

Natural Disasters and Migration: Storms in Central America and the Caribbean and Immigration to the U.S.

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Abstract

In 1998 hurricane Mitch devastated Honduras and Nicaragua, affecting more than 1,000,000 people. This was the first time the U.S. granted temporary protected status to two Central American countries due to a tropical storm. This is a clear example of policies that account for the effect of a natural disaster on U.S. migration levels. While some historical and theoretical evidence suggests a link between climate and migration, there is little empirical evidence that the environment plays a significant role in migration patterns. My research analyzes the potential relation between natural disasters and migration. To carry out the analysis, I compile data on storms, immigration and other demographic characteristics of Central American and Caribbean countries from 1980-2009. The findings have clear implications for policy-makers: the environment must be included as a potential cause of emigration from Central America and the Caribbean.

Introduction

According to the International Organization for Migration (IOM) there will be 200 million environmentally-induced migrants by 2050 (Raleigh et al., 2009). Data compiled annually in the Emergency Events Database (EM-DAT) by the Centre for Research on the Epidemiology of Disasters (CRED 2008) show a continuous increase in the frequency of natural disasters throughout the last few decades. These events, including floods, droughts, and storms, are affecting more and more people and are generating increased damages globally (Warner, 2010). Several factors account for these trends— among them, increased exposure of population to hazards (for example, through increased settlement in flood plains) and environmental degradation due to climate change. Among the many potential impacts of climate change for human societies is the possibility of changes in human migration patterns (Glantz & Ausubel, 1988; Hugo, 1996; Barnett, 2003).

The nexus of climate change and change in human migration patterns in this context draws from observation that hazards, such as natural disasters, displace people. Displacement can be the result of people losing their homes, their jobs, their neighborhoods or any other element of their daily life that gives them certain stability (Chase-Dunn & Grimes, 1995). This displacement can lead to migration. When people lose their homes and jobs, elements that gave stability to their life, they may be more likely to migrate and look for stability elsewhere, whether within their own country or abroad. In the 2001 report of the Intergovernmental Panel on Climate Change (IPCC) on vulnerability, impacts and adaptations, the question of whether such climatic changes could result in changes in human migration patterns was briefly discussed, but no major conclusions were expressed (Kates et al., 2001).

In 1998 Central America was hit by one of the most destructive hurricanes in history, Hurricane Mitch. The hurricane devastated Honduras and Nicaragua, killing

more than 10,000 people and affecting over 100,000 more (Krikorian, 1999). Despite the fact that Central America has a history of hurricanes, this was the first time the United States granted temporary protected status to immigrants due to a tropical storm. This is a clear example of U.S. policies that account for the effect of a natural disaster on migration levels.

Despite the previous example of Hurricane Mitch, there is little current evidence that the environment shapes international migration. There are, however, many documented cases of environmental change that results in displacement, including instances in the Maldives and Bangladesh. In the Maldives islands, rising sea levels due to the melting of the polar ice caps threatens inhabitants. Consequently, the president of the Maldives seeks to buy land in Sri Lanka, India or Australia to relocate the people of the Maldives after the islands disappear (Ramesh, 2008). This is one of the most extreme examples in which people will be displaced from their home country and will be obligated to migrate. Another more current and tangible example is Bangladesh. Periodic severe floods in Bangladesh cause displacement on a very significant scale. In the floods of 2007, about 32,000 Km² were inundated, affecting almost 16 million people in about 3 million households (Walsham, 2010). After this massive flood, many Bangladeshis emigrated to India.

Based on current and historic evidence of the link between the environment and human mobility, this paper looks for current evidence on natural disasters and their effect on migration levels. Specifically, I analyze the effect of severe storms in Central American and Caribbean countries on the migration levels to the United States. The United States is the major immigration hotspot in the Western Hemisphere; displaced people from Central America and the Caribbean tend to choose the U.S. as a favored destination. I analyze Central America and the Caribbean because they are two regions constantly affected by tropical storms.

This research considers historical evidence and migration theories to develop a model to investigate the effect of severe storms and floods on immigration to the U.S. Taking into account that this relationship is closely interwoven with other societal processes, this paper not only looks into the raw numbers of immigrants and the incidence of the storms, but also controls for other factors derived from theories of international migration that are thought to be closely related to the decision to migrate.

The Relationship between Climate Change and Migration

The relationship between climate and human mobility is the result of complex multivariate processes, environmental, political, social, and economic (Warner et al., 2010). While the environment is an important motor of migration it is important to consider that there are other factors that lead people to migrate.

In the wake of a natural disaster, migration can help reduce risks to lives, livelihoods and ecosystems, and contribute to income diversification and enhance overall capacity of households and communities to cope with the adverse effects of environmental degradation and change (Walsham, 2010). While environmental factors tend to be the tipping points in the decision making process, economics, society and politics play a crucial role (Hugo and Bardsley, 2010). These tipping

points occur in both rapid and slow onset events. In events such as Hurricane Mitch in 1998 and Hurricane Katrina in 2005, two rapid onset events, both disasters generated thousands of displacees and migrants (Bardsley and Hugo, 2010). These two hurricanes were clear tipping points in the decision to migrate. The events affected not only the resource base but also social networks, community structures, and more. Gradual or slow-onset processes such as soil degradation and desertification compounded by political factors (domestic, regional or geo-political) pushed a case like Darfur into a crisis tipping point. Environmental and social monitoring functions, such as famine early warning systems, will prove crucial in predicting and ascertaining when threshold are exceeded and populations will be pressured to migrate (Warner et al., 2010).

Theory and Hypothesis

Most researchers, scholars and academics claim that climate change leads to displacement and migration (Hugo, 1996; UNHCR, 2008; Raleigh, 2008; Walsham, 2010; Dunn, 2009; Warner et al., 2010; Adamo & Izazoa, 2010; Bardsley & Hugo, 2010). They base this conclusion on case studies – including those involving the Maldives, Bangladesh, Mozambique, and Vietnam (see, e.g., Dun, 2009; Ramash, 2008; Walsham 2010; Warner 2010; Warner et al. 2010). This study looks for evidence of climate-induced migration from Central America and the Caribbean over a period of thirty years (1980-2009). These regions have high levels of migration to the United States, which have been attributed to other sources, such as low economic level and political instability (Suarez-Orozco, 1999). I review economic and political theories of migration and suggest how climate change may be understood as a distinct motivation from these theories.

When rapid onset disasters like storms occur, people often leave the affected area to avoid physical harm or loss of life (McLeman & Smith, 2006). In some cases, destroyed homes obligate people to leave their hometowns. Livelihoods, crops, and livestock or other productive assets are often lost after rapid-onset events such as storms. The loss of livelihood leaves people displaced, encouraging them to move. Examples of evacuation and subsequent (permanent) displacement include Hurricane Katrina (2005), Hurricane Mitch in Honduras (1998) and the eruption of the Montserrat volcano in the Caribbean (2010) (Warner, 2010). The way that disasters of this type are managed and the sociopolitical and economic situation of the community play a role in people's decisions to migrate.

The independent, disruptive effect of climate change-induced storms and other disasters can be understood through economic theories of international migration. The "new economics of labor migration" suggests that migration decisions are based on a household need or desire to accumulate economic capital and minimize risk through household labor diversification (Massey et al., 1993). In developing economies, the markets for insurance, credit, and capital are often underdeveloped or unavailable to households. For example, there are areas that do not have insurance for crops. In other words, there is no price protection or government support for "futures markets" (Massey, 1993). Migration provides an alternative means for risk management as households diversify their sources of income. In the case of a storm, this motivation may become especially pronounced.

After a storm destroys crops belonging to a particular household, for instance, the inhabitants will be more likely to migrate if there is no insurance to help them manage during the crisis period.

On the other hand, there are theoretical reasons why displaced migrants will tend to migrate to a certain destination, in this case the United States. The dual labor market theory aims to explain this phenomenon by arguing that international migration stems from modern industrialized countries' demand for immigrant labor (Hatton & Williamson, 2002). Modern industrialized countries such as the U.S. have certain labor market characteristics that demand migrants. One of these characteristics is structural inflation, in which society and institutions ensure that wages correspond to hierarchies of prestige and status (Massey, 1993). Higher wages for lower skilled workers are improbable, because this causes inflation of wages to the hierarchy. Another characteristic are motivational problems, in which few "natives" want jobs with low pay that give neither financial nor status rewards (Castles and Miller, 2009). Migrants who want and need income often take these low paying jobs. Also, modern industrialized countries have economic dualism, in which there is a division of the labor force due to the way capitalists like to use permanent labor and reserve labor as the economy fluctuates. Another characteristic is the demography of labor supply, in which there is a demographic trend toward a smaller domestic labor supply for secondary market jobs. In the past 20 years women and teenagers have become less willing to do low paying jobs (Massey et al., 1999). These conditions apply to the United States as a modern industrialized country where low paying and seasonal jobs are typically held by immigrants. These characteristics make the U.S. a magnet for immigrants, including those displaced by natural disasters.

Society and culture also play an important role in the decision to migrate. Theories of cumulative causation explain that each act of migration alters the social context in which future decisions are made (Massey & Espinosa, 1997). For example, if someone from region A migrates to region B, the next migrant from region A is more likely to migrate to region B as well. This follows the logic of networks theory, in which previous migrants, friends and relatives from one's own country, who now live in the new location, influence the decision to leave one's home region. The number of previous immigrants increases in destination-specific ways and perhaps reduces the loss of "ethnic capital" of the emigrating culture (Hatton & Williamson, 2002). Also, immigrant networks reduce migration costs directly, since they can relax the poverty constraint on potential migrants by providing access to loans or outright gifts (Castles & Miller, 2009).

The two regions of interest in this research, Central America and the Caribbean, have a long history of migration to the U.S. Consequently, if Central American and Caribbean people decide to migrate, the U.S. will be one of their potential destinations. In addition to regular migration to the U.S., it is important to highlight that Temporary Protected Status has been granted to people of these countries during periods of civil war (Suarez-Orozco, 1999). More recently this status has been granted after severe natural disasters, contributing to the immigrant network and influencing the decision about where to go.

Migration systems theory explains that migration patterns originate between regions or countries that already have economic, cultural, or colonial ties (Castles & Miller, 2009). During the 1980s the U.S. developed closer relationships with Spanish speaking countries (Suarez-Orozco, 1999), in part due to increasing migration from Central America that continues today. The Caribbean has a history of American political intervention, and economic penetration in countries like Cuba, the Dominican Republic and Haiti (Massey et al., 1999). This history helped to establish the influx of migrants to the U.S. Migration systems theory, together with network and dual network market theories, explains why the U.S. is the region of choice for people displaced by severe storms in Central America and the Caribbean.

As Zoelberg (1989) argues, a number of theories do not adequately consider the role of other important factors on migration, such as the environment and political state. Economic capital might be at stake, but governments reserve the right to determine those who will be “beneficial” for the nation. For example, after terrorist attacks, countries tend to create more restrictive immigration policies, and economic capital loses its main role to national security (Zoelberg, 1991). This theory also addresses the situation of refugees and how labor markets and the economy do not have a main role in their decision to leave. Refugees in the developing world arrive mostly as a result of two major historical processes: the formation of new states and the confrontations over the social order in both old and new states (Zoelberg, 1989). These refugees do not arrive due to division of the labor market and the desire to accumulate capital. This theory’s arguments can be used as a basis for a critique about the exclusion of the role of the environment in migration theories. Both political and climate refugees leave their countries due to reasons that they cannot control. Therefore, drawing from the logic behind these theories and from the assumption that natural disasters displace populations, I proposed the following hypothesis: Controlling for economic characteristics and other factors, there will be an increase seen in one year in U.S. immigration from Central America and Caribbean countries that have been hit by a severe storm.

Variables

My independent variable, *severe storms*, is binary. The data for this variable was retrieved from the International Disaster Database from the Centre for Research on Epidemiology of Disasters. The data used are for the top ten severe disasters per country from 1980-2009. To be considered severe enough the storms had to meet the following criteria: 10 or more people had to have been killed, at least 100 people had to have been affected, a call had to have been made for international assistance and a state of emergency had to have been declared (not all countries experienced as many as ten disasters that met this criteria). Using only the top ten created a certain bias, since it eliminates all other storms that might have had a lesser, but still discernible, effect on the population. This bias overestimates the effect of storms. There were a total of 899 *severe storms* during this period, and there was a higher incidence in earlier years (see table 2). As a control for the severity of the storms, I gathered data on the *number of killed* and the *number of affected* from each storm. As expected, because of the wide

variation in population size and geographical vulnerability, the *number of killed* had a high variation, with a maximum of 14600 in Honduras for 1998 (see table 1). *Number of affected* also had high variation, with a standard deviation of 250205.4 and a mean of 31179.48.

The variable, *population*, was created as a control variable, since there is wide variation in population densities among the continental and island territories of the study. The data on population was retrieved from the World Bank database. As mentioned, *population* varies from 3000 in Turks and Caicos Islands to 13,300,000 in Guatemala. There are 60 observations missing from those islands that are territories of the United Kingdom, the Netherlands or France.

The independent variable, *Gross Domestic Product* per capita on current U.S. dollars, was created to control for the economic level. Migration theories give special attention to economic explanations, with special attention to the economic level of the immigrants but also to the economic conditions in the second country. According to these theories poverty constrains migration since financing investment in a long-distance move is difficult for the very poor (Hatton, 2002). Therefore, there is a division between the very poor, who cannot afford to leave, and the poor, who have enough money to leave. The data for this variable were retrieved from the World Bank Data Base. There are 266 missing observations, mostly for Caribbean countries that are territories of other countries; in some cases, such as in Belize, there is data missing for the period when it was an English colony.

The independent variable, minimum *distance* to the U.S., was roughly calculated in kilometers by the Google maps distance calculator. Since the objective was to have an overall idea of the countries that are closer to the U.S. and those that are farther, the Google tool fit perfectly. For Central American countries I measured the distance from the closest point to the Mexico/U.S. border in Texas. For the Caribbean countries and territories I measure the distance from the islands to Florida. The distance accounts for the ease (in terms of distance) to get to the U.S., and assumes that people from countries closer to the U.S. are more likely to migrate than countries that are further away. The *distance* ranges from 671 to 2629 kilometers.

The independent variable, *colony*, is a binary variable controlling for whether the territory is independent. These data were retrieved from the CIA fact book. All Central American countries are independent republics. However, there are some Caribbean countries that are territories of other nations. The variable aims to control for the likelihood that someone from a certain territory will come to the United States or will go to another country where they have ties. Thirty-four percent of the regions in my sample are colonies, and all are in the Caribbean (see table 1).

The variable, *Central America*, is binary. This variable controls for isthmus versus island status since islands might be more vulnerable to severe storms or floods than continental countries. Seventy-seven percent of the territories sampled are islands (see table 1).

The *size* variable is the area of each territory measured in squared kilometers. This data were retrieved from the CIA fact book. This variable, together with the Central America variable, controls for the vulnerability of each territory. A

severe storm in a small island might devastate the whole island and force people to leave, while a storm in a bigger island or in a continental country might cause a like amount of devastation but leave certain local areas untouched, allowing people to migrate internally instead of internationally. The size ranges from 54 to 130370 square kilometers (see table 1).

Table 1: Variables' Summary

Variable	Observations	Mean	Std. Dev.	Min	Max
<i>US immigrationⁱ</i>	851	5323.779	9578.94	0	80,173
<i>Log US immigration</i>	849	6.762134	2.214654	2.639057	11.29194
<i>Severe Stormⁱⁱ</i>	900	.1757508	.3808199	0	1
<i>Number of killedⁱⁱⁱ</i>	900	36.92667	536.3689	0	14,600
<i>Number of Affected^{iv}</i>	900	31179.48	250205.4	0	5900012
<i>GDP per capita^v</i>	634	5912.743	10352.21	239	94,908
<i>Population^{vi}</i>	840	2,248,657	3307381	3000	13,300,000
<i>Central America</i>	900	.233333	.4231878	0	1
<i>Colony^{vii}</i>	900	.3422222	.4747174	0	1
<i>Size^{viii}</i>	900	24924.49	39949.53	54	130370
<i>Distance^{ix}</i>	900	1798.433	671.1078	282	2629

ⁱ Department of Homeland Security/Immigration and Naturalization Services yearbooks (1980-2009). Data on Legal Permanent Residents by country

ⁱⁱ EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium). Top ten Natural Disasters by Country

ⁱⁱⁱ EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium). Top ten Natural Disasters by Country

^{iv} EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium). Top ten Natural Disasters by Country

^v The World Bank Database. GDP per capita
<http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries/1W?display=graph>

^{vi} The World Bank Database, Population totals
<http://data.worldbank.org/indicator/SP.POP.TOTL?display=graph>

^{vii} Central Intelligence Agency The World Fact Book
<https://www.cia.gov/library/publications/the-world-factbook/>

^{viii} Central Intelligence Agency The World Fact Book
<https://www.cia.gov/library/publications/the-world-factbook/>

^{ix} Google Maps Distance Calculator <http://www.daftlogic.com/projects-google-maps-distance-calculator.htm>

Analysis

The graphs for each country provide some indication that peaks in emigration did occur a year or two after a severe storm. This is particularly clear in the case of Anguilla, where a severe storm hit in 1999 and migration to the U.S. peaked two years later (see figure 1). The graph for the Bahamas shows that a severe storm hit the country in 1987 and immigration peaked in 1988 (see figure 2). A sharp increase in immigration from Costa Rica occurred in 1990 after a severe storm in 1988 (see figure 3).

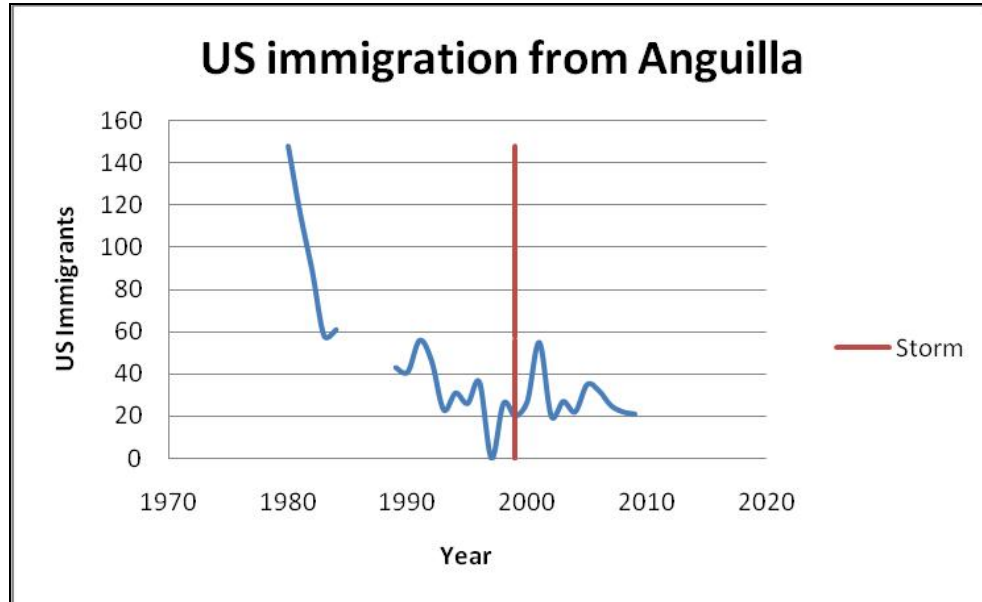


Figure 1. Severe storms and U.S. immigration from Anguilla, 1980-2010.

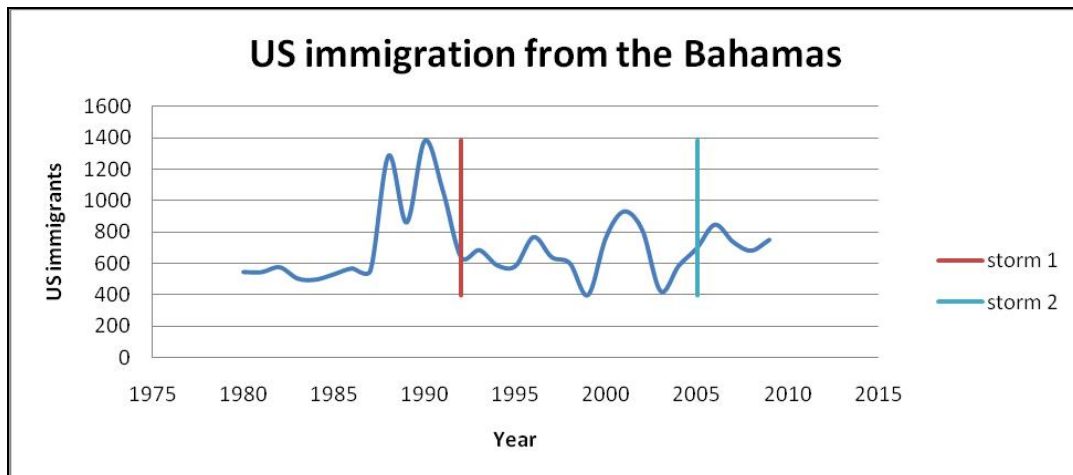


Figure 2. Severe storms and U.S. Immigration from the Bahamas, 1980-2010.

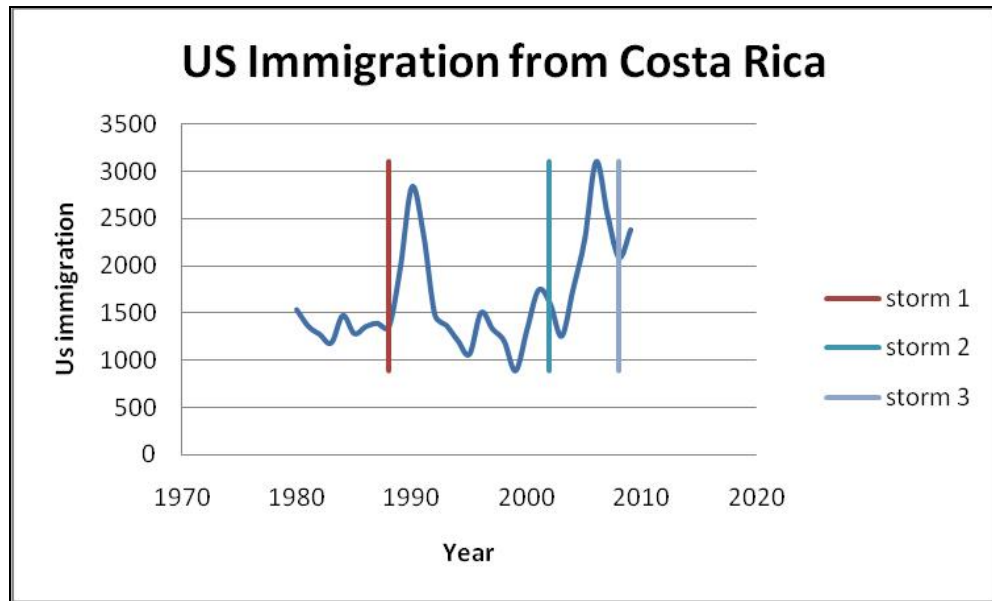


Figure 3. Severe storms and U.S. immigration from Costa Rica, 1980-2010.

Most of the graphs show a spike in immigration after a severe storm; however, there are countries that have numerous storms in consecutive years so the individual effect of the storms is not discernible (see figures 4 & 5). Consequently, not all graphs support my hypothesis. Overall, the graphs collectively show the general trends of migration to the U.S., with great variation in the number of immigrants to the United States across years.

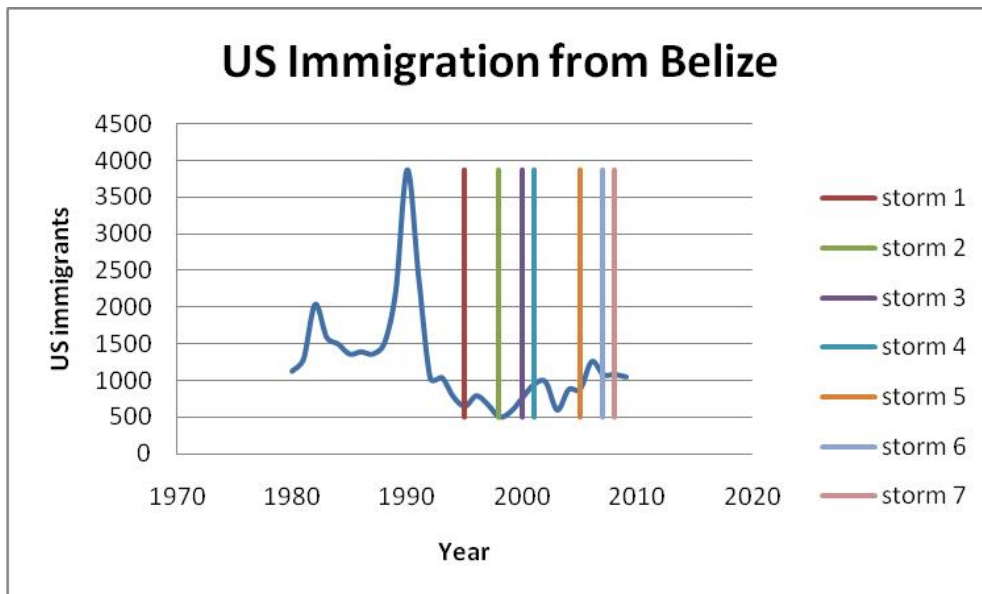


Figure 4. Severe storms and U.S. immigration from Belize, 1980-2010.

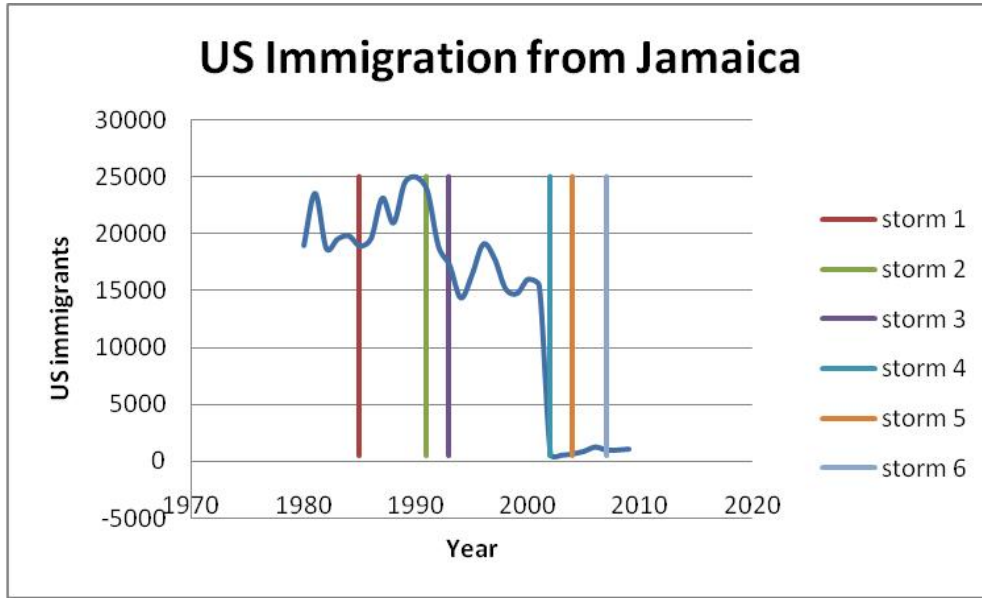


Figure 5. Severe storms and U.S. immigration from Jamaica, 1980-2010.

The mean U.S. immigration one year following a storm is significantly higher than that for a year not following a storm (see table 2). For all countries studied, the mean of U.S. immigrants in years after a storm is 8660.742, while in years that a storm did not precede, the mean is 4580.63, statistically significant at a 95% confidence level.

Table 2: Mean US Immigrants coming from Central America and the Caribbean

Years	Mean US immigrants	95% confidence interval	
Year following a storm	8660.742	6845.471	10476.01
Year not following a storm	4580.634	3914.224	5247.044
Difference	4080.108	2432.028	5728.189

The ordinary least square regression model controlling for demographic and geographical trends demonstrates a significant positive effect of storms on U.S. immigration (see table 3). Hence, when there is a storm, there is an increase of 16.5% in the number of immigrants per year after the storm, controlling for other factors that may explain variation in emigration in a given country-year. Regression I was controlled for *GDP per capita*, *population*, *distance* from the U.S., status as a *Central American* country, status as a *colony*, *year* and *geographical size*. *GDP per capita* had a significant negative effect on immigration following a severe storm, as

did *distance* to the U.S., *size*, *colony* and *year*. The variable *population* size has a significant positive effect on immigration (see table 3).

Table 3: Regression Table

	<i>US Immigration (log)</i>
<i>Storm (lagged)</i>	.1648265* (.0882867)
<i>GDP per capita</i>	-.0000107* (4.94e-06)
<i>Distance to the US</i>	-.0001684** (.0000632)
<i>Population</i>	3.86e-07*** (1.82e-08)
<i>Central America</i>	.3565029** (.1053814)
<i>Year</i>	-.0257587*** (.0047567)
<i>Size</i>	-9.49e-06*** (1.54e-06)
<i>Colony</i>	-1.911659*** (.1720033)
Constant	58.62754*** (9.450285)

Standard Error in parenthesis

* p< 0.05, ** p<0.01, *** p<0.001

Discussion

While the graphs and differences in mean immigration indicate an increase in U.S. immigration a year or two after a storm, their main function is to show trends over time. The regression is the crucial part of this study since it controls for other variables that might be influencing the decision to migrate. The regression results demonstrate that there is an increase in immigration from Central America and the Caribbean to the U.S. a year after a severe storm.

The other variables included in the regression also had a significant effect on immigration to the U.S., as predicted by the migration theories (see table 3). When *GDP per capita* is low, there is more migration to the U.S. from that country, controlling for whether there was a storm. The model demonstrates that those in

countries at the bottom end of the GDP distribution are the ones more likely to migrate. Also, the farther away a country is from the United States, the fewer the number of people from the country who migrate to the U.S. Central American countries have higher levels of migration than island territories, since most of the islands are colonies or former colonies of European countries. People in these islands are less likely to migrate to the U.S. Looking at the time domain, there are higher levels of immigration in earlier years (1980-2009) than in later ones. This is possibly due to the effect of IRCA, the 1986 legislation that provided an amnesty for undocumented migrants in the United States, which increased documented migration flows to the United States in the late 1980s. In addition, countries with a high population have higher levels of migration. Overall, all variables comply with my expectations.

However, it is important to mention that the ordinary least square regression model I used in the analysis assumes that all units of analysis are independent from each other, which is not the case. Emigration from a country in one year is correlated to emigration from the same country in another year. This might be a potential source of error in my estimates. Future analyses can deal with this problem by adjusting standard errors for correlation within countries.

Attention should be paid also to the bias in using only the top ten severe storms as well as to missing data. There is an important control variable – the networks variable – that is missing in this research due to time constraints and lack of available data. The presence of networks between Central America and the U.S. increases the likelihood of people coming to the U.S., potentially taking away some of the effect we see from the storm. Future analyses might use country and year fixed effects to control for country, year, and country-linear trends that are unmeasured in the current models.

While this research is a preliminary step towards empirically supporting the hypothesis that climate change-related disasters have an impact on levels of migration to the U.S., further research, including studies using other variables and complete data for storms, will be needed to better estimate this relationship. However, the results are consistent with the hypothesis that severe storms as a manifestation of climate change have a significant role in emigration.

Conclusion

Many scientists predict an increase in natural disasters, including severe storms, floods, and earthquakes. A larger number of people are expected to migrate due to extreme climate and gradual deterioration of environmental conditions and migration may be more permanent due to the long-lasting and, in some cases, irreversible effects of these processes. Over the past decade this increase has already been manifested. Data compiled annually in the Emergency Events Database (EM-DAT) by the Centre for Research on the Epidemiology of Disasters (CRED 2008) show a continuous increase in the frequency in manifestation of many hazards of natural or anthropological origins throughout the last few decades (Warner et al., 2010).

Rapid-onset change is linked with environmentally induced displacement and migration (Warner, 2010). Temporary displacement from natural catastrophes can

lead to permanent migration, as illustrated by the 2004 Indian Ocean tsunami and the 2005 Hurricane Katrina (McLeman and Smith, 2006). The Indian Ocean Tsunami in late 2004 displaced over 2 million people, many of whom were still living in refugee camps in the region several months or years after the event (UNHCR 2008). In the Gulf of Mexico in 2005, Hurricane Katrina resulted in the largest displacement of Americans in the country's history. Although government policies and practices drove the displacement process, Hurricane Katrina ultimately caused about 1.5 million people to be displaced temporarily and an estimated 500,000 people permanently (Grier, 2005).

These examples point to the importance of considering the impact of environmental disasters on migration, and this study points to the important relationship between climate in Central America and the Caribbean and migration from these two regions to the United States. These results were significant, even after controlling for geographical demographic variables that often influence one's decision to migrate.

Other factors have the potential to interact with the disaster-related explanation proposed in this study to more fully explain migration from these regions. Because family income plays a big role in the decision to migrate, it is possible that people who have already decided to migrate could be in the process of organizing their migration when a storm hits their respective country. A probable explanation, considering the low economic levels of most countries in Central America and the Caribbean, is that many immigrants travel to the U.S. to earn capital and reunite with family (Suarez-Orozco, 1999). If this is the case, then the storms (or other natural disasters) may hasten emigration rather than cause it.

Since this study is limited in its scope to Central America and the Caribbean and to immigration to the U.S. only, no general conclusions can be reached regarding the impact of severe storms on international migration. In order to get a more comprehensive view, levels of immigration into each receiving country need to be included, thereby eliminating the bias of including only one receiving country. Other natural disasters should be included in future research as well. Additionally, surveys can be conducted to control directly for the effect of natural disasters. These surveys would be directed to people who have migrated from a region affected by a natural disaster.

Despite the need for further research, the results of this study suggest that environmental causes of migration should be taken into account in future U.S. migration policy. Especially because of the potential for environmental changes wrought by climate change, the state of the environment needs to be factored into U.S. immigration policies from Central America and the Caribbean.

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Bibliography

- Adamo, S. (2008). Addressing environmentally induced population displacements: A delicate task. Background paper for the Population-Environment Research Network Cybersemina.
- Adamo, S. & Izazoa, H. (2010). Human migration and the environment. *Population and the Environment* 32: 105-108.
- Bardsley, D. & Hugo, G. (2010). Migration and climate change: Examining the thresholds of change to guide effective adaptation to decision making processes. *Population and the Environment* 32: 238-262.
- Barnett, J. (2003). Security and climate change. *Global Environmental Change* 13: 7-17.
- Barnett, J. & Webber, M. (2009). Accommodating migration to promote adaptation to climate change. Commission on Climate Change and Development. Stockholm, Sweden.
- Castles, S. & Miller, M. (2009). *The age of migration: International population movement in the modern world*. New York: The Guilford Press.
- Chase-Dunn, C. & Grimes, P. (1995). World-systems analysis. *Annual Review of Sociology* 21: 56-68.
- CRED/EM-DAT International Disaster Database (n.d.). Université Catholique de Louvain, Brussels (Belgium). Retrieved from www.emdat.be.
- Douglas S. M., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J.E. (1993). Theories of migration: A review and appraisal. *Population and Development Review* 19: 431-466.
- Dun, O. (2009). Linkages between flooding, migration and resettlement. Case study report on Vietnam for the environmental change and forced migration scenarios project. Retrieved from <http://www.each-for.eu/>.
- German Watch. (2004). Sea level rise in Bangladesh and The Netherlands: one phenomenon, many consequences. Retrieved from <http://www.germanwatch.org/download/klak/fb-ms-e.pdf>.
- Glantz, M. & Ausube, J. (1988). Impact assessment by analogy: Comparing the impacts of the Ogallala aquifer depletion and CO2-induced climate change. In M. H. Glantz (ed.), *Societal Responses to Regional Climate Change* (pp. 113-142). Westview Press, Boulder.
- Grier, P. (2005, September). The great Katrina migration. *The Christian Science Monitor*. Retrieved from http://www.alertnet.org/printable.htm?URL=/db/crisisprofiles/SA_TID.htm
- Hatton, T. & Williamson, J.G. (2002). What fundamentals drive world migration? *Working Paper 9159*. National Bureau of Economic Research. Hampshire, UK
- Hugo, G. (1996). Environmental concerns and migration. *International Migration Review* 30: 105-131.
- Huntley, B. (1999). Climatic change and reconstruction. *Journal of Quaternary Research* 14: 513-520.
- IPCC (2001). Climate change 2001: Impacts, Adaptation, and Vulnerability. *Contribution of working group II to the Third Assessment Report of the Intergovernmental Panel on climate change*. Cambridge: Cambridge University Press.

- Kates, R., Clark, W. C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I. ... Jäger, J. (2001). Policy forum on environment and development: Sustainability science. *Science* 292: 641–642.
- Krikorian, M. (1999). *Here to say there is nothing as permanent as a temporary refugee*. Report for Center for Immigration Studies, Washington DC.
- Laczko, F. (2010). Migration, the environment and climate change: Assessing the evidence. Study team on climate-induced migration. International Organization for Migration. Geneva, Switzerland.
- Lockeretz, W. (1978). The lessons of the Dust Bowl. *American Scientist* 66: 560–569.
- Lockeretz, W. (1989). Secondary effects on Midwestern agriculture of metropolitan development and decreases in farmland. *Land Economics* 65: 205–216.
- Massey, D., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J.E. (1999). *Worlds in Motion*. Oxford Press. New York.
- Massey, D. & Espinosa, K. (1997). What's driving Mexico-U.S. migration? A theoretical, empirical and policy analysis. *American Journal of Sociology* 102: 939–999.
- McLeman, R. & Smith, B. (2006). Migration as an adaptation to climate change. *Climatic Change* 76: 31–52.
- Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Island Press, Washington, DC.
- Raleigh, C., Jordan, L. & Salehyan, I. (2009). Assessing the impact of climate change on migration and conflict. *Working Paper Social Dimensions of Climate Change*. The World Bank Group. Washington DC, U.S.
- Ramesh, R. (2008, November). Paradise almost lost: Maldives seek to buy a new home land." *The Guardian Environment, Climate Change*. London, UK.
- Skeldon, R. (2006). Interlinkages between internal and international migration and development in the Asian region. *Population, Space and Place* 12: 15–30.
- Suárez-Orozco, M. (1999). Latin American immigration to the United States. In V. Bulmer-Thomas & J. Dunkerly (Eds.), *The United States and Latin America: The New Agenda* (pp. 2–5). Cambridge, MA: Harvard University Press.
- Tyson, P., Lee-Thorp, J., Holmgren, K. & Thackeray, F. (2002). Changing gradients of climate change in Southern Africa during the past millennium: Implications for population movements. *Climatic Change* 52: 129–135.
- United Nations High Commissioner for Refugees (UNHCR). (2008). *Climate change, natural disasters and human displacement: a UNHCR perspective*. Geneva, Switzerland.
- U.S. Citizenship and Immigration Services. (2010, May). *18-month extension of Temporary Protected Status for Honduras, Nicaragua and El Salvador*. USCIS Press Release Washington, DC, U.S.
- Van Geel, B., Buurman, J. & Waterbolk, T. (1996). Archaeological and paleoecological indications of an abrupt climate change in The Netherlands, and evidence for climatological teleconnections around 2650 BP. *Journal of Quaternary Science* 11: 451–460.

- Walsham, M. (2010). Assessing the evidence: Environment, climate change and migration in Bangladesh. Working paper. International Organization for Migration. Geneva, Switzerland.
- Warner, K. (2010). Assessing institutional and governance needs related to environmental change and human migration." Study team on Climate-induced migration. German Marshall Fund of the U.S. Washington DC, U.S.
- Warner, K., Hanza, M., Oliver-Smith, A., Renaud, F. & Julca, A. (2010). Climate change, environmental degradation and migration. *Natural Hazards* 55: 689-715.
- Yesner, D.R. (2001). Human dispersal into interior Alaska: antecedent conditions, mode of colonization and adaptations. *Quaternary Science Reviews* 20: 315–327.
- Zolberg, A. (1989). The next waves: Migration theories for a changing world. *International Migration Review* 23: 403-430.
- Zolberg, A. (1991). Bounded states in a global market: The uses of international labour migration. In P. Bourdieu and J. S. Coleman (eds.), *Social Theory for a Changing Society* (pp. 254–336). Westview Press, Boulder, CO.