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Effect of pre-disaster public finance on disaster mitigation in Eastern and Southern Africa.

Kudzanayi, Christian Maguchu
Strathmore Business School
Strathmore University

Effect of Pre-disaster Public Finance on Disaster Mitigation in Eastern and Southern Africa

KUDZANAYI CHRISTIAN MAGUCHU

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Declaration

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The thesis/dissertation of **Kudzanayi Christian Maguchu** was reviewed and approved for examination by the following:

Name of Supervisor: S. Wagura Ndiritu, PhD

School/Institute/Faculty: Strathmore University Business School

Dr. George Njenga

Executive Dean

Strathmore University Business School.

Dr. Bernard Shibwabo

Director, Office of Graduate Studies

ABSTRACT

Sub-Saharan Africa has seen an increase in the frequency, intensity and cost of natural disasters. The associated effects suggest that governments are lagging on their disaster mitigation financing obligations, since countries investing significantly in this should be able to minimize the impact of natural disasters. In consideration, the objective of the study was to assess whether the relationship between the occurrence of disasters and the resulting disaster related losses (total deaths and total people affected), is affected by the level and type of pre-disaster finance (dedicated and embedded budget allocations, contingent credit lines, insurance and reinsurance, and catastrophic bonds). The study adopted a positivism research philosophy, followed a quantitative descriptive research design using panel data analysis and utilized secondary data on six countries in Eastern and Southern Africa. Findings indicate that embedded budget allocations weaken the causal relationship between disaster occurrence and disaster losses thereby improving disaster mitigation as shown by the reduction in the total deaths and number of people affected by hazards. On the contrary, dedicated budget allocations, insurance and reinsurance and contingent credit lines did not show any significant interaction with disaster occurrence and therefore no effect on the minimization of total deaths and number of people affected. The study recommends the increased use of embedded budget allocations for effective disaster mitigation.

Keywords: Disasters, Disaster Mitigation, Disaster Risk Reduction, Pre-disaster Public Finance

JEL Classification: Q54, E22, O16

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Definition of terms

Disaster	A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to human, material, economic and environmental losses and impacts (UNISDR, 2009)
Disaster Mitigation	The lessening or minimizing of the adverse impacts of a hazardous event including reducing loss of life and property (UNISDR, 2009)
Disaster Mitigation Measures	Activities that eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs (UNISDR, 2009)
Disaster Risk	The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNISDR, 2009)
Disaster Risk Reduction	A systematic approach aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development (UNISDR, 2009)
Ex-ante	Before the event (Oseno & Wakhungu, 2017)
Exposure	The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas that are subject to potential losses (UNISDR, 2009)
Hazard	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation (UNISDR, 2009)
Pre-Disaster Finance	Financial protection strategy model which mobilizes resources to be invested in disaster risk reduction in order to strengthen institutions, build resilience and enable sustainable recovery before a disaster occurs (Oseno & Wakhungu, 2017)
Public Finance	Funding and allocating resources by governments for large scale projects and services that the private sector cannot successfully deliver on its own (Auzzir et al., 2014)

Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (UNISDR, 2009)
Total Affected	The sum of injured, homeless, and those requiring immediate assistance (basic needs of food, water, shelter, sanitation and medical assistance) during a period of emergency (EM-DAT, 2020)
Total Deaths	The sum of confirmed deaths and missing after a natural hazard occurs (EM-DAT, 2020)
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNISDR, 2009)

List of abbreviations

ARC	The African Risk Capacity
CAT DDO	Catastrophe Deferred Drawdown Option
CCRIF	Caribbean Catastrophe Risk Insurance Facility
DRR	Disaster Risk Reduction
HDI	Human Development Index
HFA	The Hyogo Framework of Action
IBLI	Index-Based Livestock Insurance
SSA	Sub-Saharan Africa
TCIP	Turkish Catastrophic Insurance Pool
USD	United States Dollars
WII	Weather Insurance Index

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"Some people do not like change, but you need to embrace change if the alternative is disaster."

Elon Musk

CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction

The chapter highlights in the background the build up to the study, describes the statement of the problem, explains the research objectives and the significance of carrying out this study.

1.2 Background to the study

On the 14th of March 2019, Tropical Cyclone IDAI made landfall in Mozambique, and went on to affect neighboring Zimbabwe and Malawi. It became the deadliest cyclone to hit the southern hemisphere (Yaghmaei, 2019), recording a total of 901 confirmed deaths and affecting a total of 2.2 million people in Mozambique and Zimbabwe (Huber, 2019). Such tragic events are global and are becoming much more frequent (Coronese et al., 2019). World disaster data for 2018 reported a total of 315 disasters, affecting 68.5 million people, with economic losses of $131.7 billion, resulting in more than 11,804 deaths (EM-DATA, 2020).

Disasters are a disruption of a system due to hazardous events, and for the purposes of this study, natural events falling under geophysical, meteorological and climatological events namely droughts, earthquakes, epidemics, extreme temperatures, floods, landslides and storms (UNDRR, 2019). Their interaction with conditions of exposure, vulnerability and adaptive capacity, often lead to human, economic and environmental losses. It is impossible to completely discontinue such occurrences (Twigg, 2015), however, through the economics of investing in disaster mitigation measures, described under the concept of disaster risk reduction (DRR), it is conceivable to minimize the associated losses (Vorhies, 2012) and attain the principle objectives of mitigation which is to reduce disaster risk, save lives and reduce economic disruption. Studies suggest that this is possible through pre-disaster risk financing, under which pre disaster public

financing mechanisms exist, which are fundamental to disaster mitigation (Edmonds & Noy, 2018; Mechler et al., 2016).

These mechanisms are deemed to be complicated as their benefit is based on an understanding of future probabilities (Alexander, 2016). They require investment to be made now in order to reduce the likely effects of an unknown probable future event. At the focus of this study are five pre-disaster public finance mechanisms namely budget allocations (dedicated and embedded), contingent credit lines, insurance and reinsurance, and catastrophic bonds (Twigg, 2015). Dedicated and embedded schemes are both budgetary allocations, in which the former is entirely reserved for disaster mitigation whilst the latter has only a fraction of a percentage earmarked. Contingent credit lines are prequalified loans which are available to a country when a hazard occurs (Clarke and Mahul, 2011) and insurance and reinsurance, and catastrophic bonds are both market-based instruments, designed to transfer disaster risk (Clarke et al., 2017). These disaster financing mechanisms embed all or some of the aspects of risk identification, risk mitigation, risk transfer, and risk preparedness (Van Niekerk et al., 2016) relevant for archiving the net benefits of disaster mitigation.

Mitigation in this context measures the costs of mitigation (which is pre-disaster public finance) against the resulting net benefits (reduction in number of disaster related deaths and number of people affected by disasters) therefore a form of cost-benefit analysis (Benson & Twigg, 2004). Financing disaster mitigation is deemed sufficient to enable a substantial reduction in the number of human lives lost, people affected and the total economic losses from a disaster (Vordzorgbe, 2006). Other benefits include development gains through the unlocking of suppressed economic potential and secondary co-benefits of positive economic, social and environmental effects. This study focuses on the first dividend (Peters et al., 2016; Tanner et al., 2015), to save lives and reduce disaster related losses.

Gordon (2013) and Jose (2012) noted that this kind of investment is very low in underdeveloped countries including the SSA region of Eastern and Southen Africa. Disaster mitigation here is still heavily dependent on resources from bilateral and multilateral cooperation (Kellett et al., 2014). The same countries were noticed to be aligned more towards managing response than promoting mitigation (Twigg, 2015) with a focus on an ex-post reflection on disaster risk rather than a proactive ex-ante view (Lavell & Maskrey, 2014).

In view of this, the pre-disaster risk finance agenda in SSA has grown to accept an all-inclusive approach to disaster mitigation. Indicating the importance of private sector participation (Auzzir et al., 2014; Pauw, 2015), individual level disaster mitigation (Jamieson, 2016) and humanitarian approaches (Hesselman & Lane, 2017; Scott, 2015). Regardless of this multidisciplinary approach, the state of disaster mitigation in Eastern and Southern Africa is relatively poor (Lazamanana et al., 2015; Zarine et al., 2015). In spite of the commitments made by most countries, including pledging to publish baseline and periodic assessments, develop national programmes for mitigation (Pearson & Pelling, 2015) and most importantly allocating resources, progress towards disaster mitigation seems slow (UNDRR, 2019) with the effect of pre-disaster public finance on disaster mitigation remaining blurred.

Studies have also suggested a complexity in implementing disaster mitigation measures, especially in Southern Africa (Holloway, 2003). This is partly attributed to the characteristics of disasters associated with these regions which are either "creeping emergencies" (e.g. famine) or complex emergencies (e.g. floods) which are also common in Eastern Africa. This revelation is further exacerbated by the dynamic nature of disasters that often render previously adequate disaster mitigation strategies obsolete (Alexander, 2016).

1.2 Statement of the Problem

Eastern and Southern Africa disaster data for 2019 reported a total of 63 disasters from 22 out of the 27 countries in the region. These affected 21.3 million people, with economic losses exceeding $2.4 million and resulting in more than 2,406 deaths (EM-DATA, 2020). By region, over the past 30 years, 47.5 percent of disasters occurred in Eastern and Southern Africa alone, with Middle; Western; and Northern Africa having 52.5 percent of the occurrences. This is despite the latter being vast in both geography and population. More than 309 million people were affected in the region under study, which is 70.8 percent of the total number affected on the African continent (EM-DATA, 2020).

It is evident that the region has been suffering more from natural hazards compared to her African counterparts and is impossible to suggest that losses will be significantly reduced in the anticipatable future (De la Poterie & Baudoin, 2015). While most countries are better equipped to manage disasters than before, there is evidence that the frequency and intensity of disasters may increase (Chakrabarti, 2012). The conditions of underdevelopment further place these states at high risk since they do not yet have in place institutional structures which are central to disaster mitigation (Van Niekerk, 2015).

It has become clearer with every new disaster, that the increase in disaster losses suggest a high level of unpreparedness, which in turn points to a questioning on either the unavailability of pre-disaster finance or the quality of domestic investment for disaster mitigation (OCHA, 2019). This is because countries investing significantly in disaster mitigation should be able to minimize the impact of disasters (Vordzorgbe, 2006; F. Vorhies, 2012) due to the moderating effect of disaster financing on disaster occurrences. This deplorable state of disaster management systems has also led to an increase in the financial implications related to disasters (Van Niekerk, 2015), including spiraling humanitarian response and recovery funding. Furthermore, other associated costs with significant implications on the macro-economy and the long-term development outlook

are also increasing. These include worsening of the fiscal position, suffering trade balances, downward pressure on the exchange rates and inflationary pressures (Vorhies, 2012). The impact of natural disasters is similarly becoming trans-border due to the interconnectedness of economies (Vidar & Medalla, 2015). It is important to examine this problem because there is need to evaluate which finance mechanisms have been effective in reducing disaster losses; where to invest more and how to leverage on the economics of pre disaster public financing in order to reduce disaster related losses (Manyena, 2016).

1.3 Research Objectives

1.3.1 General Objective

The general objective of the study was to assess the moderating effect of pre-disaster public finance on disaster occurrences towards disaster mitigation in Eastern and Southern Africa.

1.3.2 Specific Objectives

The specific objectives of the study are:

i. To assess the effect of dedicated budget allocations on disaster related deaths and people affected by disaster occurrences
ii. To assess the effect of embedded budget allocations on disaster related deaths and people affected by disaster occurrences
iii. To assess the effect of contingent credit lines on disaster related deaths and people affected by disaster occurrences
iv. To assess the effect of insurance and reinsurance on disaster related deaths and people affected by disaster occurrences
v. To assess the effect of catastrophe bonds on disaster related deaths and people affected by disaster occurrences

1.4 Research Questions

i. What has been the effect of dedicated budget allocations on disaster related deaths and people affected by disaster occurrences?
ii. What has been the effect of embedded budget allocations on disaster related deaths and people affected by disaster occurrences?
iii. What has been the effect of contingent credit lines on disaster related deaths and people affected by disaster occurrences?
iv. What has been the effect of insurance and reinsurance on disaster related deaths and people affected by disaster occurrences?
v. What has been the effect of catastrophe bonds on disaster related deaths and people affected by disaster occurrences?

1.5 Scope of the study

The study focused on the effect of pre-disaster public finance on disaster mitigation in 6 (Kenya, Uganda, South Sudan, South Africa, Zambia and Zimbabwe) out of the 27 Eastern and Southern African countries (Appendix B) over a 15-year period (2005 to 2019). Only countries which had experienced disasters over the period as recorded by the disaster database (EM-DAT) were used for the study. This was necessary to observe the relationship between disaster occurrences and disaster losses. Hence the need for a natural disaster having occurred. It concentrated on the investments in disaster mitigation under five main categories namely budget allocations, dedicated and embedded; contingency credit lines; insurance and reinsurance; and catastrophic bonds, and their usefulness in reducing disaster related deaths and total number of people affected by disasters. The study assumed a multi-natural hazard approach, meaning data collected on disaster losses was limited to all recorded disasters caused by biological, climatological, extra-terrestrial, geophysical, hydrological and meteorological hazards. These were limited to disaster occurrences through droughts, earthquakes, epidemics, extreme temperatures, floods, landslides and storms.

1.6 Significance of the study

Despite growing knowledge and understanding of natural disaster risk, the catastrophic events in Eastern and Southern Africa in 2019 alone have pointed to gaps in disaster mitigation. Making the study available to policy makers will enable benchmarking against the best regional standards towards the formulation of disaster mitigation policies aimed at overcoming the adverse consequences of natural hazards. Assessments will be done on whether governments have been diligent in implementing their commitments towards disaster mitigation and the corresponding alignment of policies. In turn, this will provide a powerful tool for civil society to register their demands for adequate policy and resources for disaster mitigation.

The results and recommendations from the study will also enable disaster management practitioners to analyze pre-disaster public spending; promote better understanding and coordination in the sector; identify the critical needs and gaps; isolate inefficient disaster mitigation expenditure; and promote better efficiency and transparency in disaster financing. The study will therefore contribute to strengthened strategic decision making for pre-disaster financing and programming (UNISDR, 2015) on a national and regional level.

Finally, the study will enhance the disaster mitigation finance literature in Eastern and Southern Africa. With the negative impacts of disasters increasing, studies need to focus on the efficacy of pre-disaster public finance. There is scarcity of information on the volume and nature of pre-disaster finance and its interactive relationship with disaster occurrence towards disaster mitigation (Chakrabarti, 2013; Osuteye et al., 2017; Padli et al., 2018).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The chapter discusses the development theory and theory of public goods in view of the state's role in disaster mitigation through pre-disaster public finance. It goes on to provide a critical review of empirical literature on pre-disaster financing from budget allocations to market-based mechanisms, focusing on the role of the same in disaster mitigation. The chapter then describes the research gaps, conceptual framework and a discussion of variables.

2.2 Theoretical Review of Literature

2.2.1 Development theory

The development theory in describing how change in the economy is best achieved, throughout its evolution, highlights the important role of the state. In 1960 Walt W. Rostow, the most influential proponent of this theory proposed the linear stages of growth model (Rostow & Rostow, 1990). In some of the principles, they determined underdevelopment as a weakness in the factors of production and insisted on the increase of investment and savings as the key to development. Development in this context being the system's capacity to provide the circumstances for human well-being on a sustainable and long-term basis (Contreras, 1999). This same proactive characteristic is embedded in disaster mitigation. To achieve the objectives of economic development, policymakers need to design development policies that not only seek opportunities for business creation and industry expansion (Tanner et al., 2015) but also address issues of economic cycles and key to the study, shocks from natural hazards and other events.

There are however criticisms to Rostow's steps towards development, the main one being the impossibility of countries to follow the same linear trajectory towards development (Baran & Hobsbawm, 1961). The theory assumes that all countries have an equal chance

to develop, disregarding issues of geographic location, population size, resources and most importantly barriers to development. This heterogeneity will define how development will occur, with other countries skipping stages. Hilsenrath (1993) also criticizes the overemphasis on investments and savings, citing that the required percentages of savings to GDP can be affected by other factors including the rate of population growth and capital output ratio.

Despite the criticisms, the concept of development reaffirms the significance of the state's role in protecting and advancing human well-being, being the main driver of development. It argues the need for policies and investments that protect citizens' interests and therefore its direct or indirect role in disaster mitigation. In disaster and development, the vulnerability to disasters is determined and exacerbated by the built environment of a community (Kapucu & Liou, 2014). Both exposure and vulnerability have been noted to increase as development and urbanization increase (Renaud, Sudmeier-Rieux, & Estrella, 2013).

In this view, Wisner (2003) dictates that disasters are associated with failure in development, and this conversation leads us to the important question relating to the role in disaster mitigation by those charged with development. To illustrate, only 32 deaths were recorded from Hurricane Andrew (1992) in the USA against over 139,000 deaths recorded from a cyclone of similar force in Bangladesh (1991), citing the relevance of public finance in development and reduction of the vulnerability of communities to disasters. The theory supports the cost-benefit approach taken by the study as a significant principle when planning and assessing development and risk management (Benson and Twigg, 2004). It provides information for a more efficient and less risky allocation of scarce resources and in turn, improved development practice and policy.

2.2.2 Theory of Public Goods

The role of the government through the provision of goods and services under the theory of public goods as postulated by Paul Samuelson (1954) also supports the above proposition. The principle sates that public goods that are collectively consumed are non-excludable and non-rivalry are best provided for by the state (Ulbrich, 2013; Zarine et al., 2015). Although they are private disaster risk investments like individual insurance policies (Zhang & Qian, 2018), most disaster mitigation mechanisms both structural and non-structural embed the characteristics of public goods (Hanger et al., 2018).

Criticisms of this theory spring mainly based on defining a public good (Cowen, 1985), with contention on what can be called one and vice-versa. In line with this, Goldin (1977) also criticized on the misleading nature of the theory if it suggested that all goods and services provided by the government are public goods. With evidence, he suggested that there is no set of goods that have inherent characteristics of public a good, however, there is an unavoidable ethical choice for every good on whether access should be selective or equal.

Following the latter criticisms on unavoidable choices, disaster mitigation goods and services are usually underprovided by the market, leaving the total responsibility to public expenditure mechanisms (Titheridge et al., 2016). In the past, disasters were considered as one-off and unpredictable events, yet the increasing use of the DRR approach suggests that just like national defense, public investment should be dedicated in order to proactively provide for this public good and minimize disaster losses (Zarine et al., 2015).

Governments are therefore required, according to the public goods theory, to be providers of disaster mitigation services (multi hazard early warning systems, shelters and hospitals etc.) to reduce loss of life and people affected by the disasters (Lazamanana et al., 2015). Furthermore, in the very act of public goods provision, the government has a risk avoidance role (Miles, 2017). Just like development, in order to reduce vulnerability and disaster risk to society, governments must refrain from actions that generate risk and hence minimize on the negative effects of natural disasters. The theory of public goods

relates to this research given that pre-disaster public financing is directed to disaster mitigation measures which are inherently public goods and are usually under provided by the market. It is suggested therefore that governments which allocate resources for provision of disaster mitigation public good might substantially reduce the severity of losses when disasters occur.

2.3 Empirical Review of Extant Literature

It has increasingly become complex to plainly identify and track the sources, instruments, volumes and outcomes of public financing for disaster mitigation (Watson et al., 2015). Domestic financing structures add further complexity due to differing national structures through which disaster mitigation finance is raised and channeled. Furthermore, the current disaster mitigation finance design is unpredictable, mostly activity focused, and the reduction of disaster risk is often not the primary motivation (Kellett et al., 2014).

Amid these complexities, Jose (2012) suggested a common classification defined by the purpose of the expenditure, whether it is for understanding hazards; minimizing exposure; or for lessening vulnerability. The study therefore breaks down the pre-disaster public finance mechanisms addressing these purposes and highlighting their contribution to disaster mitigation.

2.3.1 Effect of dedicated budget allocations on disaster mitigation

Formal disaster mitigation financing can be in form of dedicated budget allocations, which fall under departmental, functional or program budgets and are either recurrent or capital expenditures (Jackson, 2011). Although there is a founded call for integrating disaster mitigation interventions, there is a similar call to retain stand-alone disaster mitigation funding in high-risk countries (UNISDR, 2011). In line with this, many governments propose a portion of the budget in form of dedicated schemes on which 100% of the allocations are earmarked for disaster management (Chakrabarti, 2012).

A study done in SSA highlighted that Burundi, Kenya and Swaziland could not adequately budget for disaster risk reduction (Van Niekerk, 2015). In a similar study assessing disaster mitigation in India's budgeting, Chakrabarti (2013) identified 37 schemes that were exclusively dedicated to disaster management. The total financial allocation for the same budget (2011-12) was 0.94% of the total annual budget. In another study carried out in Indonesia, Darwanto (2012) concluded that, budget allocations where still lower than the internationally agreed level (1% of total budget) but growing from 0.38% to 0.69% (2006 to 2012).

The use of dedicated pre-disaster finance allocations is therefore a common practice. It has advantages in resource mobilization (Kellett & Caravani, 2013) as donors and taxpayers feel more obliged to fund disaster mitigation through a named programme for easy tracking. As for the effectiveness of the same in reducing disasters losses, it can be expressed based on structural and non-structural interventions (Miller & Keipi, 2005).

Studies have suggested that financing structural mitigations has immediate results. Lesser people are affected by disasters, lives are saved, and lesser economic losses are incurred (Owens et al., 2003). However, this is subject to diminishing marginal returns as the structures invested in depreciate and in turn increase the risks from disasters. On the other hand, financing for non-structural mitigation strategies and prevention through directing or regulating human activity in disaster-prone areas will not provide short term reduction in losses, but long-term risk reduction (Owens et al., 2003; Twigg, 2015). Consisting of awareness raising and land use planning regulations, they are a valuable means of reducing total economic losses in the longer term as they build resilience and coping capacity.

In a study on the relationship between pre-disaster distribution scenarios and household data from Zimbabwe, Owens and others (2003) concluded that pre-disaster finance through dedicated social protection, reduced poverty in non-drought years. Although there was a worsening of income in the drought year, increased financing accumulation

from the non-drought years increased household welfare and decreased poverty, therefore reducing the number of deaths and people affected by droughts.

Many studies have highlighted how, in the absence of pre-disaster dedicated allocations, disaster occurrences shift government spending away from capital expenditure toward relief and rehabilitation, causing a distortion in national budgets (Benson & Clay, 2004; Coronese et al., 2019; Gotham, 2016; Mechler et al., 2016). These diversions will in turn increase the vulnerabilities of nations, making them highly susceptible to future disaster losses.

Despite the positive effect from dedicated budget schemes, some studies have noted that the budget data consists of a larger portion of personnel costs compared to costs for procurement of services, capital goods and social transfers (Darwanto, 2012; Lazamanana et al., 2015). This brings out the notion that even though funds are set aside for disaster financing, their impact on reducing disaster losses will be limited based on these appropriations. Another study noted variances between planned and actual expenditures (Zarine et al., 2015). Where amounts spent were lower than the budgeted, indicating empty commitments to disaster mitigation. Thereby, questioning the efficiency of these allocations in reducing the total losses from disasters.

2.3.2 Effect of embedded budget allocations on disaster mitigation

Embedded budget allocations, like dedicated schemes, are funds set aside by governments towards disaster mitigation. However, in this case, the allocations towards disaster mitigation are less than 100%, but still contain elements of risk reduction (Chakrabarti, 2013). These are usually made through key sectors like health; infrastructure and urban development and planning. Their identification and tracking are much more complex than dedicated schemes (Kellett et al., 2014) as most are formulated without a direct objective to reduce disaster risk yet their nature does.

A study in India, identified 85 schemes that fell under this category, amounting to 32.02% of the total budget for the year 2011-12. These risk sensitive allocations, like dedicated

schemes are important initiatives as they encourage prevention and mitigation efforts that reduce vulnerability to disasters (Andersen, 2002). Allocations for urban planning, enforced building codes and emergency contingency plans build resilience to communities and so reduce the direct disaster losses more in the long than in the short run. Pre-disaster financing through embedded allocations has been found to reduce the disruption to life and economic activity that hazards cause (De la Fuente, 2010; Goes & Skees, 2003; Miller & Keipi, 2005).

The proactivity nature of embedded allocations reduces future disaster damages as well as reduce the risk to human life. In a study, enhancements and strengthening of the Sabaneta Dam in the Dominican Republic reduced the risk of floods when Hurricane George made landfall and there were no significant damages to the infrastructure and potential downstream flooding was avoided (Miller & Keipi, 2005). This was financing not directly attributed to disaster mitigation, yet the investment went a long way to eliminate disaster risks. Darwanto (2012) identified this duality of purpose in embedded allocations, citing their effectiveness in disaster mitigation due to the enhanced integration in other projects.

However, this same issue of embedding may cause tracking of the effects of disaster financing to be cumbersome (Chakrabarti, 2013; Ishikagi et al., 2015; Zarine et al., 2015). Thus, positive benefits arising from such might not be easily identifiable, leading to the question on whether benefits in disaster risk mitigation accrue from this mechanism. Other studies have also highlighted that this method might be insufficient if the regulatory environment is undeveloped and poorly enforced (Jackson, 2011). Therefore, loss mitigation in terms of economic and human losses might be less effective given the context in which the pre-disaster finance through embedded allocations is administered.

2.3.3 Effect of contingent credit lines on disaster mitigation

To complement budget allocations, countries can finance disasters through debt (D. J. Clarke et al., 2017). Instead of acquiring an emergency disaster loan, in contingent credit

arrangements governments obtain the right to take out a pre-qualified post-disaster loan, providing immediate liquidity after a disaster (D. Clarke & Mahul, 2011). It is an early financing means as funds from other sources are being mobilized (World Bank, 2018) and insulates countries from potentially higher post-disaster cost of borrowing. Governments pay a fee for the option of a guaranteed loan at a pre-determined rate, usually lower than market price interest rates (D. Clarke et al., 2016) and with longer payment periods (O'Donnell, 2009). When the study was being conducted, only Malawi, Morocco and Kenya had such financing in SSA under the Disaster Risk Management Development Policy Loan with a Catastrophe Deferred Drawdown Option (CAT DDO) offered by the World Bank (World Bank, 2020).

On their moderation effect on disaster occurrences, since contingent credit arrangements are pre-cleared and disbursed quickly, they give an opportunity for governments to significantly minimize the number of people affected, but not necessarily the related deaths and losses on infrastructure (Lazamanana et al., 2015; Miller & Keipi, 2005). The effect on disaster mitigation is pronounced in countries with low disaster risk as contingent credit arrangements may be a cost-effective tool. However, the advantage of contingent credit decreases and eventually reverses as the time horizon to the event narrows (Zarine et al., 2015).

Although contingent credit has a lower cost of capital relative to other financing tools, it can also worsen a country's debt burden (Suarez & Linnerooth-Bayer, 2011). After a disaster, when the loan instrument is being serviced, funds are diverted from other disaster risk reduction expenditures, thereby increasing future possible disaster losses. Most importantly, contingent credit lines do not transfer risk since the nation still bears responsibility for reconstruction (Miller & Keipi, 2005). This also means that the mechanism does not completely minimize the number of lives lost, and people affected since it is disbursed after the disaster. It therefore only helps the nation to recover quickly

from a disaster and promote long term disaster mitigation (Tanner et al., 2015), if and only if, build-back-better initiatives are incorporated in the reconstruction (Twigg, 2015).

2.3.4 Effect of insurance and reinsurance on disaster mitigation

Beyond budgetary allocations, countries can also adopt mechanisms that do not reduce risk but transfers it (UNISDR, 2011), including insurance and reinsurance schemes. These are horizontal risk transfer mechanism which are cost effective for disaster mitigation concerning intensive and residual risk (Lazamanana et al., 2015). When the potential loss from risk transferred becomes too great, the state can transfer the risk to a second tier of insurance, the global reinsurance industry (Hess & Syroka, 2005).

Under these mechanisms, governments can form insurance programs for their citizens like the National Flood Insurance programme in the United States (Kousky, 2018) and weather index insurance program in Mexico (Ritchie et al., 2016). The state can also take out a policy from a regional pool, like the case for Vanuatu (Rasmussen, 2004) in the Caribbean Catastrophe Risk Insurance Facility (CCRIF). The Turkish Catastrophic Insurance Pool (TCIP) is also an illustration of a single country scheme, which can be an option for SSA economies (Vidar & Medalla, 2015).

In SSA, insurance products have been adopted in Namibia, Ethiopia, Malawi and Mozambique (Bhavani et al., 2008). Literature has documented index-based weather insurance schemes in South Africa, Ethiopia and Malawi (Bhavani et al., 2008; Hess & Syroka, 2005), of which some of them have demonstrated the feasibility of insuring drought risk. Other studies have also documented different insurance products, including the Index-Based Livestock Insurance (IBLI) in northern Kenya (Chantarat et al., 2013) and southern Ethiopia (Takahashi et al., 2016). Burkina Faso, Senegal, Niger, the Gambia, Mali and Mauretania are some of the states insured under the Africa Risk Capacity (ARC) which is a regional institution scale providing index insurance against droughts to African Union member states (ARC, 2020).

On the moderating effect on disaster occurrences and mitigation returns from insurance, Weingärtner and others (2017) concluded that the mechanism does not prevent deaths and the number of people affected yet suggest that they compensate for covered direct economic losses thereby reducing long-term and indirect disaster impacts. In contrast, the ARC (2018) maintains that due to the early payouts, lives and livelihoods are saved, yet agree on the ineffectiveness in reducing economic losses. Using the example of droughts, they argued that through parametric models, pay-outs can go out at the earliest trigger of an event before even the devastating effects are even noticeable, thereby minimizing the number of deaths and affected. This highlights that insurance instruments might only be effective with creeping disasters and not sudden calamities (Miles, 2017; Takahashi et al., 2016).

On the other hand, insurance schemes can help to promote risk sharing both over time and among different stakeholders (Ritchie et al., 2016). They reduce opportunities for moral hazard, as the event measure can be independently verified and cannot be influenced by manipulation (Goes & Skees, 2003). In turn, this leads to resilience and capacity building since negligence can lead to no pay-outs, which in turn leads to improved disaster mitigation.

By providing the right to ex-post liquidity, it lessens the burden from disasters by securing livelihoods and expediting the recovery process (Linnerooth-Bayer & Hochrainer-Stigler, 2015). This enables governments to provide relief to the most vulnerable and to invest in reconstruction and recovery, reduces long-term losses and the significant development setbacks from disasters (Desai et al., 2015). Just like investments in prevention, insurance can therefore improve the long-term economic resilience of a nation.

2.3.5 Effect of catastrophic bonds on disaster mitigation

Catastrophe bonds (CAT bonds) are an alternative to reinsurance. Usually structured as floating rate bonds, CAT bonds allow governments to diversify their investments and increase their access to financial liquidity after disaster shocks as the risks are absorbed by financial markets through investors (O'Donnell, 2009, Vidar & Medalla, 2015). CAT bonds are designed to solve the low insurability problem of disaster risks caused by adverse selection, moral hazard, and basis risk (Porth et al., 2015).

Mexico offered a CAT bond in 2006 making it the first non-developed country to transfer its public sector catastrophe risk to the international reinsurance and capital markets (Suarez & Linnerooth-Bayer, 2011). In SSA, the ARC planned to issue a similar bond in 2016, an Extreme Climate Facility (XCF) as a multiyear funding mechanism to protect African states against climate related risks (Vincent et al., 2018).

Studies suggest that CAT bonds, with subsidized premiums can reduce the resource burden of governments with both the short and the long run benefits by providing fast access to capital and avoiding budgetary diversions and additional loans (Porth et al., 2015). This means that in the long run, lives lost, and the numbers of people affected can be significantly reduced. CAT Bonds can also provide incentives for disaster planning and mitigation thereby reducing disaster losses over the long run (Linnerooth-Bayer & Hochrainer-Stigler, 2015). Studies cited that parametric CAT bonds also create positive risk management incentives for the issuer, since payments are tied to a measurement indicator and not to a loss amount (Miller & Keipi, 2005).

The main disadvantage of CAT bonds is that the disbursement of funds to governments does not direct or influence how the funds are used, thus funds might be diverted from response, recovery and reconstruction (O'Donnell, 2009). Just like most risk-financing instruments, there is no assurance that the pay-outs will reach those most in need (Suarez & Linnerooth-Bayer, 2011) thereby reducing their benefits towards disaster mitigation.

In contrary, other CAT bond payouts can only be released to countries that have initially submitted adaptation investment plans dictating the intended use thereby reducing inefficiencies in disaster mitigation (ARC,2018).

Furthermore, the data used to determine whether a country receives a pay-out from the bonds often comes from private sources, leaving the system vulnerable and open to manipulation (Miller & Keipi, 2005). Studies have also shown that it can take a while to determine whether the country is eligible or not thus do not provide timely support and hence impedes minimization of losses. Other studies however dispute the same, citing that there is transparency of the trigger events (Porth et al., 2015). Comparing the same to indemnity payments, they argue that the disbursements are quick since they are linked to an independently evaluated trigger.

2.4 Summary of the Literature/Critique of the Literature

It is almost evident from the review of literature that pre-disaster finance assists in disaster mitigation through moderating the impact of disasters, however, research has suggested that increased mitigation and preventive measures will only reduce future damages up to a certain point (Linnerooth-Bayer & HochrainerStigler, 2015; Miller & Keipi, 2005, 2005; F. Vorhies, 2012). Although some literature has managed to highlight this phenomenon, some studies are still oblivious of the time frame on the effectiveness of pre-disaster finance on disaster mitigation (Ishikagi et al., 2015; Twigg, 2015).

In the pursuit of risk reduction, most initiatives have been cited to fail in achieving desired outcome, with minimum impact on capacity building and vulnerability reduction due to the short-term orientation of the interventions (Bendimerad, 2003). Also, studies have shown that less developed countries have higher incidences of deaths as well as economic losses as a percentage of GDP despite their investment in disaster mitigation (Bendimerad, 2003; Edmonds & Noy, 2018). This brings out issues of location and context in pre-disaster financing which is not captured by most studies.

Positively, studies have managed to capture and align certain types of pre-disaster finance to certain natural hazards (Coronese et al., 2019; Lazamanana et al., 2015; Watson et al., 2015). This assists in efficient resource allocation and most importantly in saving lives and safeguarding communities. However, it has not been clear, and no consensus have been reached on the required level of investment for such mechanisms in order to achieve a certain level of mitigation. Partial exception is Chakrabarti (2013) who highlighted that 1% of total country budget is the standard dedicated budget allocation towards disaster mitigation, yet no related benefit was attached to this.

Another issue is on residual risk, where it is not cost effective to prevent or mitigate all the risks despite the mix of instruments used in both pre-disaster and post-disaster financing (Grislain-Letrémy, 2018). Most studies have captured this (Chantarat et al., 2013; Vincent et al., 2018; Witt & Lill, 2017), but none has managed to address how countries should maneuver when faced by such in order to reduce disaster losses. Similarly, most literature has failed to express the linkages between the two and how they complement one another.

On the other hand, in highlighting the effectiveness of pre-disaster financing on disaster mitigation studies have minimally expressed the opportunity cost aspect. Instead of paying for large losses, states can incrementally reduce future losses by proofing infrastructure, improving early warning systems and critical facilities (Edmonds & Noy, 2018; Shyam, 2015; F. Vorhies, 2012). Using cost benefit analysis approaches and numerating this would go a long way in advocating for pre-disaster finance as such can save lives, protect development gains and preserve economic output.

2.5 Research Gaps

Insignificant research has been done on public investment towards disaster mitigation in Eastern and Southern Africa. Most studies have been towards post disaster financing (Cretney, 2016; Jackson, 2011; Labadie, 2008; Rey et al., 2017), donor financing for disaster mitigation (Coughlan de Perez et al., 2015; Kellett & Caravani, 2013; Russell, 2018; Scott,

2015), and private disaster mitigation financing (Chandra et al., 2016) . In line, Gordon (2013) and Kellet and others (2014) cited a scarcity of research on national financing of disaster mitigation, with specific emphasis on low-income and high-risk countries.

Although national financing has been cited as the most important in disaster mitigation (De la Poterie & Baudoin, 2015; Pearson & Pelling, 2015), only a few studies have a focus on SSA (Gordon, 2013). Furthermore, what is currently known about public investment for disaster mitigation is mostly from self-assessment documentation. Most studies that have been done in pre-disaster financing have been from Asia, Island states and coastal countries maybe because of their propensity to disasters (Chakrabarti, 2013; Coronese et al., 2019; Ishikagi et al., 2015; Lazamanana et al., 2015; Watson et al., 2015).

Table 2.1: Summary of research gaps

Author	Title	Findings	Research Gap
Adeniyi et al. (2016)	Review of finance and investment in disaster resilience in the built environment	Findings point at the shift towards financing disaster resilience through corporate social responsibility and public private partnership with direct savings in economic losses	Study only focused on structural effects of disaster and not the other important issues of total deaths and people affected by disasters
Benson & Clay (2002)	Bangladesh: Disasters and Public Finance	Findings indicate that effects of disaster shocks diminished due to investment in embedded budget allocations like food safety net operations.	Research mainly focused on implications of disasters on the public finance and economic loss in Bangladesh and did not investigate the effect on total deaths and number of people affected by the disasters.
Lazamanana et al. (2015)	Public Investment Planning and Financing Strategy for	Study concluded that a risk layering approach was to be used in order to reap the	Study focused on one country and was a case study, therefore not taking into account the

	Disaster Risk Reduction: Review of Madagascar	benefits of pre disaster public finance since other mechanisms can be co-effective with intensive risks and others with extensive.	benefits derived from panel data analysis like generalization.
Benson & Twigg (2004)	Measuring Mitigation: Methodologies for assessing natural hazard risks and the net benefits of mitigation–A scoping study	Findings indicate that numerous benefits flow to investors when they finance measures of risk identification, monitoring and evaluation including safeguarding of project assets.	Although the study brought out the cost benefit approach of viewing the benefit of financing disaster mitigation, it focused on project level mitigation and not country level.

2.6 Conceptual Framework

The interaction of variables in the study is depicted in the conceptual framework below.

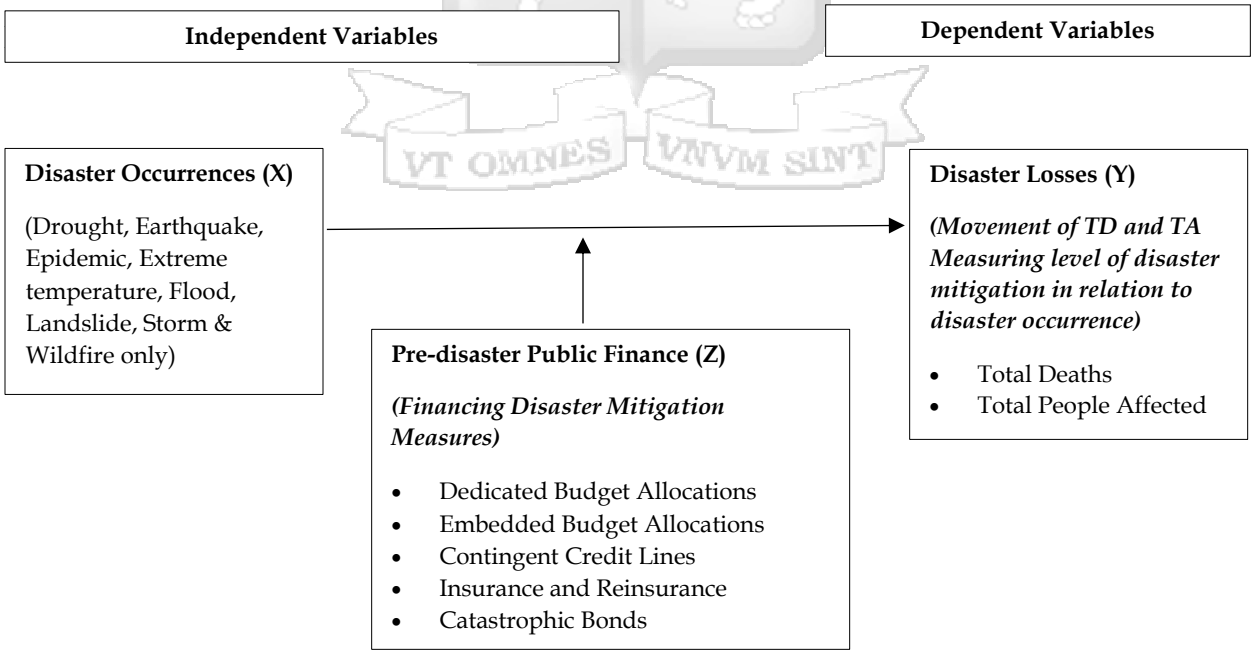

Figure 2.1: Conceptual framework for pre-disaster public finance and disaster mitigation

The study is interested in whether the relationship between the occurrence of disasters (X) and the resulting disaster related losses (Y) is affected by the level and type of pre-disaster public finance (Z).

2.7 Discussion of the Variables

There are two (2) study dependent variables namely total deaths and total affected (total people affected by disasters) to measure the effects of disasters. These, and total economic loss, which is not part of the study, represent the primary objectives of any disaster mitigation intervention and therefore essential to keep them at the forefront of any mitigation measures (Jamieson, 2016). Total economic losses were not included as part of the study due to the scarcity of the data and its unreliability. Most studies in disaster risk reduction and mitigation cite the unreliability of economic losses from disasters due to lack of standards and guidelines for estimating the costs of disasters. Most importantly, assessments are cited to be done by individuals on site often with limited or no prior specialist training (Benson and Twigg, 2004).

The operationalization of variables as found in Table 2.2 below, highlights how the study defined and measured variables, the sources as well as previous studies that have used similar approaches. The pre-disaster public finance mechanisms, as moderating variables (dedicated budget allocations, embedded budget allocations, contingent credit lines, insurance and reinsurance and catastrophic bonds) are all expected to have an inverse relationship with the relationship between disaster occurrences and disaster mitigation measurement variables (total death and total affected). This is based on many studies that highlighted that investing in disaster mitigation leads to reduced deaths and reduced number of affected (Padli et al., 2018, 2019; Shyam, 2015).

Table 2.2: List and operationalization of variables used in the study

Variables	Measures of Variables	Description and In-study definition	Supporting Literature	Source
Disaster	Disaster Occurrence *(DO)*	The number of times droughts, earthquakes, epidemics, extreme temperatures, floods, landslides and storm occurred between 2005 and 2019	(Darwanto, 2012; Dhar Chakrabarti, 2012; Jackson, 2011; Jose, 2012)	Centre for Research on the Epidemiology of Disasters (EM-DAT)
Disaster Mitigation	Total Deaths *(TD)*	The number of people who lost their lives and those reported missing, as a variable to measure level of disaster mitigation	(Padli et al., 2018; Petterson & Ray-Bennett, 2018)	Centre for Research on the Epidemiology of Disasters (EM-DAT)
	Total Affected *(TA)*	The number of people requiring immediate assistance during a period of emergency, used as a variable to measure level of disaster mitigation	(Kellett & Caravani, 2013; Padli et al., 2019; Twigg, 2015)	Centre for Research on the Epidemiology of Disasters (EM-DAT)
Pre-Disaster Public Finance	Dedicated Schemes (DS)	The total amount if 100 percent of the allocations are earmarked for DRR either as	(Darwanto, 2012; Dhar Chakrabarti, 2012; Jose, 2012) .	Country Program Based Budgets

	a budget line or a stand-alone fund to measure pre-disaster public finance		Collaborative Africa Budget Reform Initiative (CABRI)
Embedded Schemes (ES)	The total amount not specifically earmarked for DRR, but still contain elements of vulnerability reduction and promotes a cause of risk reduction to measure pre-disaster public finance	(Darwanto, 2012; Dhar Chakrabarti, 2012; Jackson, 2011; Jose, 2012)	Country Program Based Budgets Collaborative Africa Budget Reform Initiative (CABRI)
Contingent Credit Line (CCL)	The maximum possible amount available to be drawn down based on the credit agreement shown on a year-to-year reducing balance basis to measure pre-disaster public finance	(D. Clarke et al., 2016; Miller & Keipi, 2005)	Country Budgets, Financial Institutions Publications and ARTEMIS Database
Insurance and Reinsurance *(IR)*	The total amount paid in premiums based on parametric measures, modelled losses or indemnity cover to measure pre-disaster public finance	(Miller & Keipi, 2005; Talbot & Barder, 2016)	Country Budgets, Financial Institutions Publications and ARTEMIS Database
Catastrophic Bonds *(CB)*	The maximum possible amount available to be paid out to a specific country when the facility is triggered based on the contract	(Lazamanana et al., 2015; Miller & Keipi, 2005)	Country Budgets, Financial Institutions Publications and ARTEMIS Database

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The chapter covers the type of research philosophy, research design, populations and sampling methods in the initial stages. It goes on to define the data collection methods that were used, how data research quality was enhanced, the data analysis techniques employed and lastly the ethical considerations in the research.

3.2 Research Philosophy

The study followed a positivism research philosophy. The reason behind this classification is that data collected for the study was quantifiable, leading to statistical analyses on the relationship between pre-disaster public finance and disaster mitigation. Conclusions and recommendations are measurable. This resonates with most studies as the researcher is completely objective and independent of the research (Saunders et al., 2012).

3.3 The Research Design

The study followed a descriptive research design approach using panel data analysis. This included multiple variables for analysis, to survey the effect of pre-disaster public finance on the relationship between disaster occurrences and disaster mitigation. As used by Padli and Habibullah (2008), a correlation study primarily seeks to describe relationships among variables, without establishing causal relationships. The study therefore used regression models in determining the relationship between the occurrence of disasters and the resulting disaster related losses in moderation with the level and type of pre-disaster finance.

3.4 Population and Sampling

The target population for the study were 27 Eastern and Southern African countries (Appendix B). The reason why this region was considered is because studies have shown that over the past decade, countries within the regions have been more susceptible to

natural hazards more than the other regions (Relief Web, 2018) and have been suffering vast losses due to the same. Through non-probability purposive sampling, a homogeneous sample was selected to come up with 6 out of the 27 countries in the region. Kenya, Uganda, South Sudan, South Africa, Zambia and Zimbabwe had registered disasters and disaster losses over the study period and hence satisfied the selection criteria.

The study started from the year 2005 to date because of the adoption of the Hyogo Framework of Action (HFA) in 2005. The HFA was a blueprint policy adopted by over 168 countries towards disaster risk reduction and mitigation. One of its main goals was to improve on the domestic-disaster financing efforts to substantially reduce disaster losses (Olowu, 2010). Hence the study covered a period of 15 years, from 2005 to 2019, both years inclusive. Important to note, the study did not focus on the effects of the HFA, rather the fact that most countries made commitments to invest in disaster mitigation at that point in time, made it possible to track the financing as states had clear budget lines for disaster financing.

3.5 Data Collection Methods

The study in its entirety utilized secondary data from various sources, namely Country Program Based Budgets, Financial Institution Publications, Artemis database and EM-DAT database. The data collection process included the following; searching and collecting, checking, compiling, classifying, measuring, accounting and analyzing the existing certified documentation. Review and analysis of Country Program Based Budgets followed a Disaster Risk Sensitive Public Finance Review Protocol (Appendix A). The method is a hybrid approach, adopted from three different studies with the objective of tracking budget allocations for disaster management (Chakrabarti, 2013; Dhar Chakrabarti, 2012; Miller & Keipi, 2005). It involved a systematic critical review of allocations for disaster mitigation through identifying the elements that have potential

for risk reduction and was applied evenly and objectively throughout the data collection process.

3.6 Data Analysis

To determine the relationship between disaster occurrences, moderating variables pre-disaster public finance and disaster mitigation, the study estimated two sets of panel regressions following models as below;

$$\boldsymbol{ln}\mathbf{TD}\boldsymbol{it} = \beta 0 + \beta 1\mathrm{DO}it + \beta 2ln\mathrm{DS}it + \beta 3ln\mathrm{DS}^{*}\mathrm{DO}it + \beta 4ln\mathrm{ES}it + \beta 5ln\mathrm{ES}^{*}\mathrm{DO}it + \beta 6ln\mathrm{CCL}it + \beta 7ln\mathrm{CCL}^{*}\mathrm{DO}it + \beta 8ln\mathrm{IR}it + \beta 9ln\mathrm{IR}^{*}\mathrm{DO}it + \beta 10ln\mathrm{CB}it + \beta ln11\mathrm{CB}^{*}\mathrm{DO}it + \varepsilon it \quad \textbf{(1)}$$

$$\boldsymbol{ln}\mathbf{TA}\boldsymbol{it} = \beta 0 + \beta 1\mathrm{DO}it + \beta 2ln\mathrm{DS}it + \beta 3ln\mathrm{DS}^{*}\mathrm{DO}it + \beta 4ln\mathrm{ES}it + \beta 5ln\mathrm{ES}^{*}\mathrm{DO}it + \beta 6ln\mathrm{CCL}it + \beta 7ln\mathrm{CCL}^{*}\mathrm{DO}it + \beta 8ln\mathrm{IR}it + \beta 9ln\mathrm{IR}^{*}\mathrm{DO}it + \beta 10ln\mathrm{CB}it + \beta ln11\mathrm{CB}^{*}\mathrm{DO}it + \varepsilon it \quad \textbf{(2)}$$

Where *i* denotes country 1, 2, 3…n, *t* denotes the time period in years, εit is the error term and *ln* denote the natural logarithm of the variables used in the study. The measurement of the effects of disasters as a proxy for disaster mitigation used the total number of deaths (TD) and total number of people affected by disasters (TA) emanating from all recorded natural hazards. For the moderators, (DS) is dedicated budget allocation schemes; ES embedded budget allocation schemes, (CCL) is contingency credit line, (IR) is insurance and reinsurance and (CB) is the catastrophe bond. The regressor is Disaster Occurrence (DO), which is the number of times any natural disaster occurred in the country of interest over the demarcated time period. Therefore, $ln\mathrm{DS}^{*}\mathrm{DO}it$ is the logarithm of the interaction of disaster dedicated budget allocation schemes and disaster occurrences, and the explanation is true for the other four moderating variables. All

economic variables were expressed in the relative value of 2010 United States Dollars (USD) amount using the Consumer Price Index (CPI)[1].

As highlighted, panel regression techniques were employed to estimate the model. To decide between fixed or random effects a Hausman Test was run where the null hypothesis was that the preferred model is random effects and the alternative the fixed effects.

3.7 Research Quality – validity, reliability and objectivity of the research

As appropriate for scientific research, diagnostic tests to ensure validity, reliability and objectivity were carried out. These are tests for normality, stationarity, autocorrelation, multicollinearity, heteroscedasticity as well as tests for serial correlation. To confirm that the regressions are not spurious, tests for stationarity were performed using the Augmented Dickey Fuller test.

Normality tests were conducted with the objective of determining whether the data set followed a normal distribution which is a key to the use and interpretation of the regression model. To test for normality the Jarque Bera tests was conducted for all dependent and independent variables.

The test for autocorrelation was performed to establish whether residuals are correlated across time, with assumptions requiring that residuals should not be correlated across time. In order to test for correlation, the Durbin – Watson test was conducted. The Durbin-Watson tests produces a test statistic that ranges from 0 to 4. Values close to 2 (the middle of the range) suggest less autocorrelation, and values closer to 0 or 4 indicate greater positive or negative autocorrelation respectively. In addition to the test for autocorrelation, a test for heteroscedasticity was also carried out. Assumptions stipulate that residual of a model should have constant variance.

[1] 2010 Constant Dollar Value was calculated as FYDV x (CPI2010 /CPIi), where: FYDV is First year dollar value, CPI2010 is Consumer price index for base year and CPIi is Consumer price index for the year under study.

In order to safeguard against unreliable coefficients in the resultant model as a result of high standard errors and confidence intervals, tests for multicollinearity were conducted. In the study, multicollinearity was tested using Variance Inflation Factors (VIF). The purpose of calculating VIF statistic is to determine the level of multicollinearity that can be tolerated without presenting any interpretive problems in the regression analysis.

3.8 Ethical Considerations

The study used secondary data entirely, therefore reducing the interaction between the study and ethical risk. Data used was validated, published and open for use given appropriate citations. To address data confidentiality and access concerns, this research made use of publicly available secondary data sets from certified online portals and registered government publishers. No living organisms' subjects were required for this study. The researcher acquired the necessary approvals from SU-IERC under the Code of Ethics of Strathmore University (Appendix C) and satisfied the National Commission for Science, Technology and Innovation (NACOSTI) requirements (Appendix D).

CHAPTER 4: DATA ANALYSIS, FINDINGS AND INTERPRETATION

4.1 Introduction

This chapter precedes the conclusions and recommendations of the study highlighting the research findings obtained from the data analysis.

4.2 Summary and Description of the Study Variables

An unbalanced panel: n = 6, T = 9-15, N = 83, was used for this study. It comprised of two (2) dependent variables Total Deaths (*ln*TD*it*) and Total Affected (*ln*TA*it*), one independent variable Disaster Occurrence (DO*it*) and five (5) moderating variables Dedicated Budget Allocation (lnDSit), Embedded Budget Allocation (lnESit), Contingency Credit Line (lnCCLit), Insurance and Reinsurance (lnIRit) and Catastrophe Bond (lnCBit) (dropped due to collinearity). Table 4.1 below shows panel descriptive statistics for the independent, moderating and dependent variables.

Table 4.1: Descriptive Statistics for the independent, moderating and dependent variables

Statistic	N	Mean	St. Dev	Min	Max
Disaster Occurrences (Do*it*)	83	2.4	1.9	0.0	9
Total Deaths (*ln*TD*it*)	83	124.5	474.0	0.0	4,276
Total Affected (*ln*TA*it*)	83	711,528.2	1,580,121.0	0.0	8,150,692
Dedicated Budget Allocation (*ln*DS*it*)*	83	18,286,457.0	32,971,229.0	2,056	154,093,049
Embedded Budget Allocation (*ln*ES*it*)*	83	138,008,938.0	160,362,653.0	84,610	611,000,852
Contingency Credit Line (*ln*CCL*it*)*	83	2,669,741.0	17,093,409.0	0.0	110,794,233
Insurance and Reinsurance (*ln*IR*it*)*	83	237,631.4	857,850.4	0.0	3,549,052

**Amount in 2010 USD CPI*

The brief statistics above show an interesting trend, with the bulk of pre-disaster public finance being channeled through embedded budget allocations, and the least through insurance and reinsurance given the averages of 138 million and 238 thousand respectively. Contingency credit lines and insurance and reinsurance are shown as the least favored form of financing for Eastern and Southern Africa, possibly attributed to the complexity of the mechanism and also the types of disasters that occur in the region (Kellett & Caravani, 2013; Padli et al., 2019; Twigg, 2015).

There is high variability of financing towards disaster mitigation across the region, given the high standard deviation from the mean on all pre-disaster public finance mechanisms. However, the case is not the same for disaster occurrence which the statistics indicate that they occur almost evenly across the region with a standard deviation from the mean of 1.9. The maximum number of disaster occurrences in a year was 9, indicating a high frequency of disasters, with almost every month witnessing a disaster. There is high variability in the number of deaths recorded from disasters and on the number of people affected by disasters. Indicative of the nature of disasters associated with the region, being creeping and complex emergencies (Lukamba, 2010).

4.3 Results of Diagnostic Tests

4.3.1 Stationarity

To address stationarity in the data set, all the transformed variables were subjected to a stationarity test using the Augmented Dickey Fuller Test. The null hypothesis is that there is a unit root, whilst the alternative is that the data is stationary. Using *R*, the first differences of the non-stationary variables were tested on the two models, with a lag order of 2 and found to be stationary.

Table 4.2: Test for Stationarity results using

	Dickey-Fuller Statistic	Lag Order	P-value
Total Deaths (*ln*TD*it*)	-3.4133	2	0.0589
Total Affected (*ln*TA*it*)	-3.9654	2	0.01528

4.3.2 Normality

The Jarque Bera test for normality determines the skewness and kurtosis of a data set on whether it matches a normal distribution. The measurement of the test is always a positive number and if it is far from zero, it indicates that the sample data does not have a normal distribution. The rule under the Jarque Bera test is that if the P-value is greater than 0.05, then the dataset is from a normal distribution, which was the case in this study.

Table 4.3: Test for Normality results

X-Squared	DF	P-value
1.0765	2	0.5838

4.4 Panel Model Estimation

4.4.1 Fixed effects vs. Random effects

To decide between fixed and random effects the Hausman test was used. It denotes that, the null hypothesis is that the unique errors are not correlated with the regressors. Thus, if the p-value is less than 0.05, fixed effects method is used and vice versa. The tests retained a p-values less than 0.05 therefore leading to accept the test's null hypothesis indicating that the fixed effects model was to be adopted for the study.

Table 4.4: Hausman test results for fixed or random effects

	Chi-square	P-value
Total Deaths (lnTDit)	5.9783	0.0000039657
Total Affected (lnTAit)	8.08865	0.000000048199

4.4.2 Panel Regression

4.4.2.1 Panel Regression for Disaster Occurrence, Pre-Disaster Finance and Total Deaths

The results discussed here are related to the regression model below:

$$\boldsymbol{ln}\mathbf{TD}\boldsymbol{it} = \beta 0 + \beta 1 \mathrm{DO}it + \beta 2 ln \mathrm{DS}it + \beta 3 ln \mathrm{DS}^{*}\mathrm{DO}it + \beta 4 ln \mathrm{ES}it + \beta 5 ln \mathrm{ES}^{*}\mathrm{DO}it + \beta 6 ln \mathrm{CCL}i + \beta 7 ln \mathrm{CCL}^{*}\mathrm{DO}it + \beta 8 ln \mathrm{IR}it + \beta 9 ln \mathrm{IR}^{*}\mathrm{DO}it + \varepsilon it$$

Results as presented in Table 4.5 below, indicate that disaster occurrence has a positive relationship with total number of people affected at 5% level of significance (thus, when disasters occurrences increase, the number of people affected also increase). This denotes the exclusive effect of DO*it* on *In*TD*it* only when pre-disaster finance is equal to zero. The interaction shows an inverse relationship between dedicated budget allocations and total deaths when there is no disaster (DO*it* = 0) at 1% level of significance and an unexpected amplifying effect to the causal relationship of DO*it* on *In*TD*it* when disasters occur, at 5% level of significance. Also, the interaction shows a positive relationship between embedded budget allocations and total deaths when there is no disaster (DO*it* = 0) at 1% level of significance and an expected inverse correlation to the causal relationship of DO*it* on *In*TD*it* when disasters occur, at 5% level of significance.

The results, with Standard Errors (SEs) in parentheses below estimated coefficients, were as follows:

Table 4.5: Panel Regression model results (Total Deaths, *ln*TD*it*)

	Using Robust SEs
Intercept (β0)	-3.214**
	(1.500)
Disaster Occurrence (DO*it*)	1.649**
	(0.699)
Dedicated Budget Allocation (*ln*DS*it*)	-0.251***
	(0.076)
Interaction of Dedicated Budget Allocation and Disaster Occurrence	0.053**
(*ln*DS*DO*it*)	(0.024)
Embedded Budget Allocation (*ln*ES*it*)	0.486***
	(0.099)
Interaction of Embedded Budget Allocation and Disaster Occurrence	-0.103**
(*ln*ES*DO*it*)	(0.042)
Contingency Credit Line (*ln*CCL*it*)	-0.124
	(0.419)
Interaction of Contingency Credit Line and Disaster Occurrence	0.047
(*ln*CCL*DO*it*)	(0.122)
Insurance and Reinsurance (*ln*IR*it*)	0.131
	(0.209)
Interaction of Insurance and Reinsurance and Disaster Occurrence	-0.032
(*ln*IR*DO*it*)	(0.068)
Goodness of Fit statistics:	
R-squared	0.565
Adj R-squared	0.511
Chisq	10.530***
P-value	0.000000000292

***p<0.1; **p<0.05; ***p<0.01**

This means that Dedicated Budget Allocations strengthen the positive relationship between Disaster Occurrence and Total Deaths, hence an increase in the number of deaths is noticed when the budget allocations are increased. At the same time, Embedded Budget Allocations weaken the positive relationship between Disaster Occurrence and Death, hence a reduction in the number of Deaths is noticed when the budget allocations are increased.

The other coefficients and their interactions (Contingency Credit Line and Insurance and Reinsurance) are not statistically significant and therefore not interpreted for this study.

The R-squared of *0.565* from the regression analysis, indicates that Dedicated Budget Allocation, Embedded Budget Allocation, Contingency Credit Line and Insurance and Reinsurance account for 56.5% of the variance in Total Deaths when natural disasters occur.

Results are to be explored further in the next chapter under discussions, conclusions and recommendations. The resulting regression equation was;

$$\ln TD_{it} = -7.265 + 5.178*DO_{it} - 0.161*\ln DS_{it} + 0.046*\ln DS*DO_{it} + 0.851*\ln ES_{it} - 0.238*\ln ES*DO_{it} - 0.805*\ln CCL_{i} + 0.254*\ln CCL*DO_{it} + 0.797*\ln IR_{it} - 0.214*\ln IR*DO_{it} + \varepsilon_{it}$$

4.4.2.2 Panel Regression for Disaster Occurrence, Pre-Disaster Finance and Total Affected

The results, with Standard Errors (SEs) in parentheses, below estimated coefficients are as follows:

Table 4.6: Panel regression model results (Total Affected, *ln*TA*it*)

	Using Robust SEs
Intercept (β0)	-7.265**
	(3.573)
Disaster Occurrence (DO*it*)	5.178***
	(1.666)
Dedicated Budget Allocation (*ln*DS*it*)	-0.161
	(0.180)
Interaction of Dedicated Budget Allocation and Disaster Occurrence	0.046
(*ln*DS*DO*it*)	(0.057)
Embedded Budget Allocation (*ln*ES*it*)	0.851***
	0.467
Interaction of Embedded Budget Allocation and Disaster Occurrence	-0.238**
(*ln*ES*DO*it*)	(0.100)
Contingency Credit Line (*ln*CCL*it*)	-0.805
	(0.999)
Interaction of Contingency Credit Line and Disaster Occurrence	0.254
(*ln*CCL*DO*it*)	(0.290)
Insurance and Reinsurance (*ln*IR*it*)	0.797
	(0.499)
Interaction of Insurance and Reinsurance and Disaster Occurrence	-0.214
(*ln*IR*DO*it*)	(0.162)
Goodness of Fit statistics:	
R-squared	0.577
Adj R-squared	0.525
Chisq	11.05
P-value	0.0000000001143

***p<0.1; **p<0.05; ***p<0.01**

The results discussed here are related to the regression model below:

$$\boldsymbol{ln}\mathbf{TA}\boldsymbol{it} = \beta 0 + \beta 1\text{DO}it + \beta 2ln\text{DS}it + \beta 3ln\text{DS*DO}it + \beta 4ln\text{ES}it + \beta 5ln\text{ES*DO}it + \beta 6ln\text{CCL}i + \beta 7ln\text{CCL*DO}it + \beta 8ln\text{IR}it + \beta 9ln\text{IR*DO}it + \varepsilon it$$

Results as presented in Table 4.6 above, indicate that disaster occurrence has a positive relationship with total number of people affected at 1% level of significance (thus, when disasters occurrences increase, the number of people affected also increase). This denotes the exclusive effect of DO*it* on *In*TA*it* only when pre-disaster finance is equal to zero. The interaction shows a positive relationship between embedded budget allocations and total number of people affected when there is no disaster (DO*it* = 0) at 1% level of significance and an expected inverse correlation to the causal relationship of DO*it* on *In*TA*it* when disasters occur, at 5% level of significance.

This means that Embedded Budget Allocations weaken the positive relationship between Disaster Occurrence and Total Affected, hence a reduction in the number of people affected is noticed when the budget allocations are increased. The other coefficients and their corresponding interactions (Dedicated Budget Allocations, Contingency Credit Line and Insurance and Reinsurance) are not statistically significant and therefore not interpreted for this study.

The R-squared of *0.577* from the regression analysis, indicates that Dedicated Budget Allocation, Embedded Budget Allocation, Contingency Credit Line and Insurance and Reinsurance account for 57.7% of the variance in total people affected when natural disasters occur.

Results to be explored further in the next chapter under discussions, conclusions and recommendations. The resulting regression equation was;

$$\boldsymbol{ln}\mathbf{TA}\boldsymbol{it} = (-7.265) + 5.178\text{*DO}it + (-0.161)\text{*}ln\text{DS}it + 0.046\text{*}ln\text{DS*DO}it + 0.851\text{*}ln\text{ES}it + (-0.238)\text{*}ln\text{ES*DO}it + (-0.805)\text{*}ln\text{CCL}i + 0.254\text{*}ln\text{CCL*DO}it + 0.797\text{*}ln\text{IR}it + (-0.214)\text{*}ln\text{IR*DO}it + \varepsilon it$$

4.3.3 Heteroscedasticity

The study tested for heteroscedasticity using the Breusch Pagan Test using the fitted values of the models where the null hypothesis is that the variance is constant. A P-value less than a significance level of 0.05, calls the study to reject the null hypothesis (the variance of the residuals is constant and confirms the presence heteroscedasticity) and vice versa. The non-constant variance score tests for the two models as indicated show a P-value greater than 0.05 therefore indicating the absence of heteroscedasticity.

Table 4.7: Test for Heteroscedasticity results

	Breusch-Pagan	DF	P-value
Total Deaths (*ln*TD*it*)	10.787	14	0.7027
Total Affected (*ln*TA*it*)	11.083	14	0.6795

4.3.4 Multicollinearity

Multicollinearity in a data set is when at least two predictor variables are correlated. It becomes a problem when this association exceeds a certain degree, usually set at a Variance Inflation Factor (VIF). The rule states that a VIF > 5 suggests collinearity. Only one moderating variable was dropped (Catastrophe Bond, *ln*CB*it*), using the "alias" package in *R* to locate and eliminate the source of the collinearity. Running the test again after dropping the variable, the VIF of the remaining variables were as below.

Table 4.8: Test for Multicollinearity results

(DO*it*)	(*ln*DS*DO*it*)	(*ln*ES*DO*it*)	(*ln*CCL*DO*it*)	(*ln*IR*DO*it*)
1.847202	1.271193	1.595607	7.260321	3.447664

The model has a high VIF of 7.3, this is at least partially attributable to the moderating variable responsible for the high VIFs. Even after centering of

variables. However other studies accept a VIF of 10 as the maximum level (Hair et al., 1995).

4.3.5 Correlation Analysis

The study used the Durbin-Watson test for serial correlation in panel models with a test statistic that ranges from 0 to 4. Values close to 2 suggest less autocorrelation, and values closer to 0 or 4 indicate greater positive or negative autocorrelation respectively. Therefore, the models show less autocorrelation given the results below.

Table 4.9: Correlation Analysis Results

Regression Model	Durbin-Watson Statistic	P-value
Total Deaths (*ln*TD*it*)	1.5315	0.01221
Total Affected (*ln*TA*it*)	1.9166	0.3116

CHAPTER 5: DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The final chapter highlights the discussion and conclusions of the study anchored on the research findings obtained from the data analysis. Furthermore, it provides both policy and practice implications of the study under the recommendations and highlights limitations to the study as well as proposing areas of further research based on the same.

5.2 Discussion

The purpose of the study was to determine whether the relationship between the occurrence of disasters and the resulting disaster related losses (a) total deaths (TD) and (b) total people affected (TA) is affected (moderated) by the level and type of pre-disaster finance namely; (a) dedicated budget allocations, (b) embedded budget allocations, (c) insurance and reinsurance, (d), contingent credit lines and (e) catastrophic bonds (variable dropped due to multicollinearity). The dependent variables were; making two different models, all researching on the effect of pre disaster public finance mechanisms on disaster mitigation. Specific findings per mechanism are discussed below.

5.2.1 Disaster Occurrence, Dedicated Budget Allocations and Disaster Mitigation

Regression results in table 4.5 show that dedicated budget allocation has a positive correlation with the interaction between disaster occurrence and total deaths, with no statistical significance. This indicates that when a country's dedicated budget allocation towards disaster mitigation increased, there is no noted change in the relationship between total deaths recorded and disaster occurrence, although it has the propensity to strengthen that positive relationship.

Regression results in table 4.6 show that dedicated budget allocation has a positive correlation with the relationship between disaster occurrence and total number of people affected as recorded, yet without any statistical level of significance.

The above regression results are not congruent with most studies which suggested that by financing disaster mitigation through dedicated budget allocations, lesser people are affected, and lives are saved (Owens et al., 2003; Twigg, 2015). This also fails to relate to both theories of development and public goods, which propose that with increased investments in disaster related public goods, and disaster risk sensitive development, there is increased adaptive capacity and therefore improved disaster mitigation.

5.2.2 Disaster Occurrence**,** Embedded budget allocations and Disaster Mitigation

Regression results in table 4.5 show that embedded budget allocation has an inverse relationship with the positive relationship between disaster occurrence and total deaths at a 5% level of significance. This indicates that when an increase in the occurrence of disasters, the increase in the embedded allocations can reduced the negative impact of the same disaster which could have caused higher deaths if the allocations where not there.

Also, as anticipated, regression results in table 4.6 above show that embedded budget allocation has an inverse correlation with the relationship between disaster occurrence and total people affected on a 5% level of significance. This indicates that when a country's embedded budget allocation towards disaster mitigation are increased, it weakens the positive relationship between disaster occurrence and disaster losses, hence leads to a reduction in the number of people affected by disasters.

The results from the study are in line with most studies, which state that pre-disaster financing through embedded allocations reduced the disruption to life and

economic activity that disasters cause (De la Fuente, 2010; Goes & Skees, 2003; Miller & Keipi, 2005). The studies cited that the proactive nature of embedded allocations reduces future disaster damages as well as reduce the risk to human life (Miller & Keipi, 2005). This also relates to both theories of development and public goods, as increased investments in disaster related public goods, and disaster risk sensitive development reduces disaster losses.

However other studies are not aligned to these findings, as they highlight that this mechanism is not sufficient if the regulatory environment is underdeveloped and poorly enforced (Jackson, 2011), therefore, loss mitigation in terms of economic and human losses might be less effective given the context in which the pre-disaster finance through embedded allocations is administered and also the severity and frequency of the disasters.

5.2.3 Disaster Occurrence, Contingent Credit Lines and Disaster Mitigation

Regression results in table 4.5 show that contingent credit lines mechanism has an unexpected positive correlation with the positive relationship between disaster occurrence and total deaths, though without any statistical level of significance. This indicates that when a country's contingent credit lines for disaster mitigation increased, there would be a noted increase in the total deaths recorded from a natural disaster.

Regression results in table 4.6 show that contingent credit lines mechanism has an unexpected positive correlation with the relationship between disaster occurrence and total affected, though without any statistical level of significance. This indicates that when a country's contingent credit lines for disaster mitigation increased, there would be a noted strengthening of the positive relationship between the two variables, hence an increase in the total number of people affected by a natural disaster.

Previous studies noted that, since contingent credit is disbursed quickly there is significant reduction in the number of people affected, which is contrary to these findings (Lazamanana et al., 2015; Miller & Keipi, 2005). In line with the regression results also are studies which concluded that the mechanism did not completely minimize the number of lives lost and people affected but only assisted to recover quickly from a disaster and promote long term disaster mitigation (Tanner et al., 2015; Twigg, 2015) thus if a longer period would have been studied, perhaps the benefits of contingent credit lines would have been noticeable.

5.2.4 Disaster Occurrence, Insurance and Reinsurance and Disaster Mitigation

Regression results in table 4.5 show that insurance and reinsurance mechanisms have an inverse correlation with the positive relationship between disaster occurrence and total deaths, though without any statistical level of significance.

Regression results in table 4.6 show that insurance and reinsurance mechanisms have an expected negative correlation with the relationship between disaster occurrence and total deaths, though without any statistical level of significance.

Contrary to the findings Weingärtner and others (2017) concluded that the mechanism does not prevent deaths but only compensated for covered direct losses thereby reducing long-term and indirect disaster impacts. In contrast, the ARC (2018) maintains that due to the early pay-outs, lives and livelihoods are saved as evidenced in the study. In turn, other studies argued that through parametric models, pay-outs can go out at the earliest trigger thereby minimizing the number of deaths (as evidenced by study though not significant) and the number of people affected (in contrary to study) highlighting that insurance instruments might be effective with creeping disasters but not sudden hazards (Miles, 2017; Takahashi et al., 2016).

5.3 Conclusions

It is evident from the study that embedded budget allocation has an inverse moderating effect on disaster losses due to disaster occurrence, hence the best disaster mitigation pre-disaster financing mechanism, as it reduced overtime the total deaths and total number of people affected by disasters. On the other hand, dedicated budget allocations and contingent credit lines showed lesser capacity in reducing the negative effects of natural disasters.

Furthermore, although insurance and reinsurance financing were only available in one country (Kenya) significant disaster mitigation capacities were noticeable given the weakening effect on the positive relationship between disaster occurrence and total deaths. The study also validates the point that, the financing of disasters through insurance and other proactive mechanisms is indeed a new phenomenon. Recent initiatives however have been made by the ARC, DRFI, ADRF on the African continent to assist in this case.

The research therefore concludes that embedded budget allocations as a pre-disaster public financing mechanism is highly effective in minimizing the effect of disaster occurrences on total deaths and number of people affected.

5.4 Recommendations

5.4.1 Policy Implications

With the increase in the severity and frequency of hazards faced by the region, the first policy recommendation is to concretize disaster mitigation financing as a development policy priority, accompanied by an increase in budget allocations to these principal programmes. Countries should also endeavor to strengthen and institutionalize these policies in order to get much from such investment.

Aligned to other studies (Martinez-Diaz et al., 2019), disaster risk finance instruments, including embedded schemes and insurance and reinsurance validated to mitigate disaster effects should be used in combination with other instruments following a "risk-layering" policy. Only Kenya was found to have this approach, however there is need to adopt other mechanisms including CAT bonds. Although the study did not observe the existence of CAT bonds in the six countries in Eastern and Southern Africa, it is evident from studies (Dickson, 2018) that state that the mechanism will go a long way in mitigating climate related disasters. In the study focusing on the pricing of CAT Bonds in Kenya, Kungu (2018) concluded that through their adoption, government will be in a better position to respond to such shocks, and therefor reduce the related losses.

5.4.2 Practice Implications

Even countries with vigorous disaster risk management policies can still be highly exposed to shocks caused by major natural disasters. This emanates from the failed role of governments in coordinating their response and administrative challenges that often inhibit them to be proactive and operate in more efficient ways (ARC, 2015).

Practice recommendations include prioritizing the identifying and documentation of country needs and priorities as fundamental to disaster risk financing. This will lead to the designing and implementing of disaster risk financing policies, instruments and strategies aligned to the specific country (GFDRR, 2019). The recommendation comes in view of the noted increase in disaster risk financing without the corresponding decrease in disaster related losses.

5.5 Areas for further research

The study did not focus on the sources of funds allocated for disaster mitigation despite being distributed through the national treasury. It was noted through literature that although allocations were increasing internationally, most were

through official development assistance. Further research should be done to highlight the level of domestic against foreign mobilized funding as this indicates on the resilience and self-sufficiency of the institutions. Future study should also seek to divide between long and short-term implications of pre disaster public financing and measure the value for money of each mechanism against the other to quantify this study's findings.

5.6 Limitations of the study

Out of 27 countries in East and Southern Africa, the study only focused on 6 countries for a maximum 15 year period, therefore it was limited by a small dataset which was also unbalanced due to missing observations, mainly on country budgets which were not available for public consumption. It was not possible to do economic loss analysis, being a major indicator on disaster mitigation, due to missing data and unreliability of the same, therefore there is need for future studies to collect more economic loss data or proxies thereof, to study their effect on the relationship between disaster occurrences and disaster losses.

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Appendices

Appendix A: Criteria for tracking Dedicated and Embedded Schemes Budget Allocations

Step 1: Select Countries in Eastern and Southern Africa according to the United Nations Subregions of Africa.

Step 2: Purposely sample the countries from the set with disaster loss data (deaths, affected and economic losses) over the study period

Step 3: Data Collection

a. Collect full annual national budgets, insurance, contingency credit lines and catastrophic data for the selected countries from Ministries of Finance and Economic Planning websites and Government Printers Financial Institutions Publications and Artemis Database
b. Collect disaster impact data from Centre for Research on the Epidemiology of Disasters - CRED

Step 4: Define what should be assessed

c. Coverage: Only National Data will be considered
d. Budget or Expenditure: Planned Expenditure will be considered
e. Current or Capital: Both current and Capital Planned Expenditure will be considered
f. Targeted Hazards: A multi-natural hazard approach will be considered

Step 5: Classify Budget line items and other finance mechanisms

a. Mark as "Dedicated" if eligibility criteria of DS-1 below is met
b. Mark as "Embedded" if eligibility criteria of ES-1 to ES-5 below is met
c. Do not mark if the objective does not meet any eligibility criteria

Criteria for tagging Pre-Disaster Public Financing for Disaster Mitigation

#	Category Description	**Fund, Budget line, Ministry or Program**	**Amount allocated (per fiscal year)**

a) Dedicated Schemes: Allocations that are 100% dedicated to disaster mitigation.

These will be taken from Approved Budget expenditure figures for the current year.

DS-1	Funds and schemes that have the objective of understanding risk, minimizing exposure and reducing vulnerability in their entirety.

b) Embedded Schemes: Allocations that are less than 100% dedicated to disaster mitigation but are related to disaster risk management and contribute directly and indirectly to reduce vulnerabilities and enhance capacities and thereby contribute to the reduction of the risks of disasters.

These will be taken from Approved Budget expenditure figures for the current year.

ES-1	Schemes that promote research and provide services for assessment, analysis and early warning of hazards and risks in different sectors;
ES-2	Schemes that seek to provide education and skill and enhance information and awareness to promote a culture of resilience among communities;
ES-3	Schemes whose objectives are to mitigate the risks of disasters;
ES-4	Schemes that are directly targeted to reduce social and economic vulnerabilities;
ES-5	Schemes that reduce the burden of payment on producers and consumers in certain sectors, which **include** a large section of vulnerable population

c) Contingent Credit Lines

CCL-1	The maximum possible amount available to be drawn down based on the credit agreement shown on a year-to-year reducing balance basis as approved by the Financial Institution offering the product.

d) Insurance and Reinsurance

IR-1	The maximum possible amount available to be paid out based on parametric measures, modelled losses or indemnity cover

e) Catastrophic Bonds

CB-1	The maximum possible amount available to be paid out to a specific country when the facility is triggered based on the contract.

Step 5: Collate and Analyze

Appendix B: Countries in East and Southern Africa

Angola	Botswana	Burundi	Comoros	Djibouti
Eritrea	Eswatini	Ethiopia	Kenya	Lesotho
Madagascar	Malawi	Mauritius	Mozambique	Namibia
Reunion	Rwanda	Seychelles	Somali Land	Somalia
South Africa	South Sudan	Sudan	Uganda	United Republic of Tanzania
Zambia	Zimbabwe			

Source: Centre for Research on the Epidemiology of Disasters (EM-DAT)

Appendix C: Strathmore University Ethical Approval

Strathmore UNIVERSITY

23rd June 2020

Mr Maguchu, Kudzanayi
christian.maguchu@strathmore.edu

Dear Mr Maguchu,

RE: Effect of Pre-disaster Public Finance on Disaster Mitigation in Eastern and Southern Africa

This is to inform you that SU-IERC has reviewed and **approved** your above research proposal. Your application approval number is **SU-IERC0837/20.** The approval period is **23rd June 2020 to 22nd June 2021.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

for. Dr Virginia Gichuru,
Secretary; SU-IERC

STRATHMORE UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE (SU-IERC)
23 JUN 2020
TEL: +254 (0)703 034 000
P.O. Box 59857 - 00200
NAIROBI - KENYA

Cc: Prof Fred Were,
Chairperson; SU-IERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email info@strathmore.edu www.strathmore.edu

Appendix D: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **789606**

Date of Issue: **13/July/2020**

RESEARCH LICENSE

This is to Certify that Mr.. Kudzanayi Christian Maguchu of Strathmore University, has been licensed to conduct research in Nairobi on the topic: Effect of Pre-Disaster Public Finance on Disaster Mitigation in Eastern and Southern Africa for the period ending : 13/July/2021.

License No: **NACOSTI/P/20/5635**

789606

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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