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Aspen J. Ono April 3, 2018

The Impact of Environmental Disasters on the Migration of Political Refugees

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Abstract

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Analyzing the relationship between environmental disasters and population migration has been an area of increasing academic interest over the past few decades. The legal recognition of those displaced by environmental disasters and slow onset events is increasingly important with the progression of climate change. There is currently no comprehensive legal status designated to environmentally displaced persons. Population migration is usually influenced by multiple factors including social, political, economic, demographic and environmental drivers. Therefore, designating migrants or refugees into categories defined by singular causal mechanisms overlooks the true complexity of a population's decision to migrate. Using an OLS regression with robust standard errors, this paper analyzes the role that climate related environmental disasters play in the migration of United Nations recognized political refugees across international borders from 1960 to 2016, accounting for a range of control variables. This analysis finds a positive and significant relationship between the country-level number of individuals affected by climate related environmental disasters and the country-level annual differentiated number of outgoing refugees. These findings challenge existing legal migration classifications by demonstrating the multi-causal nature of political refugee migration. Given the projected augmentation of deleterious disasters associated with climate change, these results underscore the need for an international legal framework to address and acknowledge migrant populations, whose decision to move was heavily influenced by environmental factors.

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1. Introduction

The international dialogue on climate change and environmental migration accelerated in the 1980s when United Nations Environmental Programme researcher, Essam El-Hinnawi, popularized the term "environmental refugee" (El-Hinnawi, 1985). In a 1990 report released by the Intergovernmental Panel on Climate Change (IPCC), the organization projected that the single greatest impact of climate change would be human migration (IPCC, 1990). However, no consensus within the academic community nor global political networks on identifying, governing, and protecting individuals displaced by environmental disasters has been developed. Challenges in classifying individuals displaced by environmental events include identifying the causal mechanism(s) that influenced their decision to move; differentiating these populations from other migrant populations; creating an effective legal framework efficiently to meet the needs of those already displaced; and allocating legal responsibility across governance bodies and regions. These challenges hindered the development of an international legal framework to recognize and provide meaningful protection to these displaced persons.

A fundamental challenge in addressing climate change migration is the existing international legal migrant classification methodology which broadly designates migrants into basic categories of economic migrant or political refugee. Such a framework overlooks the influence that environmental, social and or demographic factors can play in a population's decision to leave their homeland. Consequently, existing international migration laws overlook the complex interactions that occur between various migration push and pull factors, thereby, underestimating the role that environmental phenomena like climate related disasters can have on

existing migration patterns. This type of causal reductionism makes identifying, differentiating, and acknowledging environmental or climate change displaced persons difficult.

Using global cross-sectional time series data spanning 1960 to 2016, this paper analyzes historical trends in the number of individuals impacted by environmental disasters and the differentiated number of outgoing political refugee migrations. Results demonstrate, controlling for a range of state characteristic variables, a positive and significant relationship between the number of individuals impacted by the environmental disasters in a given country-year and the differentiated number of refugees produced by that state in that same year. This positive and significant relationship was consistently observed in successive supplementary models which tested the relationship in cases of individual disaster types, among developing nations, and including a variable measuring country level inequality. Such results highlight the multi-causal nature that drives population migration. Furthermore, they demonstrate that environmental events already influence the movement of individuals across borders, even those legally classified as political refugees.

2. **Background**

Causal reductionism, the tendency to attribute a result to a single cause, is a fundamental challenge that most contemporary migration frameworks and legal regimes face. Migrants are most commonly defined as individuals who move from one location to another to either seek better economic opportunities or to flee political persecution (Zetter, 2008). A rising discourse around climate change displacement argues that climate change related environmental disasters and slow onset events impact population migration by threatening the habitability of a given region (Afifi and Jager, 2010; Bie Lilleor, 2011; Black et al., 2011; Bohra-Mishra, 2014; Hunter

et al., 2015; McLeman, 2014; Obokata et al., 2014). Existing migrant labels and legal classifications generally overlook the impact of such environmental disasters on migration and thereby, underestimate the complexity of interrelated push and pull factors that influence an individual or community's decisions to move. Black et al. (2011) argues that there are five categories of migration drivers: social, economic, political, demographic, and environmental, all of which overlap and interact to motivate an individual or population to migrate from their country of origin. Accordingly, when considering the impacts that one factor has on population migration, other related migration drivers must be considered.

Over the past few decades the international dialogue on environmental displacement and migration, specifically that related to climate change, has become an area of interest to scientists, politicians, the media, and the public. Such interest is demonstrated by attempts to project and quantify the number of environmental and climate change migrants that the world has seen and will see in the coming decades (Christian Aid, 2007; Houghton et al., 1992; Myers, 1995; Myers, 2002). These analyses projected that there would be between 50 million individuals displaced by environmental factors by 2010 (Myers, 2002) and 250 million individuals displaced by climate change disasters by 2050 (Christian Aid, 2007). Although these estimations brought public attention to the immediacy and extremity of environmental and climate change displacement, the methodologies used to generate such predictions were criticized for their lack of robustness (Doos, 1997; Gemenne, 2011). Gemenne (2011) and Doos (1997) argue that accurate predictions of the number of environmentally displaced persons can be generated despite historical methodological failures and call for an implementation of more rigorous methodologies in counting future environmentally displaced populations. Other scholars heavily criticized these migration estimates, citing challenges of accurately identifying individuals primarily displaced

by climate change related events or environmental disasters (Black, 2001; Boano et al., 2008; Castles, 2002; Kibreab, 1997). These scholars argue that efforts to segregate climate change or environmentally displaced persons from other migrant groups overlook the interdependent relationship between various push and pull factors that cause population migration (Black, 2001).

In recent years, many studies found that environmental factors, particularly environmental disasters, influence inter and intra state migration (Bohra-Mishra et al., 2014; Dun, 2011; Findley, 1994; Gray and Mueller, 2012; Hunter et al., 2015; Laczko and Aghazarm, 2009; Obokata et al., 2014). For example, Bohra-Mishra et al. (2014) found that climatic variations and to a lesser extent, episodic environmental disasters influenced population migration in Indonesia. Most studies recognize that there are very few cases in which climate change related environmental factors are the sole mechanism that push an individual or population (Bohra-Mishra et al., 2014; Gray and Mueller, 2012; Hunter et al., 2015; Obokata et al., 2014).

Climate change related disasters are recognized as risk multipliers for driving population migration. The extent to which environmental factors increase the probability that a given group migrates depends on that group's vulnerability to changing environments which "depends on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors," that already exist within that community (Field et al., 2012). Communities with natural resource reliant livelihoods, such as areas that rely on subsistence agricultural, are particularly vulnerable to changing environments and potentially related migration (Gray and Mueller, 2012; Kubik and Maurel, 2016; Mueller et al., 2014; Nawrotzki and Bakhtsiyarava, 2017). For example, communities in Sub-Saharan Africa are heavily dependent on agriculture, and accordingly, their limited economic and social capacity to adapt to

changing environments makes them especially vulnerable changing climates (Müller et al., 2011).

The climate change-migration or environmental-migration relationship has been well established in past studies. The related line of academic literature on climate change and environmental security has similarly found a link between climate change and both violent and non-violent conflict (Buhaug et al., 2008; Drury and Olson, 1998; Homer-Dixon, 1991; Homer-Dixon et al., 1993; Nel and Risharts, 2008; Schleussner et al., 2016). Researchers theorize that adverse environmental factors, particularly extreme environmental events, can lead to resource scarcity, competition, and re-allocation of government funds (Wood and Wright, 2016). Consequently, this can increase population grievances, existing tensions, and inequalities within a given state creating fertile ground for conflict (Wood and Wright, 2016). Some scholars found that environmental disasters can lead to violent competition among social groups (Berrebi and Otswald, 2011; Brancati, 2007; Nel and Righarts, 2008). However, other studies analyzed the relationship between climate related environmental disasters and civil conflict and found no direct causal relationship between the two variables (Berholt and Lujala, 2012; Slettebak, 2012). Such results may demonstrate the influence of other factors influencing the outbreak of conflict more strongly than extreme environmental events. Schleussner et al. (2016) argues that while environmental disasters may not directly cause conflict, they may escalate already politically and economically tense situations, thereby increasing the risk of political conflict and consequently refugee migration.

Existing literature finds links between climate change related environmental disasters, migration, and conflict; however, few studies have analyzed the impact of environmental factors on the creation of political refugees. This study attempts to determine the role that extreme

environmental disasters, specifically those related to current and continued climate change, play as threat multipliers to political refugee migration. Furthermore, this paper seeks to challenge existing migrant classifications by revealing the role that environmental disasters play in the migration of political refugees.

To analyze this relationship, a historical analysis was conducted to evaluate the connection between the number of individuals impacted by extreme climatic environmental events in a given country-year and that country-year's differentiated outgoing political refugee population controlling for the country's total population. Two geographic information system (GIS) maps were created as a visual to depict the impact of environmental disasters and identify states with relatively high outgoing refugee populations. An Ordinary Least Squares (OLS) time series regression with robust standard errors model was used to analyze how environmental disasters impacted a country's production of political refugees. The model accounted for additional variables that influence a state's vulnerability to environmental disasters or its propensity for the creation of refugee populations, including a state's population, population density, gross domestic product (GDP), level of democracy, trade as a proportion of state GDP, quality of governance, and conflict.

3. **Methods**

3.1. Data

The dependent variable, the number of UN recognized refugees, is estimated using data from the Office of the United Nations High Commissioner for Refugees Population Statistics Database (UNHCR, 2016). This dataset uses a country-year format and counts the number of refugees and individuals in 'refugee-like situations' recognized under the UNHCR's 1951 Refugee Convention and its 1967 Protocol, which define a refugee as an individual who

> "owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country or who, not having a nationality and being outside the country of his former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it" (UNHCR, 1951).

Yearly data were available from 1951 to 2016 for 219 different nations of origin including values for refugees whose origin was classified as 'Stateless' or 'Various/Unknown.'

The annual number of outgoing refugees from a given country generally assumes a pattern of punctuated surges that follow events that cause the number of refugees to deviate from a relatively uniform norm. This study is interested in years when a country produced an abnormal number of refugees. Therefore, the raw count UNHCR refugee data was converted into differentiated values for use in the final model. This differentiated dependent variable represents the difference in the number of refugees a given country produces in year t versus year t-1. The use of a differentiated variable helps identify country-years in which environmental disasters may have changed the scale of migration, specifically that of UN recognized refugees.

The World Health Organization and the Centre for Research on the Epidemiology of Disasters Joint Emergency Disasters Database (EmDAT) provided the independent variable data on the total number of people affected, meaning those who are made homeless, injured or requiring immediate emergency assistance, by various types of environmental disasters in a given country-year (Guha-Sapir et al., 2017). EmDAT defines a disaster as an event in which a state of emergency is declared, 10 or more individuals are reported as killed, one-hundred or more individuals are reported as affected, and the state calls for international assistance (Guha-Sapir et al., 2017). This model uses the number of individuals affected by a given disaster as the independent variable rather than the raw count of the occurrences of environmental disasters because the severity of a disaster's impact on a given population is not captured in the number of

disasters that occurred in a given country-year. For example, the same event could happen in two locations and have differentiated impacts on the populations living in those regions due to pre-existing vulnerabilities and capabilities to respond to the environmental event (Wisner et al, 2004). Such differences in scale of impact and population vulnerability creation cannot be captured by basic disaster occurrence data. Furthermore, the model does not use a differentiated value for this variable because some affected populations are impacted by a given disaster over multiple years and are counted as affected persons over multiple country-years. Using a differentiated value for the independent variable would fail to capture country-year changes. This study uses EmDAT country level data on the number of people affected by droughts, extreme temperatures, storms, and floods. These environmental disaster types were chosen because they are projected to increase in severity and or frequency as global climate change progresses (IPCC, 2014).

The EmDAT and UNHCR data were merged resulting in a total of 187 country matches between the years 1960 and 2016. Discrepancies between the datasets existed largely due to country of origin classifications. For example, there was data for Tibetan refugees in the UN database but, EmDAT did not have disaster data for Tibet. Additionally, unmatched data, including data for refugee origins that the UNHCR classified as ‘Stateless’ or ‘Various/Unknown’, were omitted.

To account for the complex series of variables that can lead to UN recognized refugee migration and or impact the effects of environmental disasters on populations, a range of control variables are included in the model. The control variables include social, economic, political, and demographic factors that Black et al. (2011) identified as possibly impacting population migration. This model also accounts for time and variance factors, as many variables do not

fluctuate over time. The basic state characteristic variables of population and population density were accounted for, using the World Bank's World Development Indicators data (World Bank, 2017), as states with higher and more congested populations are likely to have higher counts of individuals impacted by environmental disasters. Furthermore, if they produce refugees, the number of these individuals is likely to be higher relative to smaller nations.

The model accounted for a country's gross domestic product (GDP) per capita (World Bank, 2017) as a proxy for wealth. Past studies find that a nation's wealth influences the ability of individuals and governments to respond and adapt to natural disasters; these responses and adaptation measures can include government oppression, implementation of adaptation technologies, and internal migration (Gray and Mueller, 2012; Lybbert and Sumner, 2012; Olson and Drury, 1997; Stromberg, 2007; Toya and Skidmore, 2007). The more globalized and open a given state is, the more likely it is to have international partners from which to receive foreign aid in the wake of a given natural disaster (Berthelemy and Tichit, 2004; Stromberg, 2007). Natural disasters can often lead to social unrest (Drury and Olson, 1998; Nel and Righarts, 2008). Thus, the provision of foreign support through financial and resource donations can be valuable in establishing state stability (Bauman et al.,2007 ; Cropper and Sahin, 2009; Olson and Drury, 1997) and preventing any crisis that might provoke refugee migration. The model used the World Bank's World Development Indicator of Trade (World Bank, 2017), which measures a state's trade as a percentage of its GDP, as a proxy for state trade openness and international relations.

A state's political system and ruling regime may influence its volume of outgoing refugees. Democratic states may be less likely to produce large refugee populations than their autocratic counterparts due to the less violent and repressive methods utilized by the government

when internal conflicts evolve within their state. A number of studies find that there is an "inverted-U" relationship between the onset of domestic conflict and a state's level of democracy, stating that moderately democratic states are more likely to experience internal conflict than fully democratic or autocratic states (Boswell and Dixon, 1990; Fearon and Laitin, 2003; Hegre et al., 2001). However, Eck and Hultman (2007) find that democratic governments are less violent in these conflict situations and Davenport (2007) finds that democratic governments are less likely to employ repressive tactics. This model measures a state's level of democracy using the Polity IV index (Marshall and Gurr, 2013), which ranks countries across a 21-point scale ranging from -10 (full autocracy) to 10 (full democracy). The quality of governance within a given state also influences a state's level of oppression and propensity for conflict and instability, therefore the Quality of Government Institute's measure for this variable is also included in the model.

To account for the occurrence of inter and intra state conflict in the model, the Center for Systemic Peace's Major Episodes of Political Violence data was also downloaded (Marshall, 2017). Refugee populations are those who are seek refuge from political persecution and violence. Therefore, the presence of inter and intra state conflict influence the volume of refugees that country produces.

3.2. Geographic Information System Maps

Using geographic information systems (GIS) mapping, this study summarized the country-level number of individuals impacted by environmental disasters and UN recognized refugees for decades at the beginning and end of the study period. Two GIS maps of the decadal averages of country's per capita refugee population and per capita environmental disaster affected population for the 1970s and 2000s were generated. This model's dataset lacked

substantial data for many countries in the 1960s. Consequently, the 1970s was the first decade within the study period that provided enough data to run a thorough comparative analysis. The 2000s was the last decade for which a complete set of 10-year data was available, and was accordingly utilized as the end period decade for a comparative GIS map. To create global GIS maps, country boundary data from the Global Administrative Areas database (GADM, 2012) was uploaded into the ESRI ArcGIS software program (ESRI, 2011). The UNHCR and EmDAT data were joined to GADM data in ArcGIS. Each map shaded countries based on the decadal average per capita population affected by environmental disasters with darker colors indicating a larger impacted population. Graduated symbols, representing the decadal average per capita refugee population a country produces, were overlaid on their respective countries with larger dots representing larger refugee populations.

3.3. OLS REGRESSION WITH ROBUST STANDARD ERRORS

The effect of climate-related natural disasters on the year to year differentiated number of UN recognized refugees produced by a given country is estimated using an OLS regression with robust standard errors. An OLS regression was used because it was the simplest model that could be applied given the limited available data. This model was chosen because of the expected uneven distribution of standard errors due to the vast, punctuated range in the number of differentiated refugees produced by a country each year. Most years there is little variation in the number of refugees produced by a given country. However, there are occasionally large spikes in these values, meaning the data and consequently, its standard errors, are widely scattered. Although the dependent variable was formatted as a differentiated value, the independent variable, the number of individuals in a country impacted by a given type of environmental

disaster, was not differentiated since the data was additive. The model also included yearly-fixed effects to control for the general global increases in population migration over time.

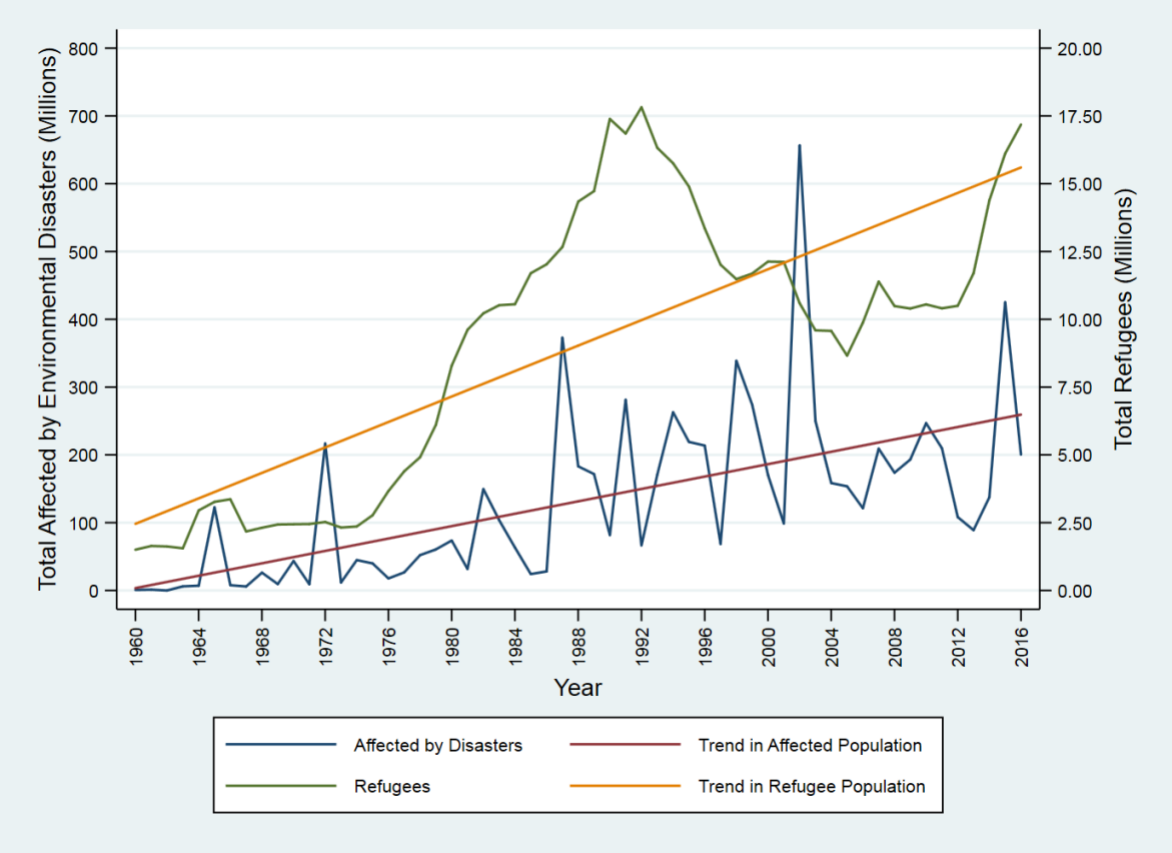
$$Ref_{(t-[t-1])} = TotAf_{it} + ln\ Pop_{\ it} + lnGDPpc_{it} + lnTrade_{it} + PolityIV_{it} + Popdens_{it} + QOG_{it} + Conflict_{it} + T - T_{j+e}$$

4. Results

4.1. Broad Trends

There was a general positive increase in both the global annual number of individuals impacted by environmental disasters and the number of refugees that crossed state lines to seek asylum in foreign nations from 1960 to 2016 (Figure 1). This trend demonstrates that there were positive increases in both the global number of refugees and climate related environmental disasters over this analysis' study period.

Figure 1: The total number of UN recognized refugees and the total number of individuals affected by climate related environmental disasters from 1960-2016



4.2. Maps

The two decadal average GIS maps (Figures 2-3) illuminate a general trend of temporal increases in both the proportion of state populations impacted by environmental disasters and the proportion of state populations that were classified as outgoing refugees. This is suggested by an increase in the number of states being shaded, particularly those being shaded in darker hues. The maps also suggest an increase in the number and size of the graduated symbols, which represent the proportion of a states' population labeled as refugees. These trends indicate that not only are individual countries possibly producing more refugees than they were in preceding decades, but that countries that previously did not produce refugees, are now doing do.

Figure 2: The decadal average percentage of a state's population that were affected by environmental disasters and the decadal average percentage of a state's population that are refugees in the 1970s

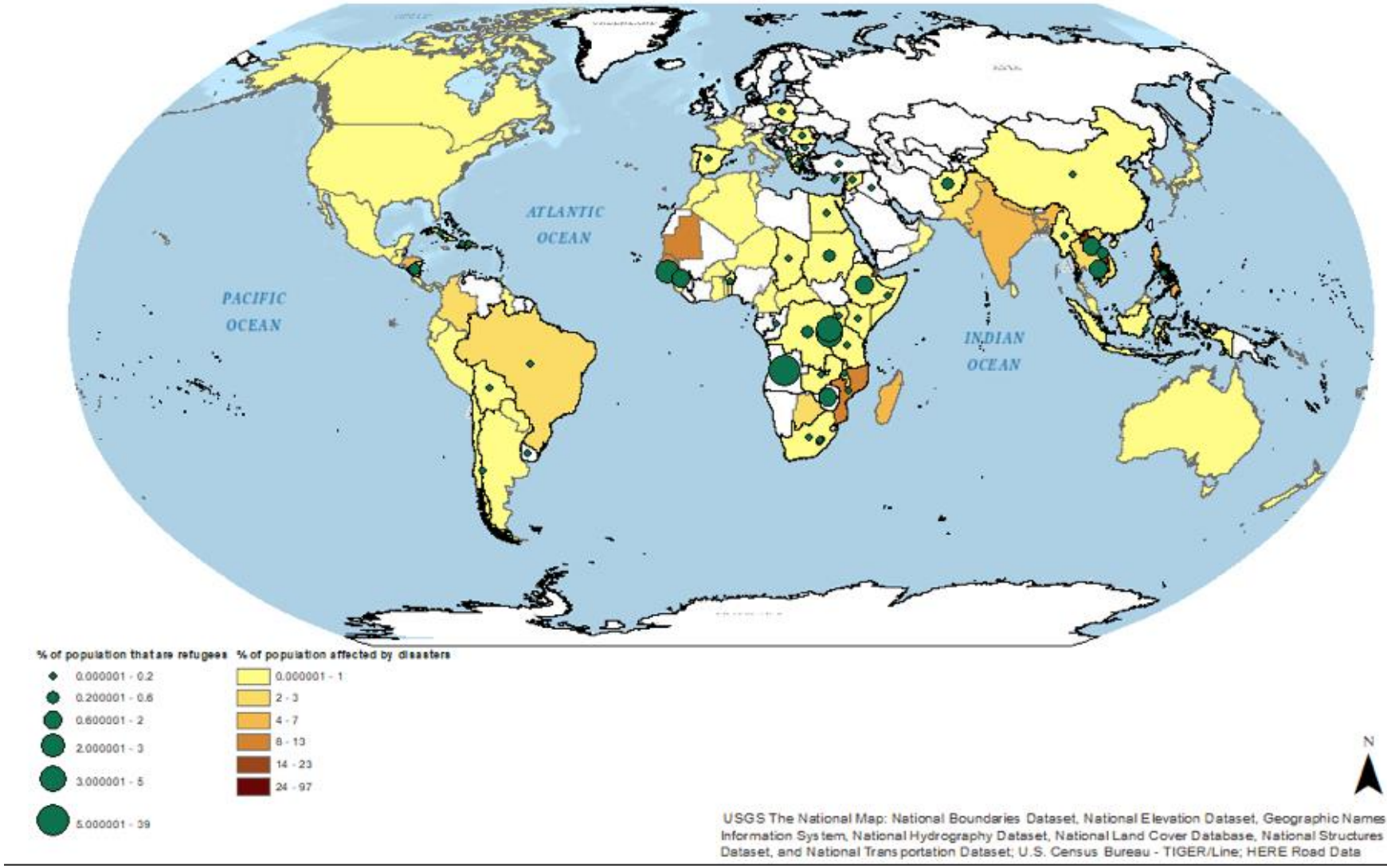
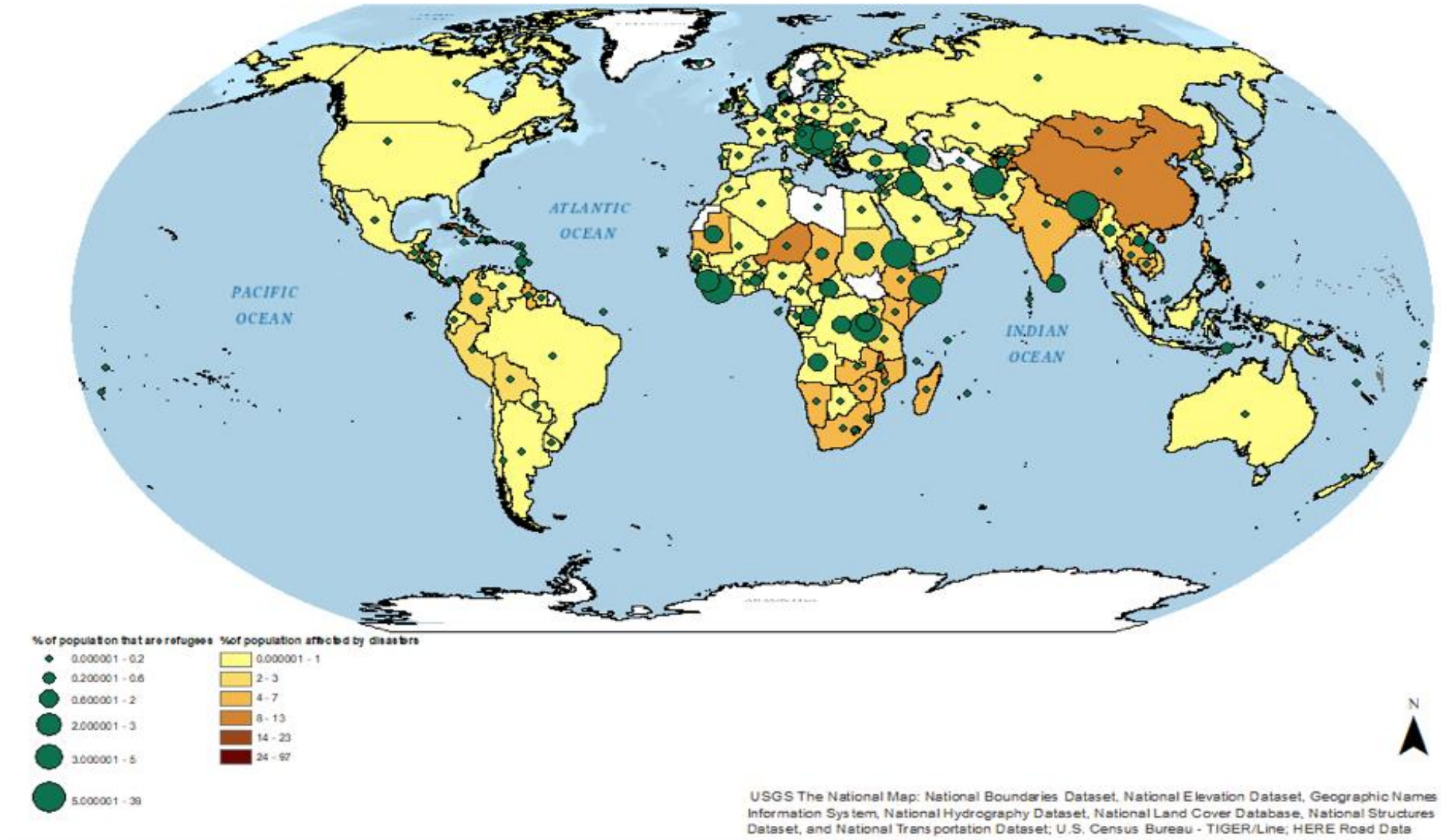


Figure 3: The decadal average percentage of a state's population that were affected by environmental disasters and the decadal average percentage of a state's population that are refugees in the 2000s



4.3. OLS Regression

The final 1961 to 2016 time series dataset, which included data for the two primary variables as well as that of the considered control variables, consisted of 2,748 observations. The foundational model for this study analyzes the number of individuals in each state impacted by all considered climate related environmental disasters, namely droughts, extreme temperatures, storms, and floods and the temporally differentiated count of outgoing refugees. All four types of environmental disaster are included in this model as many climatic phenomena are related to and impact one another, particularly in regard to anthropogenic climate change. This model indicates that there was a positive and significant relationship between the number of individuals impacted by all environmental disaster types and the differentiated number of refugees produced in a given country-year. Conflict also has a significant and positive relationship on the differentiated number of refugees produced in a given country-year, which is unsurprising since this study focused on UN recognized refugees, which include those fleeing violence. A state's level of democracy, as measured by Polity IV, demonstrates a negative and significant relationship to the differentiated number of refugees produced in a given country-year. This suggests that more democratic states are the less likely it is to produce refugees. Finally, there is a negative and significant relationship between GDP per capita and the differentiated number of refugees produced in a given country-year. This demonstrates that richer nations tend to produce fewer outgoing refugees. The remainder of the variables had insignificant impacts on the differentiated number of refugees produced in a country-year.

Table 1: OLS Regression with Robust Standard Errors on the differentiated number of outgoing refugees in a given country-year

	Change in Refugees $Year_t - Year_{t-1}$				
Total Affected by Disasters	0.001***				
	(57.86)				
Total Affected by Drought		0.001***			
		(21.95)			
Total Affected by Extreme Temp			0.001***		
			(208.95)		
Total Affected by Flood				0.001***	
				(42.34)	
Total Affected by Storms					0.001***
					(148.91)
Population(ln)	1.344	0.950	2.428	2.048	0.689
	(0.63)	(0.46)	(1.19)	(0.99)	(0.32)
GDP per capita(ln)	-5.928*	-6.797*	-7.254*	-6.282*	-6.448*
	(-1.97)	(-2.30)	(-2.46)	(-2.14)	(-2.09)
Trade(ln)	-4.439	-7.199	-6.790	-5.407	-8.468
	(-0.84)	(-1.38)	(-1.31)	(-1.05)	(-1.55)
Polity	-2.388***	-2.263***	-2.336***	-2.258***	-2.667***
	(-5.22)	(-5.05)	(-5.23)	(-5.06)	(-5.67)
Population Density	-0.027	-0.003	-0.009	-0.027	-0.005
	(-1.45)	(-0.19)	(-0.51)	(-1.51)	(-0.29)
ICRG Quality of Government	12.61	9.687	7.408	7.228	10.48
	(0.69)	(0.54)	(0.41)	(0.40)	(0.56)
Conflict	14.98***	21.85***	20.10***	14.60***	23.37***
	(8.42)	(12.45)	(11.52)	(8.42)	(12.78)
Constant	60.10	82.11	64.97	60.92	91.76
	(1.14)	(1.60)	(1.27)	(1.19)	(1.70)
Prob > F	0.000	0.000	0.000	0.000	0.000
N	2,748	2,748	2,748	2,748	2,748

t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001

The model was run with isolated disaster types to determine if certain kinds of extreme environmental events had different impacts on UN recognized refugee migration. All 4 model results are consistent with the non-differentiated disaster model, demonstrating a positive and significant relationship between the number of individuals impacted by the respective types of environmental disaster and the differentiated number of refugees produced in a given country-year.

The four individual disaster type models also mirror the base model in that they all demonstrated a positive, statistically significant relationship between conflict and the dependent refugee variable and a negative, statistically significant relationship between democracy and the dependent refugee variable. One trend captured in the independent disaster models for extreme temperature, storms and floods, that was not observed in the non-differentiated disaster model, is a negative and statistically significant relationship between a country's GDP and the refugee dependent variable.

5. Discussion

5.1. Global Trends

There are observable increases in both the global number of UN recognized refugees produced and the number of individuals impacted by climate related environmental disasters from 1960 to 2016. This does not necessarily indicate a causal relationship between these two trends. However, past theoretical analyses on the impact of environmental disasters on migration and the climate-security nexus (Barnett and Adger, 2007; Brzoska and Frölich, 2015; Burrows and Kinney, 2016; Salehyan, 2008), suggest that there is a relationship between these two trends. The two phenomena may be mutually reinforcing due to the relationship between environmental disasters, conflict and the general vulnerability of refugee populations to environmental hazards such as environmental disasters (IOM, 2007; Warner et al., 2010).

The number of individuals impacted by environmental disasters and the number of outgoing refugees in a given state fluctuate over time due to social, political, economic, climatological, and geophysical changes that the state experiences. Therefore, most states do not demonstrate a steady positive linear trend in either of these variables. Nevertheless, the maps seem to support the general global trend of increases in both refugees and individuals impacted

by environmental disasters. However, the relationship between these two variables at the state level is more difficult to analyze. The apparent non-linear relationship between these two variables at the state level may be explained by the complexity of the climate-security-migration nexus and the influence that confounding variables like state characteristics may have on the mapped data.

Comparing the 1970s and 2000s maps, India demonstrated that high proportions of their country's population were impacted by environmental disasters relative to other nations. These results align with the country's vulnerability to a wide range of extreme climate related weather disasters including sea level rise, extreme temperatures, droughts, and floods which threaten public health and food security (IPCC, 2007). Furthermore, the nation has a history of internal communal violence and persecution primarily between Hindu and Muslim religious groups (Adney, 2010), which would suggest a breeding ground for refugee populations. However, on the GIS maps, this country consistently demonstrates comparatively low proportions of its population being classified as refugees. An explanation for this observation may be the geographic size and regional heterogeneity of India. The maps only measure the number of refugees produced by a country and therefore, they do not consider the internal displacement of populations. Intra state migration is often a more economically and socio-politically feasible option for individuals seeking to leave their homelands (Goodwin-Gill and McAdam, 2017). Many studies evaluate both internal and international migration in relation to environmental disasters and find that internal migrants generally outnumber international migrants (Dun, 2011; Gray, 2009; Henry et al., 2004a). This may be especially true in a large and diverse country like India, where more climatically, economically, socially, and politically hospitable environments may be found within the confines of one's country of origin.

The emergence of relatively large refugee populations on small island nations, such as those in the South Pacific and the Caribbean, on the 2000s GIS map compared to the 1970s is also of note. There appear to be temporal increases in the number and size of refugee populations produced by island nations across the mapped time-period. There was a simultaneous increase in the relative proportions of island nations' populations that were being impacted by environmental disasters. Multiple studies indicate that small island nations, particularly those classified as developing nations, are some of the populations most vulnerable to climate change (Betzold, 2015). Consequently, these nations already experience the impacts of many climate related disasters including strong tropical storms, flooding, and droughts (Nurse et al., 2014). Following the theoretical framework that posits that environmental stressors such as food insecurity, water insecurity, and resource scarcity can lead to increased competition and conflict, increases in the state level proportion of the populations impacted by climate related environmental disasters may partially explain the observed increases in the proportion of small island nation populations classified as refugees.

This model's results suggest that climate related disasters may influence UN recognized refugee migration, which is by definition correlated to regional conflict, since escaping war or violence is one of the UN identified causes of refugee migration. Such a relationship is examined in multiple cases around the world. For example, from 2007 to 2010, the Syrian Arab Republic experienced its worst 3-year drought on state record (Trigo et al., 2010) causing over 800,000 Syrians to lose their agriculturally dependent livelihoods (UNHCR, 2010). Approximately 1.5 million Syrians moved to urban centers (IRIN, 2009; Solh, 2010) and later in 2011, the Syrian civil war and consequent refugee exodus occurred. Many scholars argue that the drought influenced the outbreak of conflict and the consequent refugee crisis in Syria (Gleick, 2014;

Kelley et al., 2015; Werrell et al., 2015). However, none of them claim that climate change was the core causal mechanism that led to the Syrian uprising. This case demonstrates the impact that environmental disasters can have on increasing the number of internal migrants and potentially external refugees.

The results comparing global refugee populations to the number of individuals impacted by environmental disasters (Figure 1) suggest increases in both trends. As acknowledged at the onset of this study, environmental factors are only one of many influences that drive population migration. This is illustrated in the state level analysis of the relationship between these two variables on the GIS maps, in which some states demonstrate diverging trends in the decadal average proportions of their populations that were impacted by environmental disasters and that were refugees. However, the purpose of this study was strictly to illuminate that environmental disasters, particularly those linked to climate change, may have historically played a role in the migration of political refugees, and to challenge existing delineated conceptions migrant classifications.

5.2. Statistical analysis results

The models all demonstrate a clear positive and significant relationship between the number of individuals impacted by climate related environmental disasters and the differentiated number of refugees produced in a given country-year. Past studies demonstrate that environmental factors increase the probability that a population will migrate (Adger et al., 2007; Bohra-Mishra et al., 2014; Gray and Muller, 2012; Gray and Wise, 2016). These studies find that climatic variations can influence a population's decision to migrate through several causal pathways including threatening economic opportunities and income sources (Raddatz, 2007),

damaging physical infrastructure and land holdings (Fussell and Harris, 2014; Gray and Mueller, 2012), reducing food and water security (Cai et al., 2016; Porter et al., 2014), and damaging entire economic sectors, such as agriculture, within a country (Burke, et al. 2015; Graff et al., 2015; Nawrotzki and Bakhtsiyarava, 2017; Porter et al., 2014). The results suggest that environmental disasters increase the probability that a country will produce an atypically large refugee population. Accordingly, environmental factors can be seen to play a role in the migration of political refugees, which challenges existing rigid legal classifications for refugees.

The four types of analyzed extreme environmental events can often occur within a single country-year. Therefore, the primary model uses the number of individuals impacted by all four studied disaster types as the independent variable. In 2011, Afghanistan's population was impacted by one drought, two storms and a flood; these events may have influenced individuals' decisions to migrate (Guha-Sapir et al., 2017). Furthermore, the occurrence of one environmental disaster may be related to that of another. For example, a tropical storm may be correlated with strong precipitation and increased storm surge, which can cause coastal flooding.

Individual environmental disaster types demonstrate a similar positive relationship between a country's production of political refugees. The relationship between extreme temperature events and the differentiated number of refugees mirror the strong relationship between extreme temperatures and migration found by many other scholars (Bohra-Mishra et al., 2014; Cerrutti and Parrado, 2015; Gray and Wise, 2016; Marchiori et al., 2012; Mueller et al., 2014). These studies suggest that extreme temperatures, particularly high ones, are especially threatening to countries with large agricultural sectors. Higher temperatures can reduce agricultural productivity (Burke et al., 2015; Graff et al., 2015; Hsiang, 2010; Porter et al., 2014),

and consequently, extreme temperature events can threaten individual agricultural household's income and a major sector of a given country's economy.

Storms also demonstrated a strong positive relationship with annual differentiated political refugee migrations. Studies find that the occurrence of rapid onset disasters like storms are correlated with spikes in out-migration (McLeman and Smit, 2006; Wrathall, 2012). For example, in the wake of Cyclone Aila, which devastated Bangladesh in 2009, an estimated 125,000 individuals migrated towards population centers in search of economic opportunities and resources (Islam and Hasan, 2016). Bohra-Mishra et al. (2014) found that rapid onset environmental disasters like storms have a smaller impact on permanent population migration in Indonesia than either extreme changes in temperature or precipitation. Many scholars suggest that rapid onset event migrations are often temporary and short distanced (Bohra-Mishra et al., 2014; Laczko and Aghazarm, 2009; Wisner et al., 2004).

This model finds a positive and significant relationship between flood and drought events and a country's differentiated outgoing refugee population. Past studies find that changes in precipitation, which include both flood and drought events, demonstrate a varied relationship to population migration. While scholars find a significant, positive relationship between changes in rainfall and migration, many find that precipitation demonstrates a comparatively weak link to population migration relative to other environmental disasters such as extreme temperatures (Bohra-Mishra et al., 2014; Gray and Mueller, 2011; Henry et al., 2004). Scholars suggest that changes in precipitation may result in shorter distanced and temporary migrations relative to temperature changes (Afifi, 2011; Bohra-Mishra et al., 2014; Findley, 1994; Henry et al., 2004). Consequently, those pushed to migrate by flood and drought events may be less likely to cross state lines and potentially be counted as political refugees.

5.3. Robustness tests

To check the robustness of this model, two follow-up statistical tests were run. These tests used the same basic model. One ran the model excluding developed nations that are members of the Organisation for Economic Co-operation and Development (OECD), to analyze if the positive and significant relationship between number of individuals impacted by environmental disasters and the annual differentiated number of outgoing refugees remained constant. The second follow-up model included a control variable for country-level inequality. These two models are not included in the primary analysis and their primary function is to serve as secondary robustness tests. The third used a the percent of a state's population affected by environmental disasters in a given country-year as the model's independent variable as opposed to the raw count of individuals impacted by disasters in that same country-year.

Our differentiated disaster models demonstrate that a country's GDP and relatedly its level of development influences a country's ability to respond and adapt to natural disasters. Past studies indicate that wealth and development influence a state's ability to respond or adapt to environmental disasters and thus, greatly influence the damages and hardships their citizen's face in a post-disaster environment (Gray and Mueller, 2012; Lybbert and Sumner, 2012; Olson and Drury, 1997; Stromberg, 2007; Toya and Skidmore, 2007). Furthermore, in the case of climate change related disasters, the UNFCCC acknowledges that least developed nations are more vulnerable to the deleterious impacts of climate change and the coalition works to facilitate funding and technology transfer to help these countries adapt to climate change conditions (Porter et al., 2014).

To determine if there is a positive relationship between outgoing refugees and environmental disasters in poorer, less developed nations, independent of their most developed counterparts, a

non-disaster differentiated model was re-run with a dataset that excluded all OECD countries. This test was designed to determine if the results remained consistent when only testing the relationship in less developed countries. Most OECD countries are developed nations with high-income economies and a high human development index. Though the OECD states are not a perfect representation of developing countries, the exclusion of these states does offer a functional proxy for evaluating the relationship between environmental disasters and outgoing political refugees in developing nations. This follow up model had 1,958 observations (Table 3). The results demonstrate a positive and statistically significant relationship between the variables of a country's number of individuals affected by environmental disaster in a given year and the number of refugees that country produces in the same year.

Table 2: OLS Regression with Robust Standard Errors on the differentiated number of outgoing refugees in a given country-year for non-OECD nations

	Non-OECD Sample				
Total Affected by Disasters	0.001***				
	(20.99)				
Total Affected by Drought		0.001***			
		(9.67)			
Total Affected by Extreme Temp			0.001***		
			(94.44)		
Total Affected by Flood				0.001***	
				(15.58)	
Total Affected by Storms					0.001***
					(65.34)
Constant	212.5	217.5	200.6	230.4	283.2*
	(1.66)	(1.77)	(1.63)	(1.84)	(2.15)
Prob > F	0.000	0.000	0.000	0.000	0.000
N	1,958	1,958	1,958	1,958	1,958

t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001

Many empirical studies find that environmental migration is often classed and or gendered (Afifi, 2011; Dun, 2011; Findley, 1994; Gray, 2010). Accordingly, a state's level of inequality may influence the degree to which environmental disasters impact its outgoing refugee

migration. One variable that measures inequality within a country is the GINI Index coefficient, which measures income inequality (World Bank, 2017). Therefore, a follow up model including the GINI coefficient was run. There were limited observations available that matched up with the dataset, therefore, imputed missing data, which input substituted variables based on existing data, was utilized. While imputing data for the missing GINI variable allows the model to be run with an acceptable number of observations, inputting values for missing data runs the risk of misrepresenting historically observed country-level country inequality. This model had 2,748 observations (Table 3). The relationship found between environmental disaster affected populations and differentiated outgoing refugee migrations generally mimicked that observed in the main non-differentiated disaster model. However, the relationship between GDP per capita on differentiated outgoing refugee migration did shift from being significant in the main model to insignificant in the model including the imputed GINI variable. This change could be explained by the GINI coefficient's consideration of the differentiated levels of wealth within a given population, which helps account for the impact that country-level wealth has on a population's vulnerability to environmental disasters.

Table 3: OLS Regression with Robust Standard Errors on the differentiated number of outgoing refugees in a given country-year including an imputed variable measuring inequality

	Controlling for Gini (imputed)				
Total	0.001***				
	(57.95)				
Drought		0.001***			
		(21.61)			
Extreme Temps			0.001***		
			(206.20)		
Floods				0.001***	
				(41.37)	
Storms					0.001***
					(145.52)
Population(ln)	0.942	0.635	2.104	1.712	0.172
	(0.44)	(0.31)	(1.02)	(0.81)	(0.08)
GDP per capita (ln)	-3.328	-4.559	-5.074	-4.115	-3.451
	(-1.04)	(-1.42)	(-1.59)	(-1.29)	(-1.02)
Trade(ln)	-0.298	-3.581	-3.293	-1.943	-3.595
	(-0.05)	(-0.61)	(-0.57)	(-0.33)	(-0.59)
Polity	-3.089***	-2.948***	-2.993***	-2.593***	-3.621***
	(-5.77)	(-5.53)	(-5.65)	(-5.55)	(-6.43)
Population Density	-0.006	0.149	0.008	-0.009	0.018
	(-0.33)	(0.72)	(0.41)	(--.46)	(8.85)
ICRG Quality of Government	37.91	33.03	30.08	30.60	42.67*
	(1.86)	(1.63)	(1.49)	(1.51)	(2.00)
i.Gini	1.241*	1.112*	1.083*	1.101*	1.509**
	(2.40)	(2.15)	(2.10)	(2.13)	(2.77)
Conflict	15.21***	22.51***	20.65***	15.49***	23.47***
	(8.56)	(12.64)	(11.69)	(8.75)	(12.55)
Constant	-38.59	-5.860	-20.28	-24.87	-25.60
	(-0.55)	(-0.08)	(-0.29)	(-0.36)	(-0.35)
Prob > F	0.000	0.000	0.000	0.000	0.000
N	2,748	2,748	2,748	2,748	2,748

t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001

Country-year level data on the number of individuals impacted by environmental disasters is only one measure that could be used to test the relationship between the impact of environmental disasters on differentiated outgoing refugee populations. Accordingly, to test the robustness of the primary model's results, the model was re-run using alternative measures of the impact of environmental disasters on a population in a given country year. The proxy measures tested were the percent of a given state's population impacted by environmental disasters and the change in the percent of a given states population that was impacted by environmental disasters.

The model using the percent of a given state's population impacted by environmental disasters as the independent variable had 638 observations (Table 4). The model using the change in the percent of a given states population that was impacted by environmental disasters as the independent variable did not have enough observations to analyze.

The follow-up model (Table 4) found that there was a positive and significant relationship between the percent of a given state's population impacted by all studied environmental disaster types and the differentiated number of outgoing refugees in a given country-year. However, when this analyzed the percent of a given state's population impacted by specific disaster types the results were more mixed. The percent of a given state's population impacted by storms showed a positive and significant relationship with the differentiated number of outgoing refugees, which is consistent with my primary model. The percent of a given state's population impacted by droughts and floods no longer demonstrated a significant relationship with the differentiated number of outgoing refugees. These results may align with those found in other papers, which indicated that precipitation related event's relationship with population migration was much weaker than that between population migration and extreme temperature (Bohra-Mishra et al., 2014). Most notably, the percent of a given state's population impacted by extreme temperatures relationship with the differentiated number of outgoing refugees became negative and significant, which contradicts the results found in the primary model. The primary model's results were based on more observations and are consequently more robust, however, the follow-up model's contradictory results indicate the need for further research on the relationship between extreme temperatures and refugee migration.

Table 4: OLS Regression with Robust Standard Errors on the differentiated number of outgoing refugees in a given country-year using the percent of a state's population affected by environmental disasters as the independent variable

	Percent Population Affected by Disasters				
Percent Affected by all Disasters (Total)	333.8* (1.99)				
Percent Affected by Drought		-383.4 (-0.87)			
Percent Affected by Extreme Temp			--10478.7*** (-7.57)		
Percent Affected by Floods				314.4 (0.65)	
Percent Affected by Storms					418.2* (2.17)
Constant	-209.2 (-1.05)	-172.8 (-0.88)	-169.4 (-0.87)	-180.2 (-0.91)	-211.3 (-1.08)
Prob > F	0.000	0.000	0.000	0.000	0.000
N	638	638	638	638	638

t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001

5.4. Limitations

This study analyzes the historical relationship between climate related environmental disasters and the outgoing migration of refugees. However, some limitations in the dataset must be acknowledged to effectively develop further work on its findings. The UNHCR dataset is limited to the refugees recognized by the United Nations and does not capture the number of individuals that crossed international borders without officially registering as a refugee. There were inconsistencies in country classifications across data sources, due to disputed territories. There were also missing data points across country-years, owing to the challenges of collecting continuous, comprehensive data. Consequently, there were missing values in the final combined dataset due to differences in coding and missing values in individual data sources. Additionally, most of the observations in the final dataset are recorded from the 1990 to 2016. Data inconsistencies may have impacted the results of the models presented in this paper. However,

the results are based on a fairly large sample of 2,748 observations and the follow up robustness tests demonstrate findings consistent with the models.

Another potential caveat to this model is judging its efficacy in capturing the influence that environmental climate disasters have on refugee migrations independent of other push and pull factors migration drivers. As previously acknowledged, there are a range of social, political, economic, environmental and demographic factors that influence a population's decision to move from one locale to another and these factors rarely exist independent of one another. However, this model includes a range of control variables to capture the effects of other factors that drive refugee migration, thereby, taking the necessary steps to isolate the influence of environmental disasters on refugee migration. An additional challenge in analyzing the influence of independent migration drivers is that many of these variables influence one another. To examine the impact that this potential correlation between control variables had on this model, we created a correlation table (Appendix: Table 3). The correlation between these variables is low and therefore, the challenge of multicollinearity can be judged as having little influence on the results.

5.5. Climate Change

This study demonstrates that climate related environmental disasters have a significant and positive relationship with the migration of UN recognized refugees. Climate change is projected to alter and, in many cases, augment the intensity, frequency, timing, duration, and geographical reach of such extreme environmental disasters (IPCC, 2014). Consequently, the impact of environmental disasters on refugee migration may increase in the coming years. This study focuses on movement of UNHCR recognized political refugees and finds that environmental factors have historically played a role in their migration. Past studies (Adger et

al., 2007; Bohra-Mishra et al., 2014; Gray and Muller, 2012; Gray and Wise, 2016) demonstrate a link between environmental disasters and migration. Accordingly, increases in environmental disasters may have a pointed impact on the future mobility and migration of global populations. However, there is a dearth of international legal mechanisms prepared to acknowledge and protect these people in coming years.

Refugee status under the 1951 Refugee Convention grants refugees access to the right to work, public education, access to the judicial system and to non-refoulement, which protects individuals from being returned to their country of origin in which their life or freedom are threatened (UNHCR, 1951, article 33). However, the majority of individuals displaced by environmental or climate change related factors are not recognized under the UNHCR's definition and therefore their status is considered legally non-binding (Warner, 2010). Accordingly, there is currently no international framework to protect 'environmentally displaced populations' and their rights (Biermann and Boas, 2010; Warren et al., 2006).

As laws to govern the rights of environmentally displaced populations fall to their home countries, a semblance of a governance institution to protect the rights of internally displaced persons exists in most nations (Biermann and Boas, 2010). However, Biermann and Boas (2010) argue that reliance on migrants' countries of origin to take responsibility for their own environmental or climate change displaced populations can give rise to three major complications. Firstly, climate change is a global problem caused by the entirety of the human population. Therefore, diverting responsibility of care for groups afflicted by the injurious impacts of climate change to their own countries, some of which are economically impoverished, is unjust and irresponsible. Secondly, some small island nations are projected to be completely submerged, meaning their citizens will become a stateless persons. If the responsibility of

climate and environmentally displaced persons falls to the citizen's home country, and that home country ceases to exist, then the rights and protection of those displaced populations are completely disregarded. Finally, many populations, especially those displaced by climate-change-induced sea level rise, will never be able to return to their homes and may therefore be entitled to special legal recognition and resettlement rights. These complications illuminate the need to fill the international legal vacuum to address environmental and climate change migrant populations. However, the best way to identify these populations and meet their needs is unclear.

5.6. Possible solutions

These findings demonstrate that there is a potential positive relationship between the number of individuals impacted by extreme environmental events and the differential number of outgoing UN recognized refugees in a given country-year. This could suggest that the migration of UN recognized political refugees is influenced by the occurrence of environmental disasters. This model's results align with previous studies' arguments that individuals are generally compelled to move by a complex and interactive network of push and pull factors (Black et al., 2011). Trying to classify populations or individuals as *solely* political refugees, economic migrants or especially as environmentally or climate change displaced persons is a legally challenging endeavor. Therefore, existing legal classification frameworks fail to acknowledge the impact of environmental disasters and climate change in the displacement of populations. Furthermore, proposed solutions to create a new legal class for environmental, specifically climate change 'refugees' (Biermann and Boas, 2010; Docherty and Gianni, 2009; Hodgkinson et al., 2008) are flawed in encompassing the true complexity of the causal networks that drive human migration.

One option to address the needs of environmentally displaced persons would be to expand the 1951 Refugee Convention's refugee definition to include those displaced by environmental factors. This alteration would not require an international body to draft and agree upon a new treaty and or mandate. Furthermore, it would allow environmental or climate change displaced persons access to the same rights provided to traditional refugees. Given the complex relationship between environmental events, conflict, and migration, the expansion of the 1951 Refugee Convention's mandate is not implausible.

The UNHCR has expressed a concern that expanding its mandate to include individuals displaced by environmental events would weaken its ability to protect traditionally recognized refugees (Atapattu, 2009; Compton, 2014; Moberg, 2009). Given projections of the number of environmental and climate migrants that the world could see in coming years (despite their probable inaccuracy), the UNHCR could find itself responsible for hundreds of millions more individuals. The expansion of the mandate would require the UNHCR to expand its services and recourses and could consequently decrease the quality of protection for all vulnerable refugees and or displaced persons. Thus, there is little international action to expand the global definition of refugees as acknowledged by the UNHCR.

Biermann and Boas (2010), Docherty and Gianni, (2009), and Hodgkinson et al., (2008) propose that rather than redefining existing legal conceptions of refugee populations, it may be more effective to create a new migrant category to encompass environmentally displaced persons, specifically 'climate change refugees.' They argue that this new classification would acknowledge the unique characteristics of climate change refugees and migrants. These proposals would require the creation of a new multilateral treaty and organizational governance body whose sole mandate would be to oversee the movement, relocation, and protection of

climate change migrants and funds. While such a treaty could provide the most exhaustive and extensive care to individuals displaced by climate related environmental disasters,

The creation of an institution and organization to govern, finance, and manage environmental and climate change migrants would be a timely and costly process, which could take years to create, negotiate, and implement. Furthermore, it would obligate that governing body to identify climate change as the central cause that forced an individual or population to migrate which, as previously stated, is a difficult case to make in a court of law (McAdam, 2011). Furthermore, such multilateral agreements often only provide the "lowest common denominator" of protection (Blum, 2008) due to bureaucratic arguments and disagreements over state and governing body capabilities and responsibilities'.

Regional adaptations of the UN's existing refugee framework could provide a functional and comprehensive legal safety net for environmental or climate change migrants. The advantages of such a framework would prevent broad but inefficient global arguments over which countries are most responsible for funding and accepting environmental or climate change migrants or refugees. A regional approach to addressing the displacement of climate change and environment migrants would allow migrants to move to countries with similar physical, cultural, and societal climates. Furthermore, such self-determination would allow environmentally displaced communities to move together, thereby aiding in the preservation of that unique society's culture and traditions. Drawbacks to utilizing such an approach is that climate related environmental disasters can impact entire regions of a given continent and cross country lines, limiting options for relocation.

Regional bodies in Africa and Central America expanded their legal definitions of refugees to encompass environmental or climate migrants (OAU, 1969; UNHCR, 1984), though

admittedly they did not do so with the inclusion of environmentally displaced persons in mind (Burleson, 2010; Renaud et al., 2007). It must be acknowledged that these legal changes only apply to refugees that move within the region and therefore, do not provide a legal safety net for individuals from other regions in the world like the extremely vulnerable small island nations. However, the creation of such regional frameworks across the globe could be an efficient and effective solution to acknowledging and aiding environmental migrants, particularly in the face of climate change.

6. Conclusion

Understanding the causal mechanisms that influence a population's decision to migrate is complex. This study found a positive and significant relationship between the number of individuals impacted by four types of climate related environmental disasters, namely extreme temperatures, droughts, floods, and storms, in a given country-year and the differentiated number of refugees produced by a state in that same country-year. These results suggest that environmental factors influence the migration of populations recognized as political refugees and consequently, demonstrate the complex network of push and pull factors that compel a population to migrate. There is a need for further research on the interactions between social, environmental, political, economic and demographic migration factors to better understand potential environments that induce population migration.

Another area that merits further inquiry is the temporal scale at which the relationship between the occurrence of an environmental disaster and the outgoing migration of refugees. Researchers have already begun to study the time scales on which populations move in reference to these environmental disasters, however, these studies often do not consider the effects of conflict and other more political and social variables associated with refugee populations and

regional unrest. Such a test was beyond the bounds of this study given that our chosen data was measured in years, which are too large of a temporal unit to comprehensively analyze the relationship between the two variables of interest. However, running a similar study in the future and including a temporally lagged independent variable would be a way to better understand the timeline at which these migrations transpire in reference to the occurrence of an environmental disaster (Appendix Table 4).

Existing international legal migrant classifications widely overlook the roll that environmental factors play in population migration. Given projected increases in the extremity and frequency of many environmental disasters in the coming years as a result of climate change, such legal gaps are concerning. The establishment of a series of regional level refugee or migration treaties governed and coordinated by the UNFCCC could provide the most efficient, effective, and culturally sensitive response to address the needs of current and future populations displaced by climate change. Bodies in Central America and Africa already created regional legal amendments that can be applied to individuals pushed to move due to environmental disasters. Further studies on how such treaties are used to protect and govern environmentally displaced persons could provide insight into the efficaciousness of such legal mechanisms in future years.

7. Appendix

Appendix Table 1: Variable Description Table

Variable	Abbreviation	Definition	Source
Refugees	Ref	Number of outgoing UN recognized refugees in a given country-year	UNHCR Population Statistics Database
Differentiated Number of Refugees	$Ref_{(t-[t-1}$	The difference between the number of outgoing UN recognized refugees in year t and [t-1]	UNHCR Population Statistics Database
Total Affected	TotAf	The sum of individuals injured, made homeless or requiring emergency assistance following a drought, flood, storm or extreme temperature event	EmDAT
Drought Affected	Drought	The sum of individuals injured, made homeless or requiring emergency assistance following a drought	EmDAT
Extreme Temp Affected	Extreme Temp	The sum of individuals injured, made homeless or requiring emergency assistance following an extreme temperature event	EmDAT
Flood Affected	Floods	The sum of individuals injured, made homeless or requiring emergency assistance following a flood	EmDAT
Storms Affected	Storm	The sum of individuals injured, made homeless or requiring emergency assistance following a storm	EmDAT
Population	Pop	Total number of people living in a given state	World Bank
GDP per capita	GDPpc	A state's gross domestic product (GDP) divided by its population	World Bank
Trade	Trade	Trade as a percentage of a state's GDP	World Bank
Political Regime	PolityIV	A country's level of democracy measured on a scale from -10 (full autocracy) to 10 (full democracy)	PolityIV Database
Population Density	Popdens	The number of people per square kilometer of land area in a given state	World Bank
Quality of Governance	QOG	A state's quality of governance	The Quality of Governance Institute
Conflict	Conflict	The occurrence of inter and intra state conflict for a given state	Center for Systemic Peace

Appendix Table 2: Summary Statistics Table

Var	Obs	Mean	Std.Dev.	Min	Max
Refugees	10,056	0	93714.63	-5524333	2145063
Total Events	10,057	743035.6	9869959	0	3.47e+08
Drought	10,057	259689.6	6161326	0	3.30e+08
Extreme Temp	10,057	10055	770679.4	0	7.70e+07
Floods	10,057	365096.6	5578729	0	2.43e+08
Storms	10,057	108194.4	1786580	0	1.07e+08
Pop(ln)	8,148	15.53374	1.960562	8.982059	21.03389
GDPpc(ln)	4,097	8.823367	1.200412	5.508054	11.47948
Trade(ln)	7,161	4.108335	0.6437873	-3.863269	5.927935
Polity 2	7,519	1.131001	7.418207	-10	10
Population Density	7,981	98.49285	135.0239	0.6322125	1336.667
Quality of Government	3,917	0.5406827	0.2260832	0.0416667	1
Conflict	9,067	0.7290517	1.794912	0	18

Appendix Table 3: Correlation Table

	Refugees	Total Affected	Drought Affected	Extreme Temp Affected	Flood Affected	Storms Affected	LogPop	GDPpc	Trade	Polity	Pop. Density	QOG	Conflict
Refugees	1.000												
Total Affected	0.018	1.000											
Drought Affected	0.004	0.676	1.000										
Extreme Temp Affected	0.014	0.11	0.009	1.000									
Flood Affected	0.009	0.874	0.287	0.020	1.000								
Storms Affected	0.008	0.578	0.262	0.018	0.411	1.000							
Pop	0.024	0.301	0.147	0.064	0.279	0.232	1.000						
GDPpc	0.021	-0.072	-0.041	0.001	-0.069	-0.043	-0.055	1.000					
Trade	-0.002	-0.104	-0.058	-0.008	-0.100	-0.060	-0.483	0.191	1.000				
Polity	-0.005	-0.111	-0.037	-0.036	-0.109	-0.095	-0.053	0.354	0.149	1.000			
Pop. Density	0.013	0.087	0.037	0.004	0.083	0.079	0.274	0.059	-0.061	0.161	1.000		
QOG	0.019	-0.007	-0.007	0.001	-0.001	-0.012	-0.008	0.708	0.115	0.432	0.106	1.000	
Conflict	0.060	0.144	0.105	-0.008	0.129	0.065	0.375	-0.217	-0.325	-0.121	0.109	-0.235	1.000

Appendix Table 4: Coefficients for Lagged Explanatory Variables

	Lag of 1	Lag of 2	Lag of 3	Lag of 4	Lag of 5
Total Affected	0.001*** (16.13)	0.001*** (12.75)	0.001*** (29.17)	0.001*** (90.38)	0.001*** (24.42)
Drought Affected	-2.981 (-0.00)	-0.001** (-3.15)	0.001*** (3.52)	-0.001** (-3.21)	0.001*** (17.23)
Extreme Temp Affected	-0.001 (-0.20)	0.001 (0.32)	0.001*** (5.39)	-0.001* (-2.52)	-0.001* (-2.36)
Floods Affected	0.001*** (16.79)	0.001*** (13.85)	0.001*** (19.99)	0.001*** (90.04)	0.001*** (36.23)
Storms Affected	0.001*** (6.30)	0.001*** (111.30)	-0.001*** (-62.29)	0.001*** (15.64)	0.001*** (16.60)

t statistics in parentheses* $p<0.05$, ** $p<0.01$, *** $p<0.001$

8. References

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