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COLLEGE OF BUSINESS AND ECONOMICS

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ENVIRONMENT AND MIGRATION, EVIDENCE FROM ETHIOPIA.

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APPROVAL SHEET

This is to certify that the thesis prepared by Abebe Wubetu entitled "ENVIRONMENT AND MIGRATION, EVIDENCE FROM ETHIOPIA" submitted in partial fulfillment of the requirement for the degree of Master of Science in Natural resource and environmental Economics for the graduate program complies with the regulations of the university meets the accepted standards with respect of originality.

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“Greater is he that is in me than he that is in the world”. First, I want to express my special gratitude to my almighty God as he is the only father I can always rely on. Second, my gratitude goes to my advisor who helped me to do my research in an interesting way, and for his generosity and forgiveness whenever I fall short of doing things at the right time. Third, I want to express my gratitude to my parents, friends and instructors who stood by my side from the very beginning. Interestingly enough, I tried to grasp at straws, and now I have finished my thesis.

Abstract

The issue of environmentally induced migration and displacement is a significant part of a significant policy debate internationally. In Ethiopia, little attention has been given to policy alternatives with regard to environmental degradation, although the severity of human life associated with environmental problems has shown a dramatic increment over the last couple of years. This paper aims to analyze the impact of the environment on both internal and international migration stocks. Coefficients of explanatory variables that have an impact on internal migration were estimated using static panel data models such as random effects regression. The SYSTEM GMM estimation technique was applied to a gravity model of international migration over the years 2000 to 2020. Based on the stata regression results, some of the environmental variables were found to have a significant effect on both internal and international migration. While standardized precipitation, sudden-onset hazards, slow-onset hazards, and conflict have a significant correlation with internal migration, we could not find any significant association between temperature anomalies and internal migration. The pooled OLS regression results of the gravity model showed that the sudden-onset hazards ratio, slow-onset hazards ratio, distance, GDP ratio, amenity index ratio, and political risk ratio had a significant relationship with international migration. Based on the Arellano-Bover/Bond estimation technique, distance, and GDP ratio(the two major gravity variables), slow-onset hazards ratio, amenity index ratio, air pollution exposure, and political risk index turned out to be significant. However, the effect of population ratio, unemployment ratio, and rainfall anomaly index on international migration stock was not significant.

Key words: gravity model, GMM,environment, migration, Ethiopia

DECLERATION

I declare that this thesis is original, and nothing was taken from the work of others except references used to support my work. In short, this work has not been submitted to any degree offering institutions such as Addis Ababa University.

ACRONYMS

- GDP----- Gross Domestic Product
- GNP------ Gross National Product
- GMM--------Generalized Method of Moments
- SYS-GMM------System Generalized Methods Of Moments
- TAI--------Temperature Anomaly
- SPI------- Standardized Precipitation Index
- RAI_RAT-------- Rainfall Anomaly Index Ratio
- SOH_RAT------- Slow-Onset Hazards Index Ratio
- ROH_RAT------- Rapid-Onset Hazards Index Ratio
- AMI_RAT-------- Amenity Index Ratio
- PRI_RAT-------Political Risk Index Ratio
- OLS-------- Ordinary Least Square
- Dist.-------Distance
- GDP_RAT-------Gross Domestic Product Ratio
- UMP_RAT-------unemployment Ratio
- POP_RAT------- Population Ratio
- APE_RAT-------Ratio Of Air Pollution Exposure
- Conf------- Conflict
- Intmig-------Internal migration
- Infr-------Inflation rate
- Mig_stock------- International Migration Stock
- DTM---------- domestic trucking matrix

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Migration can be seen from two perspectives. The first can be speculative migration where peoples migrate in order to find a job in another place(country) whereas the second is contracted migration in that individuals tends to remain migrant because of having a job in another place (Silvers, 1977). Apart from this, the reason to migrate may be borne by various factors that are manageable or not by individuals themselves. Amongst other reasons to migrate, environmental degradation and climate change have direct and indirect significant impacts on Human being. Peoples tend to migrate based on the intensity of environmental problems, and people who migrate both internally and internationally because of environmental problems are called environmentally induced migrants. Although there is no internationally agreed definition on environmental refugees, Different studies use different terms to explain migrants related to climate change and the environment. Most studies refer to the following terms such as population mobility, environmental refugees, environmental migrants, climate migrants and climate refugees.

According to *Hugo's (1996) definition, population* mobility ranges from totally voluntary migrants to forced migrants where very few decisions related to voluntary or forced migration. Lester Brown of the World Watch Institute in the 1970s used the term environmental refugees for the first time. The term is used to explain the whole group of peoples who decide to migrate or are forced to migrate because of environmental factors/ environmental problems. However, this general definition is not precise to explain all types of mobilities that may be related to environmental factors. Regarding the term environmental refugees, there are various arguments by different scholars. As Castles(2002) argued, the term indicates a mono causality that occur rarely in practice.

In an attempt to incorporate whether peoples migrate temporarily or permanently, with in a country or across borders, whether the decision is voluntary or forced and whether the occurrence is sudden or gradual, IOM (2007) defined environmental migrants as peoples/ group of peoples who are obliged to leave their home either temporarily or permanently, and who move

within their country or out of their country because of unexpected or gradual environmental changes which intern affect the life of peoples.

Greenhouse gas emission is changing the earth's climate, and low income countries are more likely to be severely affected by climate change. (Stern [39], p3-p487). There is a likely effect of climate variability on health, capital, and socioeconomic activities and the environment also. Environmental migration attracts the interest of various researchers although very few have been studied so far. According to Millock (2015), environment-induced migration is likely to happen regionally across Africa although there is a low probability of a large increase in the number of migrants internationally. On the other hand, Chen et al. (2017) studied the effect of pollution migration in China and found that air pollution has positive and significant effect on net out migration.

In spite of the fact that some studies found a significant correlation between migration and the environment, the possibility of getting consistent results become the concern of various researchers. De Haas (2012) reported that environmental change has a limited and indirect impact on migration. Another study by Grey and Mueller (2012) showed that internal migration increase with a decrease in precipitation. Hoffmann et al. (2020) attempted to examine the impact of environmental problems by employing a meta-analysis from thirty country-level studies, and found that migration is primarily to the low- and middle-income countries. Marchiori and Schumacher (2011) showed that environmental changes have a significant impact on migration. According to Paul etal.(2011), bad temperature and rainfall condition were found to negatively affect households provided that the agricultural activity is solely dependent on rainfall.

The number of migrants across the globe and modeling migration has also been a significant policy debate even recently. Out of the total of around seven billion people living on the planet earth, almost one billion peoples use to move from one place to another (Ionesco et al, 2017). The contribution of natural environmental disasters and climate changes is not a simple issue in that around 19 million people were displaced within their countries because of natural disasters. Myer (2002) on the other hand estimated that approximately 25 million people were displaced migrated because of environmental change and he predicted that the number of environmental migrants will be 200 million in 2050.

The issue of global warming increased the interest of climate-related data, natural disasters and migration. Most studies expect global warming in a predictable future. This resulted in an increasing interest to the effect of climate change adaptation and mitigation strategies, and migration is among adaptation strategies where people react to a sudden change in environmental quality.

A systematic review of environmental migration in Africa by Borderon etal.(2019) pointed out that the argument that countries in Africa are vulnerable to environmental migration because of climate change which in turn negatively affects agricultural production and livelihood of individuals does not always hold. Climate factors were found to limit migration out of the boundary, and people tend to migrate within a short distance.

For a couple of decades, environmental problems such as drought, flood, ash fall, deforestation, soil erosion, and others affect the livelihood of peoples in Ethiopia. The recent report by the international organization for migration showed the statistics of internal displacements in Ethiopia and the impact of environmental hazards on migration decision.

The dimension and sign of estimated coefficients of environmental variables differ across the studies. This resulted in the type of data, types, and numbers of environmental variables considered as well as methods of estimation employed. In Ethiopia, most environment and climate-related studies are biased against the general environment and country-level analysis, and ignore the importance of various environmental indicators such as the intensities of sudden-onset hazards, slow-onset hazards, environmental amenities, air pollution, water pollution, soil erosion, and other environmental variables. Climate-related studies have had a better concern from researchers in Ethiopia. The results obtained are comparatively as expected especially with regards to migration from rural areas of Ethiopia. Although there is a common interest on environmentally induced migration globally, it seems as if only little focus is given to the problem. So far, least developed countries in general and Sub-Saharan African countries in particular, have had a higher trend of economic and social loses due to environmental problems, and the number of migrants in Europe, the USA, and Asia consists of migrants from Sub-Sahara African countries, and particularly from Ethiopia. Given that, there is a need for more studies and policy alternatives to cope with environmental degradation and migration. This study is therefore

borne by previous research gaps in Ethiopia and the severity of environmental problems from time to time.

1.2. Statement of the Problem

Environmentally induced migration is a recent concern for different scholars although the correlation between environmental variables varies across countries depending on the livelihood status of the people under consideration. Consequently, the significance and sign of environmental problems is quite ambiguous. Given the intensity of the environmental problems and migration, many more researchers have tried to go through it worldwide. On the other hand, the impact of environmental change on migration flows varied across studies. A gradual occurrence of global warming and natural disasters with difficult local living conditions leads to a movement of the people to a better places with a comparatively better living conditions. Ecological disasters are the major causes of migration in Ethiopia (Ezra & Kiros, 2001). Ethiopia experienced a death of thousands of people because of climatological, hydrological and geo-physical disasters. Since 1990, almost 400 thousands of people died of climatological disasters (World Bank statistical division, 2020). In different waves, these disasters affected tens of thousands of Ethiopians. From 1990-1999, climatological disasters affected 33 million Ethiopians while 43 million people in Ethiopia were again affected by these disasters from 2000-2019. On the other hand, 3.1 million people in Ethiopia were adversely affected by hydrological disasters since 1990 from which 2126 people died of these disasters. Other environmental problems such as; precipitation change, increase in temperature, lack of potable water, soil erosion and salinity, deforestation, and air pollution resulted in an economic impact on Ethiopians(UNSD, 2020).

Nevertheless, the issue of environmental migration remains a gap even recently. In Ethiopia, studies have been conducted so far, and there was a tendency of estimating a climate-related factors and some environmental problems separately on internal labor displacement from one area in the country to the other part of Ethiopia. However, only few are studied, and there are no recent general studies on environmental problems and migration flows internationally as well as internally apart from climate-related studies. However, this claim is not borne by researchers only as exclusive environmental data collection institutes are a recent phenomenon in the Ethiopian context. Surprisingly, predicting the total number of internally migrated individuals

remained a difficult task because of a luck of consistent data. Even recently after international organization for migration have started collecting village assessment surveys and site assessment surveys, the tendency of policy experts to conduct a study on aggregate national displacement estimation has not been initiated.

Based on the recent regionally disaggregated number of migrants in general and environment related migrants in particular, one can find it unbelievable that environment-related factors show an increment from time to time while the attention given to it is very limited. For the past few years, thousands of farmers have lost their cattle and crop products because of environmental problems.

Environment data used indicators that are not sufficient and the time when the data collected was not suitable to make an analysis on internal migration with certainty unless primary data is used. Besides, International migration in the context of environment-related factors has not been well examined in recent times by previous researchers of Ethiopia.

This paper analyzed the impact of environmental change on migration flows internationally and displacements that occurred internally in Ethiopia. In order to estimate the coefficient of variables, the study used balanced panel data ranging from 2000-2020. Due to the necessity of other variables and geographical location of immigrants, this paper used an augmented panel gravity modeling approach to estimate coefficients of determinants of international migration and static panel data models for estimating coefficients of explanatory variables that affect internal migration. This paper used the recent survey data that have not been realized so far so that the possibility of assessing internal migration becomes realistic. The study was a general level analysis that has not been well examined by previous researchers.

1.3. Objective of the Study

The general objective of the study is to examine environmental determinants of migration from Ethiopia. Given this, the study has the following specific objectives:-

- To analyze environmental determinants of migration flows from Ethiopia.
- To analyze trends of international migration flows from Ethiopia
- To see internal migration patterns in Ethiopia.

1.4. Research Questions

The researcher pointed out the following research questions to be answered at the end of the result of the study.

- What influences internal migration Ethiopia?
- What are determinants that affect international migration from Ethiopia?
- How does migration flow in and from Ethiopia looks like?

1.5. Research Hypothesis

The study puts the following hypothesis

- Distance between the origin and destination of migrants has a negative and significant effect on migration flows from Ethiopia.
- Environmental problems do not have a significant effect on migration flows from Ethiopia.

1.4. Significance of the Study

Studies on the environment and migration are important to enable countries to know as to the extent to which environmental changes affect migration flows from Ethiopia, and what measures to be taken to solve these environmental problems. Employing a new model and data analysis techniques, this research will help future researchers to give priority for the environment in general, and to use climate change adaptation and mitigation strategies without deciding to migrate.

Since there are no sufficient studies on environmental migration, this study will be valuable in estimating coefficients of environmental factors and predicting the effect of these factors in the future. In order to set direction to migration issues, determinant factors were assessed well in this research and it will be better for policy recommendation. In addition, this study provided information on what model should be appropriately used to estimate the coefficients of determinant factors affecting migration flows from Ethiopia.

1.5. Scope of the study

The study was a general (country) level analysis which capture environmental determinants of internal migration in Ethiopia and international migration from Ethiopia to the rest of the world.

1.6. Limitation of the study

The data for all environmental variables may not be found simultaneously, the researcher faced difficulties with regards to the availability of all recent data for Ethiopia and the other destination countries for Ethiopian migrants and it is difficult to collect data from all countries under consideration since it takes time. On the other hand, most environment and migration issues conducted so far are not enough to gather information for this study, and therefore the researcher will try to look at any articles in this area to solve the problem. Environmental problems and natural hazards differ across countries and even within countries which make it difficult to analyze all environmental factors affecting migration. The other problem the researcher faced was lack of enough finance to conduct the full work.

1.7. Organization of the Study

This research paper consists of five chapters. Chapter one deals with introduction such as background of the study, statement of the problem, objectives of the study, scope of the study, significance of study, and organization of the paper. Chapter two deals with related literature review. Chapter three deals with research methodology. Chapter four deals with data analysis and interpretations while the last chapter deals with conclusions and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. Theories of Migration

2.1.1.1. Neoclassical Migration Theories

Neoclassical migration theories are amongst the old theories of migration. According to this model, migration is characterized by two levels, macro and micro levels. Migration is caused by differences in a geographical labor market at the macro level, while at micro level individual's decision is related to his/ her maximization of utility. The macro level characteristics of migration emphasized that there is an excessive labor supply and lower wages in origin countries and excessive labor demand and higher wages in destination countries. Migration therefore can be viewed as a means to reach the equilibrium condition.

The micro level characteristics of migration imply that people migrate to developed countries where they can maximize their utility. Utilities can increase when people's income increase after they migrate to better areas/ countries. The rational decision of individual's will be perceived when they migrate from poorer countries to richer countries where employment and wages are higher. Therefore, this theory asserts that migration is influenced by differential across labor markets.

This model was initially advanced to show a complementarity of migration and development by Lewis and Harris, Hicks and Todaro, neoclassicists. Massey et al. (1993)) argued that this theory forecasts a linear relationship between migration and difference in wages when there is full employment.

Furthermore, De Haas (2010) explained that migration can be seen as a process that allocates production factors as voluntary migration leads to an efficient outcome. The probability of getting a job by an individual determines his/ her decision to migrate, and this was supported by many scientists. The decision of an individual to migrate will be positive if an income in the country of origin is less than the difference between income and cost in the country of destination Reinkowski and Mitze (2010).

Although individuals decision to migrate according to Neoclassicists depend on wage differentials, Vujicic et al. (2004) showed that there are sub-groups of migrants workers such as

health care professionals who decide to migrate based on non-wage related factors. Though there are shortcomings related to this theory, it become a starting point to assess migration progress.

2.1.1.1.1. Lee's Push-Pull Theory (1996)

Lee showed that migration pattern is associated with pull factors in the sending countries and push factors in the destination countries. This theory focused on the transit costs and migratory regulatory restrictions that lead to reduction in migration, and an increase in migration and preventing migration across a border travel. However, this model was criticized based on two ways. First**,** its applicability in investigating causes of ruralurban migration is limited although there is no prior reason for not adopting this theory to a micro-level (Mabogunje, 1970). Second, De Hass (2008) criticized that this theory falls short of revealing the dominant push and pull migration factors because of its simplistic expression of determinants of migration.

2.1.1.1.2. Sjaadstad Human Capital Theory (1962)

This model uses a micro level to investigate individual decisions of migration. Social demographic issues were added to neoclassical models of migration as major determinants of migration. As individual's preferences varies from person to person even in the same country, their responsiveness to migrate becomes different and they prefer different destination countries **(**Bonin et al (2008)**.** Basically**,** Sjaadstad views an individual decision to migrate as a form of investment

2.1.1.1.3 New economic theory of migration

Mutual interdependence determines the decision to migrate, and individual's decision has nothing to do with it (Stark, 1991). It implies that an individual's decision to migrate is not solely determined by a person's decision itself. It can be determined by a combination of factors and the view of other individuals. Households react to foregone risks of income and other failures in the market unlike a human capital position where the decision to migrate is a function of individual's utility maximization perspective (Massey et al, 1993).

The model takes remittances as significant mechanisms to reduce income loss, and it was appreciated by Taylor (1999). Based on the idea of Stark (1991), irrationality does not be indicated by an individual's inability to consider rationality. However, failure to consider rationality

2.1.1.1.4. Dual labor market theory

This model assumes that irrespective of labor intensive or capital intensive technique of production, demand for labor is the major determinant of migration. However, this model is criticized by it's unrealistic assumption that there are countries with equal economic structure, and the recruitment mechanism can be the same among individuals that leads to level of risk aversion and risk minimization of household income.

2.1.1.1.5. World systems theory

It relies on the supply side of labor. According to Sassen (1988), this theory presupposes the link among the interconnection of migration to globalization, determinants of migration to world market structural change, and interdependence of economies and new ways of production.

2.1.1.2. Ravenstein Theory of Migration

This theory focuses on push and pool factors to migrate, migrants individual character, feedback effect from any migration pattern, occupation and distance. Based on census data from England and Wales, Ravenstein formulated laws of migration decision such as:

- The highest percentage of peoples migrate from agricultural to industrial areas.
- Every migration flow decreases a counter flow.
- The significant number of women migrate within a short distance whereas men migrate internationally
- Expansion of cities and towns is not a result of natural growth rather it is a result of migration.
- Migrations mostly take place within a short distance.
- Economic factors are major causes of migration flows at the center.
- Migration boosts with an increase in commercialization, industrial growth, and transport expansion.

2.1.1.3. Keynesian Theory

This theory is in favor of neo-classicist's idea that labor supply is a function of wages. However, the two theories differ in their idea about wages. Keynesian theory of migration bases its idea on nominal wages. It assumes that migration is the result of nominal wages but not real wages. This

difference is the result of the function of money in the economy. The Keynesian theory adds saving as a function of money besides the neoclassicist idea that money serves as a medium of exchange only. Based on this idea, Keynesian migration theory presupposes that migrants base their decision on nominal wages, and decide to migrate to areas with higher nominal wages. Besides, the intention of migrants to return to their origin and the interest to send remittances to their parents is a function of their nominal wages. Based on Keynesian migration theory, migration is a potential equilibrium mechanism due to the fact that it adjusts employment differences across countries.

2.1.1.4. Gravity model for migration

The origin of this model is Newton's law of gravity that the attraction between two masses is directly proportional to the product of its mass and inversely proportional to Developing countries like Ethiopia are vulnerable to environmental problems as the lives of many peoples in developing countries are highly dependent on agriculture and environment. the square of the distance between from their centers. This model was initially used for international trade. Nonetheless, it is recently being employed to analyze migration flows across countries. At the center of this theory, flow between two countries is positively related with it's size and negatively associated with the distance between them that can be taken as a proxy for transportation costs (Ramos, 2016). The size is usually measured by the number of a population in these countries. However, the main gravity model can be augmented by other push and pull factors in an attempt to incorporate variables influencing migration flows.

Although there are other theories of migration, the fore-mentioned theories are found to be more important to analyze the process and pattern of migration. The new theory of economics analyzes only micro-level analysis of migration and the recent interest to investigate migration at an aggregate level leads to a theoretical review of the fore-mentioned theories of migration interestingly enough.

2.1.2. Organizations and Programs Regarding Migration in Ethiopia

2.1.2.1. International organization for migration

International organization for migration has been performing basic research issues regarding migration in Ethiopia. Although there is no enough data on migration and displacement in Ethiopia, IOM has been trying to analyze internal displacements in Ethiopia disaggregated by

regions. Since 2017, IOM has been reporting internal displacements of different rounds. Consistent with its objective, IOM is working with the Ethiopian government and other organizations concerning international migration issues and internal displacements.

IOM is intended to achieve the following missions

- Works with the diaspora in order to support the government of Ethiopia to achieve its development goals.
- Support refugees to get health facilities, their resettlement, and visa application.
- Provide emergency assistance for flood victims and internally displaced peoples and prepare refugees for resettlement.
- Provides a counter-trafficking programs such as counseling services for migrants, potential migrants, returnees, and their families, and provision of training, information education communication and other supports.
- Working with the Ethiopian government in order to strengthen the boarder control.
- Building capacity in research, data processing on federalism and peace building, conflict management and other regional affairs.

2.1.1.2. Ethiopian expatriate affairs.

The ministry of foreign affairs of Ethiopia established Ethiopian expatriate affairs in 2002. Ethiopian expatriate affairs was mandated to the following tasks.

- Protecting the right of Ethiopian expatriates
- Promote the involvement of Ethiopians and Diasporas in the socioeconomic affairs of Ethiopia.
- "Serves as a liaison between different ministries and Ethiopian Diasporas".
- Mobilize Ethiopians abroad for image building.

EEA has been actively working to create favorable conditions for a diaspora engagement in the finance resource of Ethiopia. In 2006, the Ethiopian government esrtablished directives to regulate remittance transfers. Those irectives aimed at:

- Decreasing cost of remittance transfers in Ethiopia
- Improving formal remittance services in Ethiopia
- Improving access to international remittance service for Ethiopian nationals and making the service reliable and fast.

In 2008, the first diaspora bond called the millennium bond was issued by the Ethiopian electric power corporation. EEA provides support to return migrants and promotes investment in Ethiopia.

2.1.2.3. African Union

In 2009, the African Union passed Kampala Convention which aimed at protecting internally displaced peoples in Africa. Ethiopia was among these countries that signed the convention. The convention was according to United Nations guiding principles to protect human rights of internally displaced peoples and manage internal displacements.

2.2. Empirical Review

Previously, studies have been conducted on the impact of environmental determinants of migration. Afifi and Warner(2008) used thirteen environmental indicators to assess bilateral migration flows, and found that environmental degradation has a significant impact on migration flows as all coefficients of environmental variables except flooding were found to be significant. Another study by Findley (1994) used panel data collected in 1982 and 1989 to study migration from rural Mali, and the result showed that there was an increase in migration by women and children during 1983-1985 drought in spite of the fact that the level of migration did not occur during 1983-1985 drought. Besides, 64% of migrants were found to adopt circular ways.

In their overview to assess migration and environment, Hunter and L.M., (2005) considered both developed and developing countrie's schenario, and the result showed that the relationship between environmental problems and migration depends on various individual characteristics, settings and hazard types. However, vulnerable groups of people were more likely to migrate. Reuveny et al.(2009) studied the impact of envionmrntal degradation on migration using two sample years 1980 and 1990, and they showed that environmental degradation significantly affects outmigration. Peoples tend to migrate from their homes because of environmental degradation. In an attempt to assess macro-economic consequences of disasters, Noy. (2009) found that natural disasters significantly and adversely affect macroeconomy in the short run. The study further analyzed that developing countrie's output was found to be adversely affected by such disasters. On the other hand, Countries that own better institutions, higher per-capita income, higher literacy rate, high government spending, and high degree of openness to trade

were found to overcome the disaster and protect further shocks to the macro-economy. Saldana et al. (2009) tried to model the impact of natural disasters on human emigration in Mexico, and found that weather-related factors highly affected the economy in Mexico. The agriculture sector was severely affected by climate-related factors clearly stating that bout 80% of economic losses were the result of weathe-related factors. In an attempt to analyze determinants of migration flows in 45 SSA countries between 1965 and 2005, Naudé (2010) found that environmental pressures have a weak and an indirect impact on migration.

Another study by Dun (2011) tried to analyze displacement and migration that are caused by Mekong delta flood, and found that regular flooding events in Makong delta region were causes of governme-initiated resettlement of households, and it affect individual migration decisiona. In order to analyze the migration decision and its determinats, Alscher (2011) found environmental degradation mainly deforestation, soil erosion, and land degradation affect migration. However many peoples in the study area responded that the root cause for migration were economic problems. Similarly, these problems were found to affect migration decisions in Dominician republic inspite of the fact that the severity of the problems was not as high as in Haity. Generally, the finding of the study showed that environmental degradation, mainly deforestation, soil erosion and the impacts of tropical storms (flooding, landslides) worsen the existing economic problems and therefore accelerate the decision to migrate.

Feng etal.(2012) conducted a study on the effect of climate variability on international migration, and the finding shows that the link between temperature and international out-migration was significant and positive. Besides, there was evidence of migration to temperature-sensitive destination countries. Besides, Hornbeck(2012) found that adaptation through migration rather than an adaptation through crops choice in order to offset the impact of environmental change. Another finding by Hanson & McIntosh (2012) showed that larger and richer cohorts were more likely to migrate to the US. On the other hand, Di Falco et al.(2012) showed that climate variability has a significant effect on farm productivity and farm revenue. Bettin & Nicolli (2012) tried to see the effects of climate change proxies on international migration, and based on the statistical result, international migration was found to be significantly affected by those

proxies in the overall sample of countries. Results are confirmed also when focusing on specific geographical areas like Africa or Asia.

The empirical tests by Ragazzi (2012) revealed that the relationship between migration and climate changes was found to be significant. In the analysis, anomalies in temperature and precipitation were found to have positive impact, and the effect of extreme events was found to be ambiguous. According to the study by Marchiori etal. (2012), the empirical model showed that weather anomalies increased internal and international migration in Sub-Saharan Africa. Based on their estimate, temperature and rainfall anomalies resulted in a net displacement of about 5 million people between 1960 and 2000. Based on their analysis to understand determinants of intra-regional migration in sub-Saharan Africa, Ruyssen and Rayp (2013) found that environmental conditions have an apparent impact on the intraregional migration.

Another study by Belasen etal.(2013) pointed out that environmental degradation and natural hazards lead to a forced migration of population. Based on this analysis, natural hazards were found to have shortrun impact on migration. In addition, people in urban areas were more likely to migrate because of natural hazards than their counterparts in rural areas. In an attempt to assess the effect of natural disasters on migration rates, Drabo and Mbaye(2015) reported that natural disasters and migration rates are positively related, and their analysis was consistent with the theoretical expectation that environmental problems impact migration decisions. Cai etal.(2016) attempted to understand the relationship between climate and migration, and found that there is a positive and significant relationship between temperature and international out-migration only in most agriculture-dependent countries which is consistent with the widely documented adverse impact of temperature on agricultural productivity. Moreover, the temperature–migration relationship was found to be non-linear and resembles the non-linear temperature–yield relationship. While studying the impact of climate variability on outmigration, Coniglio and Pesce (2015) found that adverse climate events directly and indirectly affect out-migration from poor countries to rich countries.

In India, Dallman and Millock(2017) conducted a study on migration in agricultural states of the country, and they reported that the effect of drought was stronger in the agricultural state and drought frequency in the origin state rises the inter-state migration in the country. According to

their study, the magnitude of drought increase interstate migration in agricultural states of India. Goldbach, C(2017) found that there is no direct significant effect of slow-onset environmental events on migration decisions. Nonetheless, precipitation of storms was significantly associated with migration decisions in Ghana. Another study by Aburn & Wesselbaum (2017) suggest that climate change is a key driver of migration. They found that a large time dimension is crucial to identify the effects of climate change on migration as most of the literature uses decennial averages finding substantially different results of climate change on migration.

Backhaus etal.(2015) showed that temperature was found to positively affect migration, and stronger changes in precipitation were also associated with small changes in migration. These effects were robust to various model modifications. Beine etal (2016) found no direct effect of long-run climatic factors on international migration across our entire sample. Rather, we find evidence of indirect effects of environmental factors operating through wages. Another study by Abel et al.(2019) showed that climatic conditions were found to affect drought severity and the likelihood of an armed conflict in Ethiopia, and an armed conflict was also found to affect migration significantly. Beine & Parsons (2017) took a sample of 192 non-OECD countries between 1960 and 2000, and found that natural disasters deter emigration. However, these disasters tend to spur emigration to the neighbouring countries. Based on this analysis, there was an important interaction with wealth level. Damette &Gittard(2017) assessed the migration in 39 Sub-Saharan Africa countries from 1960-2000. Based on their analysis, environmental measures were found to affect migration significantly. Backhaus et al. (2015) found that the impact of climate on migration was mainly driven by agricultural dependence

According to a study by Henderson et al. (2016), climate shocks in cities with a strong manufacturing sectors were found to have higher urbanization. This study incorporated 27 Sub-Saharan Africa countries from 1990- 2009. In an attempt to Country-specific effects of climate variability on human migration in Kenya, Uganda, Nigeria, Burkina Faso and Senegal, Gray & Wise(2016) found that Migration increased with an increase in temperature anomalies in Uganda. On the other hand, migration was found to decrease with temperature anomalies in Kenya and Burkina Faso, and migrations do not show a consistent relationship with temperature

in Nigeria and Senegal. On the other hand, precipitation showed an inconsistent relationship with migration, and the result become consistent with previous studies.

Internally in Ethiopia, the work of Ezra and Kiros (2006) tried to assess migration patterns in Ethiopia, and found that there was rural out-migration in drought-prone areas of Ethiopia. The work of Yang & Choi(2007) showed that remittances can offer full insurance of income shocks for households with oversee migrants. Tegegne and Penker (2016) used household new economics labor migration framework to study determinants of rural outmigration in ethiopia, and found that perceived food insufficiency, higher education status, female household heads, household head age, household size, and the number of economic activities were positively associated with the dependent variable(migration).

Another study by Fasil& Mohammed(2017) tried to investigate determinants of rural-urban migration in southern Ethiopia. Their finding suggested that youngesters whose age ranges from 15 to 25 were more likely to migrate in that the statistics showed that almost 76% of migrants were found within that age range. In addition, better job opportunities, rural poverty, further education facilities, new business opportunities, and restrictive culture were among the major reasons for migration. Beyene& Berhe(2011) studied determinants of internal and international migration in Ethiopia, and they found that wealth and network were significant factors that affect international migration. Based on their analysis, the coefficient of wealth had a positive sign while wealth square had a negative sign indicating an inverse U-shaped relationship between wealth and migration. Past migration value was also statistically significant. Another finding by Ezra and Kiros(2001) showed that individuals from poor parents were more likely to migrate, Besides, age, sex, and education level of a household were found to be statistically significant.

In an attempt to study the development impacts of migration and remittances on a migrant sending communities, Misgana et al.(2019) used logistic and multinomial logistic regression, and they showed that wealth has a significant effect on migration in that poor peoples were more likely to migrate compared with rich peoples. Besides, the unemployment rate was found to significantly affect migration. On the other hand, Naude (2010) took the sample of 45 sub-sahara African countries over the period 1965-2005, and the result showed that armed conflict and employment opportunities have a significant effect on migration while environment and

demographic variables were found to affect migration indirectly. Another study by Asfaw et al.(2010) focused on seasonal migration in Amhara region. The result showed that shortage of farmland, debt, desire to get additional income, and lack of non-farm activities locally were found to be significantly correlated with migration.

According to a qualitative review by Andualem and Erahim(2020), food, environmental degradation, famine, conflict, poor social services, shortage of land, unemployment, lower agricultural productivity, demographic pressure, and shortage of land were found to be considered as push factors that facilitate migration. Besides, good healthcare and education facilities, higher income, security, and urban amenities were found to be pull factors. Aschalew(2021) studied rural-urban migration in Ethiopia, and the result of the study showed that drought, information flow, debt, cultural restrictions, and landlessness were significant determinants that affect migration. In addition, Kathleen and Lisa(2019) studied the impact of drought on the livelihood and migration, and they found that drought tends to increase mobility to short distances. In this analysis, farmers showed a shift from subsistence crop production to livestock sales from March to June. In an attempt to investigate the impact of climate variables on households migration decisions, Etana et al.(2020) employed discrete time event history model, and found that rainfall was negatively associated with migration during the rainy season while the correlation between migration and rainfall was positive from June to September. Besides, households changing crop type were more likely to migrate compared with households who used crop diversification whose propensity to migrate was low.

2.3. Evaluation of Reviewed Literatures

Based on the review of different studies, the researcher examined that there are gaps recently on environment and migration. Most articles and papers in Ethiopia focus on internal displacement and determinants in focused on a single environmental and specific regions/ woredas of Ethiopia, and most of these studies ignore the gap in the international migration flows from Ethiopia. Besides, some studies conducted so far are based on the data source that is not reliable and genuine, and the methodologies employed were not clearly in line with the availability of data.

Furthermore, migration and environment researches in Ethiopia are small sample size, and they do not broadly take in to account the impact of natural hazards and climate variability. Most of

which the researcher reviewed focus on climate variability. Regarding the nexus of environment and migration, some of the studies so far base their conclusion on some specific climate-related variables, and some others consider natural hazards only to emphasize the effect of environmental factots on migration. One way or the other, the debate on environmental migration is still a significant area of concern.

2.4. Conceptual Framework

The conceptual framework of the study can be organized by distinguishing dependent and independent(explanatory) variables and showing their expected sign. As a result, the conceptual framework for modeling the impact of environmental change on migration flows from Ethiopia can be applied with the objective of analyzing other explanatory variables affecting migration flows from Ethiopia.In his study the dependent variable is migration flows from Ethiopia, and explanatory variables are:

- Distance between migrant's origin and destination
- Number of population in the origin of migrants and destination of migrants
- GDP of origin and destination countries
- Unemployment rate
- Inflation rate
- Rainfall anomaly
- Air pollution exposure
- Rapid-onset environmental hazards
- Slow-onset hazards
- Amenity index
- Overall political risks

In addition to international migration flows, internal migration (displacements) was analyzed, and rapid-onset hazards, slow-onset hazards, temperature anomaly, precipitation, conflict and inflation rate are expected to affect internal migration. Based on previous theories and literature, GDP of destination countries is expected to be positively related with emigration. On the other hand, GDP of the origin countries is indeterminate due to the fact that the rise in GDP leads to the desire to migrate to developed countries. On the other hand, lower income level forces migrants to leave their homes in search of better lives.

Besides, physical distance and country adjacency dummies are proxies for transport(mobility) costs. Population is another determinant that affect out-migration, and a large population may have a negative impact on the life of individuals, and therefore it is expected to be positively related with migration decisions. On the other hand, a large population number of destination countries is related to a high supply of labor, and these lower wages which results in low migration flows to countries of high poipulation. As a result, it is expected to have negative sign.

There are also environmental factors affecting migration decisions. Based on previous literatures, environmental variables such as slow-onset hazards, rapid-onset hazards and air pollution exposure are expected to be positively related with out-migration while rainfall anomaly and amenity index are expected to be negatively related with out-migration. Other determinant factor is conflict that is expected to be positively associated with out-migration. Besides, common language between countries sharing the same language is related to a lower cost to migrate and tends to have historically more established migration flows, and therefore this variable is expected to have a positive sign. However, the choice of the explanatory variables in the study depends on the objective of the study and the availability of data among other factors.

Diagrammatically, migration and the environment can be drawn as follows:

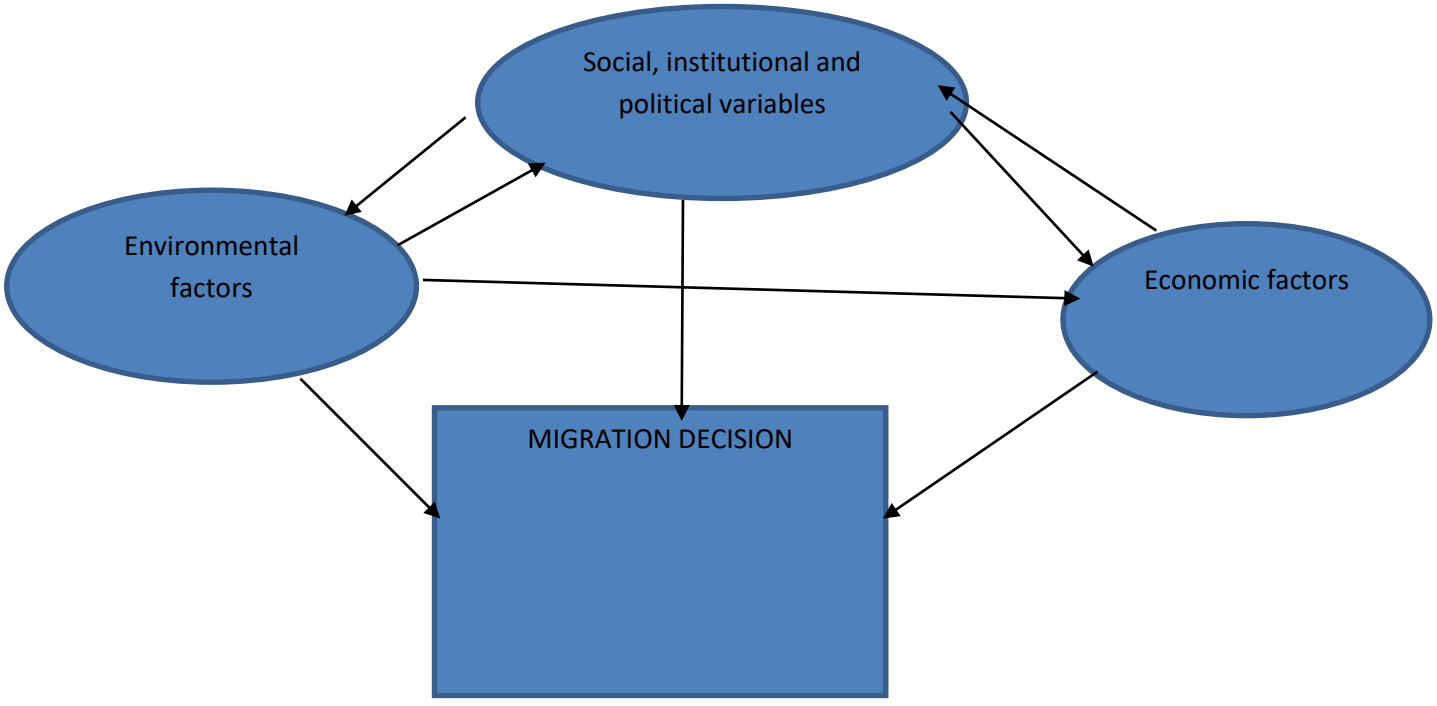


fig1: migration and its determinants

CHAPTER THREE: METHODOLOGY OF THE STUDY

3.1. Types and Sources of Data

The data sets of the study for variables related to international migration were based on unique series collected from World Bank, UNDESA, international monetary fund and the UNHCR.

3.2. Method of Data Collection

The data covering the year 2000 to 2020 for international migration and its determinants was collected through the use of secondary data collected by institutions and organizations, and secondary data was therefore collected from the above sources. The data for variables with regards to internal migration were obtained from the international organization for migration displacement tracking matrix that is the recent phenomenon in the data collection of internal migration and migrant's characteristics in Ethiopia. The international organization for migration (IOM) has been conducting survey in almost all regions of Ethiopia since the last quarter of 2017. Fortunately, the survey of IOM helped the researcher to easily have access to the data. For the internal migration, the researcher used additional data sources such as CSA from the first quarter of 2018 up to the fourth quarter of the year 2020 in addition to the macro data obtained from World Bank and UNDESA.

3.3. Method of Data Analysis

3.3.1. Descriptive Method

In this study, descriptive method of data analysis was used to summarize the data obtained from secondary sources. This analysis was applied to show mean, standard deviations, maximum values, minimum values and graphical presentations of migration flows from Ethiopia, frequency of environmental changes and their effect on people's lives.

3.3.2. Econometric Model

Econometric analysis was also applied due to the fact that the relationship between dependent and independent variables and the coefficients of explanatory variables cannot be explained only by descriptive analysis. Because of the nature of the data, panel data models were used. Panel data has several advantages over cross-sectional or time-series data sets as it adds another dimension to empirical analyses. According to Gujarati (2007), panel data models are able to

capture both cross-section and time-series variation of the dependent variable. Besides, the model can measure observable and unobservable effects that variables.

Combining time series of cross-section observations, more informative data, more efficiency, less collinearity among variables, more variability, and more degrees of freedom. Panel data consists of random effect and fixed effect models and this study used Pooled OLS and dynamic panel data models. Because of the number of variables used for the internal migration and external migration, the study employed two types of model specifications. The first model specification is for international migration flows from Ethiopia while the second specification encorporates internal migration in Ethiopia.

3.3.2.1. Gravity Model of international migration

The gravity model coined from its similarity to Newtonian gravitational force theory. The model was used in the Newton's physical theory in that two bodies attract each other in a direct proportion to their masses and inversely by the square of the distance between them. Gravity models are critical in analyzing traffic flows, migration flows, and trade flows. Timbergen (1962) and Poyhonen (1963) used the gravity model in international trade for the first time. They conducted their study on the first bilateral trade flows based on gravity-type equation although they didn't supply theoretical justification.

$$F_{ij}=G\frac{M_i M_j}{D^2_{ij}} \qquad (3.1)$$

Where F_{ij} is attraction force M_i and M_j are two different masses, D is distance between these objects and G is a gravitational constant.

Bergstrand proposed the most complete version of the gravity model using variables like GDP, GDP per capita, distance, and monetary variables. Linemann (1966) included population as an additional measure of the country size, implying that we will call augmented gravity mode1.

Given the aforementioned definitions of the gravity model, recently most studies on trade flows and migration flows are conducted by augmenting other variables. This study includes environmental factors and other institutional variables, and the model becomes an augmented gravity model.

The basic gravity model can be specified as:

$$\mathbf{Mig_{ij} = a.\ (GDP_i,\ xGDP_f) / Dist.} \qquad \textbf{(3.2)}$$

Where Mig_{ij} is migration flows from country i and country j, GDPi and GDPj are country i's and j's national incomes. $Dist_{ij}$ is a measure of distance between the two countries and a is constant parameter.

Taking the logarithm of gravity equation we obtain the linear form of the model. The corresponding equation is as follows.

Log (Mig_{it}) = a+p_i (log (GDP_i*GDP_j) –fr $(logDist_{ij})$ +$U_{i,j,t}$. Where a, p_i are coefficients to be estimated. The error term u_{ij} captures any other random factors that may affect bilateral migration between the two countries.

The linear gravity model can be specified as:

$$\mathbf{Ln(X_{it}) = \beta_0 + \beta_1 ln(Y_i) + \beta_2 ln(Y_j) + \beta_3 ln(N_i) + \beta_4\ ln(N_j) + \beta_5 ln(D_{ij}) + U_{i,t}} \qquad \textbf{(3.3)}$$

The augmented gravity model of migration uses other variables in addition to main gravity variables. In order to specify the model, we have to understand whether or not country-specific fixed effects should be added, or all variables should be indicated in a bilateral form. In the former case, both countries of origin and destination should be of large sample. Our model specification in this case used the conversion of all variables in to bilateral form. This technique is preferred so as to make the variables suitable for estimation. Using this technique will enable us to get unbiased and efficient results. As a result, the model specification now becomes:

$$\mathbf{ln(mig\_stock) = \alpha + \beta_1 ln}\left(GDP_{(i,t)}/GDP_{(j,t)}\right) + \beta_2 \mathbf{ln}\left(pop_{(i,t)}/pop_{(j,t)}\right) + \beta_3 \mathbf{ln}\left(unr_{(i,t)}/unr_{(j,t)}\right) + \beta_4$$
$$\beta_5 \mathbf{ln(inf_{(i,t)}/inf_{(j,t)}) + \beta_5 ln}(D_i) + \beta_6 \mathbf{ln}\left(soh_{(i,t)}/soh_{(j,t)}\right) + \beta_7 \mathbf{ln}\left(roh_{(i,t)}/roh_{(j,t)}\right) +$$
$$\beta_8 \mathbf{ln}\left(rai_{(i,t)}/rai_{(j,t)}\right) + \beta_9 \mathbf{ln}\left(ami_{(i,t)}/ami_{(j,t)}\right) + \beta_{10} \mathbf{ln}\left(ape_{(i,t)}/ape_{(j,t)}\right) + \beta_{11} \mathbf{ln}\left(pri_{(i,t)}/pri_{(j,t)}\right)$$
$$+ \varepsilon_{(i,j,t)} \qquad \textbf{(3.4)}$$

Where subscript "i" and "t" indicate migration flows from Ethiopia and time period respectively, and j indicates countries of destination. GDP_i And GDP_i indicate GDP of Ethiopia and destination countries of Ethiopian migrants respectively, pop_i and pop_j indicate population of Ethiopia and destination countries respectively, D_i indicates the distance between economic

centers, and other variables such as slow-onset hazard, rapid-onset hazards, rainfall anomaly, air pollution exposure, and environmental amenities are indicated in short. $soh_{(i,t)}$ And $soh_{(j,t)}$indicates slow-onset hazard index of country of origin at time "t" and slow-onset hazard index of countries of destination at time "t" respectively. Other explanatory variables are unemployment rate (ump), air pollution exposure (ape), and inflation rate (INF), rapid-onset hazards (roh), amenity index(ami), and rainfall anomaly index (rai).

3.3.2.2. Static panel data models of Internal Migration

Because of the nature of the data and variables, we employed linear panel data models such as fixed effects and random effects models. Considering the number of internal migrants and their reasons for displacement collected by IOM Ethiopia, this paper used variables such as slow-onset hazards, sudden onset hazards, temperature anomalies, standard precipitation index, and inflation. The aggregation of elements of sudden onset hazards and slow-onset hazards used the same procedure as an aggregation used for the same index in the international migration. The only exception is the frequency of data collection where IOM used quarterly and bimonthly data collection for the internal migrants. Standard precipitation index was constructed by using principal components analysis.

The model is specified as:

$$MIG_{ij,t} = \beta_0 + \beta_1 ROH_{i,j,t} + \beta_2 SOH_{i,j,t} + \beta_3 SPI_{i,j,t} + \beta_4 TAI_{i,j,t} + \beta_5 lnINFR_{i,j,t} + \beta_6 lnCONF_{i,j,t} + U_{i,j,t} \quad \textbf{(3.5)}$$

For better analysis of the data, the researcher used the natural logarithm of all variables, and the model is re-specified as:

$$\ln(MIG_{ij,t}) = \beta_0 + \beta_1 ln(ROH_{i,j,t}) + \beta_2 ln(SOH_{i,j,t}) + \beta_3 ln(SPI_{i,j,t}) + \beta_4 \ln(TAI_{i,j,t}) + \beta_5 ln(INFR_{i,j,t}) + \beta_6 ln(CONF_{i,j,t})\ U_{i,j,t} \quad \textbf{(3.6)}$$

Where MIG is a dependent variable indicating the number of internal migrants

ROH and SOH indicate indexes for sudden onset hazards in the origin place of migrants and slow-onset hazards in the origin place of migrants respectively.

SPI is standard precipitation index indicating an index for rainfall availability.

TAI is temperature anomaly index, and the CONF variable indicates conflict in Ethiopia

INFR is a quarterly inflation rate of regions considered in the sample, and U_{it} is an error term.

3.4. Choice of Appropriate Estimation Method

The first model(model of international migration) can basically be estimated by pooled ordinary least square estimation technique, static panel data models and dynamic panel data models(using generalized methods of momentum, GMM). These methods are commonly used to deal with gravity model of migration. Static panel data models such as fixed effects or random effects can be a suitable framework in the presence of unobserved heterogeneity. Although the Hausman test rejects the null hypothesis in favor of fixed effects estimation, time-invariant variables cannot be estimated using fixed effects estimation techniques. Besides the occurrence of zero observation in the dependent variable has a problem on the OLS estimation although these values can be substituted by very small values. Moreover, gravity model of migration that considers countries of origin on the one side and countries of destination on the other side can be better if estimated by pooled OLS by adding countrie's fixed effects in the regression. In case the country of origin or destination is only one, adding country-specific fixed effects in the model and applying OLS yields a biased result. In our specific cases where we have only one origin country, the pooled OLS regression may have its pitfalls. In order to solve this problem, the researcher expressed all variables in bilateral form, and the ratio of variables in the origin country to the destination was used as an indication of both countries of origin and country of destination. Distance and migration variables are already in a bilateral form, and there is no need to calculate the ratio, percentage or growth coefficients. Having all variables in bilateral form helps us to solve the problem related to an inclusion of countries' fixed effects in the model. After all, we can use pooled OLS estimation techniques with standard errors clustered on year dummies and countries also. In order to cope with problems such as autocorrelation, endogeneity, the researcher preferred the Blundell-Bond model (Blundell and Bond, 1998). The Blundell- Bond model is uses system generalized methods of momentum. Endogenous repressors taken in to analysis were lag of the dependent variable, ratio of GDP and ratio of inflation rates while other variables such as such as ratios of unemployment rates, sudden onset hazards, slow-onset hazards, rainfall anomaly, political risk index and amenity index were taken as valid instruments. Since estimated

asymptotic standard errors of two-step GMM are biased, we used one-step GMM estimation technique.

Based on our preference of the SYS-GMM estimation technique, the model specification is finally described as:

$$\ln(mig\_stock) = \alpha + \beta_1 \ln(mig\_stock_{(i,j,t-1)}) + \beta_2 \ln(GDP_{(i,t)}/GDP_{(j,t)}) + \beta_3 \ln(pop_{(i,t)}/pop_{(j,t)}) + \beta_4 \ln(unr_{(i,t)}/unr_{(j,t)}) + \beta_5 \ln(inf_{(i,t)}/inf_{(j,t)}) + \beta_6 \ln(D_i) + \beta_7 \ln(soh_{(i,t)}/soh_{(j,t)}) + \beta_8 \ln(roh_{(i,t)}/roh_{(j,t)}) + \beta_9 \ln(rai_{(i,t)}/rai_{(j,t)}) + \beta_{10} \ln(ami_{(i,t)}/ami_{(j,t)}) + \beta_{11} \ln(ape_{(i,t)}/ape_{(j,t)}) + \beta_{12} \ln(pri_{(i,t)}/pri_{(j,t)}) + \varepsilon_{(i,j,t)} \quad (3.7)$$

Similarly, the second model with a dependent variable of internal migration can be estimated using static panel data models such as pooled-OLS, random effects model and fixed effects model. The choice between random effects model and fixed effects regression was decided after running model diagnostic tests, and random effects regression was preferred. Therefore, Pooled-OLS regression analysis and random effects regression were taken as an appropriate estimation techniques to estimated coefficients of factors affecting internal migration.

3.5. Model Diagnostic Test

First pooled OLS estimation was taken and multicollinearity problems were checked using variance inflation factor. Second, panel unit root test was taken using Harris- Tzavallis test. Third, the researcher tested the preferred estimation techniques such as choosing between Pooled OLS and fixed effects model. In order to choose between Pooled OLS and fixed effects, the researcher used chaw test. Fourth, Hausman specification test was used to choose between fixed effects and random effects estimation. Special case was take for the international migration in that further steps were performed, and SYSTEM GMM was used. Heteroscedasticity and autocorrelation problems were generally assumed to be solved by GMM estimation technique. For the second model, both heteroscedasticity and autocorrelation tests were run, and there was no first order serial correlation in the dataset. So as to cope with heteroscedasticity problems, robust standard errors were reported.

3.6. Definition of Variables and their Expected Sign

Migration_stock: is our dependent variable that is expressed as a bilateral variable. Hence, Mig_stock is a dependent variable referring to the movement or displacement of peoples or a group of people from one country to the other and from one specific region of Ethiopia to

another region of Ethiopia. While analyzing international migration, this specific paper used the stock of migrants. This is because of the availability of an origin- destination data. For an internal migration, this particular paper used the total number of internally displaced people by using site assessment surveys conducted so far.

Our explanatory variables consists of two groups. The first groups of variables are variables that are expected to affect an international migration. These variables contain standard gravity variables such as distance, the ratio of total populations (origin to destinations), the ratio of GDP (origin to destinations), and the distance between Ethiopia to destination countries of Ethiopian migrants. Besides, we simply take ratio for variables such as unemployment rate and air pollution exposure. Other variables such as inflation rate, rainfall anomaly index, sudden onset hazards index, slow-onset hazards index, amenity index have negative values, we add a very small constant number to them in order to calculate their ratio. The problem of negative values affects not only ratios but also natural logarithm specification that is very essential for a gravity model. Finally, we expressed all of our independent variables in a bilateral form.

GDP RATIO (GDP_RAT): this variable indicates the ratio of gross domestic product of origin (Ethiopia) to the destination countries.

POP_RAT: is another independent variable indicating the ratio of the total number of people living in the origin country to the destination.

Distance (Dist.): is an independent variable indicating the proxy variable for migration costs.

SOH_RAT: indicates the ratio of slow-onset hazards in the country of origin to the country of destination. In this analysis, an index was constructed using principal components analysis simply by taking examples of slow-onset disasters into consideration. Drought and change in rainfall, insect infestation, riverine flood, change in availability of water and salinization of water are among the slow-onset hazards.

ROH_RAT: refers to the ratio of sudden (rapid) onset hazards in the country of origin to the country of destination. These hazards occur rapidly or suddenly, and flashflood, earthquake, landslide, forest fire, volcanoes and storms were used to form an index for rapid-onset hazards.

RAI_RAT: refers to the ratio of rainfall anomaly index of origin countries to the rainfall anomaly index of destination countries. The researcher used a method developed by Roy (1965) in order to calculate rainfall anomaly index.

Algebraically,

RAI=3*[$\frac{N-A}{M-A}$] for positive anomalies and

RAI=-3*[$\frac{N-A}{X-A}$] for negative anomalies

Where N= yearly precipitation

A= an average of yearly temperature of a historical series

M= an average of the ten highest yearly precipitation values in a historical series

X= an average of the ten lowest yearly precipitation values in a historical series.

UNP_RAT: refers to the ratio of unemployment in the origin countries to the unemployment rate of destination countries.

INF_RAT: This variable indicates the ratio of inflation rate in the country of origin to the ratio of inflation rates in the country of destination.

AMI_RAT: indicates amenity values of an environment in the country of origin to the amenity values in the country of destination. An index was calculated by using principal component analysis, infrastructure on the environment were taken in to consideration while constructing an index.

PRI_RAT: represents the ratio of an overall political risk in the country of origin to the overall political risk in the country of destination. Similarly, principal components analysis method was used to construct an index. Indicators such as political instability, internal conflict, external conflict, religious tensions, ethnic tensions, corruption, bureaucratic quality and democracy, and social accountability were considered while constructing the overall political risk index.

The expected sign of the first group of explanatory variables is summarized below.

Variable	Type of variable	Expected sign
Migration	Dependent	
DIST.	Independent	Negative
GDP_RAT	Independent	Negative
POP_RAT	Independent	Positive
UMP_RAT	Independent	Positive
INF_RAT	Independent	Positive
SOH_RAT	Independent	Positive
ROH_RAT	Independent	Positive
AMI_RAT	Independent	Negative
PRI_RAT	Independent	Positive
RAI_RAT	Independent	Negative
APE_RAT	Independent	Positive

The second groups of explanatory variables are determinants of internal migration. These variables are sudden onset hazards, slow-onset hazards, standardized precipitation index, inflation rates and temperature anomalies. All explanatory variables except the standardized precipitation index are expected to positively affect internal migration in Ethiopia.

3.5. Measuring Index of variables

Sudden-onset hazards index, slow-onset hazards index, amenity index, and political risk index were constructed after normalization of row data using MIN-MAX approach. Chand et al (2015) and Rahma et al. (2015) used MIN-MAX approach of a composite index to analyze the relative performance of a variable. Algebraically,

$$CI_i = \frac{x_i - Min(x)}{Max(x) - Min(x)} \quad \textbf{(3.8)}$$

Where Min(x) and Max(x) represent minimum value and maximum value of the variable respectively in a historical series, x_i indicates the current value of the variable. Normalized values will have a positive value between zero and one.

CHAPTER FOUR

RESULT AND DISCUSSION

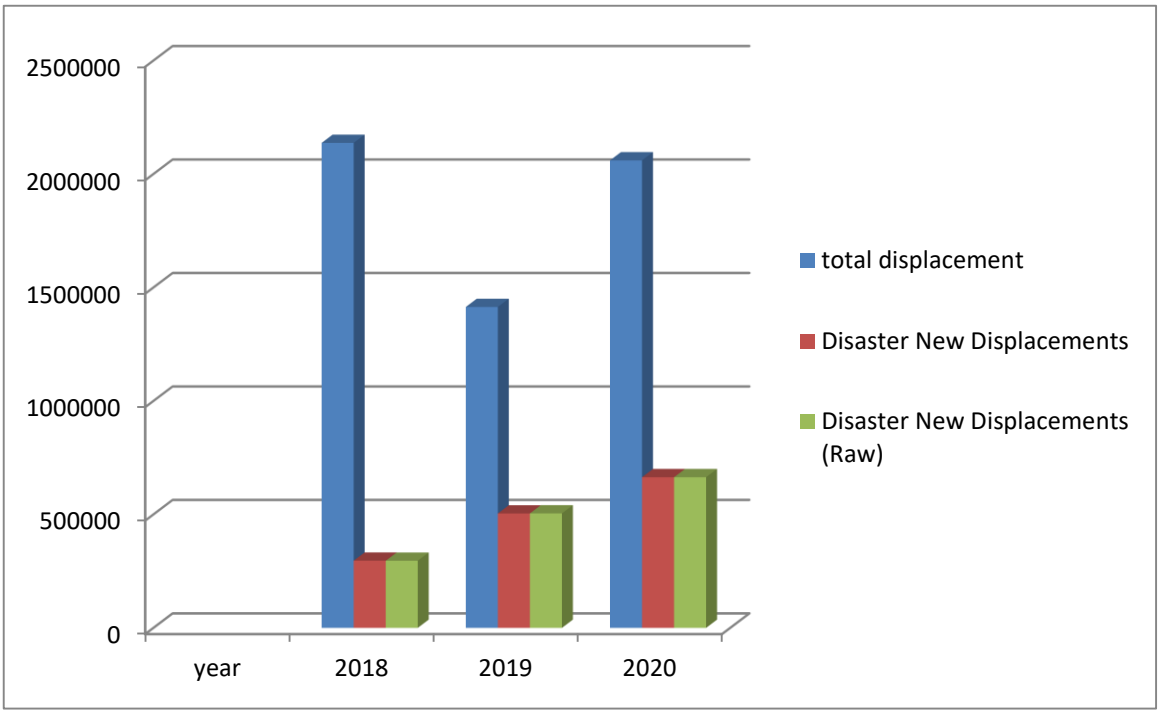
4.1. Internal Migration

As a part of our objective, internal migration was analyzed, and explanatory variables were estimated using both descriptive and econometric analysis. Results and discussions were performed accordingly. Note: the source of all tables is stata result.

4.1.1. Descriptive Analysis

The number of internally migrated individuals across the country disaggregated by regions of Ethiopia, particularly in seven major regions of Ethiopia and one city administration were found to vary from time to time. The specific summary is shown by table 1. Besides, the trend of aggregate disaster new displacements at aggregate level was also expressed in figure. The figure shows the aggregate number of disaster new displacements.

Fig 1. Disaster new displacements



Based on the above figure, the total number of disaster new displacements is found to be increasing from time to time. As indicated above, the total number of disaster new displacements

increased from 296 thousand in 2018 to 664 thousand in 2020. This indicates the extent to which the impact of disasters showed a tremendous increment as clearly stated by the survey conducted exclusively for disaster-induced displacement and conflict-induced displacement. Regionally disaggregated variables were also described by the following table. All explanatory variables were described using, mean, standard deviation, minimum value, and maximum values.

Table 1: descriptive statistics of variables across regions

VARIABLES	(1) N	(2) Mean	(3) Sd	(4) min	(5) Max
No_of migrants	96	288,341	464,521	1,364	2.056e+06
Sohi	96	1.500	1.000	0.337	2.970
Roh	96	1.000	1.000	0.331	3.627
Conf	96	1.161	0.198	0.500	1.500
TAI	96	3.004	1.322	0.271	5.379
SPI	96	1.847	0.789	0.0917	3.552
inf_rate	96	21.16	5.108	0.0954	32.55

Source: stata result.

The summary statistics indicates that the mean of migration was found to be 288,341 where the maximum value of migrants occurred in Somali region in the first quarter of the year 2019. The minimum migrants were seen in Harari region in the second quarter of 2020. One of our explanatory variables, rapid-onset hazards index had a mean value of one and the maximum value was found to be 3.267where the highest index occurred in Afar region in the third quarter of 2020. Slow-onset hazards index indicates a mean value of 1.5 with a maximum value of 2.97 that was registered in Somali region in the third quarter of 2018 and the first quarter of 2019. Standard precipitation index and temperature anomaly index had a mean index value of 1.85 and 3 respectively, whereas these variables had a maximum value of 3.552 and 5.379 respectively. The other variable that played a significant role in internal migration was conflict variable with an index measured by the incidence of death, number of affected individuals, and frequency of occurrence. This variable had a mean index value of 1.16 and a maximum value1.5. Based on the index, the highest index was observed multiplicatively in Oromia, Somali and Tigray regions of Ethiopia.

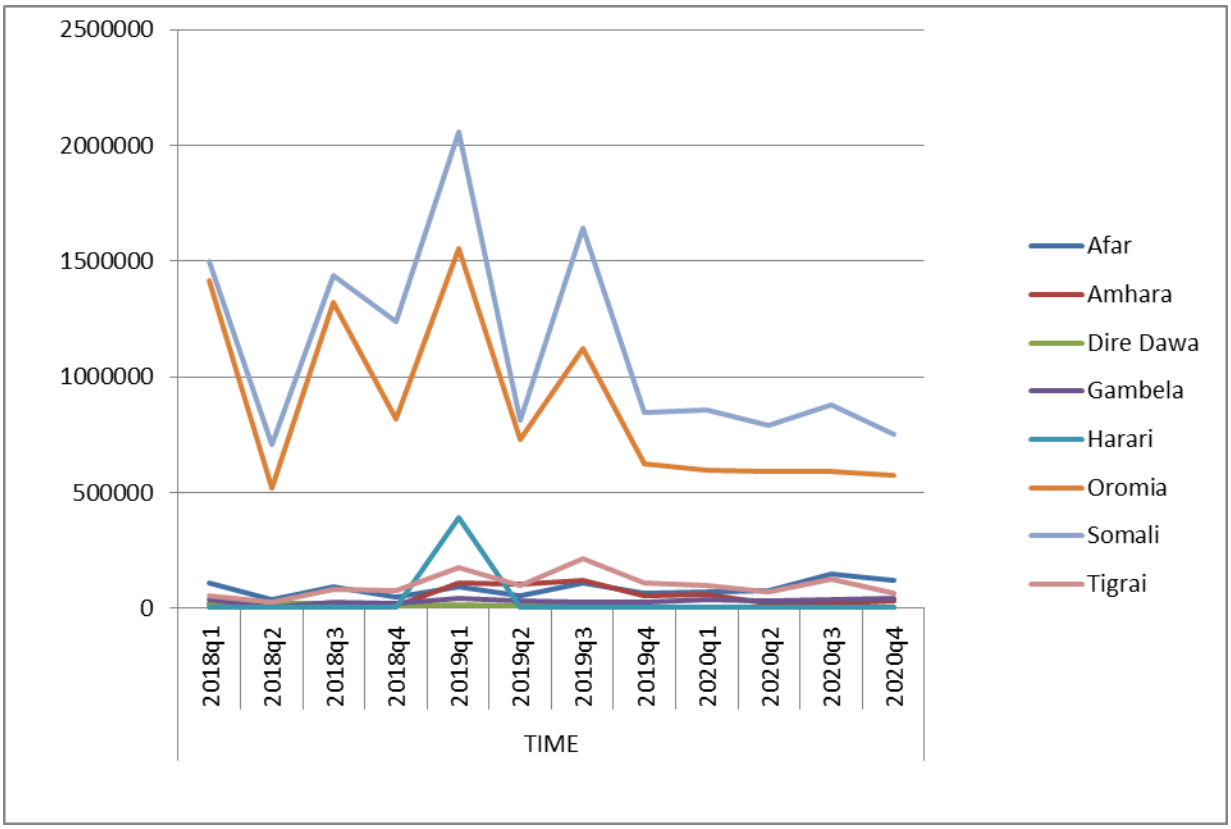


Fig 2: internal migrants disaggregated by regions.

As we can see from the graph, the two regions namely, Oromia and Somali were found to have the highest number of migrants under the study period. In Oromia, the highest number of migrants occurred in the first quarter of the year 2019. Similarly, Somali region had the highest number of migrants in the first quarter of the year 2019. However, the lowest number of migrants occurred in Dire Dawa and Harari regions of Ethiopia.

4.1.2 Model Diagnostic Tests

4.1.2.1. Multicollinearity Test

Because of simplicity and certainty, the variance inflation factor was used to test for multicollinearity in the panel dataset. Based on the variance inflation factor (VIF), it is recommended that the value of VIF less than 10 indicate a preferred level. On the other hand, the reciprocal of VIF exceeding 0.1 is recommended. Accordingly, the individual as well as the mean VIF value does not exceed 10, and therefore, there is an evidence of low multicollinearity problem in the dataset (see table 2)

Table2: Multicollinearity test

VARIABLES	VIF	1/VIF
Lnsohi	1.94	0.514728
Lnrohi	2.78	0.360235
Lntai	1.07	0.930845
Lnconfi	2.67	0.374579
Lnspi	1.42	0.703954
Lninfri	1.07	0.937015

Mean VIF= 1.83

4.1.2.2. Panel unit root test

Although stationary test is a potential sign of trouble most probably in a time series analysis, Harris-Tzavalis test was used to check for a panel unit root. This test was used to make the test procedure consistent with a test for variables that are assumed to affect international migration. Using Levin-Lin-Chu test and Harris-Tzavalis test does not have a difference in a stationary test for variables that are expected to affect internal migration. The result of panel unit root test showed that all variables are stationary with trend as well as without trend (see table 3).

Table 3: panel unit root test

VARIABLES	(1) Without trend	(2) With trend
Lnintmig	-8.6251 ***	-5.4005***
Lnsohi	-6.4848 ***	-2.5525 ***
Lnrohi	-8.8722 ***	-4.9729 ***
Lntai	-9.7366 ***	-4.5227***
Lnconfi	-9.6112***	-5.1923***
Lnspi	-9.5521***	-4.6588***
Lninfri	-10.0874 ***	-5.3294***

Z value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2.1.3. Empirical results of Hausman Specification Test

Hausman test is used to test for the difference in fixed effects estimation and random effects estimation. Based on the p-value greater than 0.5, we fail to reject the null hypothesis. Hence random effects estimation was found to override fixed effects estimation. Accordingly, we used random effects estimation as a preferred estimation technique to estimate coefficients of explanatory variables that are expected to affect internal migration (see the appendix).

4.1.3. Pooled OLS estimation results

Due to the fact that pooled ordinary least square estimators have their own importance in determining static dependent variables such as internal migration, we employed this technique in addition to random effects estimation. Coefficients of independent variables were estimated using Robust Pooled OLS, and we found that sudden onset hazards, slow-onset hazards, standardized precipitation index, and conflict had a significant effect on internal migration where as an inflation and temperature anomaly index were found have an insignificant effect on the dependent variable (internal migration). Rapid-onset hazards index is significant at 1% level of significance, and the sign is the same as expected. This shows that high internal migration is associated with high rapid-onset hazards. The coefficient of slow-onset hazards confirms that

high slow-onset hazards are more likely to boost internal migration. This variable is significant at 1% level of significance. The other most important variable is conflict that was found to significantly affect internal migration. As expected, conflict augments internal migration. On the other hand, precipitation was found to be a push factor, and its coefficient is negative as expected. This implies that peoples are not likely to migrate when precipitation is high.

VARIABLES	(1) Pooled OLS	(2) RE
lnsohi	0.814***	0.814***
	(0.0941)	(0.0935)
lnroh	0.395***	0.395***
	(0.0996)	(0.111)
lnconf	3.248***	3.248***
	(0.774)	(0.551)
lnspi	-0.610***	-0.610***
	(0.177)	(0.147)
lntai	0.0195	0.0195
	(0.105)	(0.112)
lninfr	-0.0213	-0.0213
	(0.0356)	(0.0992)
Constant	11.06***	11.06***
	(0.250)	(0.328)
Over all significance	0.0000	0.0000
Observations	96	96
R-squared	0.926	
Number of c_id		8

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Estimation results

4.1.4. Random effects estimation result

Alike the pooled OLS estimation results, random effects estimation results showed that internal migration is positively correlated with rapid-onset hazards, slow-onset hazards, and conflict. SPI is statistically significant at 1% level, and its sign is the same as expectated. Conflict variable is also significant at1% and its sign meets the expectation. Rapid-onset hazards index and slow-onset hazards index were also significant at1% level and showed the expected sign. Accordingly, an increase in internal migration is associated with increase in conflict, slow-onset hazards, and rapid-onset hazards. . To make the relationship more linear and to solve the outlier problems, we

used natural logarithm of all variables. The estimation result confirms that both the quarterly inflation rate and temperature anomaly index were not significant. Therefore, the result is almost similar with what we obtained from Pooled OLS estimation.

4.2. International Migration

4.2.1. Descriptive Statistics

In addition to econometric analysis, there is a need of describing all variables of the study due to the fact that values expressed using minimum value; maximum value, mean and standard deviation helps us to assess the intensity of migration driven by these explanatory variables under consideration. The following table shows the description. Note: the source of all tables is stata result.

VARIABLES	(1) N	(2) Mean	(3) sd	(4) min	(5) max
Migstock	250	13,085	32,506	1	245,672
gdp_rat	250	0.0917	0.138	0.00512	1.065
ump_rat	250	0.541	0.634	0.0800	4.597
rai_rat	250	1.284	0.894	0.472	12.31
Distance	250	5,921	3,723	919.7	14,413
ape_rat	250	2.097	1.318	0.398	6.408
pri_rat	250	0.714	0.298	0.382	2.789
soh_rat	250	1.154	0.653	0.128	2.200
roh_rat	250	1.319	1.288	0.0801	4.236
ami_rat	250	0.498	0.287	0.283	3.428
pop_rat	250	12.60	18.55	0.235	111.8
Number of CID	50	50	50	50	50

Table 5: descriptive analysis (international migration)

The result of descriptive statistics showed some statistical measures of dispersion such as mean, standard deviation, maximum value as well as the minimum value. Consequently, the dependent variable migration was found to have a mean value of 13 thousand and 85, with a maximum value of 245.67 thousand. The maximum number of Ethiopian migrants occurred in the USA in 2020. The researcher used distance, GDP ratio (origin to destination), population ratio (origin to destination), the ratio of rainfall anomaly index (origin to destination), the ratio of unemployment rate (origin to destination), the ratio of air pollution exposure (origin to destination), the ratio of rapid-onset hazards index (origin to destination), the ratio of slow-onset

hazards (origin to destination), the ratio of amenity index (origin to destination), and the ratio of political risk index (origin to destination). Based on the result above, the maximum distance from Ethiopia to a destination countries is 14.41 thousand km that is the distance from Ethiopia to Costa Rica, and a minimum value of 919.7 km that is the distance from Ethiopia to Yemen. While the mean value of this variable becomes 5.92 thousands km. GDP ratio on the other hand had a maximum value of 1.065 and minimum ratio value of 0.00512(the ratio of GDP of Ethiopia to GDP of the USA in 2000). The average value is 0.0917 which indicates that on average the GDP of Ethiopia lies below the GDP of most destination countries. Population ratio was found to have an average value of 12.6. This variable has a minimum value of 0.235 and maximum value of 111.8. Rapid-onset hazards index ratio and slow-onset hazards index have an average index value of 1.319 and 1.154 respectively. The maximum value of sudden onset hazards ratio and slow-onset hazards were 4.236 and 2.2 respectively. On the other hand, amenity index ratio and overall political index ratio showed a mean value of 0.498 and 0.715 respectively. These variables have a minimum value of 0.283 and 0.382 respectively. When we look at the mean value of air pollution exposure ratio, it becomes 2.097 where the maximum value is 6.408. This implies that on average air pollution exposure of Ethiopia is higher than majority of the destination countries under consideration. The origin- destination ratio of an unemployment rate has a maximum and minimum value of 0.08 and 4.597 respectively.

Below is the table of summary statistics of all variables under consideration.

4.2.2. Model Diagnostic Test, international migration

4.2.2.1. Panel Unit Root Tests

Since Levin-Lin-Chu test of unit roots assumes that the difference between time and entities become asymptotically zero, this test is not appropriate where the number of time is extremely less than the number of entities. In our case, we have 50 countries and 5 years, and Levin-Lin-Chu test is not appropriate. According to Harris and Tzavalis (2009), Harris- Tzavallis test for unit roots accounts for the appropriate measure of stationary for small time periods and large entities. Accordingly, we used Harris-Tzavalis test, and almost all variables except the political risk index were found to be stationary with trend and without trend. The political risk index is stationary only with trend. The null hypothesis of unit roots in the panel dataset was therefore rejected in favor of the alternative hypothesis (see table 6)

Table 6: panel unit root test

VARIABLES	(1) Without trend	(2) With trend
L.lnmig_stock	-11.3402***	-6.3410***
Lnd	-13.7171***	-7.555***
lnump_rat	-11.0802 ***	-6.7698***
lngdp_rat	-9.0881 ***	-5.303***
lnpop_rat	-10.2302***	-4.0805***
lnrai_rat	-11.3180***	-5.3675***
lnroh_rat	-9.1832***	-5.3269***
lnsoh_rat	-10.7988***	-3.9194***
lnape_rat	-8.9347**	-4.3566***
lnpri_rat	3.7352	-6.3410***
lnami_rat	-12.4437***	-6.0329***

Z value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2.2.2. Tests for Multicollinearity

Alike the test used for internal migration and its determinants, we used variance inflation factor to check the level of multicollinearity. As indicated by the following table, individual as well as the mean VIF values were found to lie within the recommended range. Hence, there is an evidence of low level of multicollinearity in the dataset (see table 7).

Table 7: multicollinearity test

VARIABLES	VIF	1/VIF
Lnd	1.36	0.735704
lnump_rat	1.02	0.976893
lngdp_rat	1.31	0.765674
lnpop_rat	1.04	0.962245
lnrai_rat	1.03	0.971940
lnroh_rat	4.41	0.226549
lnsoh_rat	6.78	0.147512
lnape_rat	1.05	0.949936
lnpri_rat	8.24	0.121332
lnami_rat	4.71	0.212350
	Mean VIF= 3.10	

4.2.2.3. Hausman Specification Test

In order to choose appropriate estimation techniques among the static panel data models such as random effects estimation and fixed effects estimation, we run Hausman test. The probability value being less than the acceptance level, we reject the null hypothesis in favor of the fixed effects estimation technique (see the appendix).

4.2.3. Pooled OLS estimation Results

As stated in the methodology part of this paper, pooled OLS technique was employed. The coefficients of explanatory variables were estimated after log transformation of all variables since the gravity model by itself should be linearized so as to be estimated by OLS. The result showed that distance, origin to destination GDP ratio, and origin to destination amenity index ratios were significantly and negatively associated with migration stock variable. Distance variable is significant at 1% level of significant and the sign was the same as expected. Likewise,

the GDP ratio has a negative expected sign and the result is in line with expectation indicating that peoples from poor countries are more likely to migrate in search for a better living conditions. GDP ratio is statistically significant at 1% level of significance. Amenity index ratio tends to inversely affect migrants in that high amenity in the origin countries do not let peoples leave their country. Conversely, high amenity in the destination country is considered as a pull factor (Daniela Bunea, 2012). On the other hand, Origin to destination ratio of rapid-onset hazards index, origin to destination ratio of slow-onset hazards index, and Origin to destination ratios of the political risk index were positively and significantly associated with migration stock variable. Rapid-onset hazards ratio is significant at 5% level of significance, and the coefficient meets the expectation. The coefficient confirms that propels with high rapid-onset hazards are more likely to migrate to areas where there are low rapid-onset hazards. Similarly, the coefficient of slow-onset hazards index ratio is negative as expected implying that high slow-onset hazards boost migration. Slow-onset hazards index is significant at 1% level of significance. Coefficients on both rapid-onset hazards and slow-onset hazards are in line with the expectation. Explanatory variables such as rainfall anomaly index ratio, population ratio, air pollution exposure and unemployment ratio were not statistically significant. For the sake of convenience, estimated result of Pooled OLS is shown in comparison with system GMM results.

Table 8: results of Pooled OLS (robust) and SYS-GMM estimation

VARIABLES	(1) POOLED OLS	(2) SYS-GMM
L.lnmig_stock		0.480***
		(0.131)
Lnd	-0.147***	-0.0898**
	(0.0324)	(0.0365)
lngdp_rat	-0.102***	-0.0432*
	(0.0245)	(0.0255)
lnrai_rat	-0.0392	-0.0225
	(0.0429)	(0.0302)
lnpri_rat	3.014***	1.488***
	(0.432)	(0.554)
lnump_rat	-0.00253	-0.0154
	(0.0229)	(0.0194)
lnami_rat	-0.738**	-0.617**
	(0.290)	(0.269)
lnpop_rat	-0.0114	0.0162
	(0.0148)	(0.0153)
lnape_rat	0.0248	0.0501*
	(0.0270)	(0.0292)
lnroh_rat	0.161**	0.0263
	(0.0752)	(0.0866)
lnsoh_rat	2.373***	1.297***
	(0.135)	(0.356)
Constant	8.459***	4.352***
	(0.448)	(1.062)
Observations	250	200
R-squared	0.989	
Number of CID	50	50
AR (2)		0.638
Sargan test		0.152
Hansen test		0.205
Over all significance: Prob>F		0.0000
Number of instruments		18

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2.4. System GMM Estimation Results

GMM estimation is an appropriate technique for a small number of years (T) and a large number of N panel datasets. This paper used only five years and 50 countries to analyze international migration. Therefore the appropriate estimation technique is found to be system GMM (Arellano –Bover/ Blundell-Bond model). This estimator is developed for linear functional relationships, and when the left hand side variable is dynamic. The system GMM estimator developed by Arellano–Bover (19950/ Blundell-Bond (1998) is an augmented estimator that takes into account distinguishing predetermined, endogenous and strictly exogenous variables. Estimation based on this technique uses more moment conditions. System GMM is an efficient and robust estimator to reduce heteroscedasticity and autocorrelation problems (Roodman, 2009). The result obtained from SYS-GMM estimation is almost similar with the results obtained from Pooled OLS estimation.

Based on the coefficients of explanatory variables obtained from SYS-GMM estimation, we found that the lag of the dependent variable is found to be significant at 1% level of significance. The impact of lag of the dependent variable initiated us to use dynamic panel data model. The result indicates that the previous stock of migrants positively influences the current migrant's decision. This is because the previous migrants will support current migrants to minimize costs associated with migration. The main gravity variables such as distance and GDP ratio were found to be significantly and negatively associated migration stock variable. Distance turned out to be significant at 1% level, and GDP was found to be significant at 10% level. The negative coefficient showed that migration decrease with an increase in distance between origin and destination as well as with an increase in GDP ratio. High GDP ratio indicates two scenarios. First, it may be the case that an increment in GDP of origin is higher than an increment in GDP of destination countries. Second, a decrease in GDP of the origin country is lower than a decrease in GDP of destination countries. One way or the other, GDP ratio increases if the GDP of origin country (Ethiopia) is higher than GDP of destination countries. This applies to all ratio variables. Slow-onset hazards index ratio, and political risk index ratio were found to bear a positive coefficient indicating that an increase in these political risk index ratio and slow-onset hazards index ratio augment migration stock. These two variables are significant at 1% level of significance and the result was as expected. As a result, Ethiopians tend to migrate when the level of political risk and slow-onset hazard is higher in the origin country (Ethiopia). Amenity

index ratio had a negative sign showing an inverse relationship between the level of migration and amenity index ratio. The sign of the coefficient bears the expected result. Previously Daniela Bunea (2012) showed that amenity index is a pull factor in that high amenity index attract migrants, and peoples living in country where an amenity index is high are not likely to migrate to the other countries. Although its coefficient was not significant under Pooled OLS estimation, air pollution exposure ratio is significant and positive as expected. This indicates that an increase in migration is associated with a rise in air pollution in the origin country (Ethiopia). Both Sargan test and Hansen test of over-identified restrictions are within a recommended range, and the null hypothesis was accepted. According to Roodman (2009), a probability value of higher than 10% is better to accept the results of the model. However, Roodman (2009) noted that higher values such as 25% are potential signs of trouble. Besides, Arellano bond test for AR (2) is also in the recommended range in that the null hypothesis of no second order autocorrelation was accepted. Therefore, we accepted the result of the analysis. None of our explanatory variables turned out to show unexpected result, and the theoretical as well as empirical expectation went in line with this analysis. The result table of System GMM estimation is presented by table 8 above together with the estimation results of Pooled OLS

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This paper examined the impact of environmental variables on both internal and international migration. For the sake of dealing with appropriate variables and data methodology, we employed different estimation techniques. Coefficients of internal migration were estimated by taking a sample of 8 regions in Ethiopia and 12 quarters from 2018 to 2021. Based on the analysis, we found that three out of four environmental variables were found to have a significant effect on internal migration. In addition to internal migration, international migration is another phenomenon where thousands of Ethiopians used to migrate across boundaries. In order to estimate coefficients of explanatory variables that are expected to have a significant effect on international migrants, we used Pooled OLS and one step system generalized method of momentum estimation technique using a total number of 250 observations from 50 different countries from 2000 to 2020 with five years gap. In line with the main objective of the study, environmental variables such as rapid-onset hazards, slow-onset hazards, and amenity index were found to influence international migration. In a country where there is bad bureaucratic quality, ethnic tension, religious tensions, corruption, and internal conflict, there is a low preference for the inhabitants, and peoples tend to migrate to better places where there is a relatively low level of political risk. In addition, a high slow-onset hazards lead to a higher number of out migrants in that these hazards have an adverse effect on the livelihood of peoples. On the other hand, high level of amenity index is associated with a decrease in the number of out migrants, and peoples in Ethiopia found it comfortable to stay in their country as long as amenities such as energy usage, technology, fuel usage, and clean drinking water are improved, and when the disposal of wastes is minimal. Apart from this, the GDP ratio variable turned out to negatively affect the number of Ethiopian migrants, and enhancing the income level of inhabitants is likely to let peoples prefer their home country.

5.2. Recommendation

Assuming that migration is a concern of a government, there is a need for some policy alternatives regarding Ethiopian migrants. The government of Ethiopia had better focus on environmental infrastructures such as access to an electricity, access to fossil fuels and technologies, access to clean drinking water and access to energy(renewable and nonrenewable) in that environmental amenities that were found to be inversely related with migration. In these circumstances, propel will decide not to migrate. Other policies such as drought and flood protection in particular and natural hazards in general are of a higher significance to reduce the number of out migrants. In addition, reducing internal political risk plays a significant role in reducing the number of internal and international migrants. Accordingly, improving bureaucratic qualities, government transparency and accountability, democratic reformation, and managing corruption can decrease the number of out-migrants.

As an alternative, policies regarding an improvement in gross domestic product of a country are necessary. Taking this into account, there is a need for further studies by including additional environmental variables to assess both internal and international migration. If the policy goal of any nation is to reduce the number of out-migrants, managing the severity of natural hazards is crucial. Policies with regards to climate change and environmental hazards should be put in to action. Besides, government infrastructure like dams, roads and bridges will help us to reduce the effect of floods that are a part of natural hazards. On the other hand doing away with migrants require a potential effort of securing internal peace and managing conflicts that are critical factors for the high number of internal migrants. This paper relied on the specified sample size that was preferred because of convenience (availability of data) and put these results with most variables coefficients yielding the expected result. Above all, environmental institutions in Ethiopia should collect more data on various environmental variables using relatively the same methodology and indicators. Surprisingly, there is a limitation of a data that relies on almost the same indicators, and the collection of environment and internal migration data is crucial. Moreover, further studies are necessary due to the fact the significance of variables varies across countries and over time. What has most likely common was the severity of environmentally induced migration in least developed countries. As a result, concerned bodies such as policy institutes, government, non-government organizations, and societies should cooperate to minimize environmental problems and their impacts.

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Appendix

Appendix 1: list of countries considered for the study

Argentina	Cyprus	Hungary	Nicaragua	Sudan
Australia	Czechia	Ireland	Norway	Sweden
Austria	Denmark	Israel	Poland	Switzerland
Bahrain	Egypt	Italy	Portugal	Turkey
Belarus	Finland	Jordan	Qatar	Uganda
Belgium	France	Kenya	Russia	UAE
Bolivia	Germany	Kuwait	Saudi Arabia	UK
Brazil	Ghana	Namibia	Slovakia	USA
Bulgaria	Greece	Spain	Yemen	Costa Rica
South Africa	Venezuela			
New Zealand	Canada			
Netherlands				

Appendix 2: Chow Test Result to check country effect

. testparm c_id1-c_id50

(1) c_id1 = 0

(2) c_id2 = 0

(3) c_id3 = 0

(4) c_id4 = 0

(5) c_id5 = 0

(6) c_id6 = 0

(7) c_id7 = 0

(8) c_id8 = 0

(9) c_id9 = 0

(10) c_id10 = 0

(11) c_id12 = 0

(12) c_id13 = 0

(13) c_id14 = 0

(14) c_id15 = 0

(15) c_id16 = 0

(16) c_id17 = 0

(17) c_id18 = 0

(18) c_id19 = 0

(19) c_id20 = 0

(20) c_id21 = 0

(21) c_id22 = 0

(22) c_id23 = 0

(23) c_id24 = 0

(24) c_id25 = 0

(25) c_id26 = 0

(26) c_id27 = 0

(27) c_id28 = 0

(28) c_id29 = 0

(29) c_id30 = 0

(30) c_id31 = 0

(31) c_id32 = 0

(32) c_id33 = 0

(33) c_id34 = 0

(34) c_id35 = 0

(35) c_id36 = 0

(36) c_id37 = 0

(37) c_id38 = 0

(38) c_id39 = 0

(39) c_id40 = 0

(40) c_id42 = 0

(41) c_id43 = 0

(42) c_id44 = 0

(43) c_id45 = 0

(44) c_id46 = 0

(45) c_id47 = 0

(46) c_id48 = 0

(47) c_id49 = 0

(48) c_id50 = 0

F (48, 191) = 6.36

Prob > F = 0.0000

Appendix 3: Test for the significance of year fixed effects

```
. reg lnmig_stock lnd lngdp_rat lnrai_rat lnami_rat lnpop_rat lnape_rat lnroh_ra
> t lnsoh_rat lnpri_rat lnump_rat yr_1 yr_2 yr_3 yr_4 yr_5
note: yr_1 omitted because of collinearity
```

Source	SS	df	MS	Number of obs	=	250
				F(14, 235)	=	1477.79
Model	2041.99318	14	145.856656	Prob > F	=	0.0000
Residual	23.1942872	235	.098699094	R-squared	=	0.9888
				Adj R-squared	=	0.9881
Total	2065.18747	249	8.29392558	Root MSE	=	.31416

lnmig_stock	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnd	-.1526889	.033943	-4.50	0.000	-.2195604	-.0858175
lngdp_rat	-.1112999	.0237509	-4.69	0.000	-.1580918	-.0645079
lnrai_rat	-.0437798	.0513201	-0.85	0.394	-.1448861	.0573265
lnami_rat	-.7183023	.1258418	-5.71	0.000	-.9662246	-.4703801
lnpop_rat	-.0116123	.016226	-0.72	0.475	-.0435793	.0203548
lnape_rat	.0238926	.0302587	0.79	0.431	-.0357203	.0835056
lnroh_rat	.1685711	.0547709	3.08	0.002	.0606665	.2764758
lnsoh_rat	2.380373	.0799009	29.79	0.000	2.22296	2.537786
lnpri_rat	2.985547	.1722954	17.33	0.000	2.646106	3.324988
lnump_rat	-.0031235	.0278258	-0.11	0.911	-.0579434	.0516964
yr_1	0	(omitted)				
yr_2	-.0917373	.063347	-1.45	0.149	-.216538	.0330633
yr_3	.0243432	.0656279	0.37	0.711	-.1049511	.1536374
yr_4	.0125388	.0666411	0.19	0.851	-.1187515	.1438291
yr_5	.0063978	.0679997	0.09	0.925	-.1275691	.1403647
_cons	8.492649	.3049497	27.85	0.000	7.891864	9.093434

```
. testparm yr_1 yr_2 yr_3 yr_4 yr_5

 ( 1)  yr_2 = 0
 ( 2)  yr_3 = 0
 ( 3)  yr_4 = 0
 ( 4)  yr_5 = 0

       F(  4,   235) =    1.04
            Prob > F =    0.3850
```

Appendix 4: Hausman specification test for internal migration

```
. hausman fe re
```

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnsohi	.3060986	.3262879	-.0201893	.0193583
lnrohi	.2601191	.2844344	-.0243153	.0219826
lnconfi	1.124154	1.163631	-.0394766	.0689146
lntai	.0244379	.0255044	-.0010665	.0146765
lnspi	-.3957844	-.4270639	.0312795	.0203692
lninfri	-.01948	-.0221624	.0026824	.0129981

```
                b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        3.83
                Prob>chi2 =      0.6996
```

Appendix5: Hausman specification test for international migration variables

```
. hausman fe re
```

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdp_rat	.1085007	-.1086437	.2171444	.0406533
lnrai_rat	.0421651	.0195799	.0225851	.
lnami_rat	-.2052881	-.4051367	.1998486	.
lnpop_rat	-.0012642	-.0137943	.0125301	.
lnape_rat	.0499678	.0524833	-.0025154	.
lnroh_rat	.2001792	.2255403	-.0253612	.0139661
lnsoh_rat	1.79119	2.337949	-.5467592	.0823339
lnpri_rat	2.801253	3.127927	-.3266735	.1121812
lnump_rat	.008258	.0104827	-.0022246	.

```
                b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       17.77
                Prob>chi2 =      0.0380
                (V_b-V_B is not positive definite)
```

Appendix 6: First order serial correlation test for internal migration.

```
. xtserial lnintmig lnsohi lnroh lnconf lnspi lntai lninfr

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       7) =      0.053
           Prob > F =      0.8237
```