderly members, the adult members are likely to be the ones providing care. Hence, the migration decision of the adult member will depend on the availability or cost of care services at home.

While the decision to migrate follows from the latent utility function, the researcher only observes the migration outcome, which can be represented by the probability of migration as follows:

$$Pr(Migrate) = Pr[U(y^f - I(e, y^h)) > \phi], \tag{3}$$

where ϕ is the reservation utility derived from staying at home. The reservation utility could be thought of as the emotional well being from living close to family. Given this, the probability of migration can be derived from the distribution of net utility. Suppose the reservation utility (ϕ) follows a distribution function Φ. The probability of migration is then given by

$$\Pi = \Phi(U(y^f - I(e, y^h)) > \phi) \tag{4}$$

We assume a standard utility function, concave in benefits. Hence, $U' > 0$ and $U'' < 0$. In addition, we assume a cost function that is increasing with the opportunity cost of migration. Thus $I'(e) > 0$ and $I'(y_h) > 0$. This means that the implicit cost of migration increases with the forgone home-country income, and with the need for adult labor at home.

We use this probability function to examine the effect of shocks, through changes in relative income and costs, on the migration decision. In Section 3.1.1 we discuss the comparative static effect of shocks on the net utility derived from migration.

3.1.1 Migration Response to Shocks

In rural Kyrgystan, most households raise livestock or engage in growing crops as their main source of income. Depending on their severity, natural shocks are likely to affect agricultural activities adversely, and reduce domestic income of households in rural areas. Moreover, since these shocks are aggregate in nature, they are likely to reduce household income for both migrant and non-migrant households, engaged in agricultural activities. Members of the non-migrant households affected by these adverse shocks could choose to temporarily migrate in order to insure themselves against the income reductions. On the other hand, for households with existing migrant members, the loss of household income at home is likely to make the household more dependent on outside income, reducing the possibility of recalling the migrant member.

While natural shocks are likely to affect agricultural incomes adversely, they may also increase the need for labor in rural economies where formal markets are mostly absent for the labor services required by households. For instance, households in rural Kyrgyzstan have to arrange for fuel to keep themselves warm in winters since electric heating is rarely available. Thus shocks that increase labor requirements for the household could induce the household to recall migrant members from abroad.

Thus, depending on the nature of the shocks, households could be faced with an adverse income situation that is likely to increase migration or they could experience an adverse labor situation leading to a decrease in migration. The net effect on the migration decision depends on the relative strengths of these two effects.

$$\Pi_s = \frac{d\Pi}{ds} = \Phi' U' \left(-I'(y_h) \frac{dy^h}{ds} - I'(e) \frac{de}{ds} \right) \tag{5}$$

To determine the effect of a shock s on the decision to migrate, we differentiate (4) with respect to s. Equation (5) illustrates two effects on the decision to migrate. First, the adverse effect of a shock on domestic income is represented by $\frac{dy^h}{ds} < 0$. Since $I'(y_h) > 0$, migration becomes costlier with increasing domestic income, $-I'(y_h)\frac{dy^h}{ds} > 0$. With $\Phi' > 0$, $U' > 0$, a household faced with a shock that reduces domestic income is more likely to have a migrant member.

Second, the effect of a shock that increases the need for labor help within the household is represented by $\frac{de}{ds} > 0$. Since $I'(e) > 0$, the opportunity cost of migration due to forgone adult-labor help available at home, $-I'(e)\frac{de}{ds} < 0$. With $\Phi' > 0$, $U' > 0$, a household faced with a shock that increases the need for labor at home, is more likely to recall a migrant member or not send a member abroad.

The net effect of a shock on migration would depend on the relative strengths of the income-effect and the labor-effect resulting from a shock. If the negative income-effect dominates the labor-effect of a shock, a household experiencing that shock will benefit from migration. On the other hand, if the negative labor-effect dominates the income-effect of a shock, a household experiencing that shock is less likely to have a migrant member.

The baseline estimates in Table 7 suggest that drought increases migration. This implies that the negative income-effect of a drought shock prevails. An aggregate drought shock is likely to reduce income, either due to crop damage or due to a damaging effect on livestock. In the absence of alternate income-insurance mechanisms, migrant income is likely to serve as a coping strategy. Excessive rainfall is also likely to damage crops and affect agricultural income in a way similar to that of a drought shock. However, the estimate for the shock in Table 7 though positive, is not statistically significant.

In contrast to a drought shock, a severe winter shock reduces the probability of mi-

gration (Table 7). This indicates that the labor-effect prevails in case of a winter shock. In Kyrgyzstan, winters are generally cold and a bulk of agricultural work and livestock rearing activities take place in the warm months (Atamanov and Van den Berg, 2012). Hence, winter shocks are unlikely to affect agricultural income. On the other hand, a household's requirement for labor help from adult members is likely to go up in the winter months. This is particularly the case in rural areas of Kyrgystan where electric heating methods are rare, necessitating high labor requirement to arrange for heating using coal and wood. Migrant households, typically comprised of the elderly and child members, are likely to recall adult migrants for labor help when faced with a winter shock. Similarly, non-migrant households would be less likely to send adult members abroad when faced with a severe winter.

3.2 Access to Finance and Migration

It is implicit in the above discussion that migration is used by households as a means to buffer against shocks that reduce domestic income. This implies that the increase in migration in response to income-shocks is likely to be muted when the household has other options to insure itself from negative income effects.

Informal transfers between households is widely documented to be a common coping strategy in rural regions where formal financial markets are weak, or even absent (Fafchamps and Gubert, 2007). For the above theoretical set-up, this means that y^h may not decrease in response to shocks if the households receive informal transfers to cope with the shocks. In other words, $\frac{dy^h}{ds}$ could be non-negative or even positive if informal transfers outweigh the negative income effect of a shock, for a household. More generally, we would expect the migration response to adverse shocks to be less pronounced in the presence of informal transfers or informal borrowing arrangements. On the other hand, since monetary transfers are unlikely to compensate for the greater need for labor at home,

their availability is unlikely to matter for $\frac{de}{ds}$. We investigate this mechanism below.

In what follows, we empirically examine whether the migration decision of households in response to shocks depends on access to informal finance. We investigate this by estimating the following regression equation:

$$\begin{aligned} hhmig_{i,c,t} &= \alpha_0 + X_{i,t-1}\beta + \alpha_1 shock_{i,t-1} + \alpha_2 easyfin_{c,t-1} \\ &+\alpha_3 \left(easyfin_{c,t-1} * shock_{i,t-1}\right) + \phi_t + \eta_i + u_{i,t} \end{aligned}$$

where X is a vector of the control variables that we include for our analysis, $shock$ is a one of the natural shocks, $easyfin$ is a measure of the ease of access to informal finance for all households residing in community c and $easyfin * shock$ is the interaction variable between the shock and access to informal finance.

We define the availability of access to borrowing within a community as the fraction of households in a community which report that it is easy to borrow 2000 Soms, which is approximately 30 US dollars in 2017 ($easyfin$).[15] The range of the variable is between 0, no households in a community report having access to informal finance, to as high as 87.5% of households in a community reporting having access to informal finance.

Table 8 reports the findings from estimating equation (6) for each shock separately. In line with our findings in Table 7, drought or excess rain increases the likelihood of migration. However, the negative and significant estimates for the interaction term ($easyfin * shock$) in columns 1 and 2 suggests that a household's access to informal finance lowers the probability of having a member migrate when the household is faced with the a drought or rain shock. In other words, migration response to income-shocks, like drought and rain, is muted when the household is more likely to find help within the community. These findings suggest that for income shocks such as drought and rain, having access to informal finance reduces the need for a household to have a migrant to cope

[15] The LiK survey was undertaken for 120 geographical clusters which we define as communities.

Table 8: Migration, Informal Finance and Shocks

	1	2	3	4	5
	drought	rain&landslide	winter&frost	earthquake	pest
easyfin_{t-1}	0.108*	0.086	-0.009	0.113*	0.011
	(0.059)	(0.062)	(0.067)	(0.059)	(0.058)
shock_{t-1}	0.178***	0.114**	-0.053	0.171***	-0.013
	(0.042)	(0.051)	(0.041)	(0.049)	(0.048)
$\text{easyfin*shock}_{t-1}$	-0.332***	-0.247**	0.050	-0.474***	0.066
	(0.093)	(0.110)	(0.087)	(0.102)	(0.113)
constant	-0.418***	-0.417***	-0.364***	-0.438***	-0.388***
	(0.090)	(0.091)	(0.091)	(0.090)	(0.091)
Observations	5052	5052	5052	5052	5052
Households	1781	1781	1781	1781	1781

Notes: Migration Decision is measured in period t. All independent variables are measured in period $t-1$. All regressions include the same control variables as Table 7. Standard errors are reported in parenthesis below the estimated coefficients. ***, **, * Significant at 0.01, 0.05, 0.10 level, respectively.

with the adverse effects of the shock.

We find a similar effect for the earthquake shock. The findings in Table 7 suggested that earthquake reduces migration. However, here we find that earthquake itself increases migration but access to informal finance largely offsets the effect of the shock and reduces migration. This in effect turns the overall effect of earthquake on migration to negative.

On the other hand, for winter shocks the findings indicate that the migration response is not affected by the availability of informal finance. In Table 7 we found that migration is likely to go down when a household faces a winter shock. As discussed in Section 3.1 one possible explanation for this result is that a severe winter increases adult-labor requirement at home which leads the household to not have a migrant member or to recall an existing migrant member. Unlike shocks that reduce income of households, access to finance is unlikely to play any mitigating role in the face of shocks that increase domestic labor requirement.

3.3 Decision to Recall and Send a Migrant

The estimates reported in Tables 6 and 7 are based on switches in migration status for a household over time. We include household fixed effects to account for unobserved household level heterogeneity that remains constant over time. Effectively, we observe whether a household switches from non-migrant to migrant status, or from migrant to non-migrant status, compared to no change in status - a migrant family continues to be a migrant family or a non-migrant family continues to be a non-migrant family.

To evaluate the proposed mechanisms through which shocks affect migration, we go a step further and compare two households who have the same migration status at time t but one switches its status in the next period. The change in migration status of a household can be due to two distinct decisions made by a household in response to shocks: send a member abroad or recall a migrant member. When we observe that a household is likely to be a non-migrant than a migrant, we could infer two possible household decisions - (a) a non-migrant household is *less* likely to send a migrant or (b) a migrant household is more likely to recall a migrant. When we observe that a household is *more* likely to be a migrant than a non-migrant, we could infer two possible household decisions - (a) a non-migrant household is more likely to send a migrant or (b) a migrant household is less likely to recall a migrant.

Cross-sectional data does not allow researchers to distinguish between the decisions of a household to send versus recall a migrant member. The longitudinal nature of our data, and the prevalence of temporary migration in Kyrgyzstan, allows us to compare the shock-response across households with the same migration status in a base period. Specifically, we separately examine the decision of a household to recall a migrant member, that is, switch from being a migrant household to a non-migrant household or to send a member abroad, that is, switch from being a non-migrant household to a migrant household. For the former, we restrict our sample to households that had a migrant in the previous

period and either continue to have migrants in the current year or switch to being a non-migrant household. In other words, we compare two households who are both migrants in period t-1 and test whether a shock experienced in period t-1 leads them to decide to be a non-migrant household in period t. We estimate regression (1) using a sub-sample that contains migrant households in t-1, with the dependent variable taking a value of 1 if the household recalls the migrant member in period t and 0 when the household does not recall the migrant in period t. For the switch from a non-migrant to migrant household, we compare two households who are both non-migrants in period t-1 and test whether a shock in period t-1 leads them to have a migrant in period t. Using a sub-sample that contains non-migrant households in t-1, we estimate regression (1) with the dependent variable taking a value of 1 if the household switches to being a migrant household in period t.

Table 9: Shocks and decision to recall and send migrants

	Recall	Send
	b/se	b/se
drought_{t-1}	-0.066	0.053***
	(0.054)	(0.014)
$\text{rain\&landslide}_{t-1}$	-0.101**	0.025*
	(0.045)	(0.014)
$\text{winter\&frost}_{t-1}$	0.146**	-0.004
	(0.067)	(0.013)
earthquake_{t-1}	0.016	-0.008
	(0.062)	(0.015)
pest_{t-1}	-0.023	-0.006
	(0.052)	(0.015)
constant	1.319***	-0.164**
	(0.325)	(0.077)
Observations	892	4160
Households	524	1668

Notes: Migration Decision is measured in period t. All independent variables are measured in period $t-1$. Both regressions include the same control variables as Table 7. Standard errors are reported in parenthesis below the estimated coefficients. ***, **, * Significant at 0.01, 0.05, 0.10 level, respectively.

The findings for the analysis of a household's decisions to recall or to send a migrant member are reported in Table 9. The results suggest that a rain shock both increases

the probability of sending a member abroad and reduces the probability of recalling an existing migrant member. Drought too increases the probability of sending a member abroad and reduces the probability of recalling an existing migrant member, although the latter coefficient is not statistically significant. In contrast, a winter shock increases the probability of recalling an existing migrant member but has no effect on sending decisions of a household. The findings for these effects of the shocks are aligned with our findings in Table 7.

Overall, Table 9 highlights that there are significant differences in the way different shocks affect the decision of a household to send or recall a migrant. A shock for which the loss of income effect dominates, drought shock, affects the decision to send a migrant more than the decision to recall a migrant. However, a shock for which the need for labor service dominates, winter, affects the decision to recall a migrant but not send a migrant. These finds provide support for our proposed mechanisms through which shocks affect the decision to migrate.

4 Conclusion

Using panel data for households residing in rural Kyrgyzstan, we investigate the role of temporary international migration as a risk mitigation strategy. We ask whether the decision to migrate depends on the shock experiences of a household. We use a household fixed effects model to account for unobserved correlates of a household's shock experiences and its decision to have a member migrate. In line with the previous literature, we find that shocks with adverse income effects increases migration, indicating that households might use temporary migration as a coping strategy. However, in addition, we find that severe winter and earthquake shocks reduce migration.

We argue that the effect of a shock on the decision to migrate depends on the shocks effect on household's income and labor situation. While a drought shock is likely to reduce

agricultural production and income, severe winters are less likely to affect agricultural income as agriculture is primarily done during the warmer months in Kyrgystan. Instead, severe winters increase labor requirement in rural Kyrgystan. To substantiate our claim that migration is used as a mitigation strategy in the face of negative income shocks, we explore whether the decision to migrate responds to shocks differently in the presence of alternate coping mechanism. We find that a household's migration response to negative income shocks falls when access to informal finance is easier, that is, when households find it easier to borrow. However, access to informal finance has no impact on a household's migration response to winter shocks. Our findings also suggest that while shocks for which the loss in income effect dominate have a greater effect on the decision to send a migrant, shocks for which the need for labor effect dominates affect the decision to recall a migrant. Overall, these findings provide evidence in favor of the proposed mechanisms through which shocks affect temporary migration.

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