UNIVERSITI PUTRA MALAYSIA

FACTORS AFFECTING MITIGATION OF NATURAL DISASTER FATALITIES IN SELECTED COUNTRIES

JAHARUDIN BIN PADLI

FEP 2012 22

FACTORS AFFECTING MITIGATION OF NATURAL DISASTER FATALITIES IN SELECTED COUNTRIES

JAHARUDIN BIN PADLI

DOCTOR OF PHILOSOPHY

UNIVERSITI PUTRA MALAYSIA

2012

FACTORS AFFECTING MITIGATION OF NATURAL DISASTER FATALITIES IN SELECTED COUNTRIES

by

JAHARUDIN BIN PADLI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

September 2012

DEDICATION

This work is dedicated,

To the memories of my father, Hj. Padli bin Damad, my late mother, Hjh Jamiah binti Idi and late grandmother Hjh Achil binti Badan for their love, wisdom and sacrifices,

To my beloved wife Haslina binti Musa, my lovely children, Muhammad Luqmanul Hakim, Hannah Bashirah, Rayyana Jasmine and Yusuf Rayyan. "**Thanks for your loving care and endless encouragement"**.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

FACTORS AFFECTING MITIGATION OF NATURAL DISASTER FATALITIES IN SELECTED COUNTRIES

By

JAHARUDIN PADLI

November 2011

Chairman: **Professor Muzafar Shah Habibullah, PhD**
Faculty: **Economics and Management**

The main objective of this study is to investigate the relationship between fatalities due to natural disaster and its determinant, specifically the linkages between macroeconomic variables, institutional factor and fatalities due to natural disaster. The study is conducted in order to have a better understanding of how to mitigate the fatalities. The study covers 79 countries with data spanning for the period 1980 to 2005. To achieve the goal, we employed Generalized Method of Moment (GMM) estimation developed for dynamic models in panel data, popularized by Arellano and Bond (1991) and Blundell and Bond (1998). As for the dependent variable, we used total killed/death, total affected per capita and total economic damages as a proxy for the impact of natural disaster. To test for the independent variables, ranging from macroeconomic and institutional factors, we used per capita income, square of per capita income (measure of non-linear relationship), total population, population density, investment, government consumption,

education, openness and corruption as the explanatory variables. The findings suggest that the levels of economic development are inversely related, which means that an increase in economic development will reduce the consequences or impact of natural disaster, in other words mitigates the fatalities. Another important finding is that there is a non-linear relationship between the stage of economic development and the fatalities due to natural disaster. Countries which have more risk exposure have an inverse U-shaped relationship between total killed, total economic loses and wealth and there is also a U-shaped relationship between disaster death, loses and wealth for countries which is more disaster-prone. The results also support the notion of that the positive urbanization coefficient and its negative interaction with GDP per capita indicating that low income highly urbanized countries will increase disaster fatalities than similarly urbanized high income countries. As for the population, we obtained positive relationship; both total economic losses and total affected are positively related with population, an increase in population would literally mean the dragnet would become greater. In contrast, the relationship between population densities indicates that it is positively and significantly related with fatalities due to natural disaster. The results for unemployment is also mixed, while we found that unemployment rate is significantly and inversely related with total economic losses due to natural disasters. In contrary, we also found that unemployment rate has positive relationship with total death and total affected due to natural disaster. As for investment, we found that the investment is positively related with fatalities (all three, total affected, total death and total economic loss) due to natural disaster. As for the government consumption, our finding suggest that it has a positive impact on natural disaster fatalities (total death and total economic loss), which means that if there is an increase in government consumption, it will

increase consequences of human fatalities and total economic losses due to natural hazard. Meanwhile, the behavior of openness shows both positive and negative relationship with fatalities due to natural disaster, while it has an inverse relationship with death due to natural disaster; the same could not be said for total affected whereby it has a positive relationship. Our results suggest that there is negative relationship between total economic loss due to natural disaster and education attainment which strengthened the notion of higher education attainment reducing natural disaster fatalities. Finally, the result for corruption indicates that it is positively related with fatalities due to natural disaster (total affected, total death and total economic loss), which suggest that higher level of corruption will increase the consequences of natural disaster fatalities. The study shows that while it is almost impossible to predict the happenings or occurrence of natural disaster, it is possible to mitigate the fatalities if we could formulate proper policies to impact the macro variables as well as the institutional factors.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

FAKTOR MEMPENGARUHI MITIGASI KEMUSNAHAN BENCANA ALAM SEMULAJADI BAGI NEGARA TERPILIH

Oleh

JAHARUDIN PADLI

November 2011

Pengerusi: **Profesor Muzafar Shah Habibullah, PhD**
Fakulti: **Ekonomi dan Pengurusan**

Objektif utama kajian ini adalah untuk menyiasat hubungan di antara kemusnahan akibat bencana alam semulajadi dan penentunya, khasnya hubungan antara pembolehubah makroekonomi, faktor institusi dan kemusnahan akibat bencana alam semulajadi. Kajian ini telah dijalankan untuk lebih memahami lebih mendalam bagaimana kemusnahan mahupun kematian dapat dikurangkan. Kajian ini juga mencakupi 79 buah negara merangkumi data dari tahun 1980 hingga 2005. Bagi mencapai matlamat kajian, kami menggunakan penganggar Generalized Method of Moment (GMM) khusus untuk model dinamik, yang telah perkenalkan oleh Arellano dan Bond (1991) dan Blundell dan bond (1998). Untuk pembolehubah bersandar, kami menggunakan jumlah kematian, jumlah mangsa yang terjejas per kapita, dan jumlah kemusnahan ekonomi sebagai proksi kepada kesan bencana alam semulajadi. Untuk menguji pembolehubah merdeka, meliputi faktor-faktor makroekonomi dan institusi, kami menggunakan tingkat pembangunan ekonomi, pendapatan per kapita kuasa dua (mengukur hubungan bukan

linear), jumlah populasi, kepadatan penduduk, pelaburan, perbelanjaan kerajaaan, pendidikan, keterbukaan ekonomi dan rasuah sebagai pembolehubah tidak bersandar. Hasil penemuan kajian ini mencadangkan tingkat pembangunan ekonomi berhubung secara songsang, dimana ia membawa maksud peningkatan dalam pembangunan ekonomi akan mengurangkan kesan kemusnahan akibat bencana alam semulajadi. Satu lagi penemuan kajian yang penting ialah, terdapatnya hubungan tidak linear diantara tingkat pembangunan ekonomi dan kemusnahan akibat bencana alam semulajadi. Negara yang terdedah dan juga berisiko tinggi mempunyai hubungan U songsang diantara jumlah kematian, jumlah kerugian ekonomi dan kekayaan dan terdapat juga hubungan U diantara kematian akibat bencana alam semulajadi, kerugian dan kekayaan bagi Negara yang sering dilanda bencana. Keputusan tersebut juga menyokong dan beranggapan bahawa pekali positif perbandaran dan interaksi negative dengan KDNK per kapita menunjukkan bahawa Negara-negara yang mempunyai sesebuah bandar yang amat membangun serta mempunyai pendapatan yang rendah akan menghadapi risiko peningkatan kemusnahan dan kematian berbanding dengan Negara yang menpunyai Bandar yang amat pesat membangun dan berpendapatan tinggi. Untuk kesan populasi, kami memperolehi hubungan positif; kedua-dua jumlah kerugian ekonomi dan jumlah mangsa terlibat mempunyai hubungan positif dengan populasi, peningkatan populasi secara langsung bermaksud dasar menjadi besar. Sebaliknya, hubungan diantara kepadatan penduduk menggambarkan bahawa ianya berhubungan positif dan bererti dengan kemusnahan akibat bencana alam semulajadi. Hasil penemuanan kajian untuk kadar pengganguran pula bercampur aduk, kami mendapati kadar pengangguran bererti dan mempunyai hubungan songsang dengan jumlah kerugian ekonomi akibat bencana alam semulajadi, sebaliknya mempunyai hubungan positif dengan jumlah kematian dan

jumlah terlibat akibat bencana alam semula jadi. sebaliknya kami juga mendapati kadar pengganguran mempunyai hubungan positif dengan jumlah kematian dan jumlah mangsa terjejas yang diakibatkan oleh bencana alam semulajadi. Untuk pelaburan, kami dapati ianya berhubungan positif dengan kemusnahan (kesemuanya, jumlah terlibat, jumlah kematian serta jumlah kerugian ekonomi) akibat bencana alam semulajadi. Bagi perbelanjaan kerajaan pula, hasil penemuan mencadangkan bahawa, ianya mempunyai kesan positif terhadap kemusnahan akibat bencana alam semula jadi (jumlah kematian dan jumlah kerugian ekonomi) membawa maksud jika terdapat peningkatan didalam perbelanjaan kerajaan ia akan mengakibatkan peningkatkan kematian manusia dan juga sejumlah kerugian ekonomi akibat bahaya bencana alam. Sementara itu, gelagat keterbukaan menunjukkan hubungan positif dan negatif dengan kemusnahan akibat bencana alam, namun hubungan songsang dengan kematian yang disebabkan oleh bencana alam; tidak boleh dinyatakan sama kerana jumlah yang terjejas mempunyai hubungan positif. Hasil Dapatan kami juga mencadangkan bahawa terdapat hubungan negatif diantara jumlah kerugian ekonomi akibat bencana alam, dimana ia menguatkan lagi anggapan pencapaian pendidikan yang tinggi boleh mengurangkan kemusnahan bencana alam. Dan yang terakhir, keputusan rasuah menunjukkan terdapat hubungan positif dengan kemusnahan akibat bencana alam (jumlah terlibat, jumlah kematian dan jumlah kerugian ekonomi), dimana ianya mencadangkan lebih banyak rasuah akan meningkatkan musibah kemusnahan akibat dari bencana alam. Kajian ini menunjukkan walaupun hampir mustahil untuk meramal bencana alam, adalah mungkin untuk mengurangkan kemusnahan akibat darinya jika kita dapat memformulasi polisi baik untuk mengawal pembolehubah makro serta institusi.

ACKNOWLEDGEMENTS

Firt and foremost, I would like to take this opportunity to convey my highest appreciation to my supervisor Prof. Dr. Muzafar Shah Habibullah for his time, patience, valuable suggestions and tremendous support throughout the period of the study. His consistent guidance and advice had allowed me to successfully complete this thesis. I would also like to thank Dr. Zaleha Mohd Noor and Dr. Lee Chin as members of my supervisory committee for their suggestions, views and comments at various stages of the study.

I am very grateful to my wife, Haslina Musa for her patience, especially for tolerating the vacuum I created during the period of this study. I thank her and my son and daughter for enabling me to accomplish my life long dream.

Special thanks also go to all my friends, especially Prof. Dr. Mansor Hj. Ibrahim (UPM), Associate Prof. Dr. Alias Radam (UPM), Baharom Abdul Hamid (Taylors University), Dr. Hussin Abdullah (UUM), and Hirnissa Mohd Tahir (UPM student), who had always encouraged me to endure this difficult task, given me their warmest helps along my path to graduation, and accompanying me during my most difficult time and happiest hours in the campus. My sincere appreciation also goes to the Library Unit, University Malaya (UM), particularly Mrs. Rafiati Safie (Librarian Assistant) for providing me with the required reading material.

I certify that an Examination Committee has met on ……..to conduct the final Examination of Jaharudin Padli on his Doctor of Philosophy thesis entitled "Natural Disaster Fatalities and Macroeconomic Variables" in accordance with Universities and College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Examination Committee are as follows:

Alias Radam, PhD
Associate Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Chairman)

Mohd Shahwahid Hj. Othman, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Internal Examiner)

Khalid Abdul Rahim, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Internal Examiner)

Indah Sosilowati, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(External Examiner)

_____
SEOW HENG FONG, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date :

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Muzafar Shah Habibullah, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Chairman)

Zaleha Mohd Noor, PhD
Senior Lecturer
Faculty of Economics and Management
Universiti Putra Malaysia
(Member)

Lee Chin, PhD
Senior Lecturer
Faculty of Economics and Management
Universiti Putra Malaysia
(Member)

_____
BUJANG BIN KIM HUAT, PhD
Professor/ Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, of is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

JAHARUDIN PADLI

Date: 4th November 2011

TABLE OF CONTENTS **Page**

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

OFDA/CRED	Centre for Research on the Epidemiology of Disasters
ECCU	Eastern Caribbean Currency Union
GDP	Gross Domestic Product
GDPc	Gross Domestic Product per capita
GMM	Generalized Method of Moment
IISD	International Institute for Sustainable Development
LTAFFc	Total Affected Per capita
LTC	Total economic loses
LTD	Total disaster death
ND	Natural Disaster
IMF	International Monetary Funds
NOAA	National Oceanic and Atmospheric Administration
OLS	Ordinary Least Square
ODA	Official development assistance
GMM-SYS	System Generalized Method of Moments
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UN	United Nation
WDI	World Development Indicator

CHAPTER 1

INTRODUCTION

1.0 Introduction

1.1 Overview of the Study

Fatalities of natural disasters have had profound impact upon the human race. The after effects are sometimes gruesome and are indeed feared. Steps to mitigate the losses, be it life lost, economic loss or total affected paints a grim picture. Among the recent natural disasters which had deathly and harrowing effects are such as the earthquake in Haiti on 12th January 2010, whereby an earthquake of the 7.0 occurred. The earthquake killed between 46,000 and 316,000 people. Its epicentre was at approximately 25 km from Port-au-Prince, the capital of Haiti. A dozen secondary shocks of magnitudes ranging from 5.0 to 5.9 were registered during the hours which followed. This was followed by a second earthquake of magnitude 6.1 on 20 January 2010. Its epicentre was at approximately 59 km west of Port-au-Prince, and at least 10 km beneath the surface. Haiti suffered another blow when a cholera epidemic hit outside of Port-au-Prince, killing at least 3,597 and sickening over 340,000 if that is not gruesome, another natural disaster followed on November 5th, when Hurricane Tomas hits and kills at least 10 Hatiens causing damage and worsening the cholera epidemic.

Naturally occurring events, in and of their own right, do not necessarily constitute a disaster. It is their interaction with human activity that gives rise to the potential disaster situation. At this boundary, not every situation is a disaster. The definition of

natural disaster itself is varying from various perspectives. Generally a natural disaster is a situation arises when a naturally occurring event impacts the physical, social, and economic infrastructures in an area beyond its normal absorptive capacity (Bates and Peacock, 1987). From this viewpoint, a disaster event is judged and measured in terms of its degree of severity, and in light of the societal setting and its vulnerability.

Albala-Bertrand (1993) stated that a natural disaster is one induced by a natural event (e.g. earthquake, flood, volcano), whereas a man-made disaster is one resulting from the breakdown of regular processes within the social system (e.g. war, recession, riots, technological failures). The main difference between them is simply the primary force which unleashes them. A man-made disaster is always triggered off endogenously, i.e. as a result of processes embedded in society's structure and dynamics. But the catalyst may be a natural disaster (e.g. Bangladesh's cyclone and civil war in 1970-1971). But the prevailing social vulnerability is by and large an endogenous process (e.g. drought-induced famines).

From the standpoint of healthcare providers, a disaster should be defined on the basis of its consequences of health and health services. A pragmatic definition follows:

> *A disaster is a result of a vast ecological breakdown in relation between humans and environment, a serious and sudden event (or slow, as in a drought) on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid (Gunn, 1990).*

From a public health perspective, disasters are defined by what they do to people; otherwise disasters are simply interesting geological or meteorological phenomena. What might constitute a disaster for one community might not necessarily be considered a disaster in a different community (Noji, 1999). Disasters have been defined in many ways, reflecting the various observers' scientific or professional backgrounds. Most observers mention the same main elements, but tend to emphasize particularly those related to their disciplinary or professional concerns.

A journalist, in usual sensational fashion, would emphasize the elements of human tragedy and destruction involved in disaster; a geographer, the extreme geophysical event and the location of human settlements (White and Hass, 1975; Whittow, 1980); an engineer, the behavior of physical structures, especially housing (Wiegel, 1970); an insurer, elements related to risk-assessments, a medical professional, aspects related to injuries and epidemics (Gleser, Green and Winget, 1981); a relief operator, elements of aid requirements (Krimgold, 1974; Cuny, 1983); a sociologist, aspects of institutional disruption and abnormal behavior (Dynes, 1970; Quarantelli, 1978); an economist, capital loss and supply fluctuations (Douty, 1972; Sorkin, 1984); and so on. These diversities of outlook have been sometimes analyzed, allowing for more comprehensive definitions (Westgate, O'Keefe and Wisner, 1976), but there often remains an important misconception.

The Centre for Research on the Epidemiology of Disasters (CRED), defines a disaster as a "situation or event which overwhelms local capacity, necessitating a request to national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering."

CRED (see Guha-Sapir, 2008b) further divided natural disaster into several specific groups, namely; biological (including epidemic and insect infestation), climatological (including drought, extreme temperature and wildfire), geophysical (including earthquake, mass movement dry, volcano and tsunami), hydrological (including flood and mass movement wet), and meteorological (including wind, and storm). (See Figure 1.1)

1.2 Criteria of a Disaster

According the Centre for Research on the Epidemiology of Disasters (CRED) database (see www.em-dat.be) several classifications must be achieved before to entered disaster into the database, at least one of the following criteria must be fulfilled:

- 10 or more people reported killed;
- 100 or more people reported affected;
- Declaration of a state of emergency; and
- Call for international assistance.

Another measure of economic disaster losses is the monetary damage caused by disaster. However, there are several limitations that warrant discussion. First, this measure of economic damages only includes direct costs and not indirect costs (for example lost future income) of these disasters. Secondly, developing countries have an incentive to exaggerate the scale of damages in order to secure international assistance. Third, obtaining damage estimates in developing countries is challenging because the poor are often without insurance, bookkeeping and formal markets (Tol and Leek, 1999). Nevertheless, the OFDA/CRED data is the best data on economic

damages available, and the analysis should provide an initial indication of the relationship between the level of development and economic damages from disasters.

In numerous studies, the focus has been on the following eight types of natural disasters:

1) Drought is an extended period of time characterized by a deficiency in a region's water supply that is the result of constantly below average precipitation. A drought can lead to losses to agriculture, affect inland navigation and hydropower plant, and cause a lack of drinking water and famine.
2) An earthquake is the result of a sudden release of stored energy in the Earth's crust that creates seismic waves. At the earth's surface they are felt as a shaking or displacement of the ground.
3) Extreme temperature events are heat waves and cold waves.
4) Floods are significant rise of water level in the stream, lake, reservoir or coastal region. Mass movement is divided into two categories (mass movement dry and mass movement wet)
5) Storm is referring to local windstorm and typical cyclone; strong winds caused by regional atmospheric phenomena which are typical for a certain area.
6) Volcanic activity describes activity like rock-fall, ash fall, lava streams, and emissions of gases which can result in pyretic eruptions.
7) Wildfire is described as uncontrolled burning fire, usually in wild lands, which can cause damage to forestry, agriculture, infrastructure and buildings.

8) Landslides is the geological phenomenon which includes a wide range of ground movement (such as rock fall and deep failure of scopes), and avalanche.

1.2.1 The Subsequent Phases of Disasters

Tables 1.1 and 1.2 show the most frequent economic and social effects by type of natural disaster. The post disaster period are classified into several different phases as follows: a) the emergency phase; b) the rehabilitation and recovery phase, also called the transitional phase; and c) the reconstruction phase.

The emergency phase is when it involves actions of rescuing lives. Such activities as search and rescue, first aid, emergency relief, medical assistance, evacuation and building of shelters, temporary restoration of transportations and communications networks, preliminary repairs to critical public utilities, a preliminary census of the victims and take record of the damage to public and private property.

Secondly, is the phase of rehabilitation or transitional. This phase may involve all activities designed to restore the situation in affected areas and communities back into normal. It may include the temporary repair of dwellings, buildings, transportation infrastructures and public utilities. The problem of the emotional and psychological recovery of the inhabitants of regions affected by the disaster must be tackled in this phase. By getting people back to work, creating new jobs, providing credit and financial resources and launching immediate projects to deal with the aftermath of the disaster are some of the most helpful recovery measures for victims and affected communities.

Lastly, is the phase of reconstruction whereby this phase covers all activities which is more on the reordering of the physical environment. The resources are then allocated based on the new social priorities arising from the effects of the disaster. A summarized effect due to natural disasters is presented in Table 1.1 and as for Table 1.2, summarized the immediate impact on social and economic factors. A natural disaster does not only constitute loss of life and economic losses, it also results grief, volatility in property pricing, loss of source of income and many more.

Table 1.1: Effect of Natural Disasters on Land Surface, Structure and Agriculture

Types of Disaster	Effects on land and surface	Effects on Structures	Effects on Agriculture
Earthquakes	Tremors and fissures	Damages buildings, roads, dams and bridges	None
	Landslides	Buries structures; damn rivers, causing localized flooding	Some localized losses in affected areas.
	Liquefaction of soils	Damages building with sink	None
	Underground collapses	May damage buildings, rupture underground conducts and cables; alter course of underground streams.	Temporary losses of irrigation
	Avalanches	Damages buildings, roads, dams and bridges	Localized crop and timber losses
Hurricanes, typhoons (cyclones)	High winds	Damages buildings, power lines, towers	Loss of trees; damage to standing crops, especially grains.
	Flooding (from rain)	Damages building, bridges, cause mud slides and landslides	Damage of standing crops, especially tubers; erosion
	Flooding (storms)	Damages building, roads and bridges	Extensive damage to crops and irrigation systems; leaves salt deposits and contaminates soil and wells; causes erosion
Droughts	Dry Soils	No major damage	Kills crops and trees
	Windstorms	Minor damage	Erosion and minor tree damage
			Covers land with sand; alters cropping patterns; kills trees;

			increases scrub growth
Floods	Erosion Soil saturation and landslides Silting	Undercuts and foundations Buries buildings and damages other structures No major effects	Destroys crops; changes cropping patterns Localized crop and timber losses Improves soil
Tsunamis	Flooding	Destroys or damages buildings, bridges, irrigation systems; contaminates soil and wells	Localized destruction of crops; leaves salt deposits; destroys trees along shoreline
Volcanic Eruptions	Eruption	Destroys or damages buildings and other structures	Extensive defoliation near eruption; deforestation Buries crops and renders land unusable; starts forest fires Destroys crops; makes land temporarily unusable; causes pollution; kills trees Little or no effect

Source: Adapted from Frederick C. Cuny, Disasters and Development, Oxford University Press, New York, 1983

Table 1.2: Most Immediate Social and Economic Consequences of a Natural Disaster

Types of Disaster	Short-term mitigations	Permanent migration	Loss of housing	Loss of industrial trial production	Loss of business production	Loss of crops	Damage to infra-structure	Disruption of marketing systems	Disruption of transport systems	Disruption of communications	Panic	Break-down of social order
Earthquake			X	X	X		X	X	X	X		X
Cyclone			X	X	X	X	X	X		X		X
Flood	X		X	X	X	X	X		X	X		
Tsunami			X	X	X	X	X			X		
Volcanic eruption	X		X			X		X				
Fire	X		X	X	X	X	X			X	X	X
Drought/famine	X	X				X						

Source: Adapted from Frederick C. Cuny, Disasters and Development, Oxford University Press, New York, 1983

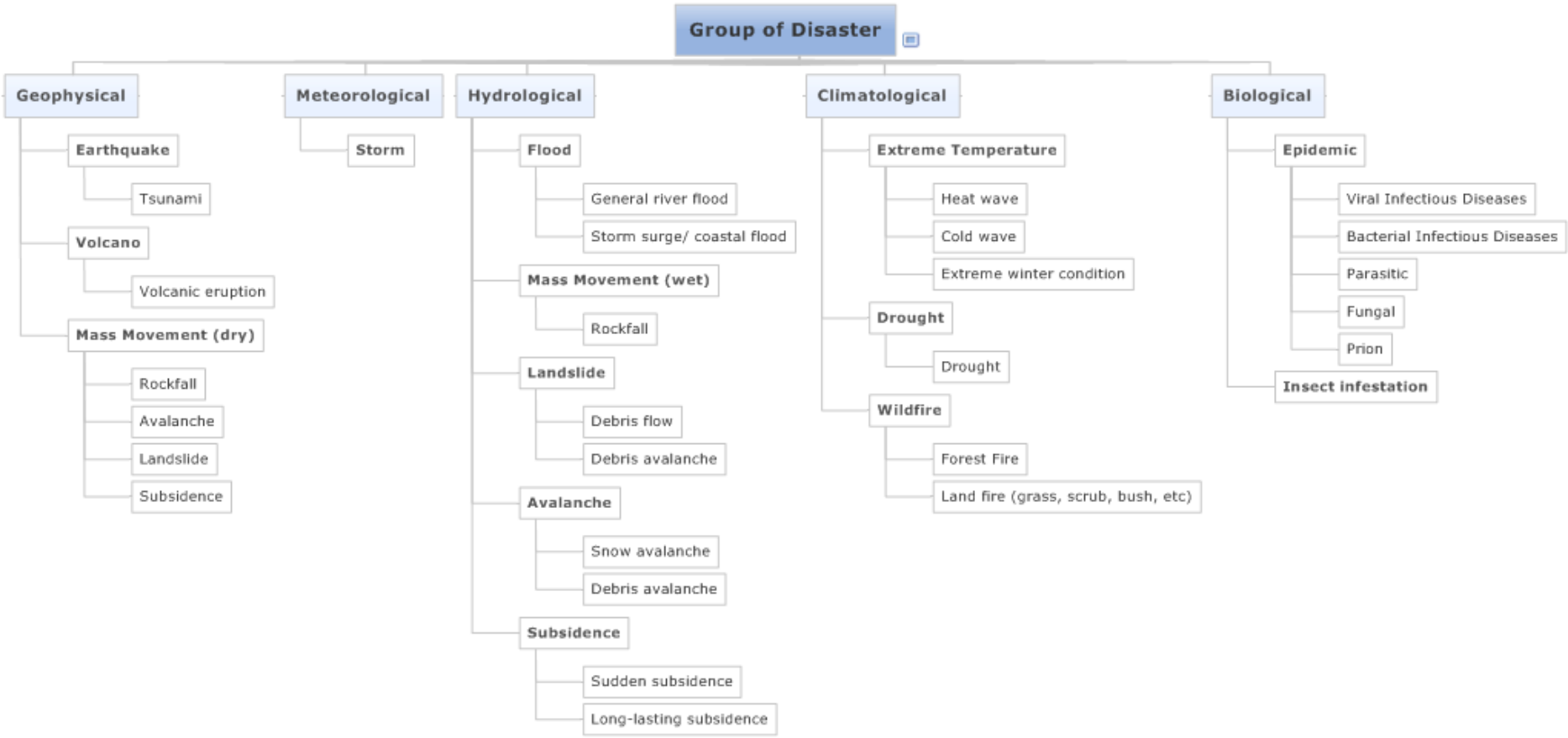


Figure 1.1: Group of Disaster

Sources: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

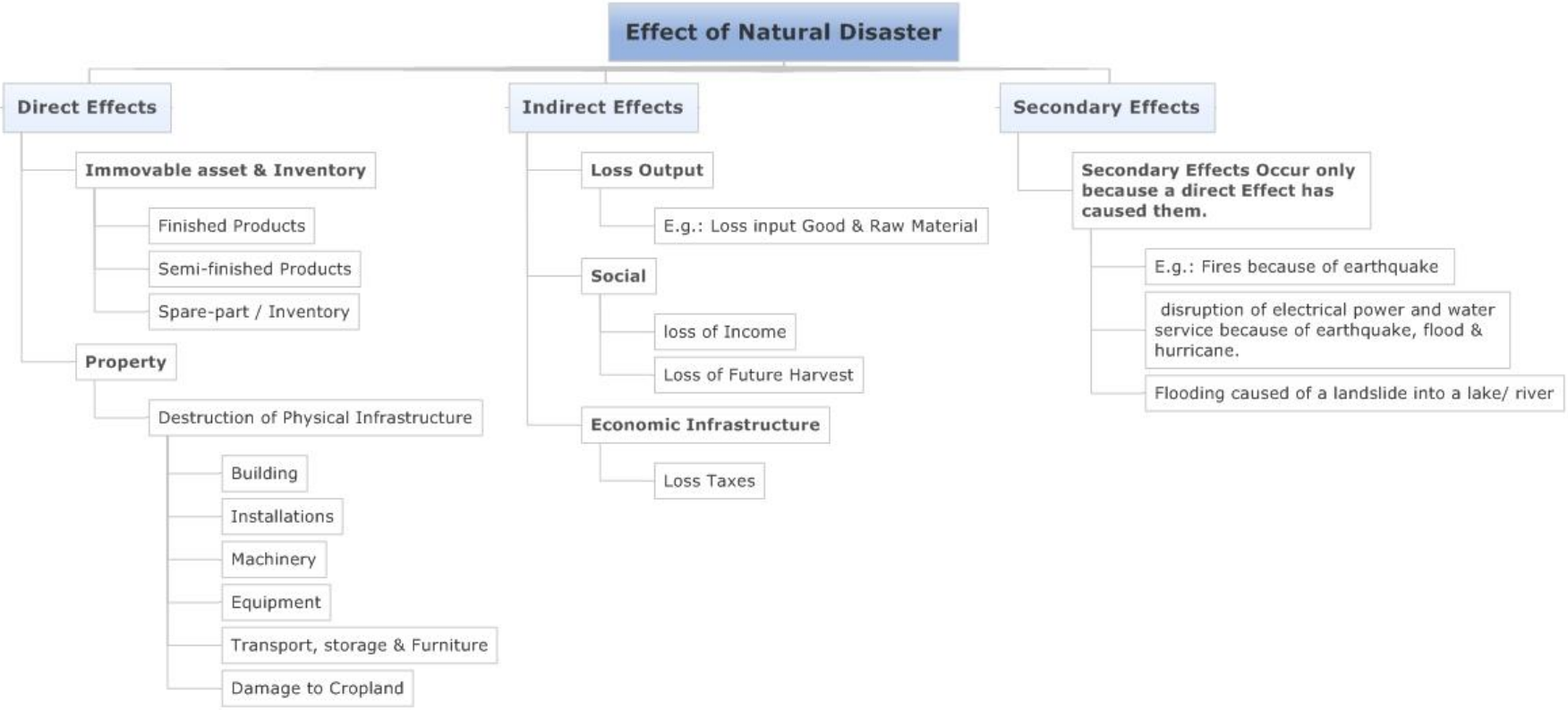


Figure 1.2: The Effect of Natural Disaster

Sources: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

1.2.2 Classification and Definition of Damage and Effects

Natural disasters do not only have readily perceptible effects, such as those caused by earthquakes, storms and floods. There are also consequences that will develop slowly or appear only long after the event, for instance, crop destruction by pests arriving in the wake of the disaster of shortages of essential products arising several months after it.

Figure 1.2 show that the effects of a natural disaster have been classified as follows: direct effects (the effects on property); indirect effects (the effects on goods and services production flows); and lastly the secondary effects (the effect on the behavior of the main macroeconomic aggregates). The first effects is more or less coincide with the disaster or occur within hours of it, while the others occur over a period of time which practical experienced has shown to be as much as five years, depending on the magnitude of the disaster.

The damage caused by direct effect is relatively easier to identify and evaluate as compared to the damage by indirect effect. These indirect effects arise at different intervals after the disaster and are therefore more difficult to identify instantly. Most indirect effects do not show up in a rapid assessment and, if it does by the time the damage is assessed, they always cannot be measured in monetary terms.

Next, the first two categories of direct and indirect effects can also be combined, with the necessary exceptions since one of the effect more concerns on the property and the other concerns on the production flows, to be sure of the overall magnitude of the

damage. Meanwhile, there is also another alternative or a different point of view in measuring the impact, which then called as secondary effects. This effect is measured by the disaster's effects on the functioning of the economy, and the resulting macroeconomic imbalances. However, we cannot combine it with the two other categories without causing redundancy or duplication.

The starting point before we start estimating the damage should be physical units such as number, square meters of built-up land, hectares, tons, etc. This is very important, will make it easier to adopt the valuation criteria most appropriate to each case. Now, we shall describe more precisely the kinds of damage to be included in each of these three categories of effects.

i) Direct Effects

Direct damage is all damage sustained by immovable assets and inventories (of finished and semi- finished products, raw materials, other materials and spare parts). It essentially involves damage to property occurring more or less simultaneously with the disaster itself and comprises, inter alia, total or partial destruction of physical infrastructure, buildings, installations, machinery, equipment, means of transport and storage and furniture, and damage to cropland, irrigation works and dams. In the particular case of agriculture, the destruction of crops ready for harvesting must also be valued and included as direct damage.

ii) Indirect Effects

Indirect damage is basically damage to the flows of goods that cease to be produced or the services that cease to be provided during a period of time beginning almost immediately after the disaster and possibly extending into the rehabilitation and reconstruction phase, which has been set at a maximum of five years although the greatest losses occur in the first two years. It is usually caused by direct damage to production capacity and social and economic infrastructure. Besides, it also includes the costs or increased costs of providing services as a result from the disaster, and losses of income as a result of the impossibility or difficulty of providing such services (which will, in turn, be reflected in the secondary effects. Some examples of indirect damage are losses of industrial output as a result of damage to factories or lack of raw materials; loss of income for service companies because of the interruption of services; losses of future harvests as a result of flooding of farmland; increased transport costs because of the need to use alternative routes or means of transport that are longer or cost more; loss of taxes because of reduced economic activity; etc. These all constitute indirect damage for the sectors concerned and are also computed as secondary effects when an attempt is made to measure the disaster's effects on the principal macroeconomic aggregates.

iii) Secondary Effects

Secondary effects refer as the disaster's impact on the behavior of the main macroeconomic variables. Their measurement is carried out from different point of view, but however carried along with the measurement of direct and indirect damage. However, secondary effects reflect the impact of direct and indirect damage and must not be added together. Although it makes absolute sense to quantify these effects for the

economy as a whole, it is essential that sectoral evaluators provide, on the basis of their specialized knowledge, the information the overall evaluator needs to integrate these effects into the main economic aggregates. This effect is measured by short and long-term impacts of a disaster on the overall economy and socioeconomic condition (e.g. fiscal and monetary performance, level of indebtedness, the distribution of income and scale and incidence of poverty). Secondary Effects occur only because a primary effect has caused them. For example, fires ignited as a result of earthquakes, disruption of electrical power and water service as a result of an earthquake, flood, or hurricane or flooding caused by a landslide into a lake or river.

1.3 The Issue

It has been generally accepted that natural disasters would result in significant economic and human loss for millennia. Media coverage reports have displayed how the inevitable disasters possess human and material costs in many ways. Tragic events such as earthquakes, volcanoes, droughts, floods and tsunamis have exerted a profound impact on humans' life and economic structure of the affected countries. It can clearly be observed that natural disasters would not only killed thousands of people and produce a substantial damage to infrastructure and large number of industries, but also destroyed capital stocks, and disrupt the ordinary flow of productions, consumptions and nation's income. Based on Figure 1.3, we could presume and estimate the total economic losses due to natural disaster from 1980 - 2008. Past literatures reiterate that high income nation that are disaster prone, are more exposed to damages and losses (Tol and Leek, 1999; Khan, 2005; Skidmore and Toya, 2007).

Based on the report we could conclude that the worst impacted nation is the United States of America, which suffered an economic loss of $466 million, followed by Japan ($206 million), Germany, France and United Kingdom, ($29 to $33 million) for the period of 28 years. Figure 1.4 displays the number of life lost due to natural disaster for the same period, this time, and the worst impacted countries are the developing countries. Countries that recorded the highest life casualties are such as Ethiopia (302,000), followed by Indonesia (186,000), Bangladesh (181,000), while Sudan, China and India (123,000 to 150,000). These countries are exposed to natural disasters such as earthquake, flood, drought, plagues and others.

As for Figure 1.5, it depicts the number of people reportedly killed due to major natural disasters, and the mortality trend is for the period of 1980 to 2008.Mixed results could be observed from the two windows, decreasing trend from 1996 to 2002 and increasing trend after that period, This trend raises questions such as whether this is due to a better preparedness, a better response of Government and humanitarian agencies during emergencies or due to better prevention and mitigation measures put in place by the Government or other national and international agencies; or due to better reporting on occurrence of disasters .

Figure 1.6 clearly shows that developing regions such Asia (1.103 million), and Africa (582,000) monopolizing top two spots, the other spots are occupied by America (140,000), Europe (121,000) and Oceania (4,000). The causes of mortalities could be segregated as below:

- Geophysical – 554,000 (Asia)

- Meteorological – 381,000 (Asia)
- Climatological – 533,000 (Africa)

The graph also shows that the fatalities are not limited to life casualties but also economic losses running into billions of dollars due to these mega-disasters, for example for the year 2011 alone, Asian countries experiencing earthquake and tsunami incurred a economic loss of $200 million on top of 20,000 life casualties. Thailand is also not exempted from natural disasters, as it experiences a severe flood as recent as August 2011, which causes 813 deaths, and economic loss of $40 million.

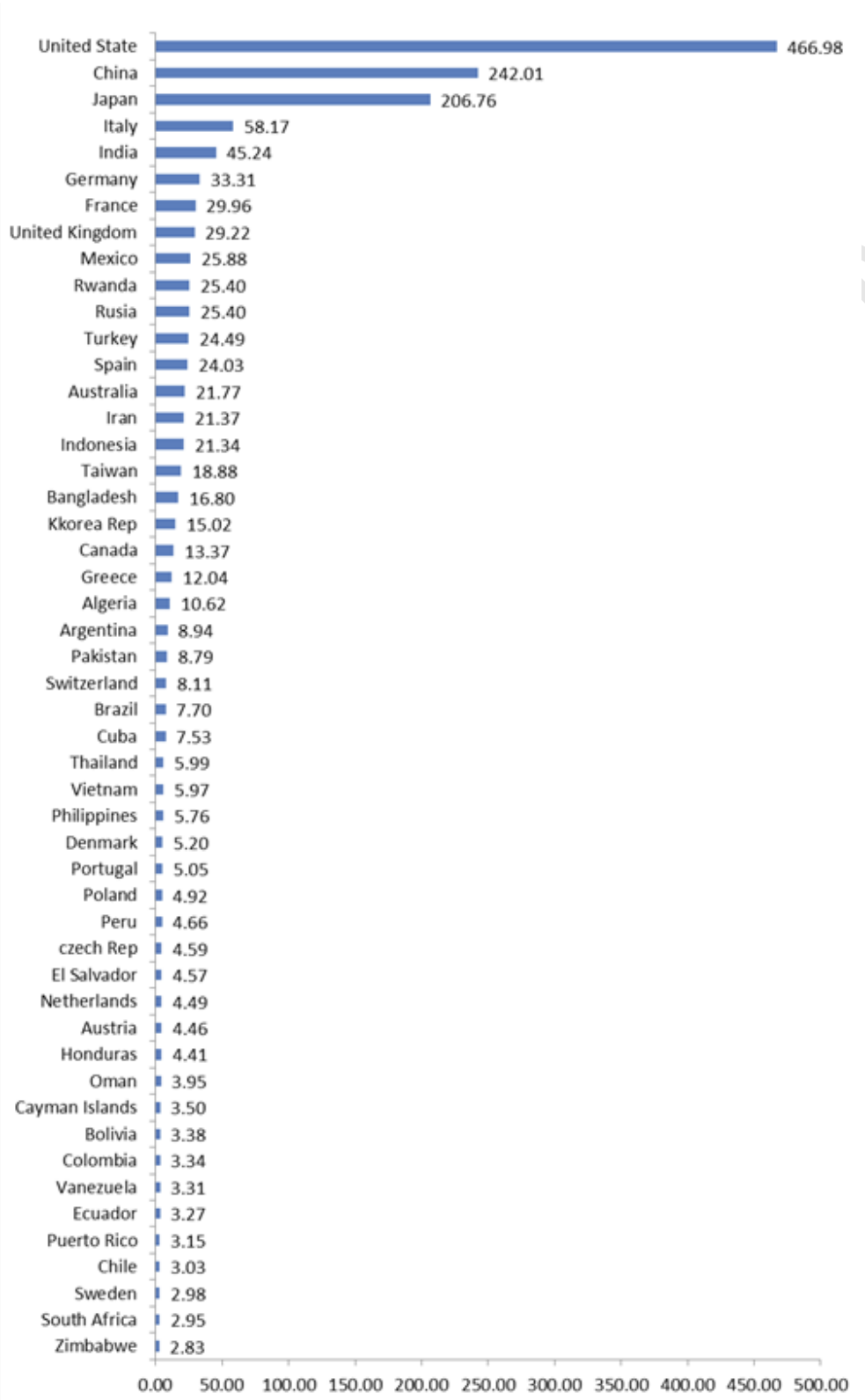


Figure 1.3: Total Amount of Reported Economic Damages: All Natural Disasters 1980-2008 (in US$ Million)

Sources: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

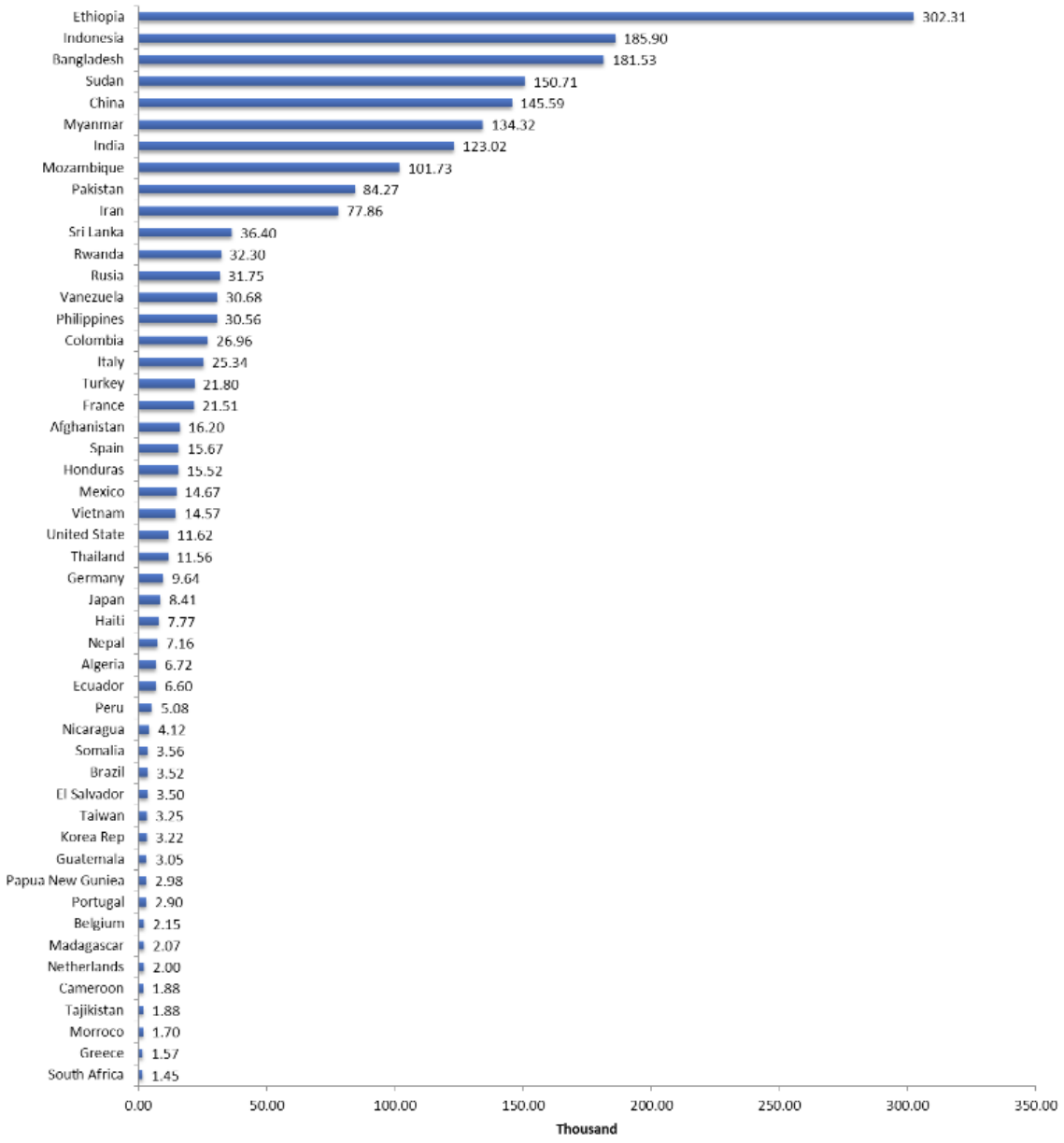


Figure 1.4: Total Amount of Reported Death: All Natural Disasters 1980-2008 (in Thousand)

Sources: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

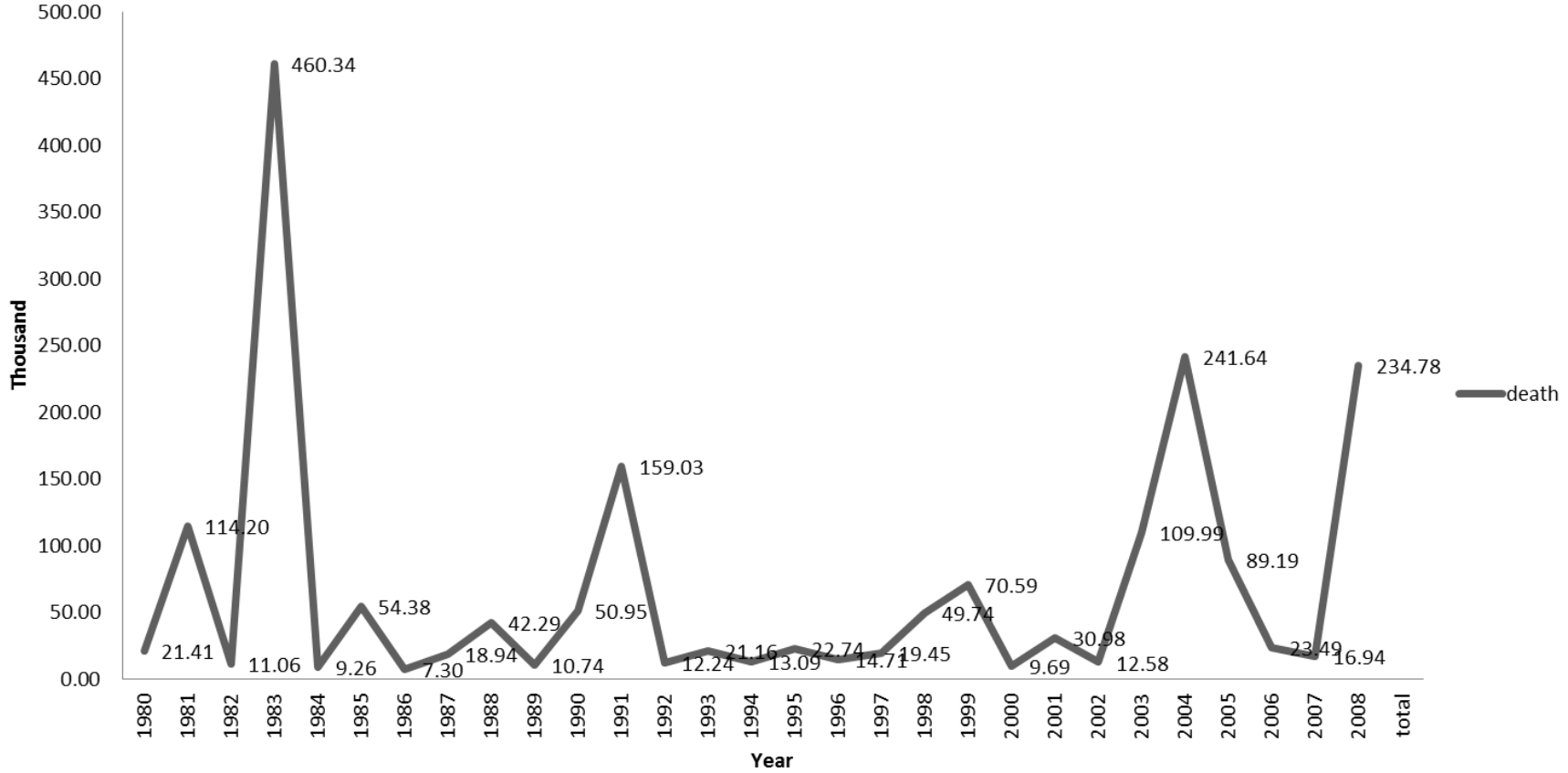
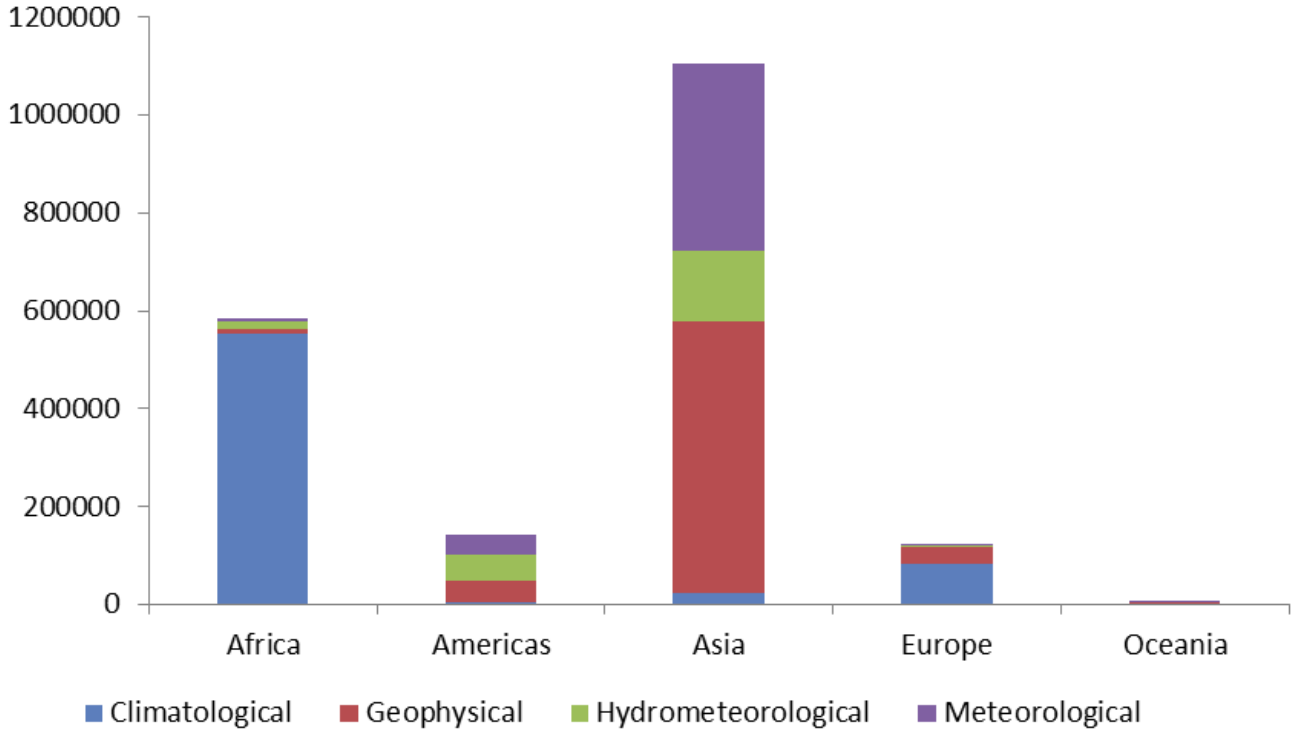


Figure 1.5: Number of People Reported Killed By Natural Disasters 1980-2008 (in Thousand)
Sources: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium



	Africa	Americas	Asia	Europe	Oceania
Climatological	553,584	5,234	22,995	82,574	202
Geophysical	9,347	43,308	554,815	33,052	2,531
Hydrometeorological	16,598	53,812	143,957	3,846	609
Meteorological	3,434	38,428	381,956	2,174	839
Total	582,963	140,782	1,103,723	121,646	4,181

Figure 1.6: Number of People Reported Killed, Per Million Inhabitants By Continent and Disaster Origin: 1980-2008

Evidences revealed in empirical literature suggested that natural disasters produce a devastating impact on macroeconomic conditions in short run, resulted in sudden collapsed in domestic production and more pronounced slowdown in national income. Worse, in line with the collateral damaged they caused, such irreversible loss of human capital, affect not merely on the standard of living, but also increased the poverty level, resulted in more chronic economic decay. In line with the increasing frequency of natural disasters in recent years, the social, economic and physical impact has heightened the public awareness and brought the issue to the forefront of public attention worldwide.

"Statistical Yearbook for Asia and the Pacific 2007" stated that natural disasters have produced a profound impact on the quality of life through their destruction of food crops and livestock, and forced dislocation of households and communities. Their toll on lives and the instant poverty caused are among their most devastating effects (UNESCAP, 2007. p. 175). The economic impact of a disaster usually, among others, consists of damaged to infrastructure, crops, housing, loss of revenue, unemployment, market destabilization on the local economy. The Canadian Red Cross (World Disasters Report, 2007) has reported that in the year 2007 alone, the total number of natural disasters has reached to a staggering 546, which more than half were weather-related (see also Schlein, 2008). Schlein (2008) reports that the climate-related disasters, floods and windstorms are the two disasters which have killed more people in 2007 than they have overall in the last five-year average.

However, despite its negative impact that have always been highlighted and discussed extensively in the media and previous research, natural disasters might also turn out to promote a positive outcome during the recovery process, depending upon a country's institution, pre-existing economic situation, precautionary measures and prudential action. Reconstruction and redevelopment framework may generate a remarkable substantial improvement in a short period of time, suggesting that natural disasters are desirable means of economic revitalization. The type of natural disasters also play a vital role, droughts and geologic disasters have always been presumed to exacerbate a more severe effect than climate disasters.

1.4 Problem Statement

Huge coverage has been given and extensive researches have been done on the issue of natural disasters and the impact on quality of living and economic condition. It cannot be denied that natural disasters almost cannot be prevented or predicted, but the impact of natural disasters fatalities can be minimized or mitigated. Based on past literatures, we presume there are linkages between variables such as income, education level, unemployment, population and other important socio, macroeconomic variables and institutional factor with the fatalities such as death, economic loses and total affected due to natural disasters. Natural disasters exert a profound impact on standards of living overall economy of the affected countries. Newspaper and a plethora of research has reported how disasters exerted substantial damage to infrastructure and affect the economic structure in many ways. Tragic events such as earthquakes, volcanoes, droughts, floods and tsunamis were not only killed thousands of people, million dollars

worth of damage, destroyed capital stock, but also disrupted the ordinary flow of productions, consumptions and nation's income.

However, natural disaster is something beyond human prediction and control. The government and individuals have to assess their risk and prepare to mitigate the impact of natural disasters, precautionary measures and prudential action. As argument past literature, most of researchers are believed there are linkages between variables such as income, education level, inflation, population and other important socio and macro-economic variables with the fatalities such as death, damages and total affected due to natural disasters and they also sincerely believed that the impact of natural disasters fatalities can be minimized (Khan, 2005; Skidmore and Toya, 2007; Raschky, 2009; and etc). Institutional factors such as corruption also play an important role in determining fatalities due to natural disasters, for example corrupted government will approve sub-standard buildings which are vulnerable in case of natural disaster and number of death and lives lost will be tremendously high compared to non-corrupted government. Thus, it is in practice to answer the questions whether the economics and institutional factor play an important role to mitigate fatalities due to natural disasters. We need to have clarities in understanding the relationship between the economic variables as well as the institutional variables, in order to tackle the problems faced by us in facing natural disasters. Though we might not be able to prevent it happening, but we could mitigate the losses.

1.5 Objectives of the Study

General Objectives:

The general objective of this study is to examine the linkages and meaningful relationship between macroeconomic variables and the fatalities due to natural disasters.

The specific objectives are:

i. To determine the macroeconomic and institutional factors associated with various fatalities due to natural disaster.

ii. To explore the nonlinear relationship (if any) between fatalities due to natural disaster and economic development; and

iii. To suggest policy recommendation to mitigate the fatalities due to natural disaster.

1.6 Significance of the Study

This study would be filling up the gap, whereby most of the studies and researches that have been and still being done, concentrated on the impact of natural disasters on economic condition, whereby this study will attempt to explore, investigate and determine the impact of economic variable (e.g. socioeconomic, Macro-level) and institutional factors on the fatalities of natural disasters, which we expect an important

and comprehensive contribution. While most of the literatures concentrated on selected countries and regions and either cross sectional in nature or covers a short time span, this study is quite comprehensive covering 79 countries and covered 5-year average from 1981 till 2005 (1981-1985, 1986-1990, 1991-1995, 1996-2000, and 2001-2005). We also hope that the finding of this study might be an important tool for the society as a whole and policy makers specifically in order to minimize the risk of death and damages from natural disaster. While most of researchers are not denying that natural disasters will continue to occur, the least we could do being prepared.

REFERENCES

Alesina, A. and Dollar, D. (2000). Who Give Foreign Aid to Whom and Why?. *Journal of Economic Growth*, 5(1), 33-63.

Albala-Bertrand, J.M. (1993). *Political Economy of Large Natural Disasters*. New York: Oxford University Press.

Anbarci, N., Escaleras, M. and Register, C.A. (2005). Earthquake fatalities: the interaction of nature and political economy. *Journal of Public Economics*, 89(9-10), 1907-1933.

Anderson, T.W. and Hsiao, C. (1982). Formulation and Estimation of Dynamic Models Using Panel Data. *Journal of Econometrics*, 18, 47-82.

Arellano, M. and Bond, S. (1991). Some Tests of Specific Action for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies* 58, 277-297.

Arellano, M. and Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error- Component Models. *Journal of Econometrics*, 68, 29-52.

Baum, C.F. (2006). *An Introduction to Modern Econometrics Using Stata*. Texas: A Stata Press Publication.

Barro, R.J. and Lee, J.W. (1996). International Measures of Schooling Year and Schooling Quality. *American Economic Review*, 86(2), 218-23

Barro, R.J. (1991). Economic Growth in a Cross Section of Countries.*The Quarterly Journal of Economics*, 106(2), 407-443.

Bates, F.L. and Peacock, W.G. (1987). Disaster and Social Change, in Dynes, R.R., de Marchi, B. and Pelanda, C (Eds). *Sociology of Disasters: Contribution of Sociology to Disaster Research*, F. Angeli Libri, Milan, pp. 291-330.

Becker, G.S., Murphy, K.M., and Tamura R.F. (1990). Human Capital, Fertility and Economic Growth. *Journal of Political economy*, University of Chicago Press, 98(5), 12-37.

Benson, C. and Clay, E.J. (2003). Disasters, vulnerability & the global economy, in A. Kreimer, M. Arnold & A. Carlin (eds.). *Building Safer Cities: The Future of Disaster Risk*. Washington: World Bank.

Bilham, R. (2010).Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction.*Nature, 463* (7282) 735-735,

Blundell, R.W. and Bond, S.R (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115-143.

Blundell, R.W. Bond, S.R. (1999), GMM estimation with persistent panel data: an application to production functions, *Cemmap Working Paper*, CW99/4. London: Institute for Fiscal Studies.

Bond, S.(2002). Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice. CWP09/02. London: Centre for Micro Data Methods and Practice, Institute for Fiscal Studies.

Boone, P. (1994). The Impact of Foreign Aid on Saving and Growth. Mimeo, London School of economics.

Boone, P. (1996). Politics and The Effectiveness of Foreign Aid. *European economic Reviews*, 40, 289-329.

Buchanan, J. M. (1975). The Samaritan's dilemma, *in* E. S. Phelps, ed., 'Altruism, morality and economic theory', Russell Sage Foundation, pp. 71–85.

Burnside, C. and Dollar, D. (2000). Aid, Policies, and Growth. *American economic Review*, 90(4), 847-868.

Cuaresma, J.C., Hlouskova, J. and Obersteiner, M. (2008). Natural disaster as creative destruction? Evidence from developing countries. *Economic Inquiry*, 46(2), 214-226).

Cuny. F.C. (1983). *Disaster and Development*. New York: Oxford University Press.

Clijsters, G. and Peeters, L. (2005). Agglomeration Economies at work, paper prepared for presentation at the 45th Congress of the European Regional Science Association.

Coate, S. (1995). Altruism, the Samaritan's Dilemma, and Government Transfer Policy. *American Economic Review*, 85(1), 46–57.

Dacy, D. C. and Kunreuther, H. C. (1969). *The Economics of Natural Disasters*. New York: Free Press.

Douty C.M. (1972). Disasters and Charity: Some Aspects of Cooperative Economic Behavior. *American Economic Association*.

Dynes, R.R. (1970). Organizational involvement and changes in community structure in disaster. *Am Behav Sci*, 13(3)430.

Forest, natural disasters and human security, The International Institute for SustainableDevelopment (IISD), *www.iisd.org/**pdf**/2005/security_arborvitae27.pdf*

EMDAT. The OFDA/CRED International Disaster Database. Universite Catholicque de Louvain, Brussels, Belgium. Available online at www.em-dat.be.

Escaleras, M., Anbarci, N., and Register, C. A. (2007). Public sector corruption and major earthquakes: A potentially deadly interaction. *Public Choice*. 132, 209-230.

Gassebner, M., Keck, A. and Teh, R. (2010). Shaken, Not Stirred: The Impact of Disasters on International Trade. *Review of International Economics*, 1892), 351-368.

Gleser, G.C., Green, L., and Winget, C. (1981). *Prolonged Psychosocial Effects of Disaster: A Study of Buffalo Creek.* Academic Press, New York.

Guha-Sapir, D. (2008b). EM-DAT's new disaster classification. *Cred Crunch*, 13.

Gujarati, D.N. (2003). *Basic Econometrics, International Edition*. Fourth Edition,McGraw Hill Companies, Inc., New York

Gunn, S.W.A. (1990) Multilingual Dictionary of Disaster Medicine and International Relief', Kluwer Academic Publishers, Dordrecht, London, Boston.

Gupta, S., Clements, B., Baldacci, E. and Mulas-Granados, C. (2005). Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries.*Journal of International Money and Finance,* 24, 441-463.

Green, P. (2005). Disaster by DesignCorruption, Construction and Catastrophe. *British journal of Criminology*, 45(4), 528-546.

Green, P. and Ward, T. (2000). State Crime, Human Rights, and the Limits of Criminology. *Social Justice*, 27(1), 101–15.

Green, P. and Ward, T. (2004). *State Crime: Governments, Violence and Corruption*. London: Pluto Press. GULKAN, P. (2001), 'An Essay on the Cancellation of Building Inspection Decree with Forceof Law 595 and the Subsequent Building Inspection Law 4708', available online at:www.metu.edu.tr\wwwdmc.

Green, P., AL Hussaini, A. and Curry, C. (2002). Disaster Prevention and the 1999 TurkishEarthquake, ESRC Award, Reference number R000223401.

Haque, C.E. (2003). Perspectives of Natural Disaster in East and South Asia, and the Pacific Island States: Socio-economics Correlates and Need assessment. *Natural Hazards*, 29, 465-483.

Henderson, V. (2002). Urbanization in developing countries. The World Bank Research Observer 17 (1), 89–112.

Heston, Alan, Robert Summers & Bettina Aten (2009): Penn World Table Version 6.3. University of Pennsylvania: Center for International Comparisons of Production, Income and Prices.

Hoeffler A.K. (2002). The augmented Solow Model and the African growth debate. *Oxford Bulletin of Economics and Statistics* 64(2), 0305-9049.

Horwich, G. (2000). Economic lessons from the Kobe earthquake. *Economic Development & Cultural Change*, 48,521-542.

Human Development Report, (2008). *Fighting climate change: Human solidarity in divided world*. United Nations Development Programme, UNDP.

Hyndman, D. and Hyndman, D. (2008).*Natural Hazards and Disasters*. Second Edition. Brook Cole.

IFS, (2008). International Monetary Fund CD-ROM, www.imf.org.

International Monetary Fund. (2003). Fund assistance for countries facing exogenous shocks. http://www.imf.org/external/np/pdr/sustain/2003/080803.pdf.

Jepma, C. (1997). On the Effectiveness of Developing Aids. World Bank, Unpublished.

Kahn, M.E. (2005). The death toll from natural disasters: The role of income, geography & institutions. *The Review of Economics and Statistics*, 87(2), 271-284.

Kellenberg, D.K., Mobarak, A.M. (2008). Does Rising Income Increase or Decrease Damages Risk From Natural Disaster. *Journal of Urban Economics*, 63, 788-802.

Kenny, C. (2008) "Why do people die in earthquakes? The costs, benefits and institutions of disaster risk reduction in developing countries", draft, World Bank, Washington, DC

Krimgold, F. (1974). *Pre-Disaster Planning: The Role of International Aid for Pre-Disaster Planning in Developing Countries***.** Stockholm: Stockholm Pub.

Lensink, R. Van der Molen, R., Gangopadhyay, S. (2003). Business groups, financing constraints and investments: the case of India. *Journal of Development Studies* 40, 93- 119.

Lindell, M.K. and Prater, C.S. (2002). Assessing Community Impacts of natural Disaster. *Natural Hazard Review*, 4(4), 176-185.

Lucas, R.E., Jr. (1988). On The Mechanics of Economic Development. *Journal of Monetary Economics*, 22, 3-42.

Narayan, P.K. (2003). Macroeconomic impact of natural disasters on a small island economy: Evidence from a CGE model. *Applied Economics Letters*, 10, 721-723.

Nelson, R. and E. S. Phelps. (1966), Investments in Humans, Technological Diffusion and Economic Growth, *American Economic Review: Papers and Proceedings*, Vol. 56, 69-75.

Noy, I. (2008). The macroeconomic consequences of disasters. *Journal of Development Economics* 88, 2, 221-231

Noji, E.K. (1996). Disaster Epidemiology. *Emergency Medicine Clinics of North America*. 14(2), 289-300

Okuyama, Y. (2003). Economics of natural disasters: a critical review. Research Paper 2003-12, Regional Research Institute, West Virginia University, USA.

Olson, R.S., Olson, R.A. and Gawronski, V.T. (1999). *Some Buildings Just Can't Dance: Politics, Life Safety, and Disaster*. Stamford, CT: Jai Press.

Otero, R. and R. Marti.(1995). The Impacts of Natural Disasters on National Economies and the Implications for the International Development and Disaster Community, *Disaster Prevention for Sustainable Development: Economic and Policy Issues*, edited by M. Munasinghe and C. Clarke. Geneva and New York: International Decade for Natural Disaster Reduction and World Bank, 1995, 11–40.

Padli, J. and Habibullah, M.S. (2009). Natural disaster and socio-economic factors in selected Asian countries: A panel analysis. *Asian Social Science*, 5(4).

Padli, J., Habibullah, M.S. and A.H. Baharom. (2010). Economic Impact of Natural Disasters' Fatalities. *International Journal of Social Economics*, 37(6): 429-441.

Pelling, M. and Uitto, J.I. (2001). Small island developing states: Natural disaster vulnerability and global change. *Environment Hazard* ,3, 49-62.

Pelling, M. Ozerdem, A. and Barakat, S. (2002). The Macro-economic Impact of Disasters. *Progress in Development Studies*, 2(40, 283-305.

Political Risk services and International Country Risk Guide (ICRG) (2006). The PRS Group Inc.: International Country Risk Guide, Tech. rep

Price, G.N. (2008). Hurricane Katrina: Was there a political economy of death?. *Electronic copy available at: http://ssrn.com/abtract=1129242*

Quarantelli, E. L. (1978), ed. Disasters: Theory and Research. *London: Sage Publications Ltd*

Rappaport, J.M. and Sachs, J.D. (2003. The United States as a Coastal Nation. *Journal of Economic Growth*, 8(1), 5-46.

Raschky, P.A. (2008). Institution and the losses from natural disasters. *Natural Hazards and Earth System Sciences.* 8, 627-634.

Raschky, P.A. and Swhwindt, M. (2009). Aids, Natural Disasters and the Samaritan's Dilemma. *Policy Research Working Paper 4952.*

Rasmussen, T.N. (2004). Macroeconomic implications of natural disasters in the Caribbean. *IMF working paper WP/04/224.*

Romer, P.M. (1990). Human Capital and Growth. Theory and Evidence. *Carnegie-Rochester Conference Series on Public Policy*, 32(1), 251-286.

Schlein, L. (2008). Asia hardest hit by natural disasters in 2007. *Voice of America*. 18 January 2008. [Online]Available:http://www.voanews.com/english/archive/2008-01/2008-01-18-voa52.cfm? CFID=64454741&CFTOKEN=86050072

Schumacher, I. and Strobl, E. (2008) Economic Development and Losses due to Natural Disasters: The Role of Risk. *Working paper hal-00356286_v1*. Available at:http://hal.archives-uvertes.fr/docs/00/35/62/86/PDF/cahier_de_recherche_2008-32.pdf

Skidmore, M. and Toya, H. (2002). Do natural disasters promote long-run growth?. *Economic Inquiry*, 40(4), 664-687.

Skidmore, M. and Toya, H. (2007). Economic development and the impact of natural disasters. *Economics Letters*, 94, pp 20-25.

Skoufias, E. (2003). Economic Crises and natural Disaster: Coping Strategies and Policy Implications. *World Development*, 31(7), 1087-1102.

SorkinA.L. (1984). Economic Aspects of Natural Hazards. *American Journal of Agricultural Economics*, vol. 66, No. 1 (Feb., 1984), p. 114

Sutter, D. and Simmons, K.M. (2010). *The Socioeconomic Impact of Tornadoes*. In The Economics of Natural and Unnatural Disasters, William Kern, (ed). Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, pp. 103-132.

Tol, R., Leek, F., (1999). *Economic analysis of natural disasters*. In: Downing, T., Olsthoorn, A., Tol, R. (Eds.), Climate Change and Risk. Routledge, London, pp. 308–327.

United Nations Economics & Social Commission for Asia & the Pacific (UNESCAP). (2007). *Statistical Yearbook for Asia & the Pacific 2007*. Washington, D.C.: United Nation. http://www.unescap.org/stat/data/syb2007/17-Information-and-communication- technology.asp

WDI,(2008). World Development Indicators on CD-ROM. The World Bank

Westgate, K., O'Keefe, P. and Wisner, B. (1976). Taking the naturalness out of natural disasters. *Nature*, vol. 260, pp. 566-567.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48, 817-838.

Whittow, J.B. (1980). *Disasters : the anatomy of environmental hazards / John Whittow*. Allen Lane, London

White, G.F. and Hass J.E. (1975). *Assessment of Research on Natural Hazards*. Cambridge, MA: MIT Press

Wiegel, R.L. (1970). *Earthquake Engineering*. Prentice Hall Inc, Englewood Cliffs, New Jersey.

Wildavsky, A. (1988). *Searching for Safety*. New Brunswick, N.J.: Transaction.

World Bank, 2003, "Caribbean Economic Overview 2002: Macroeconomic Volatility, Household Vulnerability, and Institutional and Policy Responses," Report No. 24165- LAC (Washington: World Bank).

World Disasters Report, 2007, "Discrimination in Disasters," available online at http://www.ifrc.org/docs/pubs/disasters/wdr2007/wdr2007-english.pdf

Yamamura, E. (2008). Learning effect and social capital: A case study of natural disaster from Japan.*MPRA Paper No. 10249.*

Yang, D. (2005). Coping with disaster: The impact of hurricanes on international financial flows, 1970-2001. *Research Seminar in International Economics, Discussion Paper No. 534.*

Zapata-Marti, R. **(**1997). Methodological approaches: the ECLAC methodology. In Center for the Research on the Epidemiology of Disasters (CRED), *Assessment of the economic impact of natural and man-made disasters*. Proceedings of the expert consultation on methodologies, Brussels, 29–30 September, Universite Catholique de Louvain, Belgium, 10–12.