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The Effects of Climate Change on Internal and International Migration: Implications for Developing Countries

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ASTRACT

This synthesis paper informs the development community about the effects of climate change on migration patterns within and out of developing countries, concentrating on the *economic* aspects of migration. Empirical evidence shows that people in developing countries respond to climatic change by migrating internally. Evidence on the relationship between climate change and international migration is limited. The effect of climate change on migration decisions depends crucially on socio-economic, political, and institutional conditions. These conditions affect vulnerability to climate change and hence how important climate change is in determining migration decisions. Migration has been an effective response to climate variability and change in the past and might be one in the future, but only under certain pre-conditions. Access to information on the economic and social costs of migration, on advantage and disadvantages of potential destination locations, and the absence of credit constraints and other barriers can help potential migrants to make decisions that will improve livelihoods. Policy intervention is also required to reduce potential negative impacts in both the sending and receiving region. Badly managed migration is associated with high economic, social and psychological costs.

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PART I: Important concepts

1. Causes for migration

- *People's reasons for migrating are very diverse. They include economic, political or social reasons. Environmental reasons increase economic incentives for migration if they decrease people's income.*
- *Typically, migration decisions cannot be traced back to only one category of reasons. Instead, different reasons interact and form the basis for migration decision.*

An economic migrant leaves his or her place of residence in order to improve living standards and quality of life or to take up employment outside their original location. A political migrant migrates to locations of more political freedom, for example freedom of speech is guaranteed. Social causes for migration include migration for marriage or family reunion. Environmental migration is migration with the prime motive to move from environmentally poor to environmentally better conditions. It includes people moving away from places with gradual environmental degradation as well as places with sudden environmental shocks, e.g. natural disasters.

2. Types of migration

- *Depending on destination: International and internal migration*
- *Depending on duration: seasonal migration, medium-term, and permanent migration*
- *Depending on reasons: Climate migrants, economic migrants, political, social etc.*
- *Depending on choice: forced vs. voluntary migration*
- *Depending on development outcome: productive vs. unproductive migration*

Migration can take many forms. Depending on a migrant's destination it can be international (crossing a country border) or internal migration (staying within home country borders). Migrants can decide to stay for a temporarily (e.g. seasonal or circular migration) or permanently in the destination location. Migrants can also be distinguished according to their main reason for migrating. These include economic, political, social, or environmental reasons. The literature on migration has also distinguished between forced and voluntary migration. Forced migration includes situations where "the migrants are faced with death if they remain in their present place of residency" (Hugo, 1996: 107); voluntary migration occurs where "the choice and will of the migrant is the overwhelmingly decisive element encouraging people to move," (Hugo, 1996: 107). Finally, migration can also be defined in terms of development outcomes. Migration is an important adaptation strategy in the face of spatial disparities in economic opportunities, political and environmental conditions. If people move to places that make them better off, then migration has a positive effect on economic development for the individual.

3. Defining environmental refugees and environmental migrants

- *Generally speaking environmental refugees leave their place of residency because of sudden environmental change, whereas environmental migrants leave due to gradual, long-term climatic change.*
- *The legal status of environmental refugee and environmental migrant remain undefined in international law.*
- *One reason for the lack of definition is linked to the difficulty of isolating environmental factors from other drivers of migration.*

- *In this paper, we will focus on migration decisions by people confronted with gradual environmental change, less on people forced to leave by sudden environmental shocks and natural disasters.*

In the debate on the effects of climate change on migration different terms are applied to those moving for environmental reasons, for example environmental or climate refugee and environmental or climate migrant. Broadly speaking, the term 'environmental refugee' is used for people who "are compelled to flee by sudden, drastic environmental change that cannot be reversed," (Keane 2004: 214). The term is often applied to people affected by environmental disaster as opposed to people affected by gradual climate change. The second category of environmental migrants generally applies to people who leave their place of residency because of long-term, and often gradual, climatic changes that have negative effects on their present or future living conditions.

Until now, the status of people leaving their place of residency due to environmental reasons remains undefined in international law. Legally speaking, the term 'environmental refugee' is a legal misnomer. "[...] refugee status results from the denial of human rights," (Keane 2004: 215). While "people forced from their homes by floods, earthquakes and other natural disasters are not in the same position. Their government is sympathetic towards them. It is not driving them away, and they still have rights. [...] There is no such thing as an environmental refugee," (Lubbers, 2004). The term 'migrant' is more general compared to 'refugee'. The United Nations defines a migrant as an individual who has resided in a foreign country for more than one year irrespective of the causes, voluntary or involuntary, and the means, regular or irregular, used to migrate.

"[...] environmental damage or degradation is not recognized by Article 1 of the Refugee Convention as a valid legal ground for seeking asylum," (Keane, 2004). One reason for the lack of definition relating to migration caused by environmental degradation or change is linked to the difficulty of isolating environmental factors from other drivers of migration (Dun et al.: 10). It is also not in the political interest of most developed countries' policy makers to extend the range of acceptable reasons for immigration and increases in the number of immigrants.

Yet, the UN expects that climate change will lead to increased numbers of displaced people. Defining their legal status would increase the efficiency with which policy makers could plan and implement population movements due to climate change.

PART II: The Economic Effects of Internal and International Migration on Developing Countries

1. Through which channels may climate change affect migration?

In this section, we will discuss through which channels changes in climate may affect people's decisions to migrate. In other words, we are asking why one might expect so see changes in climate causing changes in migration patterns. We will in particular discuss two channels: climate's effect on income and climate's effect on conflict. There exists rich evidence on climate's effect on income, in particular income from agriculture. Changes in income are routinely seen as a main driver of internal and international migration patterns (e.g. Borjas, 2014). The relationship between climate and conflict is much more controversial. Finally, this section will show that – for both channels – the net effect of climate on migration is not an 'automatic' response but is shaped by conditioning factors.

1.1. Climate's effect on income

- *Differences in income levels shape migration patterns across the world.*
- *Excessive heat may decrease income by decreasing agricultural and labour productivity.*
- *Climate change will increase extreme heat events and may increase incentives for migration by increasing income differentials.*
- *Incomes of people working in agriculture are likely to be especially affected. Incomes of people in the urban economy or people with good access to credit are substantially less affected.*
- *Climate change may decrease incentives for migration by reducing people's income from agriculture and exacerbating credit constraints of potential migrants.*
- *Empirical evidence shows people to respond to adverse climatic change by increased internal migration. Evidence on the effect of adverse climatic change on international migration is mixed.*

One of the most important driving forces shaping migration patterns across the world are differences in income levels. If a person expects that her income or living standards more generally would increase by moving to another place or country, then she has incentives to do so (e.g. Borjas, 2014). Hence, in cases where climate change affects people's current or future income or their living standards climate change may affect people's decision to migrate. Generally speaking, one would expect that decreases in income lead to increases in migration. In the context of developing countries, however, where financial markets work imperfectly, decreases in income may impose severe credit constraints, especially on the poorest parts of the population, and reduce the number of people able to migrate.

1.1.1. Decreases in agricultural productivity

A large share of people in developing countries relies on the agricultural sector for their livelihoods. The agricultural sector is expected to be most affected by climate change. As a result, income in developing countries is likely to be affected by climate's effect on agricultural productivity. The negative economic effects of climate change, often exacerbated by land degradation, are expected to be particularly severe for developing countries' economies. In addition, developing countries are mostly located in areas with warm climate and areas with already relatively warm climate are expected to be especially affected because of nonlinearities in the effect of temperature on plant growth.

Empirical evidence show strong effects of climatic change on income in developing countries, in particular in the agricultural sector. For India, Burgess et al. (2014) show that excessive heat during the growing season decreased income from agriculture and increased mortality among the rural population. The authors point out that dependence on agriculture is the key factor shaping this strong income effect of climate. The same excessive heat does not affect people employed in the urban economy. Interestingly, people in the rural economy are not all equally affected. The effect is mitigated for people with access to credit, e.g. through microcredit institutions.

1.1.2. Decreases in labour productivity

Adverse climatic conditions may also reduce income through their effect on labour productivity. In the short term, heat decreases physical and cognitive abilities and hence labour supply (Heal and Park, 2013; Deryugina and Hsiang, 2014). In the medium- and long-term, temporarily reduced income and food intake can have long-lasting effects on labour productivity, especially for those affected as children. Aguilar et al. (2011) show a lasting negative effect of reduced agricultural productivity and food intake due to El Nino Southern Oscillation (ENSO) events on cognitive development and skills.

1.2. Climate's effect on conflict

- *The relationship between climate change and conflict remains highly controversial because the effect of climate on conflict is heavily dependent on a country's socio-economic, institutional, and political characteristics.*
- *Developing countries are relatively dependent on agriculture and their political institutions often have limited ability to cope with economic shocks. Financial markets, social safety nets or insurance systems are often weakly developed. Due to their dependence on agriculture, they are likely to be especially affected by climate shocks. Due to their political, economic and institutional conditions they are generally in an especially weak position to mitigate its outcomes.*
- *There is evidence of specific historical cases where changes in climatic conditions increased pressure on resources and led to violence.*
- *There is also evidence on economic shocks and conflict today (Miguel et al. 2004; Burke et al., 2014).*
- *People displaced by conflict often have little economic resources and little scope to choose their destination with detrimental economic effects for migrants/refugees and receiving communities.*

Conflicts have displaced many people. It has been argued that climate change may affect the frequency or severity of conflicts and thereby increase the number of displaced people.

1.2.1. The effect of adverse climate on conflict in the past

It has been shown in historical settings that adverse climatic conditions were associated with more frequent violent conflict. The European witch hunt and persecution of Jewish population coincided with times of economic distress caused partly by adverse climatic conditions that lowered agricultural productivity (Oster 2004; Anderson et al., 2014). Likelihood of rural uprisings in China also increased with incidences of drought (Jia, 2013). However, with the introduction of the more drought-resistant sweet potato this relationship disappears. It is important to keep this in mind: There is a relationship between resource scarcity and violence, but the effect of climatic conditions on resource scarcity must be understood in the socio-economic context. Climatic conditions caused resource scarcity if socio-economic conditions could not mitigate its adverse effects.

1.2.2. The effect of adverse climate on conflict today

A potential relationship between climatic distress and conflict has also been shown for today (see Burke, Hsiang, Miguel, 2014, for a summary). For example, the conflict in Syria has coincided with a record drought in the Fertile Crescent, made two to three times more likely by climate change (Kelley, Mohtadi, Cane, Seager and Kushnir, 2015). For low-income settings, an important mechanism is economic: adverse climate affects the agricultural sector and reduces income for a large part of the population. However, "climatic conditions are neither necessary nor sufficient for conflicts to occur," (Burke, Hsiang, Miguel, 2014: 4).

1.2.3. Climate and conflict – conditions

The relationship between climate change and conflict remains highly controversial because the effect of climate on conflict is heavily dependent on a country's socio-economic, institutional, and political characteristics. For example, Burke et al. (2014) study the relationship between climate and conflict and find important effects. The authors, however, study this relationship only in specific parts of the world, especially in the developing world. Developing countries are characterized by certain political, economic and institutional conditions. For example, they are relatively dependent on agriculture and their political institutions often have limited ability to cope with economic shocks. Financial markets, social safety nets or insurance systems are often weakly developed.

Due to their dependence on agriculture, they are likely to be especially affected by climate shocks. This, combined with sometimes weak political, economic and institutional structures, limits capacity to manage and recover from shocks. When describing the relationship between climate and conflict it is therefore important to specify under which conditions a relationship appears and under which it does not. Unsurprisingly, for developed countries that depend little on agriculture and whose institutions respond swiftly to negative economic shocks, such as the UK, such a relationship has not been observed.

2. Which type of climate events matter for migration?

- *Short-term weather events as well as long-term climate change may affect people's decision to migrate because they may have a direct effect on their living standards and present and future income. In particular people working in agriculture are expected to be affected.*
- *Relevant climate events include more frequent periods with extreme heat, more frequent periods of reduced precipitation and droughts, floods and storms as well as long-term changes in mean temperature.*
- *It affects livelihoods through its effect on agricultural productivity and possibly through its effect on non-agricultural income.*
- *The effect of the predicted climate change on migration depends on a country's and an individual's ability to adapt to these changes and to mitigate their outcomes, e.g. by using access to credit.*

Predictions say that climate change will entail more frequent periods of very warm temperatures, more frequent droughts and floods, and more frequent incidences of heavy storms. It will also lead to long-term increases in mean temperature. Such extreme weather events already take place from time to time now. Researchers have studied such events to learn about their consequences for living standards. In this section, we will discuss their findings, the channels through which specific climate shocks have affect living standards in the past, and which conditions shape the effect.

2.1. The effects of specific climate shocks

Periods of extreme heat

A prominent feature of future climate will be more frequent periods of very high temperatures. Studies on the effects of very high temperatures in the past find that even slight increases in the number of days with extreme temperature directly affect income and livelihoods, in particular for people in developing countries working in agriculture[1]. For India, a study found that one additional very hot day[2] increases annual mortality by roughly 0.75 % (Burgess et al., 2014: 3). For Mexico, researchers found that one additional very hot day[3] increases mortality by 0.15 percentage points (Compean, 2013).

Reduced precipitation and droughts

Droughts have important effects on economic outcomes (e.g. Munshi, 2003), on labour productivity (Aguilar et al., 2011) and health (Compean, 2013). Similarly to the effect of extreme temperature, an important channel through which drought may affect living standards is through its effect on productivity in agriculture, in particular in rain-fed agriculture (Munshi, 2003: 552).

Floodings

The IPCC predicts that climate change will entail more frequent episodes of flooding. Floods are unexpected and drastic events. Among other factors, floods can be caused by heavy rainfall that exceeds the capacity of watercourses or by storm surges following tropical cyclones.

In the short-term, floods regularly lead to heavy destruction of infrastructure, and loss of lives.[4] Flooding in the aftermath of Hurricane Katrina in New Orleans alone caused more than 1000 deaths, especially among citizens above 60 years (Knabb et al. 2005: 11). Globally, flood events alone have displaced 22 million people per year since 1985, according to data from the Dartmouth Flood Observatory. Flooding regularly destroys crop outputs, for example those during the harvest season related to the ENSO (El Nino Southern Oscillation) in 1998-1999 (Aguilar et al., 2011: 2).

In the long term, the impact of floods varies. McDermott et al. (2015) find that after one year negative effects of flooding on economic growth are no longer apparent. One explanation for this phenomenon is that floods often attract lots of government attention (Mueller et al., 2014). On the one hand, research regularly finds that the *long-term* economic effects of floods are limited.

Storms

Tropical cyclones are predicted to increase in number with climate change. In the past, tropical cyclones have caused heavy destruction in infrastructure, important loss of life and long-term soil erosion. Hurricane Katrina in 2005, for example, destroyed infrastructure,

1 The effect of temperature on economic outcomes and health is highly non-linear. Extreme temperatures have especially adverse effects (Burgess et al. 2014: 14; Deschenes and Greenstone, 2007).

2 The effect of a very hot day is defined as the effect of a day of mean temperature above 97◦ F relative to a day with a mean temperature between 70◦-72◦ F.

3 The effect of a very hot day is defined as a day with above 30 degree Celsius compared to one day with a temperature of 16-18 degrees Celsius.

4 Historically, and under certain circumstances, regular flooding has also had important positive economic significance. The annual Nile flood, for example, was crucial to pre-modern Egypt's agricultural productivity. Abnormally high or low levels of flood, however, still caused social unrest as they lowered agricultural productivity the following year (Chaney, 2013).

especially in high-rising buildings and coastal communities (Knabb et al., 2005: 12). During the "American Dust Bowl" large dust storms led to severe erosion of top soil and made large areas in the American Plains unsuitable for agriculture (Hornbeck, 2012).

Sea-level rise

Sea-level rises between one and five meters are likely due to climate change (Oliver-Smith, 2009: 9). Currently about 600 million people or 10% of the current population in low-elevation zones (0-10m above sea level will be at risk. Sea level rises may lead to land being completely submerged and thereby to forced displacement of people. Before that happens, sea level rises already have more gradual effects, e.g. salinization of ground water, rising water tables, and impeded drainage (Oliver-Smith, 2009: 28). This may seriously harm wetlands, estuaries, and mangroves which are in many cases essential to the livelihoods of communities, especially to coastal communities in developing countries.

The effect of sea-level rises is exacerbated by the trend that more and more people move to coastal and low-lying areas. This phenomenon is tightly linked to the rapid process of urbanisation taking place in most parts of the world. Cities are often located in low-lying areas along the coast or estuaries. Their growth puts a growing number of people at risk of being affected by sea level rises (Nicholls et al. 1999: S70).

Long-term increases in mean temperature

A long-term increase in mean temperature is one of the major predictions for the current climate change. The question to what extend such long-term increases will affect people's living standards is controversial. The key parameter of uncertainty is the rate of adaptation that one can reasonably expect. On the one hand, human societies have successfully adapted to challenging climatic conditions in the past (e.g. Tol and Langen, 2000). Technological advances and advances in research methods should enable societies to adapt again today.

On the other hand, it seems obvious that higher temperatures impose a cost on economies. Agricultural sectors in developing countries depend heavily on climatic conditions. Higher temperatures will dry out soils and reduce or stop plant growth (Schlenker et al. 2009). Agricultural sectors in developed countries are in a better position to adapt to changing climates, e.g. through the use of increased irrigation, fertilizers or by systematically switching or modifying crop varieties (Burke and Lobell, 2010). However, even if they were able to maintain productivity levels, these adaptation measures are still costly and might hence reduce the sector's overall productivity. Researchers have also shown empirically that even a highly developed agricultural sector as the US agricultural sector has shown little sign of adaptation over a period of 20 year (Burke and Emerick, 2015) and that its productivity is affected by temperature changes (Deschenes and Greenstone, 2007, 2012). Researchers have also assessed the effect of increases in mean temperature on economies as a whole in the short- and medium-run (Dell et al. 2012) and in the long-run (Waldinger, 2014).

2.2. Channels through which climate shocks matter for migration

Income from Agriculture

In this section, we will discuss through which channel specific weather events have affected living standards. As discussed in the previous section, it is expected that climate will affect living standards through its effect on agricultural productivity. In the Indian context, extreme temperature affects mortality as it reduces agricultural productivity and income from agriculture (Burgess et al, 2014). The researchers find that even a few additional days with

extreme temperatures per growing season may stop crop growth and increases the likelihood of harvest failure[5]. The same mechanism is at work in the Mexican context (Compean, 2013).

Flooding, especially in developing countries, has also had important effects on agricultural productivity. Aguilar et al. (2011) find important effects of flooding in rain-fed agricultural settings. El Nino Southern Oscillation (ENSO) events in the 1998-1999 maize harvest seasons caused extreme precipitation shocks and severely decreased crop outputs and hence agricultural income. Households affected by these events decreased their intake from fruits, vegetables and animal proteins. For those, who were children at the time, this had long-lasting effects on cognitive development, e.g. language development, working and long-term memory, and visual-spatial thinking. These parameters are also important indicators of labour productivity in later lifetime.

Large storms have compromised agricultural productivity in the past. During the "American Dust Bowl", for example, large dust storms led to severe erosion of top soil and made large areas in the American Plains unsuitable for agriculture (Hornbeck, 2012).

Sea level rises are predicted to lead to increased salinization of ground water, rising water tables, and impeded drainage in coastal and low-lying areas (Oliver-Smith, 2009: 28). Coastal and low-lying areas are essential to agricultural productivity in various ways, especially for coastal communities in developing countries.

Income from Non-Agricultural Sources

Besides climate's effect on agricultural productivity, several studies also discuss climate's effect on income from non-agricultural activities. This channel is more controversial. Empirical evidence is not unequivocal and theoretical links are not as clearly established. The rationale here is that – while temperature is not an input factor in non-agricultural production processes in the same way as it is in agricultural production processes – it may still cause thermal stress to humans and lower their labour productivity[6]. Researchers have found effects of extreme temperatures on non-agricultural income, though smaller in size compared to effects on agricultural income. Mueller et al. (2014) find that extremely high temperatures in rural Pakistan reduced non-agricultural income by 16% compared to reductions in agricultural income by one third (Mueller et al., 2014: 184). For the US, researchers find that high temperature reduces both farm and non-farm income, where the effect on non-farm income around one fifth of the effect of temperature on farm income (Deryugina and Hsiang, 2014). Burgess et al. (2014), however, find that mortality among the population of urban India is not affected by extreme temperature, possibly because their income allows them to adapt to more extreme temperatures.

2.3. Conditioning factors

Specific weather shocks do not have an 'automatic' effect on living standards. Instead, effects of specific weather shocks are highly context-specific. They unfold in certain context as a

5 The link between heat stress, agricultural productivity and income from agriculture is clearly established in both theoretical and empirical research. Crop growth will increase with temperature until a temperature optimum is reached. Further increases in temperature will decrease crop growth, extreme temperatures may stop crop growth altogether (Schlenker and Roberts, 2008).

6 Not dissimilar to certain crops, the human body is best adapted to a certain temperature range. If temperatures lie below or above this range, it has to resort to protective mechanisms to regulate its temperature such as shivering, arteriovenous shunt vasoconstriction, sweating and
precapillary vasodilation. The body's ability to adapt to extreme temperatures, however, is costly and limited. It is costly because it requires additional nutritional value to be dispensed on these bodily functions. It is limited because it is only able to regulate body temperature within a certain range.

consequence of socio-economic, political, and institutional conditions. The same weather shock would not have the same effect in a different context because different socio-economic, political, and institutional conditions would have led to different initial conditions and would lead to different responses in the aftermath of the shock. In many cases, it is clear that these initial conditions as well as responses to the shock are decisive in shaping the magnitude of the damage. In other words, the effect of climate change on living standards and income depends on an individual's or a country's ability to adapt to these changes and to mitigate their outcomes.

In the Indian context, the strong effect of extreme temperature on mortality is also a consequence of the farmers' inability to react to extreme temperature, e.g. by increasing irrigation, or to protect themselves from the outcomes, e.g. by using savings. Areas with access to microcredit were significantly less affected as were people living in urban areas who did not depend on agriculture for their living (Burgess et al., 2014).

The effect of temperature on mortality is exacerbated in settings where credit constraints prevent investment in and use of adaptive measures. The strong relationship between hot temperature and mortality at the beginning of the 20th century has declined since then due to the use of air conditioning (Barreca et al., 2013).

Flooding often leads to important destruction and hardship in the short-term. It can have adverse effects in the long-term, for example on cognitive skills (Aguilar et al., 2011). In the long-run, however, the economic effects of flooding are less clear. McDermott et al. (2015) find that after one year negative effects of flooding on economic growth are no longer apparent. One explanation for this phenomenon is that floods often attract lots of government attention. This might be due to the fact that floods are visually very powerful. They attract media attention as well as public funding for reconstruction (Mueller et al., 2014).

Rebuilding the economic infrastructure gives people the opportunity of return to their work and to the pre-flooding state of things. On the other hand, these efforts also reduce the costs of flooding to the population and thereby reduce incentives to adapt to regular flooding, e.g. by migrating to less flood-prone areas (Boustan et al., 2012: 238).

3. Empirical Evidence on Climate's effect on migration

- *Strong evidence of climate's effect on internal migration (Marchiori et al., 2011; Barrios et al., 2006)*
- *Decline in precipitation in Africa have increased rural to urban migration within Sub-Saharan African countries (Barrios et al., 2006; Henderson et al. 2014).*
- *Limited evidence on international migration (Beine, 2013; Piguet et al. 2011).*
- *The poorest and most vulnerable are often unable to migrate because they lack resources; they are trapped (Gray and Mueller, 2012; Dustmann and Okatenko, 2014; Robalino et al. 2015).*

In the previous section, we have examined channels through which climate change could affect migration decisions, in particular climate's effect on income and conflict, and studied examples of relevant climate shocks. In this section, we will assess the outcomes of studies that have directly investigated the relationship between climate change and migration. So far, can we see that short-term climatic shocks and long-term trends have shaped migration decisions? Or do socio-economic or political conditions play a more important role?

3.1. Climate's Effect on Internal Migration

Barrios et al. (2006) investigate the effect of changes in rainfall in Sub-Saharan Africa on internal migration, in particular on rural to urban migration. Agriculture is especially important to Sub-Saharan Africa economies, compared to other developing countries, and is relatively little irrigated. Changes in rainfall are therefore likely to have an especially important effect on income from agriculture. Barrios et al. (2006) find that decline in rainfall leads to increases in rural to urban migration. Robalino et al. (2014) examine the effect of natural disasters on internal migration. They find that, on average, natural disasters increase the number of migrants. Especially severe disasters, however, decrease the number of migrants. Henry et al. (2004) find that inter-provincial migration in Burkina Faso is shaped by environmental as well as socio-demographic factors.

3.2. Climate's Effect on International Migration

Compared to the number of people in developing countries engaging in internal migration the number of people engaging in international migration is small (Piguet et al. 2011: 15). The relationship between climate change and international migration has still received considerable attention in public and policy debates. One prominent argument is that climate change will affect income and livelihoods of people in developing countries especially, therefore increasing their incentives to migrate to rich countries. Beine et al. (2013) test this hypothesis empirically. The authors estimate the effect of long- and short-term temperature changes on migration. They also include other variables, such as incidences of conflict, in their model to estimate to what extent the effect of climate on migration compares to the effect of other relevant variables. They do not find evidence for an effect of climate on migration, but do find strong evidence for conflict to affect migration. This indicates that existing barriers to migration, e.g. international laws, transportation costs, credit constraints, uncertainty about income in receiving countries, appear to outweigh the effect of climate on migration. Piguet et al. (2011) argue that 'rapid onset phenomena' lead to short-term internal displacement rather than long-distance and long-term migration.

In reality, however, changes in income driven by climatic change is only one factor among many that affect people's decisions to migrate as well as their choice of destination. Other factors include the costs of migration (e.g. transportation costs, set up costs [learning a new language, finding work, losing a social network]). International barriers to migration dramatically increase costs of migration and reduce the expected returns on migration. Research on the relationship between climate and migration has consistently shown an effect of climatic events on internal migration, but has shown little evidence on international migration.

3.3. Climate change and reduced migration

Much of the debate on climate change and migration has discussed a model of migration where climate change potentially increases the number of migrants. Recent contributions, however, also emphasise the limits that credit constraints may impose on people's migration decisions. Dustmann and Okatenko (2014) find that credit constraints inhibit migration, especially in the poorest parts of the world in Sub-Saharan Africa and parts of Asia. For our discussion of the relationship between climate change and migration this implies that climate change may reduce migration if climate change reduces the disposable wealth of the relatively poor who become too credit-constrained to migrate (for other studies on the importance of credit-constraints for migration see Abramitzky et al., 2013, and McKenzie and Rapoport, 2007). As a result, the poorest and most vulnerable are often not those who

migrate because they lack the necessary resources. Gray and Mueller (2012) examine the effect of climate change on credit constraints and migration decisions. They find that incidences of drought in rural Bangladesh increased mobility of households that were not directly affected while reducing mobility of the most affected households. This shows that incidences of climate change can reduce migration by increasing credit constraints. Robalino et al. (2015) examine the effect of natural disasters on migration. Consistent with Gray and Mueller's (2012) finding, they conclude that the most severe disasters, through their effect on credit constraints, reduce migration.

3.4 Climate's Effect on Historical Migration Movements

Estimates of the effect of climate on modern-day population movements necessarily depend on contemporary changes in climate. In the history of humankind, however, human societies have already been exposed to drastic climatic change. How have they been affected by these climatic changes and did it affect their migration behaviour? Over the past millennia, "whole empires collapsed and their their people were diminished to much lower subsistence levels, whereas in other cases, populations migrated and adapted to new subsistence modes," (deMenocal, 2001: 669). Archaeological evidence indicates that periods of drastic climatic change coincided with the collapse of past civilisations. It has also been shown that populations moved into more favourable areas in order to increase their chances of survival (Riehl et al., 2014: 12348). Urban centres of the Harrapan Society in the Indus Valley, now in Pakistan, were abandoned during a 200-year drought (Marris, 2014). During the African Humid Period (ca. 9000 to 6000 years ago) the Sahara was home to lakes and vegetation (Claussen et al., 2003). This enabled inhabitants of the Sahel region to enter this area and to cross it reaching the European and Asian continents. Wet conditions and increased vegetation in the Central Sahara/Sahel region in the pre-historic period (e.g. 195,000 and 120,000–110,000 years ago) coincided with periods of human expansion into this region (Castaneda et al., 2009).

The observed relationship between societal collapse, outmigration and climate in the past, however, should not be interpreted as a deterministic relationship, so that changes in climate automatically led to societal collapse and outmigration. "In all cases, the observed societal response reflects an interaction between human cultural elements (socioeconomic, political, and secular stresses) and persistent multi-century shifts in climate," (deMenocal, 2001: 669).

Past episodes of climate change are not necessarily good guides to the future. Studies of climate change-induced migration forecast large streams of migrants (e.g. Myers 2002), but the underlying evidence is often weak. For a given shock, less migration may result compared to historical times because international borders and international laws limit migration. Increased migration could occur because of lower transportation costs and greater availability of information.

4. Economic Effects of Internal and International Migration on Developing Countries

- *Households in developing countries use migration as a risk management strategy to cope with adverse economic shocks, caused e.g. by adverse climate shocks. This includes temporary (seasonal, circular) migration and permanent migration.*
- *Empirical evidence shows a relationship between adverse climate shocks and* internal *migration; there is little evidence for a relationship between adverse climate shocks and* international *migration.*
- *Migrants typically engage in non-agricultural activities or in agricultural activities in more productive areas.*

- *Economic effects of internal migration tend to be positive if migrants move to areas with higher returns to labour; otherwise, there is no effect.*
- *Economic effects of international migration on households in developing countries and developing countries' economies can have negative and positive effects. Negative effects include the loss of high-skilled worker and net fiscal contributors. Positive effects include additional income from remittances, benefits of extended networks, and benefits from returning migrants who have acquired capital and new skills abroad. These benefits, however, only materialize if migrants remain in contact with their sending community.*

For people in developing countries migration, in particular internal migration, has been an important strategy to cope with economic distress and adverse climatic conditions, especially in rural settings. "[M]ost migration triggered by environmental factors concern internal migration," (Pieguet et al. 2011: 15). Evidence on international migration as a response to economic distress is mixed.

4.1. Internal Migration

- *Through internal migration, households seek to diversify their portfolio of economic activities in order to ensure survival or to improve their standards of living (Ellis, 1998: 1). Migration is used as a risk management strategy.*
- *Evidence show positive economic effects of internal migration on migrants' income (e.g. De Brauw and Harigaya, 2007).*
- *The positive effect depends on the receiving province' characteristics. Only migration to provinces with growing industries and labor markets reduces income inequality (Phan et al. 2009: 110f.).*
- *Benefits of internal migration only arise under certain conditions:*
    - *Access to community networks for finding jobs in urban areas*
    - *Access to transportation infrastructure*
    - *Information on potential returns to labour in distant markets (De Brauw et al., 2012).*
    - *Land tenure security: the risk of expropriation deters rural-urban migration (for China, see Mullan et al., 2011).*
    - *Access to credit (Phan et al. 2009: 110).*

Internal migration is a frequent phenomenon in developing countries. It can take various forms. Circular and seasonal migrants return to their homes after a limited period of time, typically less than six months. Permanent migrants shift their work and residence completely to a new location (Findley, 1994: 540).

Through internal migration, households seek to diversify their portfolio of economic activities in order to ensure survival or to improve their standards of living (Ellis, 1998: 1). This can help households, in particular rural and poor households (Ellis, 1998: 18). Household members access new opportunities in distant labour markets. Diversificaton from rural to non-rural activities implies that income risks in different economic activities of the household are not correlated (De Brauw et al., 2012: 549). It has been predicted that climate change will increase income risk for rural households in developing countries. Diversification through internal migration may therefore in the future increase in importance as a risk management strategy by rural households in developing countries.

Households in Vietnam used seasonal migration to increase their living standards. Annualized expenditure grew by 5.2 percentage points due to increased migration (De Brauw and

Harigaya, 2007). The study highlights the importance of community networks for finding jobs in urban areas. Poor transportation infrastructure and limited off-farming employment opportunities limited people's ability to use migration for diversification. In this case, the typical migrant was relatively well-educated, relatively young and male (De Brauw and Harigaya, 2007: 434).

Other barriers to migration include lack of information on potential returns to labour in distant markets. Migrant networks can play an important role in transmitting information about opportunities. Migration increases with better information as it reduces the costs of migration (De Brauw et al., 2012). Migration patterns are also shaped by an economy's institutional arrangement. Land tenure security, for example, increases migration. Evidence from China indicates that the risk of expropriation – which increases as people leave land behind – deters rural-urban migration (Mullan et al., 2011).

Liquidity constraints lead to poverty-related labor immobility (Phan et al. 2010: 110). Evidence from Vietnam showed that the effect of migration on income inequality varied depending on the receiving province' characteristics. Migration to the provinces with growing industries and labor markets reduces income inequality, while migration to other regions does not (Phan et al. 2010: 110f.).

Economic growth and internal migration can be seen as complements. Migration fuels economic growth and economic growth, especially when it is spatially localized, fuels migration. Migration to fast-growing areas can reduce income inequalities between provinces (Phan et al. 2010: 111).

4.2. International migration

- *Economic effects of international migration on households in developing countries and developing countries' economies can have negative and positive effects.*
- *<u>Negative effects</u>:*
    - *Skilled migrant are net fiscal contributors and their departure therefore represents a loss for those left behind.*
    - *Skilled and unskilled labour are complements in the production process. Loss of skilled labour may decrease productivity (and wages) of unskilled labour left behind and increase productivity (and wages) of skilled labour. As a result, inequality between skilled and unskilled labour may increase.*
    - *Skilled labour attracts foreign direct investments and R&D activities (Docquier et al. 2007)*
- *<u>Positive effects</u>:*
    - *additional income from remittances*
    - *extended business networks*
    - *benefits from returning migrants who have acquired capital and skills abroad*
- *Benefits only materialize if migrants remain in contact with their sending community.*

"Debates on the climate change-migration nexus often seem to focus overwhelmingly on international migration, and particularly on flows from the "South" to the "North". But this bias tells more on Western fears than on actual trends [...]," (Piguet et al. 2011: 15). Compared to the number of people in developing countries engaging in internal migration the number of people engaging in international migration is small.

The purposes of migrating abroad are similar to the purposes of migrating internally: increased living standards, improved income stability. Income differentials between countries provide incentives to leave a country with relatively low income levels and move to a country with relatively high income levels.

The average international migrant from developed countries have above average education and income levels. The international transfer of human capital, hence relatively highly educated individuals from developing to developed countries has been termed "brain drain" (Beine et al. 2008: 631). International outmigration of talented people from developing countries can have a number of negative as well as positive consequences at the household and country level. First, skilled migrant are net fiscal contributors and their departure therefore represents a loss for those left behind. Secondly, skilled and unskilled labour are complements in the production process. Loss of skilled labour may decrease productivity (and wages) of unskilled labour left behind and increase productivity (and wages) of skilled labour. As a result, inequality between skilled and unskilled labour may increase. Finally, skilled labour attracts foreign direct investments and R&D activities (Docquier et al. 2007)

On the other hand, international migration may also bring advantages to developing countries' economies. Having a household member abroad still benefits the sending household if she sends remittances. Remittances reduce income variability and the risk of complete income failure in the sending household. Remittances from the USA to Mexico, for example, constitute an important part of GDP and increase investment in Mexico. The ultimate impact of remittances on the welfare also depends on household spending patterns. Remittances spent on durable goods, education or investment have a different effect on poverty and household welfare than remittances devoted to consumption.

Furthermore, the prospect of migration may also motivate people in developing countries to obtain better education. In developing economies, education is not valued as much as in developed economies. Wages for high-skilled workers are generally substantially higher in developed economies. If migration to a developed country is a real possibility, then people in developing countries may decide to invest in their education. In the end, not everyone is going to migrate, and the developing economy benefits from increased stocks of human capital (Beine et al. 2001: 276f., Mayr and Peri, 2008).

Then, by going abroad migrants extend their own network. If they stay in touch with their home community, this also extends the network of those left behind. The importance of networks has been shown for business and investment decisions, and – not least – for future migration decisions (Docquier et al 2007).

Finally, developing countries can benefit from migrants who decide to return. Until now, however, return migration is most common for migrants from the Middle East, Asia (except India) and the developed world. "There is little indication of any return for immigrants from Africa," (Dustmann and Weiss, 2007: 7).

PART III: Migration as an Adaptation Strategy

- *Historically, migration has been an important tool for adapting to climate change provided that the location change increased people's productivity.*
- *Today, under certain conditions, migration may again be a useful tool to adapt to climate change.*

1. Migration risks and opportunities

Whether the economic consequences of migration are positive or negative and whether migration allows people to adapt efficiently to climate change depend on an array of socio-economic, political and institutional conditions.

Migration can have positive economic effects if migrants go to productivity-enhancing areas. It can have negative economic effects if migrants go to areas where their labour force is not efficiently employed. Migration can be efficient and productivity-enhancing if certain pre-conditions are satisfied. These pre-conditions include efficient institutions, e.g. land tenure security, sufficient information about potential migration destinations and about alternatives to migration, such as local adaptation. Violent conflict, mis-information, or credit-constraints, on the other hand can lead migrants to destinations where they will be unable to be productive.

2. Developing Alternative Adaptation Options

Migration is not the only strategy to adapt to climate change. While migration can be a powerful tool for adaptation it is also very costly. The use of alternative adaptation strategies will therefore often be preferred, e.g. local adaptation of the agricultural sector, rather than migration to cities. An integral part of using migration as an efficient adaptation strategy is a solid understanding of those alternatives. Migration becomes a viable choice when its costs and benefits compare favourably to those of other adaptation options.

Being aware of all alternatives gives people a choice between migrating away and less costly ways of adapting to new environmental conditions. The costs and benefits of migration choices need to be understood – including psychological and social costs. For example, the fact that migration is a highly gender-specific process – with most migrants being young men – systematically disturbs social processes such as family formation and adds to the social costs of migration.

3. Helping people make efficient, welfare-enhancing migration choices

If people chose migration over other adaptation options then, it is in the interest of the policy maker and national economy that they make the most efficient choice. Public policy has a role to play in helping people make efficient migration choices.

3.1 Information provision

Insufficient information on potential costs and benefits of migrating to certain destinations can lead to inefficient migration decisions. Migrants may incur the costs of migration but overestimate economic opportunities (Bryan et al., 2011; Munshi, 2003). Reliable information on migration destinations is key to making efficient migration decisions. In addition, taking into consideration all types of costs, be they economic, social or psychological, is an integral

part of making an informed choice about migration. Currently, migrant networks play an important role in transmitting such information by those who have already migrated and their home communities (for Vietnam: De Brauw and Harigaya, 2007; for Bangladesh: Bryan et al., 2011; for Mexico: Munshi, 2003).

3.2 Alleviating credit-constraints

Liquidity constraints lead to poverty-related labour immobility (Phan et al. 2010). In other words, people will not be able to migrate to the most suitable, productivity-enhancing locations if they are credit-constrained and unable to cover costs of migrating to these destinations. Instead, they might move to less suitable, but closer areas. Hence, credit constraints can force people to take the "wrong" migration decision because migrants incur up-front costs (transportation costs, costs from not working, set up costs in destination location). These costs are especially high in areas with poor transportation infrastructure and in areas with limited access to credit.

3.3 Avoiding forced migration

In cases of forced migration, if "migrants are faced with death if they remain in their present place of residency," (Hugo, 1996: 107) they often have no choice but to leave irrespective of the productivity potential of origin and destination location. Conflict may also increase credit constraints and force people to choose sub-optimal locations, for example a neighbouring country regardless of its economic opportunities. In addition, absence from the labour market the refugees' human capital will deteriorate.

3.4 Improving institutional quality

People may choose not to migrate even if they and their families would benefit from migration if inadequate institutions reduce their incentives to do so. Land tenure security, for example, can affect incentives to migrate, for example if people are not able to sell their land in order to generate capital or are not confident reclaiming it upon return (Deiniger et al 2006; for China: Mullan et al., 2011). Improved land tenure security also increase people's choice of alternative adaptation options because alternative adaptation options, for example adaptation in local agriculture, are long-term investments that create costs in the short-term and benefits in the long-term. They will only be undertaken if an individual is confident they will reap the benefits in the long-term (Besley, 1995).

3.5 Clarifying legal status

Defining the legal status of people migrating due to environmental reasons: Until now, the legal situation of people migrating due to environmental reasons remains undefined. Environmental migrants do not have a legal status comparable to a refugee's legal status which would grant them legal protection to enter a country. Yet, the UN expects that climate change will lead to increased numbers of displaced people. The legal status of environmental migrants needs to be defined, for example in a process led by the UN or UNHCR, in order to give people certainty about their legal situation.

4 Managing economy-wide effects

Policy makers should be aware that people staying in areas affected by outmigration may be negatively affected if public goods and services are no longer provided. This may lead to growing economic disparities within countries and have direct negative effects on stayers. Flanking measures may be needed in areas affected by outward migration, but also in the receiving jurisdictions.

4.1 Supporting areas affected by outward migration

The effect of outward migration and "brain drain" can be lessened by promoting links between migrants and their region of origin. Persisting links between migrants and those staying behind can mitigate potentially negative effects of migration, e.g. if migrants send remittances back home or return to invest newly-acquired capital or skills.

It is possible that climate change will make certain areas all but inhospitable. In such situations, voluntary migration may eventually give way to "managed retreat" (defined as "the progressive abandonment of land and structures in highly vulnerable areas and resettlement of inhabitants" [Mearns et al. 2010: 116]). While reducing people's vulnerability to the adverse consequences of climate change, resettlement may increase their social and economic vulnerability. Resettlement is often a heavily politicized and delicate process. Not only the economic, but also the psychological and social costs of people being resettled are very high, requiring careful processes and thorough consultation (see e.g. World Bank's Operational Directive 4.30 on Involuntary Resettlement).

4.2 Supporting receiving jurisdictions

Migration will also pose challenges to the receiving jurisdictions. Public policy can help alleviating them by helping to manage the absorption process, especially in urban areas. The arrival of migrants poses important economic and social challenges to receiving communities. A receiving city's labour market and infrastructure might not have the capacities to accommodate rapidly increasing numbers of people. If arriving migrants encounter problems entering the labour market or do not have access to public goods this will lead to economic and social problems. It is therefore crucial to strengthen the absorptive capacity of migration destinations, in particular urban labour markets and public services.

There may also be a need to direct migration movements to areas of decreased environmental risk. An important part of migrants moves from environmentally vulnerable areas to areas that are equally vulnerable, albeit for different reasons. For example, migrants might leave drought-prone agricultural areas to cities located in low-elevation coastal areas that are prone to increased flooding. It is important to identify such migration movements and take measures to redirect them.

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