Working Paper Series 724
(ISSN 2788-0443)

Access to Financial Resources and Environmental Migration of the Poor

Aizhamal Rakhmetova
Roman Hoffmann
Mariola Pytliková

CERGE-EI
Prague, March 2022

ISBN 978-80-7343-531-8 (Univerzita Karlova, Centrum pro ekonomický výzkum a doktorské studium)
ISBN 978-80-7344-633-8 (Národohospodářský ústav AV ČR, v. v. i.)

Access to Financial Resources and Environmental Migration of the Poor*

Aizhamal Rakhmetova[†], Roman Hoffmann[‡], Mariola Pytlikova[§]

March 15, 2022

(work in progress)

Abstract

Despite an increasing number of studies, there is no scientific consensus on the extent and conditions under which environmental factors influence migration. In particular, little is known about the role played by financial resources that may facilitate or hinder migration under environmental stress. Empirical evidence shows that some households migrate in response to environmental hazards while others remain in place, potentially being trapped due to lack of resources, i.e. poverty constraints. However, little is known about how access to financial resources influences the decision of a household to stay or migrate. On one hand, financial resources can help to alleviate poverty constraints and to cover migration costs, thereby increasing migration (climate-driver mechanism); on the other hand, financial resources can also improve the adaptation capacities of households at the place they reside, and thus reduce migration responses to environmental changes (climate-inhibitor mechanism). To shed light on households' migration decisions in response to climate shocks depending on their access to financial resources, we utilize rich micro-data from Indonesia and exploit two sources of variation in climate and cash transfers. Our results suggest that better access to financial resources facilitates the climate-inhibitor mechanism for short-term rainfall shocks and natural disasters. At the same time, better accessibility to financial resources enhances the climate-driver mechanism for accumulated rainfall shocks and temperature anomalies.

Keywords: Climate Change, Migration, Financial Resources, Adaptation

---

*We would like to thank Andreas Menzel, Vasily Korovkin, Michal Bauer, and participants of the EALE 2021 conference in Padua and YEM 2021 in Brno, for their valuable comments and suggestions. This study is kindly supported by the Czech Academy of Sciences, GACR project No. 20-31615S, and by Charles University, GAUK project No. 584120. The usual disclaimer applies.

[†]Corresponding author, CERGE-EI, a joint workplace of Charles University and the Economics Institute of the Czech Academy of Sciences, Politickych veznu 7, 111 21 Prague, Czech Republic, Aizhamal.Rakhmetova@cerge-ei.cz

[‡]The International Institute for Applied Systems Analysis (IIASA), roman.hoffmann@oeaw.ac.at

[§]CERGE-EI, Mariola.Pytlikova@cerge-ei.cz

1 Introduction

Anthropogenic climate change is causing increases in average temperature and changes in precipitation patterns, rising sea levels and more frequent extreme weather events, such as droughts, heatwaves, and floods (IPCC, 2013; Jones and O'Neill, 2016). Climate change affects all countries, but the impact will be felt more strongly by less developed ones (IPCC, 2014). Deterioration in the quality of life and hazardous environmental conditions are expected to lead to an increase in migration flows from affected areas. Since the 1980s, scholars and international organizations have predicted that environmental change will lead to a substantial increase in migration flows worldwide, with predictions ranging from 50 to 200 million additional climate migrants per year (Myers, 2002; Renaud et al., 2007; Stern, 2007; Biermann and Boas, 2010).

Despite an increasing number of studies, as of now, no scientific consensus exists as to what extent and under which conditions environmental factors influence migration. In particular, little is known about the role resources play in enabling or hindering mobility under environmental stress. While some households are found to migrate in response to environmental hazards, others remain in place, potentially being trapped due to lack of resources and liquidity constraints (Black et al., 2013; Zickgraf and Perrin, 2016). While this pattern has been observed in previous work, little is known empirically about how access to financial resources influences the decision of a household to stay or migrate. Theoretically, additional resources can both increase or reduce environmental migration as they support *in-situ* adaptation. Likewise, the loss of resources due to an environmental shock can both trigger migration (climate-driver mechanism) and reduce out-migration (climate-inhibitor mechanism).

In this study, we investigate household migration behavior as a response to climatic shocks conditional on different possibilities to access financial resources. We focus specifically on the situation of resource-constrained poor households. Our study uses data from the Indonesian Family Life Survey (IFLS), which is an on-going longitudinal survey. The sample is representative of about 83% of the Indonesian population and contains over 30,000 individuals living in 13 of the 26 provinces in the country. The survey contains detailed information about the migration history of individual household members. Additionally, due to the longitudinal panel nature of the data, we can trace back the migration of entire households, thereby allowing us to estimate the impact of environmental conditions on mobility outcomes. As a country particularly affected by environmental changes and rapid onset disasters, Indonesia offers an interesting case to study the moderating effect of resources on environmental migration.

To identify the impact of slow and fast-onset environmental events on migration processes, we combine the IFLS data with additional secondary data sources. First, we use publicly available weather data from the Climate Research Unit (CRU) of the University of East Anglia to estimate the impact of changing environmental conditions on migration. In addition, we use the information on natural disasters from IFLS to look into fast onset events. To test for the moderating role of resources in influencing migration outcomes due to environmental stress, we make use of several cash transfer programs that was implemented in Indonesia starting from 2005. In particular, we examine three government programs targeted to poor households in Indonesia: two unconditional cash transfer programs and one conditional cash transfer program. We exploit temporal variation in the receipt of the unconditional cash transfer as well as temporal and spatial variation in the conditional cash transfer program. We make use of this variation and the longitudinal data of the IFLS to estimate the moderating impact of resource access on environmental migration.

Our results demonstrate heterogeneous responses to different kinds of climate shocks and the differential role of cash transfer in adaptation. We find that households that received cash transfers migrate less in response to current-year rainfall shocks. However, when exposed to rainfall shocks for several years, they change their behavior and utilize the money to move out of affected areas. Regarding temperature variability, we find that households that receive financial support from the government migrate more after temperature anomalies than those that do not receive the support. Another finding suggests that households affected by natural disasters, such as floods, landslides, and droughts, tend to migrate less if they receive cash transfers, which is consistent with the evidence we find for short-term rainfall shocks. Finally, our results suggest that members of a household that received cash transfers are less likely to change jobs and enter the risky agricultural sector, and are more likely to leave an occupation in the agricultural sector as a response to rainfall and temperature shocks.

Thus, our research contributes to better understanding of adaptation strategies to climate shocks, particularly in the form of migration, depending on having access to financial resources. From the policy perspective, our study shed light on how the choice of adaptation mechanisms of poor households changes conditional on having additional financial resources.

The remainder of this paper is organized as follows. Section 2 provides an overview of the related literature. Section 3 describes the setting and the data. Section 4 presents our empirical and identification strategy. Section 5 presents results of our empirical analyses, while Section 6 is dedicated to the Robustness Checks for our main results. Finally, Section 7 concludes.

2 Literature Review

The study builds on two strands of literature. First, on the literature within determinants of migration and the climate-migration link. Although the research area is developing rapidly, there are still questions that have not been addressed by existing studies. This study addresses one of them: how households decide whether to migrate as a response to a climate shock depending on their access to resources.

Building on the second strand, we investigate how access to resources influences a household's decision to migrate. We provide an overview of several studies in this area. Although the findings differ, there is evidence that accessibility to financial resources can be a significant factor in the migration decision. In this section, we firstly introduce literature on the climate-migration nexus, and then literature on the influence of access to financial resources on migration.

There is a growing body of literature that investigates the influence of climate shocks on migration, part of which examines the effect of fast-onset events, such as floods, landslides, earthquakes, and hurricanes, on migration flows. Majority of existing studies agree that migration in response to fast-onset events tend to be over short distances and temporary (Cattaneo et al., 2019). Halliday (2006) exploits earthquakes in El Salvador as an exogenous shock for households and finds that migration to the United States increased at all wealth levels. However, the author finds that wealthier households tend to migrate more since they are less liquidity constrained. Using municipality-level data in Mexico, Saldana-Zorrilla and Sandberg (2009) demonstrate that municipalities that experienced disasters (droughts, floods, hurricanes) more often exhibit higher migration rates in the 1990-2000 period.

Carvajal and Pereira (2010) use panel data of households in Nicaragua to study how people adapt to natural hazards. The study shows that hurricane Mitch, which hit Nicaragua in 1998, induced affected households to migrate more than those who were unaffected.

Another part of the literature examines the effect of slow-onset events, such as the rise in temperature, change in rain patterns, and droughts, on migration. Here, the most relevant study for us is the paper by Thiede and Gray (2017), which shows how migration in Indonesia is influenced by climate shocks, in particular by rising temperature and monsoon delay. The authors find that increasing temperatures decrease out-migration from affected areas, while monsoon delay does the opposite. Their results vary significantly for different groups of people depending on gender, age and other characteristics, which imply the heterogeneous use of migration as an adaptation strategy. Dillon, Mueller and Salau (2011) use panel data of Nigerian households to investigate how households respond to variability in temperature and the days suitable for growing crops. The study shows that males decide to migrate as a response to ex-ante and ex-post risk. Mueller, Gray and Kosec (2014) study the effect of heat stress on rural migration in Pakistan. The authors find that heat consistently increases the migration of men due to its adverse effects on farm and non-farm income.

Cattaneo and Peri (2016) conduct a cross-country study to demonstrate that an increase in temperature decreases the migration flow from poor countries, consistent with the hypothesis of the presence of liquidity constraints. Nawrotzki and Bakhtsiyarava (2017) use census and climate data for Senegal and Burkina Faso to understand whether the population adapts to climate shocks *in situ* or decides to migrate. They show that excessive precipitation increases international out-migration from Senegal, while increasing temperature decreases migration out-flow from Burkina Faso. The authors conclude that adverse climate shocks can lead to trapping the poor population, thereby undermining their ability to migrate. Groschl and Steinwachs (2017) show in a cross-country study that droughts increase migration for middle-income countries consistent with the presence of liquidity constraints for migration in poor countries. Rich countries do not exhibit increased out-migration due to developed insurance schemes.

There is also a vast literature that considers a link between access to financial resources and migration. Stecklov et al. (2005) use data from the Progresa/Oportunidades conditional cash transfer program in Mexico to study its effect on internal and external out-migration. The authors exploit the random program assignment to the treatment and control communities during a pilot phase. The results of the study demonstrate that conditional cash transfers reduce out-migration to the United States but do not change internal migration patterns. Angelucci (2015) also uses data on the same conditional cash transfer program to study labor migration to the United States. In contrast to the paper by Stecklov et al. (2005), the author finds that better access to financial resources for poor households in Mexico increases labor migration to the United States. Specifically, conditional cash transfers allow less skilled migrants to move to the United States. The results of the two papers seem to be contradictory; however, the studies focus on two different types of migration: overall migration and labor migration.

Bryan, Chowdhury, and Mobarak (2014) develop a model with risky migration and test it using data from a randomized trial. The authors randomly assign an \$8.50 incentive to households in rural Bangladesh to temporarily out-migrate to the urban areas during the "lean season"[1]. The study shows that financial incentives induce more people to migrate and increase their consumption. In this case, access to financial resources can work as a

[1]the lean season is the time of year between planting and harvest when food runs out

complement to migration because, without it, households were liquidity constrained or too risk-averse.

Poggi (2019) uses a quasi-random experiment in Thailand to study credit availability and internal migration. The author studies the effect of the Thailand Village and Urban Community Fund Program (VFP). In 2001, the Thai government introduced this microfinance initiative, which distributed to each village one million Baht or US $24,000 in 2001 prices. A group of village members provided short-term credit to fellow villagers. The exploited variation comes from the equal amount of money that all of the villages received despite their size. Employing an instrumental variables approach, the author finds that borrowing reduces internal migration in the medium-term, but it does not affect migration when the policy is first introduced.

The reviewed studies demonstrate evidence supporting two different hypotheses. The studies by Stecklov et al. (2005) and Poggi (2019) support the hypothesis that better access to financial resources improves living conditions at the place of residence, making it less profitable to out-migrate. As a result, they observe decreasing migration flows. The studies by Angelucci (2015) and Bryan, Chowdhury, and Mobarak (2014) support another view that better access to financial resources induces out-migration due to relaxing the liquidity constraints of the population. In our study, we try to reconcile the research question in a slightly different framework that also incorporates climate shocks. We attempt to understand whether better access to financial resources induces people to migrate after a climate shock (climate-driver mechanism), or whether it results in the household deciding to adapt to the climate shock at the place of residence due to better adaptation capacity (climate-inhibitor mechanism).

Studies by Halliday (2006), Nawrotzki and Bakhtsiyarava (2017), Cattaneo and Peri (2016),and Groschl and Steinwachs (2017) elaborate on the climate-inhibitor mechanism and liquidity constraints that poor countries and poor households face after adverse climate shocks, thus making people unable to migrate. However, their findings are based on the comparison between rich and poor and do not reveal how poor households respond to climate shocks when they gain better access to financial resources. Our study contributes to the literature by filling this gap. Specifically, we use cash transfer programs in Indonesia to identify adaptation strategies of households in reaction to environmental distress in case of better access to financial resources.

3 The Background and Data

Climate change has affected Indonesia with more frequent droughts, heatwaves, and floods occurring in the country. These shocks pose an increasing threat to the country's development (Climate Change Profile: Indonesia, 2018). The World Bank has ranked Indonesia 12th among 35 countries that face high mortality risks due to multiple hazards such as increasing temperature, changing rainfall patterns, and, more importantly, exposure to various natural disasters. Considering the high exposure of Indonesia to environmental hazards, the country offers a well-suited setting for our analysis.

Our choice of Indonesia is also based on the presence of the country's governmental cash transfer programs: Bantuan Langsung Tunai (BLT), Program Keluarga Harapan (PKH), and Bantuan Langsung Sementara Masyarakat (BLSM) conducted by the government of Indonesia. In our research, the reception of cash transfer serves as a case of better access to financial resources for poor households. The goal of two unconditional cash transfer programs was to increase the consumption of the poor population by providing them with some external finances. Although there is no spatial variation in receiving these transfers, there are temporal differences: we observe in the data that different households received the transfers in different years in a small window. The goal of the PKH is the alleviation of poverty by providing financial resources to families with children if they fulfill basic obligations by utilizing health and education services. The useful (for our research design) features of this particular conditional cash transfer program is the gradual introduction of the program to other provinces. PKH first started with a pilot-program and only after that gradually started to expand over the country, which, for our study, creates time and spatial variation in the access to this program. Seven provinces that participated in the pilot program are West Java, East Java, West Sumatra, North Sulawesi, Gorontalo, East Nusa Tenggara, and DKI Jakarta. These provinces were chosen to represent various types of areas that are present in Indonesia (World Bank, 2012).

We concentrate on the population that remains consistently poor in our studied period in order to have a best possible treatment and control groups. Thus, we focus on households with similar characteristics that are eligible for the receiving of cash transfer programs. This study utilizes variation in receiving the cash transfers to understand how better access to financial resources influences the adaptation of the households to climate shocks; more specifically, we investigate migration as an adaptation strategy.

To conduct the analysis, we use data from several sources, the first of which is the Indonesian Family Life Survey (IFLS)[2], an on-going longitudinal survey in Indonesia. IFLS is representative of about 83% of the Indonesian population (Strauss, Witoelar, and Bondan, 2007) and has 5 waves: IFLS1 in 1993-1994, IFLS2 in 1997-1998, IFLS3 in 2000, IFLS4 in 2007-2008, and IFLS5 in 2014-2015. Since the PKH was introduced in 2007, the last three waves of the IFLS are appropriate sources of information for our analysis. IFLS data is especially suitable for studying migration due to the high effort to track the respondents over time, which leads to low rates of attrition. This data set records all the moves longer than 6 months by people older than 12 years of age. In addition to detailed information about migration, IFLS also has data on socio-economic and demographic characteristics of households and individuals.

Sources that provide data about weather characteristics are abundant. They include the dataset produced by the Climatic Research Unit at the University of East Anglia, weather data obtained from the Center for Climatic Research at the University of Delaware, and NASA MERRA-2, among others. All of these datasets provide information about precipitation and temperature on grids of 0.5 by 0.5 degrees, which corresponds to about 50 by 50 kilometers in Indonesia. We use weather data obtained from the Climatic Research Unit at the University of East Anglia[3], particularly data about temperature and precipitation, which we use to investigate the effect of slow-onset events on migration.

[2] retrieved from https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS/download.html

[3] retrieved from https://www.uea.ac.uk/groups-and-centres/climatic-research-unit

For natural disasters we use the data from IFLS, since this survey also has information about natural disasters occurring in different parts of Indonesia. This data turned out to be more precise for our purposes than our initial choice, EM-DAT. Data from the International Disaster Database EM-DAT record natural disasters and can be used to study the effect of the fast-onset events. EM-DAT contains data on the occurrence and effects of mass disasters in the world from 1900 until today.

After combining the data about precipitation and temperature with different waves from IFLS we now have the household-year panel dataset, which contains information about poor households in Indonesia with several socio-economic characteristics as well as the history of weather and natural disasters that they experienced each year. Table 1 below shows the summary statistics of our panel dataset.

Table 1: Summary Statistics

	Mean	SD	Min	Max	N
Migration	0.08	0.26	0.00	1.00	17,546
1 Person Migration	0.05	0.23	0.00	1.00	17,546
Family Migration	0.03	0.17	0.00	1.00	17,546
Cash Transfer	0.16	0.36	0.00	1.00	17,546
Temperature Shock	0.15	0.36	0.00	1.00	17,546
Rainfall Shock	0.08	0.27	0.00	1.00	17,542
Flood	0.03	0.18	0.00	1.00	17,546
Landslide	0.01	0.10	0.00	1.00	17,546
Tsunami	0.00	0.01	0.00	1.00	17,546
Drought	0.02	0.13	0.00	1.00	17,546
Assests	2.00	0.93	1.00	4.00	17,544
Urban	0.33	0.47	0.00	1.00	17,546
Household's Size	4.88	2.47	1.00	16.00	17,536
Female household head	0.13	0.34	0.00	1.00	17,354
Share of children	0.35	0.23	0.00	1.00	17,534
Share of females	0.53	0.20	0.13	1.00	17,411
Share of mobile	0.37	0.16	0.08	1.00	15,814
Muslim	0.85	0.35	0.00	1.00	17,534

4 Identification Strategy

We use the status of receiving a cash transfer in a particular year as a variation in the access to resources. Since we have two sources of variation in cash transfers and in climate, we use the following approach:

$$M_{ist} = \alpha_1 + \alpha_2 * X_{ist} + \mu_t + \mu_i + \mu_s$$

$$+\beta_1 * ClimateShock_{ist}$$

$$+\beta_2 * CashTransfer_{ist}$$

$$+\beta_3 * (CashTransfer_{ist} * ClimateShock_{ist}) + \epsilon_{ist}$$

where i indexes households, s indexes sub-districts, and t indexes time.

X_{ist} is a vector of the control variables of the household, μ_t, μ_s, and μ_i are time, sub-district, and household fixed effects. The outcome variable M_{ist} is the migratory decision of the household - dummy variable that equals one if a household sends a migrant and zero if not. The variable $CashTransfer_{ist}$ is a dummy variable, which equals to 1 if the household has a cash transfer in this year, 0 if not. The variable $Climate_{ist}$ can be discrete (1 if household hit by climate shock, 0 if not) or continuous (deviation from the historical mean in precipitation/temperature).

We are interested in the coefficient before the interaction term. The obtained coefficient measures variation in migration for the cash transfer group relative to the non-cash transfer group for households that were strongly hit by a climate shock, relative to those that were hit less, between the before and after period.

Changing rainfall patterns demonstrate more variability in Indonesia than variation in the temperature, which is visible in Figure 1 and Figure 2, with larger variation in the rainfall than temperature. As a result, floods and landslides are two of the most frequent disastrous events that occur in Indonesia, both of which are precipitated by heavy rains. For this reason, we concentrate on the rainfall variation more, but we also explore temperature variation as well as natural disasters such as floods, landslides and

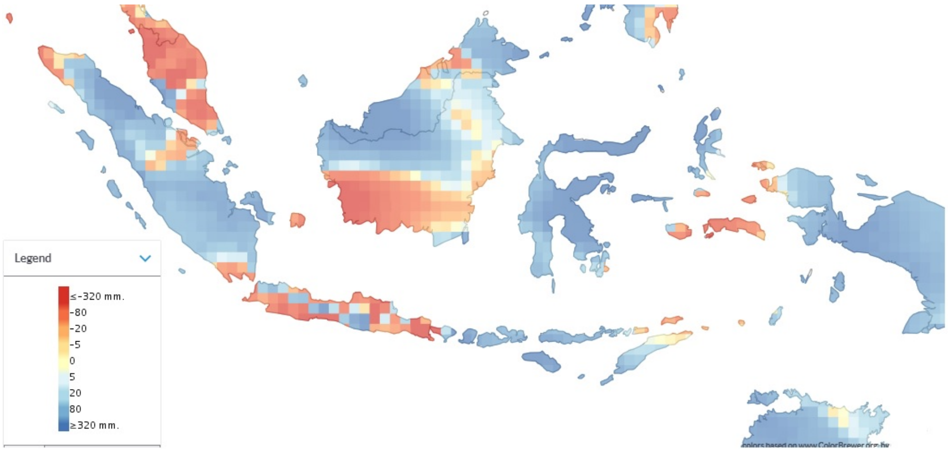

Figure 1: Trends in Rainfall, 1901-2012

Figure 2: Trends in Temperature, 1901-2012

Notes: Figure 1 presents areas in Indonesia with less rain than historical mean (red) and with more rain than historical mean (blue). Figure 2 does the same for the temperature trends - higher temperatures (red) and lower (blue).
Source: Climatic Research Unit at the University of East Anglia

droughts. Thus, we explore two types of climate shocks: slow-onset events (temperature and precipitation anomalies) and fast-onset events (natural disasters).

For a sub-district s in year t, we define its own rainfall anomaly as:

$$RA_{st} = \frac{Rainfall_{st} - \overline{Rainfall_s}}{SD_s} \tag{1}$$

where s indexes sub-districts, and t indexes time. We say that the household is hit by a shock if it lives in the sub-district where in year t $|RA_{st}| > 2$. Thus, if we observe in the data that subdistrict s experienced rainfall anomaly in year t that was highly drastic,

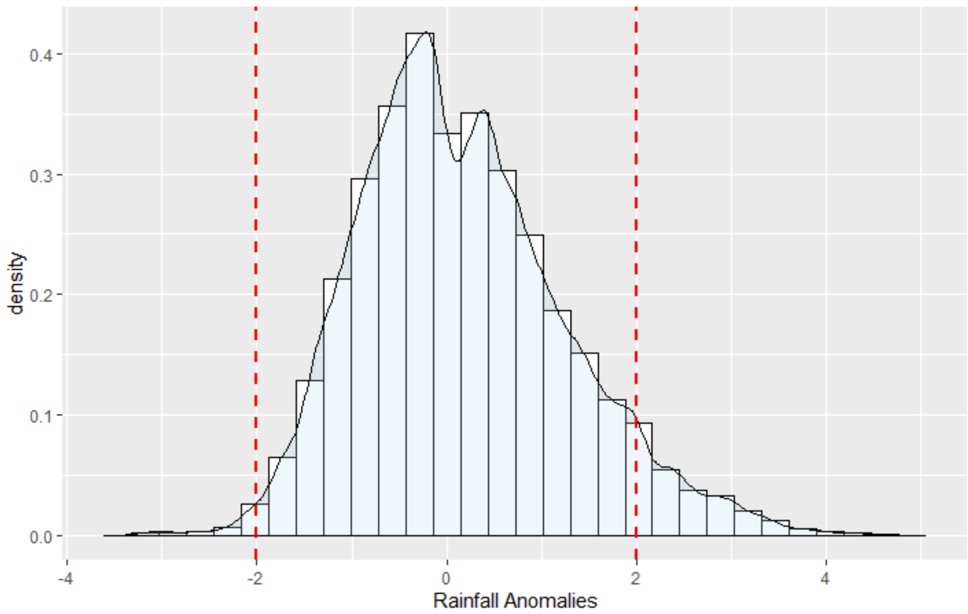

Figure 3: Distribution of Rainfall Anomalies

Notes: Figure 3 presents a histogram of rainfall anomalies in the studied period. Red lines are thresholds for creating the rainfall shocks variable; if the value of rainfall anomaly lies beyond the red line, we consider this a rainfall shock.
Source: Authors' calculation based on data from the Climatic Research Unit at the University of East Anglia

we designate a rainfall shock to that district. Figure 3 demonstrates the distribution of rainfall anomalies by their magnitude.

Figure 4 shows the rainfall anomalies in Indonesia in different years and indicates no clear pattern in the rainfall anomalies area-wise, which supports the identification strategy that we build on - unexpected deviations from the normal historical amount of rain for certain areas.

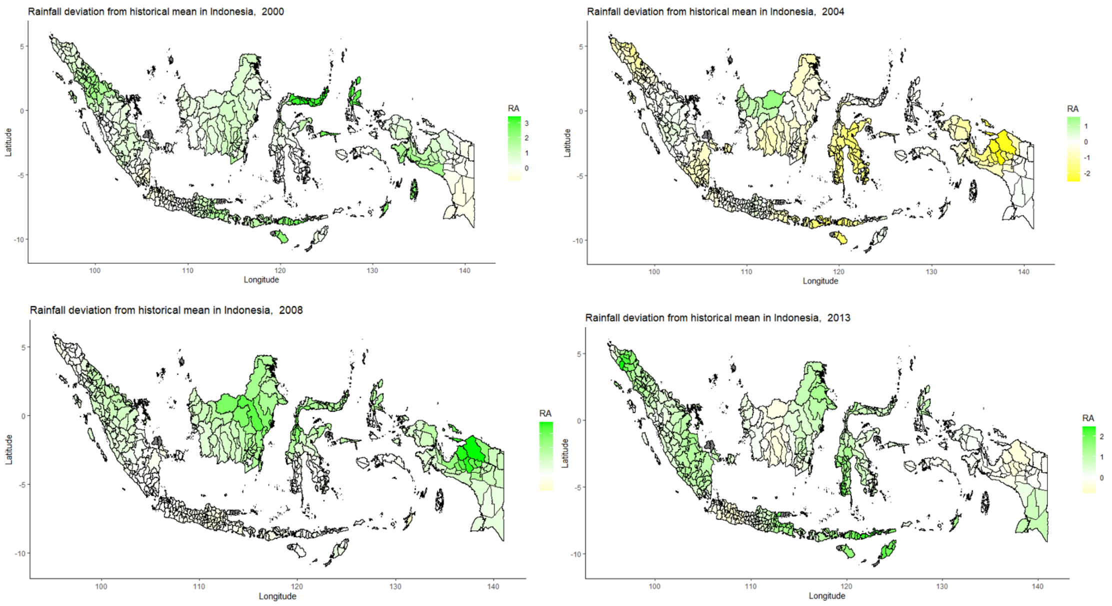

Figure 4: Rainfall Anomalies in Indonesia

Notes: Figure 4 presents maps of rainfall anomalies in different years. Green means a higher than historical mean amount of rain, yellow - lower.
Source: Authors' calculation based on data from the Climatic Research Unit at the University of East Anglia

For a sub-district s in year t, we define its own temperature anomaly as:

$$TA_{st} = \frac{Temperature_{st} - \overline{Temperature_s}}{SD_s}$$

where s indexes sub-districts, and t indexes time.

As indicated in Figure 5, the distribution of temperature anomalies in Indonesia is not centered around 0. Unlike rainfall, temperature in the studied period was much higher than historical means. Following the literature, we define that the household is hit by a shock if it lives in the sub-district where in year t $TA_{st} > 2$ and $TA_{st} < 0.4$. A second cut-off was chosen to contain the same percentage of negative shocks as positive ones. In the same manner as for the rainfall shocks we designate temperature shock to the district if it experienced a drastic deviation from the historical mean temperature.

As Figure 6 demonstrates, temperature in Indonesian districts also demonstrates variability throughout the years, although somewhat less than precipitation. To ensure that migration is not dictated by anticipation of the shocks rather than the shocks themselves,

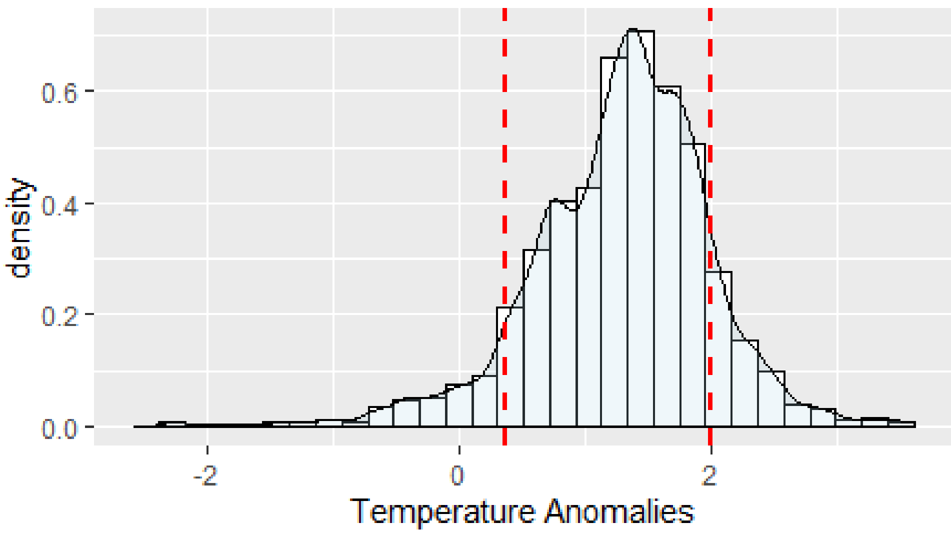

Figure 5: Distribution of Temperature Anomalies

Notes: Figure 5 presents a histogram of temperature anomalies in the studied period. Red lines are thresholds for creating the temperature shocks variable; if the value of temperature anomaly lies beyond the red line, we consider this a temperature shock.
Source: Authors' calculation based on data from the Climatic Research Unit at the University of East Anglia

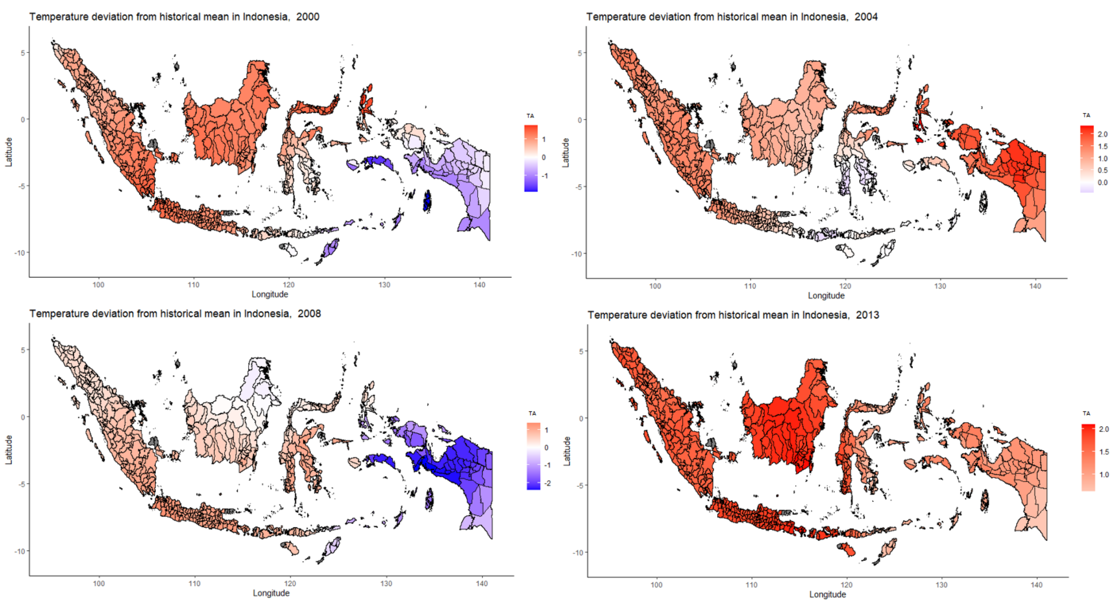

Figure 6: Temperature Anomalies in Indonesia

Notes: Figure 6 presents maps of temperature anomalies in different years. Red means that the temperature was higher than the historical mean, blue - lower.
Source: Authors' calculation based on data from the Climatic Research Unit at the University of East Anglia

we check this empirically in the Appendix.

5 Results

5.1 Rainfall Shocks

In this subsection, we concentrate on the precipitation shocks in the data. Based on the literature (Thiede and Gray (2017); Mueller, Gray and Kosec (2014); Nawrotzki and Bakhtsiyarava (2017)), we construct the shock climate variable as follows: if average yearly precipitation in *kecamatan* (sub-district in Indonesia) deviated from the historical mean (calculated on the time span from 1901-2015) more than 2 standard deviations, the *kecamatan* is considered to have a shock.

Table 2 shows the relationship between rainfall shocks, cash transfer status, and migration decisions. To ensure that our identification is not threatened by anticipation of the shock and a causal relationship between cash transfer and the shock, we empirically test it. In the Appendix, Table 13 checks that receiving a cash transfer in year t is not dictated by being hit by a rainfall shock in year t (orthogonality checks), and Table 12 checks that there is no anticipation of shock.

In line with Thiede and Gray (2017), precipitation variation in the form of rainfall shocks is not significantly important for migration decisions. Table 2 shows that the interaction term of cash transfer and rainfall shock is decreasing migration in treated areas: under the shock, households that had access to a government cash transfer in that year decide to migrate less frequently compared to those who did not receive a cash transfer. The result is stable in size and significance both in specification with and without controls. We conclude that the effect of interest - the interaction between rainfall shock and receiving a cash transfer - has a significant negative effect on the migration of poor households, which suggests that the interaction term facilitates the climate-inhibitor mechanism in the short term. We believe that the logic is similar to an insurance mechanism: since migrating is a costly strategy both in terms of finance and mental costs, affected households use the finance provided by the government as a means to adapt to a short-term shock on the place of residence rather than choosing costly migratory behaviour. To

Table 2: Rainfall Shocks, CT, and Migration

	Migration and Rainfall Shocks		Migration, CT, and Rainfall Shocks	
	(1)	(2)	(3)	(4)
Rainfall Shock	-0.0151	-0.0146	-0.0093	-0.0090
	(0.0127)	(0.0126)	(0.0142)	(0.0141)
Cash Transfer			0.0084	0.0075
			(0.0077)	(0.0078)
Rainfall Shock × Cash Transfer			-0.0402**	-0.0391**
			(0.0190)	(0.0191)
Observations	18440	18291	18440	18291
Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the baseline results of the regression analysis. The dependent variable is all migration decisions. Columns (1) and (2) report the coefficient estimate after estimating rainfall shock influence on migratory decisions without and with controls. Columns (3) and (4) report the key estimates from fitting our main model with and without controls, respectively. Controls include: household size, the share of mobile hh members, assets, muslim, urban

strengthen this result in the section with Robustness check, we estimate several different specifications. First, we change the definition of the shock from a yearly dummy to how many months in a given year the rainfall exceeds the monthly historical mean (Table 9). We find a similar pattern, with a cash transfer decreasing the probability of migration as a response to a rainfall shock. Subsequently, we try the same baseline specification, but we change the studied period to a larger one - from 1997 to 2014 (Table 10). We use a smaller period in the main specification because cash transfer programs started from year 2005. To have data more or less symmetrically distributed around those years, we use three waves of IFLS beginning from 2000. In this check as well, the result survived the inclusion of additional time periods and we still observe negative effect of the interaction term on the migration decision.

We find some evidence of a behavioral change from a cash transfer as a response to a current shock. However, we are also interested in the influence of being exposed to a rainfall shock several times. Thus, we next explore accumulated rainfall shocks and their connection with migration and the moderating effect of cash transfers.

We have already found evidence that a cash transfer can play a moderating role in facilitating the climate-inhibitor mechanism for the short-term shock in period t. However, being exposed to rainfall anomalies multiple times might change the behaviour of the households. We construct a measure of accumulated shock for several periods that occurs if a household received a sum of the rainfall anomalies exceeding a certain threshold. We define Accumulated shock=1 if $\sum_{t-n}^{t} |RA_{st}| > Cutoff$. The baseline results of the model with n=3 and *Cutoff*=5 are in Table 3. To ensure that our results are not dictated by chosen thresholds, we conduct robustness checks with a different number of years for which the shock is calculated and different cutoffs, see Table 11 in the Robustness Check section. Orthogonality check is in Table 14 in the Appendix.

Table 3: Accumulated Rainfall Shocks, CT, and Migration

	Migration, Accumulated Shock for 4 periods		
	(1) All	(2) 1 person	(3) Family
Accumulated Shock for 4 Periods	-0.0234**	-0.0197**	0.0066
	(0.0093)	(0.0085)	(0.0071)
Cash Transfer	0.0066	0.0035	-0.0163*
	(0.0077)	(0.0069)	(0.0095)
Accumulated Shock for 4 Periods × Cash Transfer	-0.0124	-0.0096	0.0997**
	(0.0132)	(0.0114)	(0.0389)
Observations	21114	21114	21114
Controls	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from fitting our main model. Outcome variables are all moves, moves undertaken by one person, and moves undertaken by part or whole households stored in Columns (1), (2), and (3), respectively. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Several things are of interest here. First, the accumulated shocks have a heterogeneous effect on the migratory decisions of the poor population depending on the types of moves. It seems to decrease the probability of sending 1 migrant from the household, but the sign for migration of the whole household is different. The interaction term seems to have a negative effect on all moves and moves undertaken by 1 person, but it has a positive significant effect on moves undertaken by families, which implies that for this group a cash transfer facilitates the climate-driver mechanism. This might be explained by the households changing their beliefs about how hazardous the place of residence is: one period shock might not be enough for households to change their beliefs, but being exposed to a shock several times leads to a reassessment of the risk of being hit by a rainfall shock in the future, which leads to the household choosing the migration option as an adaptation strategy.

5.2 Temperature Shocks

In this subsection, we move to another slow-onset event that threatens Indonesia, which is increasing temperature. We attempt to unpack whether a cash transfer distorts the behaviour of poor households as a response to drastic temperature shocks. Table 4 shows our baseline estimations that replicate the same models we estimated for rainfall shocks.

Table 4: Temperature Shocks, CT, and Migration

	Migration and Temperature Shocks		Migration, CT, and Temperature Shocks	
	(1)	(2)	(3)	(4)
Temperature Shock	-0.0113	-0.0129	-0.0168*	-0.0184*
	(0.0091)	(0.0092)	(0.0101)	(0.0103)
Cash Transfer			0.0068	0.0060
			(0.0083)	(0.0083)
Temperature Shock=1 × Cash Transfer=1			0.0280	0.0284
			(0.0197)	(0.0193)
Observations	17541	17406	17541	17406
Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the baseline results of the regression analysis. The dependent variable is all migration decisions. Columns (1) and (2) report the coefficient estimate after estimating temperature shock influence on migratory decisions without and with controls. Columns (3) and (4) report the key estimates from fitting our main model with and without controls, respectively. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

We find that temperature variation is significantly important for migration decisions - households that experienced high temperatures tend to migrate less than those that did not. This finding is again in line with what Thiede and Gray (2017) find in their paper - temperature deviations significantly decrease the probability of migration. However, we do not find any significant effect of cash transfers on the migratory behaviour of the households. We might note, though, that a solo cash transfer effect is positive, as it is for the rainfall shocks, and the interaction term of interest has a positive sign, which is the opposite of what we find for the rainfall shocks. The effect is close to being significant at the 10% level. Thus, we may presume that temperature shocks are perceived differently than rainfall shocks and that is the reason for the different use of a cash transfer in this case.

Table 5 shows the effect of accumulated temperature shocks and cash transfers. Although non-significantly, the main pattern remains as in the case of accumulated rainfall shocks: migration of the whole or part of the household is facilitated by a cash transfer as an adaptation strategy to a shock.

Table 5: Accumulated Temperature Shocks, CT, and Migration

	Migration					
	n=2		n=3		n=4	
	All	Family	All	Family	All	Family
Accumulated Shock	-0.0018	0.0048	-0.0034	0.0032	-0.0111	-0.0029
	(0.0107)	(0.0062)	(0.0105)	(0.0075)	(0.0127)	(0.0071)
Cash Transfer	-0.0005	0.0018	0.0020	0.0028	0.0029	0.0009
	(0.0084)	(0.0070)	(0.0089)	(0.0071)	(0.0100)	(0.0079)
Accumulated Shock × Cash Transfer	0.0314*	0.0005	0.0238	-0.0036	0.0139	0.0032
	(0.0162)	(0.0101)	(0.0177)	(0.0093)	(0.0174)	(0.0099)
Observations	17406	17406	17406	17406	17406	17406
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our main model. Outcome variables are all moves and moves undertaken by part or whole households. Columns (1) and (2) present the results for accumulated shocks calculated for two periods. Columns (3) and (4) show the results for accumulated shocks calculated for three periods. Finally, Columns (5) and (6) present the results for accumulated shocks calculated for four periods. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

5.3 Natural Disasters

In this subsection, we examine how natural disasters influence the migration decisions in our data. Natural disasters are assumed to be unexpected events and are often used in different areas of research as a source of exogenous variation (Halliday (2006) Carvajal and Pereira (2010)). We incorporate the interaction term into the same model to understand if recipients of cash transfer programs react to natural disasters differently than non-recipients. The results are presented in Table 6.

Table 6: Natural Disatsers, CT, and Migration

	Migration					
	Flood		Landslide		Drought	
	All	Family	All	Family	All	Family
Event	-0.0066	-0.0086	-0.0029	-0.0059	0.0077	0.0065
	(0.0132)	(0.0058)	(0.0176)	(0.0132)	(0.0158)	(0.0109)
Cash Transfer	0.0047	0.0024	0.0049	0.0034	0.0042	0.0030
	(0.0070)	(0.0068)	(0.0071)	(0.0068)	(0.0070)	(0.0067)
Event × Cash Transfer	-0.0035	-0.0176	-0.0112	-0.0626***	0.0172	-0.0636*
	(0.0205)	(0.0205)	(0.0236)	(0.0207)	(0.0312)	(0.0347)
Observations	21114	21114	21114	21114	21114	21114
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our main model with three types of shock. Outcome variables are all moves and moves undertaken by part or whole households. Columns (1) and (2) present the results for floods. Columns (3) and (4) show the results for landslides. Finally, Columns (5) and (6) present the results for droughts. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 6 shows that the interaction term has a mostly negative effect on migration decisions, meaning that poor households use additional money to adapt to the shock at the place they reside rather than move away. This is supported by evidence from the literature that records short-term movements out of affected areas after a natural disaster but returning to the area in the longer term. The findings of Table 6 also mimic the results from rainfall shocks (short-term).

5.4 Change of Occupation

Next, we investigate another adaptation strategy that household use to cope with climate shocks - occupational change. We also attempt to uncover how the presence of a cash transfer program influences occupation decisions and how households act when they are exposed to a climate shock and receive a transfer. We assume that agriculture is the sector that suffers from rainfall and temperature shocks the most, and we look into two outcome variables: change out of the agricultural sector and change into the agricultural sector, expecting the opposites signs from our interaction term. We consider stayers only (households that did not have migration recorded) because migration and change of occupation mostly occur simultaneously. Tables 7 and 8 examine the relationship between the change into and out of agriculture, cash transfers, and rainfall and temperature shocks.

Table 7: Rainfall Shocks, CT, and Occupational Choices in Agriculture

	Out of Agriculture	Into Agriculture
	(1)	(2)
Rainfall Shock	-0.0054	0.0092
	(0.0098)	(0.0128)
Cash Transfer	0.0073	0.0180**
	(0.0082)	(0.0084)
Rainfall Shock × Cash Transfer	0.0346	-0.0426***
	(0.0282)	(0.0150)
Observations	8594	8594
Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Household Fixed Effects	Yes	Yes
Sub-district Fixed Effects	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our model, in which outcomes are change occupation by hh member out (Column 1) and into agriculture (Column 2). Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 8: Temperature Shocks, CT, and Occupational Choices in Agriculture

	Out of Agriculture	Into Agriculture
	(1)	(2)
Temperature Shock	-0.0161**	-0.0071
	(0.0065)	(0.0074)
Cash Transfer	0.0081	0.0175**
	(0.0079)	(0.0082)
Temperature Shock × Cash Transfer	0.0153	-0.0082
	(0.0145)	(0.0162)
Observations	8437	8437
Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Household Fixed Effects	Yes	Yes
Sub-district Fixed Effects	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our model, in which outcomes are change occupation by hh member out (Column 1) and into agriculture (Column 2). Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Tables 7 and 8 indicate that receiving a cash transfer decreases the probability of household members changing their job into risky agricultural sector after a shock. Conversely, although not as evident, the tables show that receiving a cash transfer increases the likelihood of household members leaving the agricultural sector. Both interaction terms are of the same sign for rainfall (Table 7) and temperature shocks (Table 8).

6 Robustness Check

We conduct several robustness checks to ensure that the patterns we observe in our baseline results are robust to several modifications. First, to strengthen our result, we also consider a second discrete measure of rainfall shock. For a sub-district s, we define its monthly rainfall anomaly as:

$$RA_{sm} = \frac{Rainfall_{sm} - \overline{Rainfall_s}}{SD_s}$$

where s indexes sub-districts, and m indexes months.We define Rainfall Shock for a given year=Number of months in a given year with $|RA_{sm}| > 2$. Table 9 summarizes the results from our baseline and from the new measure of the shock.

Table 9: Rainfall Shocks, CT, and Migration

	Migration			
	Rainfall Shock (Yearly Measure)		Rainfall Shock (Monthly Measure)	
	(1)	(2)	(3)	(4)
Rainfall Shock	-0.0093	-0.0090	-0.0023	-0.0022
	(0.0142)	(0.0141)	(0.0031)	(0.0031)
Cash Transfer	0.0084	0.0075	0.0126	0.0119
	(0.0077)	(0.0078)	(0.0085)	(0.0086)
Rainfall Shock × Cash Transfer	-0.0402**	-0.0391**	-0.0111	-0.0114*
	(0.0190)	(0.0191)	(0.0069)	(0.0069)
Observations	18440	18291	18440	18291
Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses
Sub-district Clustered SE
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our main model with two different measures of rainfall shocks. Columns (1) and (2) are baseline results with the shock defined in the main result section. Columns (3) and (4) use a different measure of rainfall shock based on the number of months in the given year with severe rainfall anomalies. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

As indicated in Table 9, even if we change the way we define rainfall shock, we still obtain the same pattern in the results. We still find that households that received a cash transfer migrated less as a response to a current rainfall shock compared to households without a cash transfer.

In our second robustness check we include the earlier waves of IFLS. We concentrate on information from the last 3 waves of IFLS since cash transfer programs were introduced only after 2000. However, to check that result still stands, we present results with all waves in Table 10.

Table 10: Rainfall Shocks, CT, and Migration

	Migration	
	(1) Rainfall Shock, 2000-2014	(2) Rainfall Shock, 1997-2014
Rainfall Shock	-0.0153	-0.0152
	(0.0126)	(0.0111)
Cash Transfer	0.0122	0.0141*
	(0.0078)	(0.0078)
Rainfall Shock × Cash Transfer	-0.0353*	-0.0339*
	(0.0205)	(0.0205)
Observations	17850	20545
Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Household Fixed Effects	Yes	Yes
Sub-district Fixed Effects	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our main model for two different periods. Column (1) is baseline results from 2000 to 2014. Column (2) uses different timespans from 1997 to 2014; we use one more wave of the IFLS survey for this specification. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Again, our result survives the robustness check and we find the same pattern and even the same magnitude of the effect of a cash transfer on migration decision after a rainfall shock. Therefore, we conclude that our result for a short-term rainfall shock is stable and does not change with modifications. Next, we conduct a battery of robustness checks for accumulated shocks. We vary the number of years for which a shock is calculated as well as the threshold. The results are presented in Table 11 below and show that the pattern we observe for our baseline results is also present in our robustness checks for different modifications of the model.

Table 11: Rainfall Shocks, CT, and Migration

	Migration									
	n=2		n=3		n=4, cutoff=5		n=4, cutoff=4.5		n=4, cutoff=5.5	
	All	Family	All	Family	All	Family	All	Family	All	Family
Accumulated Shock	-0.0010	-0.0004	-0.0019	0.0087	-0.0234**	0.0066	-0.0075	0.0052	-0.0178**	0.0015
	(0.0101)	(0.0066)	(0.0079)	(0.0063)	(0.0093)	(0.0071)	(0.0060)	(0.0051)	(0.0089)	(0.0084)
Cash Transfer	0.0065	-0.0163*	0.0078	-0.0162*	0.0066	-0.0163*	0.0086	-0.0088	0.0068	-0.0164*
	(0.0076)	(0.0091)	(0.0078)	(0.0094)	(0.0077)	(0.0095)	(0.0079)	(0.0100)	(0.0076)	(0.0094)
Accumulated Shock × Cash Transfer	-0.0128	0.1189***	-0.0192	0.1045**	-0.0124	0.0997**	-0.0164	0.0404	-0.0137	0.1059***
	(0.0129)	(0.0445)	(0.0130)	(0.0406)	(0.0132)	(0.0389)	(0.0112)	(0.0283)	(0.0126)	(0.0405)
Observations	21114	21114	21114	21114	21114	21114	21114	21114	21114	21114
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-district Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
Sub-district Clustered SE
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate from estimating our main model. Outcome variables are all moves and moves undertaken by part or whole households. Columns (1) and (2) present the results for accumulated shocks calculated for two periods. Columns (3) and (4) show the results for accumulated shocks calculated for three periods. Columns (5)-(10) present the results for accumulated shocks calculated for four periods with different cutoffs for creating shock variables. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

7 Conclusions

In light of the predicted adverse changes in temperature, precipitation, and increased frequency of natural disasters, research that investigates how environmental stress influences people's livelihood is highly relevant. Although the literature that considers the link between climate shocks and migration has grown significantly in the recent decades, there are still gaps in our understanding of different factors that affect people's decision to migrate. One such factor is access to financial resources. This access is especially crucial for poor households since they have fewer opportunities to build resilience against climate shocks.

Our study investigates how cash transfer programs in Indonesia influence the decision of poor households to migrate in response to climate shocks. We use the Indonesian Family Life Survey as well as data on climate and conditional cash transfers to answer the research question. This study can help to understand whether better access to financial resources induces poor households to migrate (send a migrant) or induces them to adapt to climate shocks at the place where they reside. The results may be beneficial from a policy perspective as they may unravel which strategy poor households choose to adapt to climate shocks if they are provided with financial aid programs.

The limitation of this study is that we can only observe moves longer than 6 months, which leaves migration for smaller periods unobserved for us.

Our findings suggest that a cash transfer program influences the behaviour of poor households in response to a climate shock, but it does so in different ways. First, it allows poor households not to choose migration as an immediate response to rainfall anomalies and natural disasters, potentially playing the role of insurance from a costly adaptation strategy and facilitating the climate-inhibitor mechanism. At the same time, receiving a cash transfer provides additional resources for an entire household to relocate in response to a long-term rainfall shock, exacerbating the climate-driver mechanism for such hazardous shocks. We also find evidence of a more prominent influence of temperature changes on migration; our results show that temperature shocks significantly decrease the probability of migration for poor households, which may suggest the presence of liquidity traps created by this kind of shock. This is supported by our finding that households that receive cash transfers overcome the trap and migrate more in response to temperature shocks compared to those that do not receive them. Natural disasters have a similar pattern as rainfall shocks: households with cash transfers migrate less in response to floods, landslides, and droughts. Here the explanation might lie in the nature of these shocks: they are usually rare and unexpected, and thus one event is not enough to change people's belief about how hazardous the place of their residence is. Therefore, people who were affected by a natural disaster, and possibly lost some assets, can use the money provided by the government to deal with the consequences at the place where they reside. Finally, we explore what households that decide to stay do to adapt to climate shocks. In particular, we investigate the occupational choices in the agricultural sector. We find that members of the household that received a cash transfer are less likely to change their job into the risky agricultural sector and are more likely to leave an occupation in the agricultural sector as a response to rainfall and temperature shocks.

We see many avenues for further development in this research area. We are currently working on the effect of conditional cash transfers only, since the experimental nature and gradual expansion of PKH creates a unique opportunity that we want to exploit for our identification strategy. We are also testing different measures of climate shocks, since it is clear from our results that different shocks may have different effects on migration. Another endeavor is to create a panel of individuals to complement our current research at the households level. Other interesting questions that potentially can be answered are following: Are households that decide to send someone to migrate or migrate altogether better off in terms of consumption? What happens in the labor market, and how do climate shocks influence the people's occupational choices? Another extension of this study concerns the heterogeneous effects of access to financial resources and climate shocks on migration. Heterogeneous effects with respect to the age and gender of the household head are important dimensions to investigate because they may shed light on how policies concerning climate adaptation can be better targeted to assist those in need. We hypothesize that households with higher shares of males and mobile people and households with male heads are more likely to migrate or send migrants in response to climate shocks if they have better access to financial resources.

References

Angelucci, M. (2015). Migration And Financial Constraints: Evidence From Mexico. *Review of Economics and Statistics*, 97(1), 224-228. doi:10.1162/RESTa00487

Biermann, F., Boas, I. (2010). Preparing for a Warmer World: Towards a Global Governance System to Protect Climate Refugees. *Global Environmental Politics*, 10(1), 60-+. doi:10.1162/glep.2010.10.1.60

Black, R., Arnell, N. W., Adger, W. N., Thomas, D., Geddes, A. (2013). Migration, immobility and displacement outcomes following extreme events. *Environmental Science Policy*, 27, S32-S43. doi:10.1016/j.envsci.2012.09.001

Bryan, G., Chowdhury, S., Mobarak, A. M. (2014). Underinvestment In A Profitable Technology: The Case Of Seasonal Migration In Bangladesh. *Econometrica*, 82(5), 1671-1748. doi:10.3982/ecta10489

Cahyadi, N., Hanna, R., Olken, B.A., Prima, R.A., Satriawan, E., Syamsulhakim, E. (2018). Cumulative Impacts of Conditional Cash Transfer Programs: Experimental Evidence from Indonesia. *NBER Working Paper No. 24670*, doi:10.3386/w24670

Carvajal, L., Pereira, I. (2010). Evidence on the Link between Migration, Climate Shocks, and Adaptive Capacity. In: Fuentes-Nieva R., Seck P.A. (eds) *Risk, Shocks, and Human Development*. Palgrave Macmillan, London. doi:10.1057/978023027412911

Cattaneo, C., Beine, M., Frohlich, C. J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., Millock, K., Piguet, E., Schraven, B. (2019). Human Migration in the Era of Climate Change. *Review of Environmental Economics and Policy*, 13(2), 189-206. doi:10.1093/reep/rez008

Cattaneo, C., Peri, G. (2016). The migration response to increasing temperatures. *Journal of Development Economics*, 122, 127-146. doi:10.1016/j.jdeveco.2016.05.004

Climate Change Profile: Indonesia (2018). Ministry of Foreign Affairs of the Netherlands. Retrived from https://www.government.nl/binaries/government/documents/publications/2019/02/05/climate-change-profiles/Indonesia.pdf

Dillon, A., Mueller, V., Salau, S. (2011). Migratory Responses to Agricultural Risk in Northern Nigeria. *American Journal of Agricultural Economics* 93(4), 1048-1061. doi:10.1093/ajae/aar033

Groschl, J., and Steinwachs, T. (2017). Do natural hazards cause international migration? *CESifo Economic Studies* 63, 445–80.

Halliday, T. (2006). Migration, risk, and liquidity constraints in El Salvador. *Economic Development and Cultural Change*, 54(4), 893-925. doi:10.1086/503584

IPCC (2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, in Stocker T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgeley (eds.), Cambridge University Press.

IPCC (2014), *Climate change 2014: impacts, adaptation, and vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.

Jones, B., O'Neill, B. (2016). Spatially explicit global population scenarios consistent with the shared socioeconomic pathways, *Environmental Research Letters*, 11(8), 10. doi:10.1088/1748-9326/11/8/0840

Mueller, V., Gray, C., Kosec, K. (2014). Heat stress increases long-term human migration in rural Pakistan. *Nature Climate Change*, 4(3), 182-185. doi:10.1038/nclimate2103

Myers, N. (2002). Environmental refugees: a growing phenomenon of the 21st century. *Philosophical Transactions of the Royal Society B-Biological Sciences*, 357(1420), 609-613. doi:10.1098/rstb.2001.0953

Nawrotzki, R. J., Bakhtsiyarava, M. (2017). International Climate Migration: Evidence for the Climate Inhibitor Mechanism and the Agricultural Pathway.*Population Space and Place*, 23(4). doi:10.1002/psp.2033

Poggi, C. (2019). Credit Availability and Internal Migration: Evidence from Thailand. *Journal of Development Studies*, 55(5), 861-875. doi:10.1080/00220388.2018.1498969

Renaud, F., Bogardi, J.J., Dun, O. Warner, K. (2007). Control, adapt or flee: how to face environmental migration?. *UNU-EHS InterSecTions*. UNU- EHS

Saldana-Zorrilla, S. O., Sandberg, K. (2009). Spatial econometric model of natural disaster impacts on human migration in vulnerable regions of Mexico. *Disasters*, 33(4), 591-607. doi:10.1111/j.1467-7717.2008.01089.x

Stecklov, Guy Winters, Paul Stampini, Marco Davis, Benjamin. (2005). Do Conditional Cash Transfers Influence Migration? A Study Using Experimental Data From the Mexican Progresa Programme. *Demography*. 42. 769-90. doi:10.1353/dem.2005.0037

Stern, N. (2007). The economics of climate change: The Stern review, Cambridge University Press. doi:10.1017/CBO9780511817434

Strauss J, Witoelar F, Bondan S. (2016). The fifth wave of the Indonesia family life survey: overview and field report. RAND.

Thiede, Brian Gray, Clark. (2017). Heterogeneous Climate Effects on Human Migration in Indonesia. Population and Environment. 39. 10.1007/s11111-016-0265-8.

World Bank. (2012). PKH Conditional Cash Transfer Social Assistance Program and Public Expenditure Review 6. Jakarta, Indonesia: World Bank.

Zickgraf, C., and N. Perrin. (2016). Immobile and Trapped Populations. In *Atlas Der Umweltmigration*, edited by F. Gemenne, D. Ionesco, and D. Mokhnacheva, 44–46. München: oekom.

8 Appendix

Table 12 shows that leads of the rainfall shock could not predict migration decisions. Thus, people are not reacting to the predicted shocks.

Table 12: Leads

	Migration	
	(1)	(2)
Rainfall Shock t+1	-0.0092	
	(0.0126)	
Rainfall Shock t+2		-0.0127
		(0.0134)
Observations	17099	15937
Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Household Fixed Effects	Yes	Yes
Sub-district Fixed Effects	Yes	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate of leads of rainfall shocks and their influence on migration decisions. None of the leads can predict the migration. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 13 checks that receiving the cash transfer in period t is not caused by the rainfall shock in t.

Table 13: Orthogonality Check, Rainfall Shocks

	Cash Transfer
	(1)
Rainfall Shock	-0.0126
	(0.0181)
Observations	18291
Controls	Yes
Time Fixed Effects	Yes
Household Fixed Effects	Yes
Sub-district Fixed Effects	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate of rainfall shocks on receiving a cash transfer. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 14 shows that receiving the cash transfer in period t is not caused by the accumulated rainfall shock in t.

Table 14: Orthogonality Check, Rainfall Shocks

	Cash Transfer
	(1)
Accumulated Shock	-0.0142
	(0.0097)
Observations	21114
Controls	Yes
Time Fixed Effects	Yes
Household Fixed Effects	Yes
Sub-district Fixed Effects	Yes

Standard errors in parentheses

Sub-district Clustered SE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate of accumulated rainfall shocks on receiving a cash transfer. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 15 shows that leads of the temperature shock could not predict migration decisions. Thus, people are not reacting to the predicted shocks.

Table 15: Leads

	Migration	
	(1)	(2)
Temperature Shock t+1	-0.0159	
	(0.0097)	
Temperature Shock t+2		-0.0072
		(0.0103)
Observations	16275	14912
Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Household Fixed Effects	Yes	Yes
Sub-district Fixed Effects	Yes	Yes

Standard errors in parentheses
Sub-district Clustered SE
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate of leads of temperature shocks and their influence on migration decisions. None of the leads can predict the migration. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Table 16 checks that receiving the cash transfer in period t is not caused by the temperature shock in t.

Table 16: Orthogonality Check, Temperature Shocks

	Cash Transfer
Temperature Shock	0.0147
	(0.0125)
Observations	17406
Controls	Yes
Time Fixed Effects	Yes
Household Fixed Effects	Yes
Sub-district Fixed Effects	Yes

Standard errors in parentheses
Sub-district Clustered SE
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the coefficient estimate of temperature shocks on receiving a cash transfer. Controls include: household size, the share of mobile hh members, assets, muslim, urban.

Abstrakt

Navzdory rostoucímu počtu studií neexistuje vědecký konsensus o tom, do jaké míry a za jakých podmínek ovlivňují enviromentální faktory migraci. Konkrétně je málo prozkoumána role finančních zdrojů při ničivých environmentálních změnách. Empirické výsledky ukazují, že některé domácnosti v reakci na enviromentální nebezpečí migrují, zatímco jiné zůstávají, což může být zapříčíněno existencí chudoby a nedostatku zdrojů na migraci. Nicméně, víme jen velmi málo o tom, jak přístup k finančním zdrojům ovlivňuje migrační rozhodnutí domácností. Na jednu stranu, finanční zdroje mohou pomoci zmírnit omezení chudobou a pokrýt náklady na migraci, čímž zvyšují migraci (mechanismus posilující migraci). Na druhou stranu, finanční zdroje mohou pomoci zlepšit možnosti domácností přizpůsobit se změnám klimatu v místě, kde žijí, a zmírnit tak migrační reakci na enviromentální změny (mechanismus brzdící migraci). V této studii přispíváme k poznání v této oblasti tím, že zkoumáme migrační rozhodnutí domácností s použitím mikro-dat z Indonésie, v situaci rozsáhlých environmentálních dopadů klimatických změn a také změn v politice finančních dávek domácnostem, které využíváme jako zdroje variace. Naše výsledky naznačují, že lepší přístup k finančním zdrojům brzdí migraci v případě krátkodobých šoků projevujících se v úhrnu srážek a přírodních katastrofách. Lepší přístup k finančním zdrojům zároveň posiluje migraci v souvislosti s kontinuálními změnami klimatu v podobě akumulovaných šoků v úhrnu srážek a teplotních anomáliích.

Klíčová slova: změna klimatu, migrace, finanční zdroje, environmentální přizpůsobování

Working Paper Series
ISSN 2788-0443

Individual researchers, as well as the on-line version of the CERGE-EI Working Papers (including their dissemination) were supported from institutional support RVO 67985998 from Economics Institute of the CAS, v. v. i.

Specific research support and/or other grants the researchers/publications benefited from are acknowledged at the beginning of the Paper.

Published by
Charles University, Center for Economic Research and Graduate Education (CERGE)
and
Economics Institute of the CAS, v. v. i. (EI)
CERGE-EI, Politických vězňů 7, 111 21 Prague 1, tel.: +420 224 005 153, Czech Republic.
Phone: + 420 224 005 153
Email: office@cerge-ei.cz
Web: https://www.cerge-ei.cz/

Editor: Byeongju Jeong

The paper is available online at https://www.cerge-ei.cz/working-papers/.

ISBN 978-80-7343-531-8 (Univerzita Karlova, Centrum pro ekonomický výzkum a doktorské studium)
ISBN 978-80-7344-633-8 (Národohospodářský ústav AV ČR, v. v. i.)