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NATURAL SHOCKS AND MIGRATION DECISIONS: THE CASE OF KYRGYZSTAN

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NATURAL SHOCKS AND MIGRATION DECISIONS: THE CASE OF KYRGYZSTAN[2]

Previous research has shown that the effects of natural shocks on household migration decisions may go in different directions. This paper explores the impact of natural shocks (self-reported) on the migration of members of Kyrgyz rural households. Employing a panel dataset from the Life in Kyrgyzstan Survey (2010-2013) we show that out of five studied shocks only droughts and floods negatively affect migration, while other shocks (cold winters, earthquakes and landslides) on average do not lead to any statistically significant change in migration. However, available migration networks, household financial capacity and involvement in agriculture are sources of differential impacts. Exploring the means of migration funding, we find that both liquidity and borrowing constraints are important for the poorest households. Help from friends and relatives for financing migration, if it comes, is sourced to rich households.

Key words: labour migration, migration decision, Kyrgyzstan, natural disasters, financial constraints

JEL Classification: Z.

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Introduction

Households may face different external shocks (natural, technogenic, anthropogenic, etc.) affecting them through diverse mechanisms: reduced incomes, destruction of assets, price changes, etc. Shocks may also have a different scope: idiosyncratic - affecting single households - or aggregate - affecting the community as a whole. In developed countries, households are able to prevent or overcome the adverse consequences of shocks through systems of social support, credit and insurance markets.

Options for households in developing countries, where such systems are not or only partly available, are different. Moreover, the less households invest in technology, the more they become dependent on uncontrolled external factors (such as the temperature, precipitation, livestock epidemics). Households still can choose between a number of ex-ante and ex-post coping strategies: consuming part of their assets or savings, formal and informal borrowing and transfers, reducing investments and the redistribution of labour. The literature also distinguishes between individual and cooperative strategies; it is a question of interest whether households help each other when a shock arrives [Fafchamps, Udry, Czukas 1998; Kazianga, Udry 2006; Fafchamps, Lund 2003].

The migration of household members is one of several ways to cope with risk. The new economics of labour migration (NELM) [Stark, Bloom 1985] suggest that a household might send migrants to insure against income shocks while facing insurance and borrowing constraints. The NELM literature mostly describes permanent migration and looks at remittance flows to support the theory. In the modern world, international migration shifts from permanent to temporary and circular forms. Hence, migration can also work as an ex-post coping strategy when economic conditions at home have deteriorated due to a shock. Migration can also be viewed as a cooperative strategy if other households provide help for financing migration.

However, migration is costly, and it may not be feasible for affected households if their assets have been damaged. For an aggregate shock, borrowing funds to finance migration may also become impossible. Finally, in some cases, migration may become a less attractive option if there is a need to use labour at home. Thus, the effect of a natural shock on migration participation is an empirical question and is the result of an interplay of multiple mechanisms.

This paper explores the effects of natural shocks on migration in the Kyrgyz Republic, where households face income fluctuations due to natural factors. Using Life in Kyrgyzstan panel data[3] (waves 2010-2013), we investigate if there are any effects of natural disasters, such as droughts, floods, cold winters, landslides and earthquakes, on migration participation by Kyrgyz rural household members. We use self-reported shocks aggregated at the community level[4] as shock measures and find either negative or insignificant effects of the shocks on migration participation. Further, we try to uncover the mechanisms through which natural shocks affect households. To explore these mechanisms we add to the regressions interactions of shocks with household and community characteristics which reflect household wealth, involvement in agriculture and the availability of migration networks.

We find little evidence that households more involved in agriculture (and possibly suffering more losses from climate variation) send more migrants in response to shocks. Changing productivity in agriculture does not seem to be an important push factor for migration. Droughts seem to be the only exception. Migration networks are an important condition for rural residents responding to shock with more migration in response to non-climatic shocks: earthquakes and landslides. This might indicate that for climatic shocks households use migration as an ex-ante strategy, while for less anticipated events they use migration ex-post if they are part of a migration network. Finally, we find evidence for financial constraints which restrain households from using migration as a coping strategy. While migration reduces for the poorest it increases for the wealthier.

To explore whether financial constraints are constraints of liquidity or borrowing (or both), we inspect migration participation by source of funding. We find that both types of constraints are active. More interestingly, not only are constraints of liquidity less binding for wealthier households but also borrowing constraints as rich households tend to increase migration financed by friends and relatives in response to shocks. This finding sheds light on how social networks operate in Kyrgyz society. Unlike their poorer counterparts, richer households have better developed connections which help them in case of trouble, suggesting some risk-sharing within their network.

This paper contributes to the growing literature on the impact of climate variability on international migration. Even though there are a large number of studies investigating how

[3] Brück, T., D. Esenaliev, A. Kroeger, A. Kudebayeva, B. Mirkasimov and S. Steiner (2014): "Household Survey Data for Research on Well-Being and Behavior in Central Asia". Journal of Comparative Economics, vol. 42, no. 3, pp. 819-35
[4] Communities in rural areas are the so-called population points, which were the primary sampling units of the survey

environmental events affect migration, our paper is one of few that compares the effects of several different natural shocks. This paper is also related to research on coping strategies of households as it questions whether migration is used as an ex-post coping strategy by Kyrgyz households. Finally, our results are in line with research on inter-household risk-sharing arrangements.

The rest of the paper is organized as follows: after a description of the current views on how natural shocks affect migration participation, our dataset is presented. This is followed by a discussion of the empirical strategy and a presentation of the statistical estimations. In the conclusion, we summarize our findings.

How natural shocks affect migration participation

In the face of climate change, research has been paying more attention to the possible effects of natural disasters on human migration. The most general results on effects of climatic factors on long-term migration using macro data can be found in [Beine, Parsons 2015] and its extensions [Beine, Parsons 2017] and [Gröschl, Steinwachs 2017]. These papers analyze panel data for bilateral migration flows between 226 origin and destination countries 1960-2000 [Özden et al. 2011]. They capture many short-term environmental factors with such events as droughts, earthquakes, extreme temperatures, and floods. The results suggest that disasters on average have little effect on long-term international migration, while considerably stimulating internal migration. Although the effects are not that straightforward: disasters do spur migration to bordering countries. The effect also depends on the country's level of development: for middle-income countries, a push effect can be found.

It is, therefore, not surprising that case studies of different countries and events report such diversity in their results. Examples can be found of positive, negative or no effect of natural shocks on internal and international migration[5]. These results depend on the country context, nature, the strength and abruptness of the shock as well as the on duration and directions of the migration streams which are studied. Micro-level research provides more flexibility in defining migration type (both in terms of duration and destination) and enables researchers to explore the variability of the effects of shocks arising from variation in household characteristics such as income and wealth, pre-shock economic activities and access to migration networks.

[5] Detailed reviews of recent evidence can be found in Mbaye and Zimmermann (2015), Belasen and Polachek (2013) and Berlemann and Steinhardt (2017).

Natural shocks have diverse effects on households. A shock can alter incentives for labour migration through changing income at home. This may happen through local labour market wages, employment opportunities and through productivity in domestic production (as a result of destroyed capital or a change in labour efficiency). A shock can also push up costs of living by increasing prices and damaging the infrastructure. Massive damage due to a shock may put a household in need of investment to recover from the losses, and migration could provide funds for such investments. Finally, migration may become less feasible due to loss of income and assets or the borrowing opportunities needed to finance migration.

The literature reports that negative shocks of a different nature may have the opposite impact on the migration decision even within the same community as they awaken different mechanisms. Halliday (2006) shows that the loss of livestock and harvests had a positive effect on migration participation and remittance receipts by households in El Salvador, while an earthquake had a negative effect on migration. The author explains the observed negative effect of the earthquake on migration by the "preference to retain labor at home". As a result of the shock, the marginal productivity of labour from domestic production changed, making migration relatively less profitable [Halliday 2006, Halliday 2008]. Another possible mechanism is the need to ensure a minimum level of yield, which requires large labour resources in case of negative productivity shocks [Halliday 2012]. Exploring the same case of the earthquake in El Salvador, Yang [2008] attributes the negative effect to financial constraints which arise if a shock strikes the whole community and does not arise if a single household if affected. Households are unable to get support for financing migration when the whole network experiences a shock. Thus, Yang makes a distinction between the effects from idiosyncratic and aggregate shocks.

Another possible distinction can be made between anticipated and unanticipated natural disasters. For anticipated disasters, a migration strategy could have been used ex-ante to insure against possible losses. It has been shown that variability in natural conditions is an important migration push factor [Dillon et al. 2011; Bohra-Mishra et al. 2014]. In the case of unanticipated shocks, the immediate migration response could be much more intensive.

The context of Kyrgyzstan

Economic situation

Kyrgyzstan is a predominantly mountainous country in Central Asia with considerable variation in climatic and socio-demographic conditions across the country. Its population is growing by 1-2% each year and reached 6.3 million in 2018. The two large regions are the mountainous and more economically developed northern region and the flat, more populous and poorer southern

region. According to the World Bank classification, before 2013 Kyrgyzstan was located in the low-income group of countries and in the lower-middle-income economy group. Specifically, the GNP of Kyrgyzstan grew from $860 in 2009 to $1,220 in 2013[6]; the level of unemployment was just above 8%; the average per capita consumption per day in 2009 was $5.6 at 2011 PPP; and the poverty level according to the national poverty line was 31-38% (37-41% for the rural population) 2009-2013.

The agricultural sector plays significant role in the Kyrgyz economy (21% and 17% of GDP in 2009 and 2013, respectively), with almost equal contributions from cattle production and farming. About 30% of the employment is agricultural while about 65% of population live in rural areas. Arable lands occupy 7% of the country's territory, of which 85% are pastures. Crop production, which was less important than cattle production in the Soviet period, became one of the main sources of economic growth from 1994 to the early 2000s. This included both the enhancement of Kyrgyzstan's own food production and the fodder base for livestock. In contrast to the Soviet period, when Kyrgyzstan was the main producer of wool, at present, the breeding of dairy cows and horses predominates. A large number of households in the country maintain a small number of livestock.

As a result of the reforms enacted in the 1990s, 90% of agricultural land is privately owned. About 85% of all farms are small farms up to 1 hectare, while the largest share of cultivated land (40%) is occupied by farms from 1 to 10 hectares. Having their own agricultural production allows many households to survive, but it is not always effective and is more exposed to natural risks. Smaller farms use fewer fertilizers, less crop rotation and costly irrigation systems (irrigation farming occupies 75% of the land used) [Light 2007].

Migration

From the beginning of 2000s, the Kyrgyz population has become more and more involved in labour migration: the share of migrant remittances in GDP rose from 20% in 2009 to 31% in 2013. According to estimates released by Kyrgyz authorities, from 2010 to 2014, 5-10% of the economically active population left the country yearly [IOM 2016]. For 2014 they estimate that 650-700,000 Kyrgyz citizens are working abroad during the year. The main destinations for Kyrgyz migrant workers are Russia (about 80% of migrants abroad) and Kazakhstan (about 10%). Migration strategies vary among Kyrgyz citizens working abroad. According to a survey

[6] Here and hereafter: data from World Bank development indicators are available from http://databank.worldbank.org/data/

by the Kyrgyz National Institute of Strategic Studies in 2013, cited in [FIDH 2016], "two-thirds of migrants work all year and one-third are seasonal". Most Kyrgyz migrants come from the southern parts of Kyrgyzstan: Batken province (35% of migrants abroad as of 2014), Djalal-Abad province (28%), Osh (22%) [FIDH 2016]. Women play an important role in migration; according to some estimates they make up 53% of the migrant workers abroad [IOM 2012].

Migrants themselves indicate that migration is a strategy to support their families and improve material conditions [Schmidt, Sagynbekova 2008]. Although this strategy, being costly, might be not feasible for the poorest part of the population. Evidence suggesting that migration increases with area of land owned could be an indication of financial constraints to migration for the poorest households in rural areas [Atamanov, van den Berg 2012].

Natural disasters

The mountainous territory of Kyrgyzstan is subject to various natural shocks, such as landslides, rock falls, mudflows, floods, avalanches, earthquakes. All of them cause significant material damage to the country's economy. Different types of shocks can come together: for example, excessively heavy rainfall and earthquakes can cause landslides, which, in turn, can cause flooding. The territory of Kyrgyzstan is heterogeneous in climate and landscape, so different regions suffer from different types of disasters.

Annually, Kyrgyzstan experiences over 300 earthquakes [World Bank 2015]. As estimated by the World Bank [2017], about 200,000 people are affected annually by earthquakes, the annual affected GDP on average is $200 million (in 2015 US dollars), the annual average number of fatalities is about 200 and capital losses caused by earthquakes are about $100 million. About 66% of the population live in housing which is highly vulnerable to strong earthquakes [World Bank 2015]. Exceptionally strong earthquakes may cause considerable sudden damage. For example, the magnitude 6.6 Nura earthquake completely destroyed the Nura settlement and caused 74 deaths. Houses built of clay and straw were completely destroyed (152 constructions), whereas panel wooden houses were only slightly damaged [Kalmetieva et al. 2009].

According to [Kalmetieva et al. 2009], the southern regions of the country are especially vulnerable to rockfalls, landslides and mudflows (Osh, Jalal-Abad and Batken provinces). The authors claim that "there are more than 5,000 active landslides covering the territory of the Kyrgyz Tien-Shan. If ancient and stabilized rockfall-landslide blocks are taken into account, their number is even higher. These are large-scale landslides and rockfalls, which take place rarely, but their consequences are disastrous". Landslides may be extremely dangerous: the deadliest landslide of 1988-2007 caused 238 deaths [World Bank 2015].

The Talas, Naryn and Osh provinces suffer from floods more than other provinces. The World Bank [2017] provides estimates that on average 80,000 people annually are affected by flooding, while the GDP loss is on average about $70 million (in 2015 US dollars).

The interannual variation in temperature and precipitation in Kyrgyzstan is high [Mirzabaev 2013]. Extreme weather conditions (droughts, extreme temperatures) are a serious threat to the welfare of households. A significant part of farm produce is consumed by the households themselves, so a decrease in yield and fodder base for livestock can directly affects consumption levels. Weather shocks also affect food prices [Mirzabaev, Tsegai 2012]. Finally, droughts raise the cost of electricity, as about 90% of power in the country is provided by hydroelectric power plants.

Data description

To study the migration behavior of Kyrgyz households, we use the data from the Life in Kyrgyzstan Survey (LIK) collected by the German Institute for Economic Research in cooperation with Humboldt University of Berlin, the Center for Social and Economic Research (CASE-Kyrgyzstan) and the American University of Central Asia. The dataset derives from a panel survey conducted annually on a representative sample of Kyrgyz households in 2010-2013. The survey is representative of the country, the rural and urban population, and the south/north regions. The questionnaires include settlement, household and individual levels. An unbalanced panel contains information on more than 1,000 urban and more than 1,500 rural households. As we control for pre-shock household characteristics, we are left with a sample of about 16,000 observations for rural working-age individuals.

There is a certain difficulty to determine a household in the panel dataset. A household is a dynamic structure, family composition changes, children leave the parental home and create their own families. We choose to attribute to an individual the characteristics of the person's current household (or previous period's characteristics of the current household). Thus, we assume that household members make their decisions based on their current household characteristics.

Descriptive statistics

Our main variable of interest is individual migration. We define several versions of this variable. We consider international migration, internal migration and any migration that combines the two. These indicators are created from questions on absent household members and relocation experiences during the previous 12 months for members present in the household. We consider only those individuals who have left the household for work purposes to be migrants. Individuals

who are or were absent from the household for other reasons are excluded from the analysis and their households are considered non-migrant households.

For a subsample of migrants now abroad (this group comprises about 75% of all migrants), a survey question queries their sources of funding for going abroad[7]. We can distinguish three groups of sources: the household's own funds (the sale of a house, the sale of land, the sale of other assets, savings), help or an informal loan from friends and relatives (assistance from family members abroad, assistance from family members in Kyrgyzstan, loan from relatives, loan from friends), and formal loans (loan from banks, financial institutions or moneylenders).

Table 1 presents migration participation by individuals in Kyrgyzstan for 2010-2013. During this time, international migration is much more common than internal. Nearly every 10^{th} rural resident from 17 to 65 has worked abroad in the previous 12 months. These are low-bound estimates of migration from the Kyrgyz Republic as they do not capture the migration of whole families. The most common source of funding is one's own funds which is used by 56% of migrants. Help from friends and relatives is less common (39% of migrants). Formal loans are the least popular source.

[Table 1]

Several groups of factors can be expected to affect individual migration decisions. These are individual, household and community characteristics. At the individual level we control for the individual's age, educational attainment, gender, marital status, ethnicity and relation to the household head. Further, we consider household demographic characteristics: the size and age-gender structure as well as the age and education of the household head. It is also important to account for a wide range of characteristics of pre-shock wealth and economic activities: household per capita income[8] and income composition, household per capita consumption and the share of consumption that is home-produced, asset index[9], land owned, land cultivated, and the market value of livestock owned. Finally, the community level is also important. Apart from location and community size, we need to proxy the migration networks available for community members. To do this, we account for the pre-shock share of migrant households in the

[7] The question has been asked about the two oldest absent migrants.
[8] All per capita variables are adjusted according to the OECD equivalence scale.
[9] The asset index has been constructed using principle component analysis and includes the following household dwelling characteristics and assets: number of living rooms per household member, type of drinking water source, type of floor material, type of walls material, type of roof material, another house/apartment, garage, motocycle, car, refrigerator, gas stove, microwave air conditioner, washing machine, vacuum cleaner, sofa, bed, kitchen furniture, complete music system, video/DVD player, video camera, photo camera, personal computer/laptop, satellite dish, mobile phone, internet connection.

community. We also account for the major economic activity in the community and the major agricultural activity of its inhabitants.

Table 2 compares characteristics of migrant and non-migrant households in the pooled sample. The average migrant is 28 years old, 67% of them are men, and majority are of Kyrgyz and Uzbek ethnicities. Migrant households are larger, with a higher share of women and a lower share of children. Migrant households own and cultivate smaller land parcels but they own more livestock. They also have a lower share of income from the local labour market. There are no statistically significant differences between migrants and non-migrants in terms of household income and consumption, but migrants do have a lower asset index. Generally, migrants originate from larger settlements in the southern and western areas of Kyrgyzstan, with a higher share of households participating in migration.

[Table 2]

The shock variables

One of serious methodological complications in the analysis of the effects of natural shocks on household behavior is the choice of reliable shock measures. In this paper we use a subjective measure – the self-reported experience of being affected by a shock – aggregated at the community level. Subjective measures have been frequently used in literature [Udry 1994a, 1994b; Halliday 2008; Gray and Mueller 2012].

Using a subjective shock measure is useful for the level of disaggregation and the ability to easily control for several shocks at a time, which is important because some of the shocks might be correlated (e.g. floods and landslides or earthquake and landslides). The main disadvantage, however, is a non-random measurement error which varies with the exposure and vulnerability of the respondent to climatic shocks and many other personal characteristics (like age, educational attainment, psychological traits and other). This problem can be partly eliminated by properly conditioning on observed variables which explain climatic factor dependence (such as wealth and type of economic activities) and accounting for unobserved time-invariant heterogeneity.

Five different shocks are considered in our paper: drought; too much rain, or flooding; very cold winters; earthquakes; and landslides. The question used to measure the self-reported experience of being affected by a shock is formulated as follows:

"Now I would like to ask about shocks your household as a whole or any member faced in the last 12 months. During the last 12 months, has your household been affected by the following shocks?"

In 2012 and 2013, households could answer "yes" or "no". In 2011, households could indicate "yes, a little" or "yes, a lot" or "no". To provide consistency between survey rounds we aggregate the first two 2011 answers.

Table 3 presents the proportions of rural households that experienced shocks among all households, migrant households and non-migrant households. There is considerable variation between the surveyed years. In all years except 2013, there are statistically significant differences in the responses of migrant and non-migrant households, although the sign (positive or negative) of difference varies. The strong unconditional correlation between shocks and migration status could have stemmed from systematic differences in shock exposure and applying migration as an ex-ante coping strategy. This does not seem to be the case in our data.

[Table 3]

One possible check of the adequacy of shock question is the consistency between the answers of residents of the same community, as natural shocks usually strike the whole community. Figure 1 shows there is a large share of communities where no one reports experiencing specific shocks. The remaining densities are concentrated below 20% and above 80%. Thus, there is very strong correlation between the individual answers and the community-level measures.

[Figure 1]

Self-reported indicators are subject to measurement errors that might not be random. Thus, we might suspect that various household characteristics (e.g. economic activities, productivity, wealth, etc.) affect the participants' responses to this question.

The reported shock experience may not represent the strength of the shock objectively but rather the extent of exposure to the shock (the extent to which household members, assets and economic activities are situated in the area that could be affected by the shock) and the extent of vulnerability to the shock (the propensity of exposed elements to suffer adverse effects when impacted by hazard events [Cardona et al. 2012]). Both exposure and vulnerability could be managed by various ex-ante strategies, for example, by relocating the household (or a part of the household) to less risky territories (or territories with uncorrelated risks), diversifying economic activities, investing in risk-mitigating production technologies. Therefore, we want to examine the extent to which observable household characteristics can predict a reported shock experience.

Unfortunately, we cannot investigate how time-variable unobserved characteristics affect the reported shocks, but if we do not find any correlation with observable characteristics it is more likely that such unobservable characteristics do not exist.

Reported shocks aggregated at the community level are often said to reduce the endogeneity problem. Still, community-level measures are not free from such concerns either, for several reasons: (1) Some of the risk-mitigating investments may be undertaken at the community level; (2) households with similar characteristics may self-select into the same community; and (3) there might exist a number of community-level characteristics that directly affect the extent to which a community would suffer from a natural disaster, for instance, the level of trust and cooperation among residents or the quality of governance. Not all of these characteristics are time-invariant and are captured by fixed effects.

Table 4 shows how household characteristics predict the experience of a shock at the household and the community level. Notably, we do not see any considerable differences in the predictability of shocks reported by households and shocks aggregated at the community level. Very few of the household pre-shock economic characteristics (including migration) help to predict the experience of a shocks. Household head characteristics (age, education and ethnicity) do affect a shock experience in many cases (we observe that household heads have changed in a number of households). This might be a concern as the characteristics of household heads affect not only the reported shocks, which could have been a result of biased perceptions, but also the community-level shocks, which might indicate that the characteristics of household heads might be related to residing in a shock-exposed area.

[Table 4]

To explore the effects that natural shocks exert on migration and to uncover the underlying mechanisms, we need to understand the channels through which those shocks affect households.

We expect natural shocks to damage various aspects of household wellbeing: assets, productive technology and associated incomes from home production, labour market opportunities, prices and exchange rate. Therefore, a set of regressions were run with various household outcomes[10] as dependent variables and natural shocks among the explanatory variables. We detected few statistically significant effects. There is a negative effect of droughts and floods on income from household enterprises and a respective negative effect on total income. For earthquakes,

[10] All variables are measured in per capita terms adjusted for household size and age structure.

coefficients are negative as well, but not statistically significant. Money transfers from friends and relatives (both in Kyrgyzstan and abroad) respond significantly only to landslides. We find no statistically significant impact of shocks on household consumption. These results suggest that households are able to smooth their consumption even if income and its composition is affected by shocks.

[Table 5]

Econometric specification

To investigate the effects of natural shocks on individual migration decisions, we estimated several model specifications. There might be persistent unobserved heterogeneity on the individual or household and community levels. A migration decision is affected by many unobserved characteristics which could be considered constant in the short-term and common for members of a single household. These are motivation and aspirations, risk attitudes, and cognitive and non-cognitive skills. Not accounting for this unobserved heterogeneity biases estimation results. Thus, we condition on unobserved heterogeneity at the household level. We estimate the following equation:

$$Mig_{it} = \alpha + \lambda' Z_{it} + \sum_{s=1}^{S} \beta_s' X_{sht-1} + \gamma_k' shock_{kht} + \delta' shock_{kht} * X_{sht-1} + D_t + u_h + \varepsilon_{it} \quad (1)$$

Mig_{it} – the migration status of individual i in year t;

$shock_{kht}$ – the natural shock k experienced by household h in year t, k=1..K;

X_{sht-1} – household pre-shock characteristic, s = 1…S;

some specifications would also include an interaction term of a certain household characteristic X_{sht-1} and a natural shock $shock_{kht}$;

Z_{it} – individual characteristics;

D_t – year dummy, t = 1…T;

u_h – household effect;

ε_{it} – a random error such that $E[\varepsilon_{it} | u_h, x_{1i}, \ldots x_{1T}] = 0$.

Because our variables of interest are likely to have correlated effects at the community level, standard errors are clustered at the community level in all specifications.

To estimate model (1) we have to make an assumption about the individual effect, u_h. The assumption of a random effects model, that unobserved heterogeneity is not correlated with our variable of interest (self-reported shock), seems too strong (consider, for example, the risk attitudes of household members). The fixed effects model does not assume exogeneity, however, by employing a fixed effects model we should take care of heterogeneity, which is likely to be an issue in our case.

We estimate equation (1) as a linear probability model (LPM) using ordinary least squares (OLS). Although the LPM might be biased and inconsistent unlike nonlinear models like probit or logit (Horrace and Oaxaca 2006), it was chosen because unobserved heterogeneity is more serious in our case. A possible alternative – a logistic regression with fixed effects would lead to losing a considerable part of the sample. Another concern in using LPM are possible negative predicted probability values, however LPM is able to accurately predict the probability for the values of variables close to the sample mean (Wooldridge 2010)[11]. Finally, LPM is inherently heteroskedastic, so we use cluster robust standard errors in all our estimates.

Similar to many other labour market outcomes, we can suspect state dependence in an individual decision to migrate (being a migrant today increases the probability of being a migrant tomorrow). Even in the case of circular migration where migrants incur fixed costs of each migration (buying tickets, looking for a job and accommodation, etc.), the overall costs will go down with their migration experience due to accumulating information and destination-specific human and social capital. Thus, the model of the migration decision may contain a dynamic component. Moreover, as suggested by the NELM approach, family experience is relevant for making individual decisions.

Controlling for the migration experience (individual or family) of previous periods in a household fixed effects model would break the exogeneity assumption due to the correlation between past experience and unobserved household effects. To avoid this problem, we estimate model (2) that controls for unobserved heterogeneity at a higher – community – level[12]:

$$Mig_{it} = \alpha + \xi_i Mig_{it-1} + \xi_h Mig_{ht-1} + \lambda' Z_{it} + \sum_{s=1}^{S} \beta_s' X_{sht-1} + \gamma_k shock_{kht} + \delta' shock_{kht} * X_{sht-1} + D_t + u_c + \varepsilon_{it} \quad (2)$$

Mig_{it} – the migration status of individual i in year t;

[11] As a robustness check, the calculations were replicated with a logistic model that did not introduce considerable changes in the results

[12] We are not applying any method to solve the initial condition problem as our panel is too short.

Mig_{ht-1} – the household migration experience in period *t-1*;

$shock_{kht}$ – the natural shock *k* experienced by household *h* in year *t*, *k*=1..K;

X_{sht-1} – household pre-shock characteristics, $s = 1 \ldots S$;

some specifications would also include an interaction term of a certain household characteristic X_{sht-1} and a natural shock $shock_{kht}$;

Z_{it} – individual characteristics;

D_t – year dummy, $t = 1 \ldots T$;

u_c – community effect;

ε_{it} – random error such that $E[\varepsilon_{it} | u_c, x_{1i}, \ldots x_{1T}] = 0$.

Results

Effects of shocks

Let us first look at the overall effect of shocks on international and internal migration. Table 6 presents estimation results for the pooled OLS model and models (1) and (2). Overall, we see strong and robust negative effects of the first two shocks – droughts and floods – on international migration. For internal migration, there are no statistically significant effects.

We controlled for a wide range of individual, household and community characteristics in the regressions. For the determinants of the migration decision other than shocks, we note the negative correlation between migration and the size of cultivated land (which to some extent can illustrate that agriculture and migration are alternative livelihood strategies).

It is also significant how migration participation in the community affects the migration decision. Whereas more migration in a primary sampling unit (psu) correlates with a higher migration probability in the pooled OLS model, when variation in a separate community or household is concerned, more migration in a psu correlates with a lower migration probability for an individual. This probably illustrates a situation when "those who wanted to leave have already left" in high-migration communities.

[Table 6]

Mechanisms behind the effects

As discussed earlier, the observed effects of natural shocks on migration result from the simultaneous effect of various pushing and restricting mechanisms which can compensate for each other. To uncover the underlying mechanisms, we add multiple interactions of shocks with various household characteristics to the basic specification. By interacting shock with a measure of involvement in agriculture (size of cultivated land[13]), we test if being more exposed to a shock affecting agricultural productivity is a push-factor for migration. The financial constraint hypothesis is tested by interacting a shock with a measure of household welfare. Three different variables are applied: monetary income per capita, total consumption per capita and food consumption per capita. Each of these has a slightly different interpretation. Because liquid funds are needed to finance migration, monetary income seems to be a better measure to demonstrate liquidity constraint. Consumption and food consumption in particular seem to be more suitable characteristics to measure the quality of life for rural households with largely home-produced food and services. Finally, we interact a shock with a measure of the migration network – the pre-shock share of households participating in migration in a psu. This shows us whether a cost reduction with growing network size is an important push-factor for migration.

Let us discuss the results presented in Table 7. Migrants' networks are important for migration responses to earthquakes (see Panel D Table 7) and landslides (see Panel E Table 7). Communities with a high share of households participating in migration before the shock have a much stronger migration response to these shocks. We can hypothesize that networks are especially important for earthquakes and landslides because these shocks are more unpredictable, therefore households do not create migration networks to ensure against them in advance.

We expect that weather shocks, which affect agricultural productivity the most, would have stronger effects on households involved in agriculture. We find some evidence that the migration response to disasters depends on the extent households are involved in agriculture. The migration response to droughts – the shock that had the strongest negative effect on incomes from home production – is stronger for individuals whose households cultivate more land (see Panel A Table 7). There is also a significant interaction coefficient for cold winters (see Panel C Table 7). A relation between agricultural activities and migration response to shocks is not that strong. That is likely to be explained by ex-ante adjustments to climatic shocks which affect agricultural

[13] Other measures (share of income obtained from household agricultural enterprises in total income, livestock value, monetary value of income obtained from household agricultural enterprises) have been also checked but do not lead to any considerably different results

productivity the most. Climatic variation is known ex-ante and households adjust their production technology to known risks and also try to diversify income.

For excessive rain and floods we find some, although weak, evidence of financial constraints for the affected households (see Panel B Table 7). There are positive and slightly significant interactions between shocks and household monetary income per capita and food consumption per capita in the model with community fixed effects (there might be not enough between-year variation of income within a household for significance in the household fixed effects model). There is a positive interaction between cold winter shocks and per capita consumption (see Panel C Table 7). Finally, for landslides there is support for the financial constraint hypothesis as households with higher income respond to the shock with more migration (see Panel E Table 7). An alternative interpretation of these findings could be that richer households suffer more losses from such shocks, therefore, their response is stronger. Although, this interpretation is not supported by the results in Table 4 which showed that shock reports cannot be predicted by wealth indicators. We find no evidence of financial constraints for earthquakes and droughts.

The mechanisms beyond the observed average effect of each shock are quite different. While ex-ante adjustments may explain the variation in network and agriculture participation mechanisms, it is harder to explain how financial constraints operate. It remains puzzling why earthquakes and droughts do not give rise to financial constraints.

[Table 7]

Financial constraint hypothesis

To explore the mechanism of financial constraints in more detail, additional regressions were estimated. For a subsample of migrants who are now abroad, we have information about their source of migration funding. As discussed, we aggregated the sources of funding into three groups: own funds, financial help of friends and relatives, and formal credit. The third group was excluded from analysis because of the lack of observations. We estimate models (1) and (2) with the binary dependent variable equal to 1 if a certain source was used and 0 if individual stayed at home for the whole year (return migrants are excluded from the analysis).

We are interested in the following questions. (1) Are affected households able to replace one source of funding with another? A simultaneous decrease in the usage of one source and an increase in the other could be interpreted as an answer to this question. (2) Is it possible to find support for existing liquidity constraints? If households have a liquidity constraint, we expect to see a positive coefficient for the interaction between household welfare and a shock in the

regression for self-funded migration. (3) Do poor households receive more help to finance migration? Shock-affected poor households may be unable to finance migration from their own funds, so they are the ones in need of support. To explore this issue, we examined the coefficient of shock interaction with household welfare in the regressions of migration funded with the help of friends and relatives.

Table 8 presents the estimates of shock effects together with shock interactions with household welfare characteristics. Regarding question (1), on average we do not find that households replace one source of funding with another.

[Table 8]

Regarding question (2), we find that a self-financed migration response to shock varies with household wealth for droughts and landslides. We interpret this finding as an indication of a liquidity constraint facing households.

Migration financed through the help of friends and relatives increases with the level of household wealth in response to floods, cold winters and landslides. This might indicate that shock-affected poor households are restricted by borrowing constraints from participating in migration. Wealthier households may have better developed social networks that are ready to help them in case of trouble. They are also more attractive as borrowers as they may appear to be more likely to repay a loan.

Our finding is in line with the literature on risk-sharing networks. It is well-known that risk-sharing networks are formed endogenously with wealth being one important factor [De Weerdt 2002]. For Kyrgyzstan, it has been reported that social connections are segregated in terms of wealth and that "the networks of the poor are shrinking and becoming more homogeneous, networks of the non-poor are expanding and diversifying" [Kuehnast and Dudwick 2004]. There is less chance that a more diverse network would experience a universal shock, so rich households will have better borrowing opportunities. Moreover, as networks in Kyrgyzstan (as elsewhere) play an important role in migration participation, it is natural to assume that monetary help comes together with information that helps migrants to choose their destination and look for a job abroad.

Our exploration of sources for migration funding show that borrowing constraints rather than liquidity constraints underlie previously reported financial constraints. The question remains, however, as to why borrowing constraints do not arise in the case of earthquakes and droughts, unlike other shocks.

Conclusion

The literature reports that the effects of natural shocks on household migration decisions may go in different directions. A negative shock can be a push factor for migration when it suppresses economic incentives at home or creates a need to quickly recover damaged capital. A negative shock can also restrict migration as a result of liquidity or borrowing constraints that arise after the shock or if household has a preference to retain labour at home due to increased demand for workers in home production.

Our paper explored the impact of the experience of natural shocks (self-reported) on migration participation by rural Kyrgyz households. Employing a panel dataset from the Life in Kyrgyzstan Survey (2010-2013) we show that droughts and floods negatively affect migration, while other shocks (cold winters, earthquakes and landslides) on average do not lead to any statistically significant change in migration participation by the rural population in Kyrgyzstan. We also explored mechanisms behind individual reactions to shocks. We find that the migration response to shocks may depend on the availability of migration networks, household welfare and the involvement in agriculture. We also show that borrowing rather than liquidity constraints are mainly responsible for poor households being unable to use migration to cope with natural shocks ex-post. Help from friends and relatives to finance migration, if available, is sourced to wealthier households.

Our results demonstrate a unique set of mechanisms emerging as a result of each natural shock. This suggests that predicting possible migration outcomes of natural shocks is not an easy task. It is a matter of further research to determine what peculiarities of each shock make its effects so unique.

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Tables and figures

Figure 1. Share of households in the community experiencing shocks

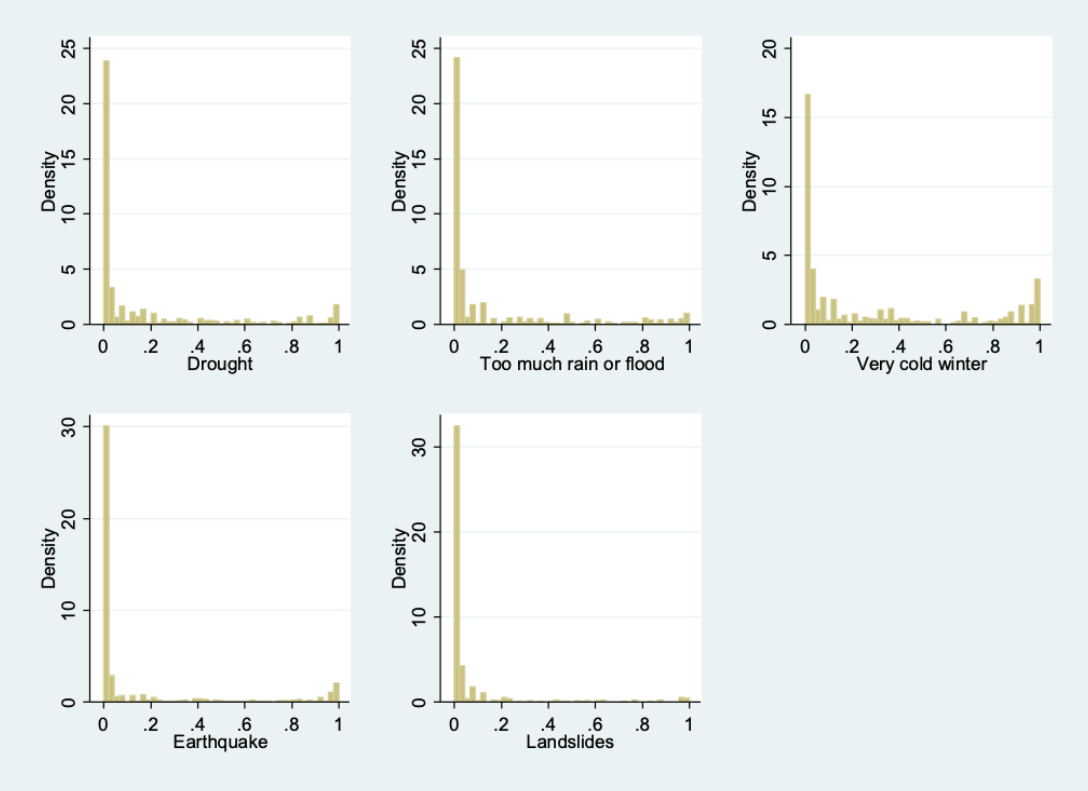

Table 1. Migration participation rates

	Frequency	%
Migration participation (last 12 months)		
Non-migrant	18,794	88.1
Internal migrant	486	2.3
International migrant	2,056	9.6
Total	21,336	100
Source of funding international migration (migrants abroad)		
Self-financed	851	56.0
Help from friends and relatives	597	39.3
Other	72	4.7
Total	1,520	100

Table 2. Descriptive statistics

	non-migrants	s.e.	migrants	s.e.
Individual characteristics				
Age	36.7	0.1	28.3	0.2
Gender, %	48	0.4	67.3	1
Married, %	70.3	0.3	44.4	1.1
Ethnicity				
Kyrgyz, %	71.7	0.3	76.8	0.9
Uzbek, %	12.4	0.2	18.2	0.9
Russian, %	3.7	0.1	0.7	0.2
other, %	12.2	0.2	4.3	0.4
Relation to hh head				
Hh head	28	0.3	8.6	0.6
head spouse	24.5	0.3	3.9	0.4
head son/daughter	31.5	0.3	68.5	1
other	16	0.3	18.9	0.9
Household characteristics				
Number of hh members	6.1	0.0	6.9	0.1
Share of pensioners, %	6.5	0.1	5.8	0.3
Share of children under 14, %	25.3	0.2	20.6	0.4
Share of women, %	32.2	0.1	34.8	0.4
Hh head age	52.6	0.1	54.5	0.2
Hh head education				
Below secondary general	15.6	0.3	14.1	0.8
Secondary general	56	0.4	60.3	1.1
Basic vocational	6.5	0.2	5.3	0.5
Secondary vocational	11.7	0.2	11.5	0.7
Higher	10.3	0.2	8.8	0.6
Owned land (ha)	1.3	0.02	0.9	0.03
Cultivated land (ha)	1.1	0.03	0.6	0.04
Per capita monetary income (som)	4475	35.3	4282.6	86.4
Per capita consumption (som)	3913.2	33.4	4117.8	64.2
Share of consumed food that is purchased, %	65.6	0.2	65.6	0.6
Asset index	0.3	0.02	-0.1	0.05
Livestock market value (thousand som)	119	2	142	14
Share of wage income in total income, %	30.4	0.3	26.2	0.8
Community characteristics				
Population size	6480	64.4	8298	237.8
Share of households with international migrants in the psu, %	19.8	0.2	33.0	0.5
Community has access to safe drinking water	80.7	0.3	80.8	0.9

Agriculture is the major economic activity in the community	90.7	0.2	91.3	0.6
Major agricultural activity				
Cattle breeding	65.3	0.3	52	1.1
Cotton crops	17.5	0.3	30.1	1
Grain crops	74.1	0.3	73.4	1
Potato crops	54.7	0.4	47.2	1.1
Fruit crops	20.3	0.3	22.8	0.9
Province				
Issyk-Kul	8.9	0.2	2.4	0.3
Jalal-Abad	19.4	0.3	30	1
Naryn	5.1	0.2	0.5	0.2
Batken	8.3	0.2	13.4	0.8
Osh	31.3	0.3	44.1	1.1
Talas	5	0.2	4.5	0.5
Chui	22.1	0.3	5.1	0.5

Note: hh – household; psu – primary sampling unit

Table 3. Proportion of rural households affected by natural shocks

	All households		Households with migrants		Households without migrants	
	%	s.e.	%	s.e.	%	s.e.
2010						
Drought	4.5	0.5	2.0***	0.9	4.9	0.6
Too much rain or flood	19.7	1.0	23.4	2.7	19.1	1.0
Very cold winter	22.5	1.0	17.7*	2.4	23.3	1.1
Earthquakes	6.9	0.6	10.1***	1.9	6.4	0.6
Landslides	9.8	0.7	14.5***	2.2	9.0	0.7
2011						
Drought	40.7	1.2	46.6*	3.0	39.5	1.3
Too much rain or flood	21.9	1.0	16.3***	2.2	23.1	1.1
Very cold winter	22.1	1.0	11.0***	1.9	24.3	1.1
Earthquakes	43.9	1.2	54.1***	3.0	41.8	1.3
Landslides	8.2	0.7	7.4	1.6	8.3	0.7
2012						
Drought	34.0	1.2	31.8	2.7	34.6	1.3
Too much rain or flood	15.7	0.9	26.8***	2.5	13.1	0.9
Very cold winter	56.6	1.2	65.6***	2.7	54.6	1.4
Earthquakes	3.0	0.4	4.0	1.1	2.8	0.4
Landslides	8.6	0.7	16.2***	2.1	6.9	0.7
2013						

Drought	15.4	0.9	16.0	2.1	15.3	1.0
Too much rain or flood	16.2	0.9	17.3	2.2	15.9	1.0
Very cold winter	27.6	1.1	25.7	2.5	28.1	1.3
Earthquakes	11.9	0.8	12.4	1.9	11.8	0.9
Landslides	4.5	0.5	2.6*	0.9	4.9	0.6

Note: Difference between migrant and non-migrant households *** p < 0.01, ** p < 0.05, * p < 0.1

Table 4. Predictors of shock experience, linear regression with household fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	drought		too much rain or flood		very cold winter		earthquake		landslides	
	reported shock	share of hh in the psu reporting shock	reported shock	share of hh in the psu reporting shock	reported shock	share of hh in the psu reporting shock	reported shock	share of hh in the psu reporting shock	reported shock	share of hh in the psu reporting shock
Community characteristics										
Agriculture is the most important activity for households in the community (in previous round)	-0.07	-0.06	-0.00	-0.00	-0.04	-0.04	0.06	0.07	-0.03	-0.03
	[0.113]	[0.110]	[0.097]	[0.095]	[0.138]	[0.136]	[0.068]	[0.067]	[0.060]	[0.059]
Community population size, log (in previous round)	0.29	0.28	0.16	0.16	0.17	0.17	0.32	0.32	0.19	0.19
	[0.244]	[0.246]	[0.224]	[0.221]	[0.216]	[0.218]	[0.252]	[0.248]	[0.119]	[0.123]
Share of households in the community having migrants (in previous round)	-0.43*	-0.43**	0.12	0.08	-0.10	-0.06	0.21	0.20	-0.29	-0.27
	[0.219]	[0.210]	[0.303]	[0.300]	[0.274]	[0.271]	[0.253]	[0.247]	[0.201]	[0.187]
Household characteristics (all as of previous survey round)										
Household had migrants (in previous round)	-0.02	0.01	-0.04	-0.03*	0.05*	0.03	0.01	-0.02	-0.01	-0.02*
	[0.024]	[0.020]	[0.024]	[0.018]	[0.029]	[0.023]	[0.026]	[0.017]	[0.017]	[0.011]
Asset index	-0.02	-0.01	-0.00	-0.01	-0.03	-0.01	-0.01	-0.02	-0.02**	-0.01*
	[0.016]	[0.014]	[0.013]	[0.012]	[0.018]	[0.018]	[0.012]	[0.012]	[0.008]	[0.006]
Total consumption per capita, log	-0.02	-0.03	0.02	0.00	-0.03	-0.04	0.00	-0.00	-0.00	-0.02
	[0.059]	[0.057]	[0.055]	[0.053]	[0.056]	[0.052]	[0.041]	[0.039]	[0.022]	[0.019]
Total income per capita, log	-0.02	-0.02	0.03	0.02	-0.00	-0.00	-0.01	-0.02	0.01	0.01
	[0.022]	[0.021]	[0.021]	[0.018]	[0.025]	[0.023]	[0.020]	[0.019]	[0.011]	[0.009]
Share of hh income from home production	0.05	0.04	0.02	-0.05	-0.09	-0.10	0.01	-0.01	-0.00	-0.04
	[0.044]	[0.045]	[0.045]	[0.042]	[0.068]	[0.063]	[0.052]	[0.045]	[0.036]	[0.033]
Share of hh income from wages	0.04	0.04	0.06	0.02	-0.05	-0.02	0.06	0.04	0.07*	0.04*
	[0.051]	[0.045]	[0.038]	[0.034]	[0.068]	[0.056]	[0.046]	[0.040]	[0.036]	[0.024]
Estimated value of owned livestock, log	0.00	0.00	-0.01**	-0.01**	-0.00	-0.00	0.00	0.00	-0.00	-0.00
	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]	[0.002]	[0.002]	[0.001]
Cultivated land, log	-0.01	-0.01	0.02	0.01	0.01	0.01	-0.01	-0.00	0.00	0.00
	[0.011]	[0.010]	[0.010]	[0.009]	[0.009]	[0.009]	[0.007]	[0.007]	[0.008]	[0.008]

Owned land, log	0.00	0.00	-0.02*	-0.01	-0.01	-0.01	-0.00	0.00	-0.01	-0.01
	[0.008]	[0.008]	[0.010]	[0.010]	[0.012]	[0.012]	[0.006]	[0.006]	[0.007]	[0.006]
Total number of hh members	-0.02	-0.02	0.01	0.01	-0.00	-0.01	-0.00	0.00	-0.00	0.00
	[0.014]	[0.012]	[0.011]	[0.010]	[0.016]	[0.014]	[0.012]	[0.011]	[0.009]	[0.006]
Share of pensioners	-0.06	0.10	0.05	0.03	0.02	-0.00	0.01	0.05	0.03	0.02
	[0.129]	[0.090]	[0.115]	[0.076]	[0.156]	[0.145]	[0.109]	[0.085]	[0.057]	[0.040]
Share of children under 14	0.10	0.11	-0.17	-0.08	-0.05	0.01	0.04	-0.12	-0.05	-0.11*
	[0.162]	[0.109]	[0.109]	[0.096]	[0.132]	[0.122]	[0.141]	[0.105]	[0.075]	[0.060]
Share of women	-0.10	-0.10	-0.08	-0.06	-0.13	-0.07	-0.15	-0.13	-0.03	-0.05
	[0.140]	[0.100]	[0.126]	[0.070]	[0.133]	[0.115]	[0.135]	[0.107]	[0.067]	[0.047]
Characteristics of hh head										
Education level (secondary general - base category)										
Below secondary general	0.23***	0.11*	0.22***	0.16***	0.11	0.12**	0.01	0.01	0.12**	0.09**
	[0.076]	[0.062]	[0.067]	[0.049]	[0.072]	[0.056]	[0.053]	[0.048]	[0.057]	[0.035]
Secondary special	-0.08	-0.13*	0.08	0.01	-0.11	-0.07	-0.05	-0.04	-0.01	-0.04
	[0.100]	[0.067]	[0.075]	[0.067]	[0.110]	[0.095]	[0.052]	[0.045]	[0.060]	[0.054]
Professional	-0.03	-0.07	0.05	-0.04	-0.08	-0.07	-0.02	-0.02	0.00	-0.00
	[0.069]	[0.057]	[0.059]	[0.036]	[0.065]	[0.058]	[0.043]	[0.038]	[0.031]	[0.019]
Higher	-0.04	-0.03	-0.07	-0.10*	-0.14	-0.09	-0.10	-0.12**	-0.02	-0.05
	[0.073]	[0.051]	[0.072]	[0.050]	[0.094]	[0.076]	[0.058]	[0.044]	[0.056]	[0.034]
Age	-0.00**	-0.00***	-0.00*	-0.00***	-0.00	-0.00	0.00	0.00	-0.00	-0.00*
	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Ethnicity (Kyrgyz - base category)										
Uzbek	0.54***	0.55***	0.13	0.11	-0.23**	-0.14	0.42***	0.43***	0.43***	0.08*
	[0.073]	[0.072]	[0.090]	[0.081]	[0.094]	[0.088]	[0.084]	[0.079]	[0.049]	[0.043]
Russian	-0.28***	0.14	0.04	0.06	0.05	-0.05	0.05	0.15	0.02	0.03
	[0.100]	[0.186]	[0.078]	[0.070]	[0.130]	[0.091]	[0.383]	[0.321]	[0.082]	[0.079]
Other	-0.04	0.21	0.10	0.12	0.08	0.10	0.09	0.11	0.11	0.11
	[0.086]	[0.206]	[0.086]	[0.077]	[0.128]	[0.097]	[0.439]	[0.366]	[0.107]	[0.100]
Observations	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546
R-squared	0.096	0.157	0.045	0.061	0.124	0.176	0.352	0.467	0.061	0.116
Number of households	1,690	1,690	1,690	1,690	1,690	1,690	1,690	1,690	1,690	1,690

Note: household, month and year of interview fixed effects included; standard errors clustered at primary sampling unit(psu) level reported in brackets; hh – household; psu – primary sampling unit

Table 5. Effect of natural shocks on rural households' income, consumption and spending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Aid from persons living in Kyrgyzstan (relatives /friends)	Income from wage employment	Money transfers from persons living abroad	Social transfers	Property income	Income from hh enterprises	Other income	Total income	Total consumption	Spending on repair and construction
Drought	0.27	0.16	-0.03	0.08	-0.13	-0.83***	0.14	-0.18*	-0.08	-0.05
	[0.226]	[0.349]	[0.229]	[0.241]	[0.192]	[0.234]	[0.205]	[0.094]	[0.063]	[0.317]
Too much rain or flood	-0.00	-0.11	-0.32	0.01	-0.20	-0.85**	-0.15	-0.30**	0.01	-0.25
	[0.421]	[0.371]	[0.350]	[0.298]	[0.171]	[0.352]	[0.327]	[0.117]	[0.066]	[0.482]
Very cold winter	-0.27	0.16	-0.24	-0.00	0.17	0.36	0.21	-0.01	0.08	0.49
	[0.312]	[0.314]	[0.259]	[0.285]	[0.188]	[0.252]	[0.200]	[0.102]	[0.053]	[0.340]
Earthquakes	0.12	0.60	-0.02	0.06	0.03	-0.36	0.01	0.09	-0.02	0.10
	[0.259]	[0.412]	[0.248]	[0.235]	[0.144]	[0.251]	[0.271]	[0.101]	[0.089]	[0.330]
Landslides	0.89*	1.01	1.16**	0.40	-0.23	0.23	-0.51	0.39	-0.03	0.06
	[0.510]	[0.850]	[0.560]	[0.707]	[0.288]	[0.481]	[0.505]	[0.236]	[0.122]	[0.733]
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Households fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3,898	3,901	3,901	3,898	3,898	3,901	3,898	3,898	3,909	4,131
R-squared	0.060	0.094	0.079	0.433	0.038	0.139	0.156	0.109	0.210	0.191
Number of households	1,594	1,595	1,595	1,594	1,594	1,595	1,594	1,594	1,596	1,607

Note: Shock measure – share of households in psu that report having shock; controls include: number of household members, share of children, women and pensioners, household head's education, gender and age, total months employed per working age household member, value of owned livestock, size of owned and cultivated land, share of owned land that is irrigated, asset index, agriculture is the most important economic activity in the community(dummy), log of community population size, share of households that had migrants(previous year), interview month and year dummies ; standard errors clustered at psu level reported in brackets, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6. Determinants of individual migration decision (linear probability model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	International migration				Any migration				Internal migration			
	pooled OLS	psu FE	HH FE	HH RE	pooled OLS	psu FE	HH FE	HH RE	pooled OLS	psu FE	HH FE	HH RE
Share of hh in community that experienced:												
drought	-0.03**	-0.04**	-0.04**	-0.03**	-0.04**	-0.05**	-0.05**	-0.04**	-0.01	-0.01	-0.01	-0.01
	[0.016]	[0.018]	[0.017]	[0.016]	[0.018]	[0.020]	[0.020]	[0.018]	[0.009]	[0.012]	[0.012]	[0.009]
too much rain or flood	-0.04**	-0.05**	-0.04*	-0.04**	-0.04*	-0.06**	-0.05**	-0.04*	-0.00	-0.01	-0.01	-0.00
	[0.018]	[0.021]	[0.023]	[0.018]	[0.020]	[0.024]	[0.024]	[0.020]	[0.012]	[0.014]	[0.014]	[0.012]
very cold winter	0.01	0.02	0.02	0.01	-0.00	0.00	-0.00	-0.00	-0.02	-0.02	-0.02	-0.02
	[0.013]	[0.014]	[0.015]	[0.013]	[0.016]	[0.018]	[0.018]	[0.016]	[0.011]	[0.014]	[0.014]	[0.011]
earthquakes	-0.02	0.01	0.01	-0.01	-0.02	-0.00	-0.00	-0.02	-0.01	-0.01	-0.01	-0.01
	[0.018]	[0.018]	[0.017]	[0.017]	[0.019]	[0.020]	[0.019]	[0.018]	[0.009]	[0.009]	[0.009]	[0.008]
landslides	0.02	-0.04	-0.05	0.01	0.01	-0.04	-0.06	-0.01	-0.02	-0.01	-0.01	-0.02
	[0.027]	[0.041]	[0.038]	[0.027]	[0.028]	[0.045]	[0.043]	[0.029]	[0.014]	[0.018]	[0.018]	[0.013]
Person was an international migrant last year		0.44***										
		[0.025]										
hh had an international migrant last year		0.02*										
		[0.010]										
Person was an internal or international migrant last year						0.38***						
						[0.024]						
hh had an internal or international migrant last year						-0.00						
						[0.009]						
Person was an internal migrant last year										0.19***		
										[0.054]		
hh had an internal migrant last										-0.01		

year												
										[0.008]		
hh characteristics (before shock)												
Log per capita consumption	0.04***	0.01	-0.00	0.03**	0.05***	0.01	-0.01	0.03***	0.01	0.00	-0.01	0.01
	[0.013]	[0.011]	[0.013]	[0.012]	[0.013]	[0.013]	[0.015]	[0.013]	[0.006]	[0.006]	[0.008]	[0.006]
Log per capita monetary income	-0.02***	-0.01*	-0.01*	-0.01***	-0.02**	-0.01**	-0.01*	-0.02**	-0.00	-0.00	-0.01	-0.00
	[0.006]	[0.006]	[0.007]	[0.006]	[0.006]	[0.006]	[0.008]	[0.006]	[0.003]	[0.003]	[0.004]	[0.003]
Share of consumed food that is purchased	0.03	0.00	0.01	0.02	0.03	0.00	-0.01	0.02	0.01	0.00	-0.02	0.00
	[0.022]	[0.022]	[0.025]	[0.021]	[0.022]	[0.021]	[0.026]	[0.021]	[0.011]	[0.013]	[0.016]	[0.010]
Asset index	0.00	-0.00	-0.01	0.00	-0.00	-0.00	-0.01*	0.00	-0.00*	-0.00	-0.00	-0.00
	[0.002]	[0.001]	[0.004]	[0.002]	[0.002]	[0.002]	[0.005]	[0.002]	[0.001]	[0.001]	[0.002]	[0.001]
Log livestock market value	-0.00	0.00	0.00**	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Share of wage income in total income	-0.02*	-0.00	0.02	-0.01	-0.02	-0.01	0.02	-0.01	0.00	-0.00	0.00	0.00
	[0.012]	[0.009]	[0.014]	[0.011]	[0.012]	[0.010]	[0.016]	[0.012]	[0.006]	[0.006]	[0.010]	[0.006]
Log owned land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.002]	[0.001]	[0.001]	[0.002]	[0.001]
Log cultivated land	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00	-0.00	-0.00	-0.00
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]	[0.000]
Number of hh members	0.00***	0.00	-0.01*	0.00**	0.01***	0.00**	-0.00	0.01***	0.00**	0.00**	0.01	0.00**
	[0.002]	[0.002]	[0.004]	[0.002]	[0.002]	[0.002]	[0.006]	[0.002]	[0.001]	[0.001]	[0.004]	[0.001]
Share of pensioners	0.03	0.04	0.05	0.03	0.05*	0.05*	0.09	0.05*	0.02	0.02	0.06	0.03
	[0.030]	[0.024]	[0.043]	[0.026]	[0.031]	[0.027]	[0.057]	[0.029]	[0.017]	[0.017]	[0.045]	[0.017]
Share of children under 14	-0.00	0.00	-0.00	-0.00	-0.02	-0.02	-0.00	-0.02	-0.02	-0.02	-0.01	-0.02
	[0.017]	[0.014]	[0.047]	[0.017]	[0.023]	[0.019]	[0.056]	[0.023]	[0.019]	[0.017]	[0.036]	[0.018]
Share of females	0.07***	0.06***	-0.03	0.07***	0.07**	0.05**	-0.08	0.06**	0.00	0.00	-0.05	0.00
	[0.025]	[0.020]	[0.051]	[0.023]	[0.028]	[0.023]	[0.064]	[0.028]	[0.017]	[0.017]	[0.041]	[0.017]
hh head education (Baseline - Secondary general)												
Below secondary general	-0.01	-0.01	-0.04	-0.02	-0.02	-0.01	-0.03	-0.02*	-0.00	-0.00	0.01	-0.00

	[0.011]	[0.007]	[0.036]	[0.012]	[0.011]	[0.008]	[0.028]	[0.012]	[0.006]	[0.005]	[0.015]	[0.006]
Basic vocational	0.01	0.01	-0.02	0.01	0.01	0.02*	0.00	0.01	0.00	0.01	0.01	0.00
	[0.013]	[0.011]	[0.042]	[0.015]	[0.013]	[0.011]	[0.040]	[0.015]	[0.007]	[0.007]	[0.014]	[0.007]
Secondary vocational	0.00	0.01	-0.02	0.00	0.00	0.01	-0.02	-0.00	-0.00	-0.00	-0.00	-0.00
	[0.012]	[0.009]	[0.023]	[0.012]	[0.012]	[0.010]	[0.022]	[0.012]	[0.004]	[0.004]	[0.009]	[0.004]
Higher or above	-0.01	0.00	-0.01	-0.01	-0.01	0.00	-0.03	-0.01	-0.00	-0.00	-0.03*	-0.00
	[0.012]	[0.008]	[0.041]	[0.012]	[0.012]	[0.009]	[0.040]	[0.012]	[0.005]	[0.004]	[0.015]	[0.005]
Hh head age	-0.00***	-0.00**	-0.00	-0.00***	-0.00***	-0.00**	-0.00	-0.00***	-0.00	-0.00	-0.00*	-0.00*
	[0.000]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
Individual characteristics												
Age	0.00**	0.00	0.00	0.00*	0.00**	0.00	0.00	0.00*	0.00	0.00	0.00	0.00
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
Gender	0.08***	0.05***	0.08***	0.08***	0.08***	0.05***	0.07***	0.07***	-0.00	-0.00	-0.00	-0.00
	[0.014]	[0.009]	[0.014]	[0.014]	[0.014]	[0.010]	[0.014]	[0.014]	[0.005]	[0.004]	[0.004]	[0.004]
Married	-0.06***	-0.04***	-0.06***	-0.06***	-0.07***	-0.05***	-0.06***	-0.07***	-0.01**	-0.01*	-0.01*	-0.01**
	[0.013]	[0.011]	[0.015]	[0.014]	[0.013]	[0.011]	[0.015]	[0.014]	[0.006]	[0.006]	[0.007]	[0.007]
Ethnicity (baseline - Kyrgyz)												
Uzbek	-0.03*	-0.01	-0.07*	-0.03	-0.04*	-0.02	-0.07**	-0.03	-0.02**	-0.03**	-0.01	-0.01**
	[0.018]	[0.016]	[0.035]	[0.018]	[0.021]	[0.020]	[0.035]	[0.020]	[0.007]	[0.011]	[0.007]	[0.007]
Russian	-0.01	-0.00	0.01	-0.01	-0.01	-0.01	0.04	-0.01	-0.00	-0.01*	0.02	-0.00
	[0.015]	[0.016]	[0.040]	[0.014]	[0.016]	[0.017]	[0.044]	[0.016]	[0.008]	[0.007]	[0.021]	[0.008]
Dungan	-0.03**	-0.01	0.01	-0.03**	-0.03**	-0.00	0.03	-0.03**	-0.00	0.00	0.01	-0.00
	[0.012]	[0.009]	[0.036]	[0.012]	[0.012]	[0.011]	[0.038]	[0.013]	[0.007]	[0.008]	[0.017]	[0.007]
Relation to hh head (baseline - hh head)												
Other	0.17***	0.10***	0.16***	0.16***	0.17***	0.11***	0.16***	0.16***	0.02	0.01	0.02	0.02
	[0.025]	[0.017]	[0.026]	[0.025]	[0.026]	[0.018]	[0.028]	[0.025]	[0.011]	[0.010]	[0.011]	[0.011]
Spouse	0.06***	0.03***	0.05***	0.06***	0.05***	0.03***	0.04***	0.05***	-0.00	-0.00	-0.01*	-0.00
	[0.012]	[0.009]	[0.012]	[0.012]	[0.012]	[0.009]	[0.012]	[0.012]	[0.005]	[0.004]	[0.005]	[0.005]
Son	0.16***	0.10***	0.16***	0.16***	0.18***	0.12***	0.17***	0.18***	0.04***	0.03***	0.04***	0.04***
	[0.023]	[0.016]	[0.024]	[0.022]	[0.024]	[0.017]	[0.027]	[0.024]	[0.012]	[0.011]	[0.013]	[0.012]
Community characteristics												
Share of households with international migrants in the psu	0.19***	-0.32***	-0.11*	0.13**	0.18***	-0.27***	-0.11	0.13**	-0.00	-0.00	-0.00	-0.00
	[0.056]	[0.058]	[0.062]	[0.057]	[0.056]	[0.065]	[0.067]	[0.057]	[0.016]	[0.027]	[0.027]	[0.016]
Size of community	-0.00	-0.02	-0.01	-0.00	-0.00	-0.01	-0.01	-0.00	-0.00	-0.01	-0.01	-0.00

	[0.008]	[0.051]	[0.050]	[0.008]	[0.008]	[0.051]	[0.051]	[0.008]	[0.003]	[0.013]	[0.012]	[0.003]
Drinking water access (dummy)	0.01	0.02	0.01	0.01	0.01	0.02	-0.00	0.00	-0.00	-0.01	-0.01	-0.00
	[0.010]	[0.022]	[0.023]	[0.011]	[0.011]	[0.024]	[0.026]	[0.011]	[0.006]	[0.014]	[0.017]	[0.006]
Agriculture is the major economic activity in the community	0.01	0.02	0.02	0.01	-0.00	0.01	0.00	-0.00	-0.01	-0.01	-0.01	-0.01
	[0.012]	[0.014]	[0.016]	[0.012]	[0.015]	[0.022]	[0.021]	[0.014]	[0.009]	[0.016]	[0.015]	[0.009]
Major activity by the people in community												
Cattle breeding	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	-0.00	-0.00	0.00
	[0.010]	[0.012]	[0.011]	[0.010]	[0.011]	[0.013]	[0.013]	[0.011]	[0.006]	[0.009]	[0.009]	[0.006]
Cotton crops	0.01	-0.00	-0.01	0.01	0.01	0.01	0.01	0.01	-0.00	0.02	0.02	-0.00
	[0.017]	[0.023]	[0.024]	[0.018]	[0.019]	[0.026]	[0.027]	[0.019]	[0.007]	[0.014]	[0.013]	[0.007]
Grain crops	-0.01	-0.00	-0.00	0.00	-0.01	0.00	-0.00	-0.00	-0.01	-0.00	-0.00	-0.01
	[0.012]	[0.015]	[0.014]	[0.012]	[0.015]	[0.020]	[0.020]	[0.015]	[0.009]	[0.015]	[0.015]	[0.009]
Potato crops	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.02	-0.01*	-0.01	-0.01	-0.01*
	[0.014]	[0.015]	[0.015]	[0.014]	[0.014]	[0.019]	[0.018]	[0.014]	[0.005]	[0.012]	[0.011]	[0.006]
Fruit crops	-0.01	0.02	0.01	-0.01	-0.00	0.01	-0.01	-0.01	0.00	-0.01	-0.01	0.00
	[0.014]	[0.023]	[0.023]	[0.016]	[0.015]	[0.027]	[0.027]	[0.017]	[0.007]	[0.011]	[0.012]	[0.007]
Province (baseline - Jalal-Abad)												
Issyk-Kul	-0.04**			-0.06***	-0.03			-0.04*	0.02			0.02
	[0.020]			[0.019]	[0.023]			[0.023]	[0.012]			[0.012]
Naryn	-0.09***			-0.09***	-0.01			-0.01	0.08***			0.08***
	[0.020]			[0.020]	[0.025]			[0.025]	[0.016]			[0.017]
Batken	0.02			0.02	0.04*			0.04*	0.04***			0.04***
	[0.020]			[0.022]	[0.020]			[0.021]	[0.012]			[0.012]
Osh	-0.02			-0.02	-0.02			-0.02	0.00			0.00
	[0.017]			[0.019]	[0.019]			[0.020]	[0.008]			[0.008]
Talas	0.02			0.01	0.07***			0.06***	0.07***			0.07***
	[0.016]			[0.015]	[0.020]			[0.020]	[0.023]			[0.021]
Chui	-0.10***			-0.11***	-0.10***			-0.11***	-0.01			-0.01
	[0.016]			[0.016]	[0.018]			[0.018]	[0.010]			[0.010]
Month and year of interview dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-0.17	0.29	0.40	-0.06	-0.13	0.27	0.51	-0.02	0.05	0.15	0.32**	0.07
	[0.140]	[0.476]	[0.479]	[0.135]	[0.153]	[0.472]	[0.488]	[0.149]	[0.068]	[0.119]	[0.132]	[0.069]
Observations	13,928	13,924	13,928	13,928	14,400	14,400	14,400	14,400	13,014	13,014	13,014	13,014

R-squared	0.134	0.234	0.086		0.132	0.206	0.092		0.049	0.050	0.026	
Number of communities		69				69				69		
Number of households			1,626	1,626			1,627	1,627			1,625	1,625

Note: hh – household; psu – primary sampling unit; standard errors clustered by psus in brackets
*** p < 0.01, ** p < 0.05, * p < 0.1

Table 7. Interactions of shocks and household characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE
Panel A						
Drought	-0.16*	-0.16*	-0.17	-0.29	-0.19	-0.26
	[0.083]	[0.095]	[0.183]	[0.186]	[0.194]	[0.177]
Drought*Share of hh with international migrants in the psu	0.20*	0.17	0.22*	0.18	0.22*	0.18
	[0.105]	[0.106]	[0.111]	[0.116]	[0.110]	[0.114]
Drought*Log cultivated land	0.00	0.01**	0.00	0.01**	0.00	0.01**
	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.003]
Drought*Log per capita income	0.01	0.01				
	[0.009]	[0.011]				
Drought*Log per capita consumption			0.01	0.02		
			[0.021]	[0.024]		
Drought*Log per capita food consumption					0.01	0.02
					[0.024]	[0.024]
Panel B						
Too much rain or flood	-0.26**	-0.24*	-0.35*	-0.28	-0.42**	-0.30*
	[0.107]	[0.132]	[0.190]	[0.231]	[0.162]	[0.178]
Too much rain or flood *Share of hh with international migrants in the psu	-0.01	-0.04	-0.01	-0.02	-0.01	-0.02
	[0.134]	[0.121]	[0.134]	[0.121]	[0.129]	[0.121]
Too much rain or flood *Log cultivated land	0.00	0.00	0.00	0.00	0.00	0.00
	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]
Too much rain or flood *Log per capita income	0.02*	0.02				
	[0.013]	[0.016]				
Too much rain or flood *Log per capita consumption			0.04	0.03		
			[0.023]	[0.029]		
Too much rain or flood *Log per capita food consumption					0.05**	0.03
					[0.021]	[0.023]
Panel C						
Very cold winter	0.01	0.02	-0.29*	-0.18	-0.34**	-0.24*
	[0.100]	[0.118]	[0.158]	[0.155]	[0.133]	[0.139]
Very cold winter*Share of hh with international migrants in the psu	-0.03	-0.04	-0.04	-0.05	-0.04	-0.05
	[0.075]	[0.068]	[0.071]	[0.066]	[0.068]	[0.065]
Very cold winter*Log cultivated land	0.00	0.00*	0.00	0.00*	0.00	0.00*

	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Very cold winter*Log per capita income	0.00	-0.00				
	[0.012]	[0.015]				
Very cold winter*Log per capita consumption			0.04*	0.02		
			[0.020]	[0.020]		
Very cold winter*Log per capita food consumption					0.05**	0.03*
					[0.018]	[0.018]
Panel D						
Earthquake	-0.15*	-0.09	-0.02	-0.22	0.18	-0.02
	[0.082]	[0.103]	[0.157]	[0.180]	[0.177]	[0.168]
Earthquake*Share of hh with international migrants in the psu	0.28***	0.26**	0.30***	0.28**	0.28***	0.27**
	[0.099]	[0.100]	[0.106]	[0.108]	[0.106]	[0.107]
Earthquake*Log cultivated land	0.00	0.00	0.00	0.00	0.00	0.00
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Earthquake*Log per capita income	0.01	0.00				
	[0.011]	[0.014]				
Earthquake*Log per capita consumption			-0.01	0.02		
			[0.019]	[0.021]		
Earthquake*Log per capita food consumption					-0.03	-0.01
					[0.022]	[0.021]
Panel E						
Landslides	-0.70***	-0.72***	-0.82*	-0.82	-0.32	0.00
	[0.218]	[0.242]	[0.469]	[0.505]	[0.265]	[0.274]
Landslides*Share of hh with international migrants in the psu	0.46***	0.45**	0.50***	0.50***	0.53***	0.57***
	[0.168]	[0.173]	[0.176]	[0.182]	[0.183]	[0.183]
Landslides*Log cultivated land	0.00	-0.00	0.00	0.00	0.00	0.00
	[0.005]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]
Landslides*Log per capita income	0.07***	0.07**				
	[0.025]	[0.028]				
Landslides*Log per capita consumption			0.08	0.08		
			[0.058]	[0.061]		
Landslides*Log per capita food consumption					0.02	-0.02
					[0.034]	[0.035]

Note: hh – household; psu – primary sampling unit; shock measure – share of households in psu reporting being affected by the shock. Included control variables: depending on specification: log per capita total consumption or log per capita food consumption or log per capita monetary income; in all specifications: Individual characteristics (age, gender, marital status, ethnicity,

relation to hh head, person was an international migrant last year); Household characteristics (share of consumed food that is purchased, asset index, log livestock market value, share of wage income in total income, log owned land, log cultivated land, number of hh members, share of pensioners, share of children under 14, share of females, hh head education, hh head age); Community characteristics (share of households with international migrants in the psu, size of community, drinking water access (dummy), agriculture is the major economic activity in the community, major activity by the people in community, province); month and year of interview dummies

Standard errors clustered by psus in brackets*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8. Determinants of individual migration decision by source of funding (linear probability model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE	psu FE	HH FE
	Migration financed with own funds								Migration financed with help of friends and relatives							
Drought	-0.02	0.00	-0.16***	-0.24***	0.06	-0.06	0.05	-0.07	-0.00	-0.02*	0.03	0.04	0.01	0.08	0.02	0.14
	[0.012]	[0.010]	[0.055]	[0.074]	[0.079]	[0.098]	[0.104]	[0.118]	[0.003]	[0.012]	[0.059]	[0.058]	[0.125]	[0.150]	[0.112]	[0.136]
Drought*Log per capita income			0.02**	0.03***							-0.00	-0.01				
			[0.007]	[0.009]							[0.007]	[0.007]				
Drought*Log per capita consumption					-0.01	0.00							-0.00	-0.01		
					[0.009]	[0.012]							[0.015]	[0.018]		
Drought*Log per capita food consumption							-0.01	0.01							-0.00	-0.02
							[0.013]	[0.015]							[0.014]	[0.017]
Too much rain or flood	-0.05***	-0.03**	-0.17**	-0.18*	-0.05	-0.04	-0.16	-0.12	0.00	-0.04***	-0.22***	-0.24***	-0.44***	-0.38**	-0.38***	-0.32**
	[0.017]	[0.012]	[0.068]	[0.101]	[0.108]	[0.164]	[0.099]	[0.153]	[0.004]	[0.016]	[0.069]	[0.082]	[0.115]	[0.157]	[0.085]	[0.123]
Too much rain or flood*Log per capita income			0.02*	0.02							0.02***	0.03**				
			[0.008]	[0.012]							[0.009]	[0.010]				
Too much rain or flood*Log per capita consumption					0.00	-0.00							0.05***	0.04**		
					[0.013]	[0.020]							[0.014]	[0.019]		
Too much rain or flood*Log per capita food consumption							0.01	0.01							0.05***	0.04**
							[0.013]	[0.020]							[0.011]	[0.016]

Very cold winter	0.00	0.01	0.02	0.05	0.01	0.04	-0.07	-0.03	-0.01	0.00	-0.03	-0.04	-0.25***	-0.30***	-0.22***	-0.25***
	[0.011]	[0.010]	[0.060]	[0.077]	[0.086]	[0.109]	[0.082]	[0.115]	[0.004]	[0.010]	[0.058]	[0.069]	[0.089]	[0.103]	[0.056]	[0.080]
Very cold winter*Log per capita income			-0.00	-0.01							0.01	0.01				
			[0.007]	[0.009]							[0.007]	[0.008]				
Very cold winter*Log per capita consumption					-0.00	-0.00							0.03***	0.04***		
					[0.010]	[0.013]							[0.011]	[0.013]		
Very cold winter*Log per capita food consumption							0.01	0.01							0.03***	0.04***
							[0.011]	[0.015]							[0.008]	[0.010]
Earthquakes	0.01	-0.01	-0.07	-0.11	0.05	-0.02	0.16*	0.14	0.00	0.01	-0.01	0.01	-0.10	-0.05	-0.01	0.00
	[0.012]	[0.010]	[0.064]	[0.073]	[0.081]	[0.101]	[0.090]	[0.108]	[0.005]	[0.012]	[0.051]	[0.069]	[0.104]	[0.123]	[0.084]	[0.091]
Earthquakes*Log per capita income			0.01	0.02							0.00	-0.00				
			[0.008]	[0.010]							[0.006]	[0.009]				
Earthquakes*Log per capita consumption					-0.00	0.00							0.01	0.01		
					[0.010]	[0.013]							[0.013]	[0.016]		
Earthquakes*Log per capita food consumption							-0.02	-0.02							0.00	-0.00
							[0.012]	[0.015]							[0.011]	[0.012]
Landslides	0.01	0.01	-0.25**	-0.43***	-0.22	-0.44**	-0.28**	-0.28	0.00	-0.01	-0.36**	-0.37*	-0.77**	-0.53	-0.33**	-0.03
	[0.022]	[0.027]	[0.101]	[0.143]	[0.136]	[0.186]	[0.120]	[0.174]	[0.006]	[0.020]	[0.153]	[0.185]	[0.321]	[0.466]	[0.158]	[0.217]
Landslides*Log per capita income			0.03**	0.05***							0.04**	0.04*				
			[0.012]	[0.018]							[0.019]	[0.023]				
Landslides*Log per capita consumption					0.03	0.05**							0.09**	0.06		

	[0.017]	[0.022]			[0.039]	[0.056]		
Landslides*Log per capita food consumption			0.03**	0.03			0.04**	0.00
			[0.017]	[0.024]			[0.020]	[0.029]

Note: hh – household; psu – primary sampling unit; shock measure – share of households in psu reporting being affected by the shock. Included control variables: depending on specification: log per capita total consumption or log per capita food consumption or log per capita monetary income; in all specifications: Individual characteristics (age, gender, marital status, ethnicity, relation to hh head, person was an international migrant last year); Household characteristics (share of consumed food that is purchased, asset index, log livestock market value, share of wage income in total income, log owned land, log cultivated land, number of hh members, share of pensioners, share of children under 14, share of females, hh head education, hh head age); Community characteristics (share of households with international migrants in the psu, size of community, drinking water access (dummy), agriculture is the major economic activity in the community, major activity by the people in community, province); month and year of interview dummies. Standard errors clustered by psus in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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