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INSTITUTIONS AND DISASTER LOSSES IN LOWER-MIDDLE-INCOME COUNTRIES: A DYNAMIC PANEL DATA APPROACH

Abina V P∗ and Meenakshi Rajeev∗∗

Abstract

With the growing global concern over disaster risks, research on disaster vulnerability has expanded significantly. However, much of the existing literature continues to focus on development indicators as the primary determinants of vulnerability, often overlooking the critical role of institutions in shaping disaster outcomes. This gap is particularly evident in the context of lower-middle-income countries (LMCs), which are among the most affected in terms of human losses from natural disasters. Therefore, this study seeks to address this gap by examining the role of institutions in determining disaster impacts in LMCs by employing annual data of 47 countries for the period 2000 to 2023. Using a system GMM approach, this study reveals that while exposure remains a critical factor in exacerbating human losses from natural disasters, institutional effectiveness can significantly offset these adverse effects. In particular, strong governance, active civil society participation and effective foreign aid can substantially reduce disaster impacts, even in highly exposed contexts. In this context, the findings underscore that disaster mitigation in LMCs is not merely a technical challenge, but fundamentally a matter of governance and institutional capacity. Building resilient communities requires a holistic approach that integrates sound economic policies, institutional reforms, active community participation, and the strategic use of international assistance.

JEL Classifications: O1, Q54

Keywords: Natural disasters, Human losses, LMCs, Good governance, Civil society, Foreign aid, Generalised method of moments.

Introduction

Natural disasters are not new to human life, but their impact has intensified, posing significant threats to societies and economies worldwide. The risks associated with these events are shaped by the interaction between hazardous occurrences and the society's level of exposure and vulnerability. Historically, disasters with low probability but high intensity, such as rare floods or earthquakes, have underscored the importance of exposure in determining disaster losses. However, recent shifts in disaster trends indicate that natural hazards are occurring with high probability and are often beyond human control. This has brought vulnerability to the forefront as a critical factor in understanding the growing impacts of such events, which are shaped largely by socio-economic development and the quality of institutions (UN ISDR, 2004; IPCC, 2020).

The literature that concentrates on the determinants of vulnerability has predominantly focused on development indicators such as income (Bertrand, 1993; Benson, 1997; UNDP, 2001; Freeman *et al*,

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2003; Wildavsky, 1998; Horwich, 2000; Leek, 1999; Toya, 2013; Freeman, 2003), human capital (Toya and Skidmore, 2007; Padli *et al*, 2018), trade openness, financial stability (Skidmore & Toya, 2007; Mercer & Reed, 2015), inequality (Anbarci, 2005; Escaleras & Register, 2005), etc. But sometimes countries having similar economic development and affected by disasters of the same magnitude are experiencing differentiated impacts. For example, a 6.8 Richter scale earthquake killed 2700 people in Algeria[1] in 2003, whereas, in Iran in 2002, the same magnitude earthquake caused only 261 deaths. This is primarily attributed to the high preparedness measures and pre-quake institutions at Iran (Anbarci *et al*, 2005). Also, it indicates that in the context of less developed countries, along with development, political factors like quality of institutions also have the equal potential to influence the disaster losses.

Moreover, the Intergovernmental Panel on Climate Change (IPCC) has recognised the role of institutions, particularly the significance of governance in shaping societies' vulnerability to natural disasters. Governance affects all the three components of risk by shaping policies, regulations, and institutional capacities that manage and reduce disaster risks (UN ISDR, 2004; IPCC, 2012; Kusumasari, B., & Alam, Q., 2012). Apart from that, the active engagement of civil society organisations can expedite recovery and reconstruction by promoting local participation and ensuring that community needs are effectively communicated and integrated into national recovery strategies. (Barone, G., & Mocetti, S., 2014). However, the role of institutions, particularly the role of governance and civil society organisations in disaster mitigation at the macro-cross-country level remains an underexplored area, especially in the context of lower middle-income countries (LMCs).

In light of this, the present study aims to examine this relationship more thoroughly. This study builds on the existing but limited literature (see, for example, Kahn (2005) that explored the role of institutions in determining disaster impacts). We extend our research in three significant directions. Firstly, methodologically, we employ a dynamic panel data method using system GMM approach under the assumption that countries preparedness will be also determined by the past losses from natural disasters as well. Secondly, we construct an overall governance index by combining six individual governance indicators, rather than analysing them separately as done in previous studies (Skidmore & Toya, 2010; Register, M., 2012; Yamamura, E., 2012). This composite index provides a more comprehensive measure of governance quality and helps capture its broader influence on disaster outcomes. Lastly, unlike most studies that use disaster-induced mortality as the dependent variable (Kahn; 2005; Raschky 2007; Padli. et.al, 2018), we measure disaster severity using human losses by combining the number of people affected and killed with appropriate weights.

To explore this relationship, the study has employed annual data of 47 LMCs for the period 2000 to 2023. These countries, which have a similar range of income levels, account for the highest share in terms of natural disaster occurrences and their immediate impacts (EM-DAT, 2023). Between the periods 2000 to 2023, out of the total number of natural disasters, 30% of them occurred in LMCs and it accounts for 49% of total disaster induced mortalities and 41% of total people affected by natural disasters (EM-DAT, 2023). In line with the existing literature, the study has found that LMCs characterised by quality governance with relatively high income per capita, experience fewer human losses from natural disasters.

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[1]   Algeria has a per capita income of $5,260, while Iran's per capita income stands at $4,502.

Though exposure remains as a critical factor in exacerbating human losses from natural disasters, institutional effectiveness can significantly offset these adverse effects. Against this backdrop, the present paper unfolds as follows: the next section discusses some of the existing studies that have investigated the role of institutions in determining disaster impacts, followed by the conceptual framework. Subsequently, it addresses the data and methodology, followed by a discussion on the empirical results and finally presents conclusions, and policy implications.

A Brief Literature Review on the Role of Institutions in Determining Disaster Impacts

The degree to which a country is getting affected by natural disasters primarily depends upon its exposure and vulnerability to such events. Though the proximity to natural disasters is determinied by the inherent natural hazard risk associated with the geographical location, vulnerability to such events is mainly driven by socio-economic factors (Kahn, 2005; Kellenberg and A. Mobarak, 2011). The existing, but limited literature highlights that economic development and institutional quality are two key factors that significantly influence vulnerability to natural disasters, and the associated human and physical losses (Anbarci, 2004; Kahn, 2005; Barone, G., & Mocetti, S., 2014).

Studies has found that in disaster mitigation, higher institutional quality leads to shorter recovery periods and faster reconstruction efforts. Moreover, the quality institutions ensure efficient allocation of aid that can result in productive outcomes (Barone, G., & Mocetti, S., 2014). Further, it has been observed that countries with less corruption, greater accountability, and stronger democratic governance tend to experience less severe impacts from such events (Strömberg, 2007). Particularly in the case of developing economies, government efficiency plays a crucial role in disaster mitigation and recovery. That is because people in developing nations generally believe that the government will take the initiative to reduce the disaster risk and reconstruction activities. In most of the cases, they believe that it is the sole responsibility of the governmnet to undertake the reconstruction activities (Buchnan,1975; Waldman,1991; Freeman, 2003).

Both Central and local government play a significant role in reducing disaster impacts. Coordination between different levels of government will ensure the proper implementation of disaster management policies at various levels and easy rescue operations. In this regard, recently, most of the countries have started giving more decentralised power to local government to deal with disaster events (Kusumasari, B., & Alam, Q., 2012). Moreover, A strong local government can expedite recovery and reconstruction through active local participation and by aligning local recovery plans with national strategies (Barone, G., & Mocetti, S., 2014; Bardhan, 2002; Escaleras and Register, 2012; Toya, 2013).

The existing literature suggests that while natural disasters cannot be prevented, collective efforts by quality institutions can significantly reduce future disaster risk (Anbarci, 2004; Kahn, 2005; Barone & Mocetti, 2014; Di Macrober Ardino, 2024). Despite its importance, the role of institutions in disaster risk reduction remains an underexplored area in disaster research. While some studies have explored the interaction between institutional quality and disaster losses, their findings vary due to differences in methodology, country selection, and the variables considered. For example, Kahn (2005) examined the impact of institutional quality on earthquake death tolls, using ethnic fragmentation, the

income Gini coefficient, and democracy as measures. Similarly, Raschky (2008) analysed the role of institutions in determining fatalities and economic damages from natural disasters by considering factors like government stability and investment climate in the context of major natural disasters from 1984 to 2004. Further, Raddatz, 2005 and Strömberg, D, 2007, have also contributed to this discussion by using government effectiveness and democracy indices as a measure of institutional quality. However, there is a gap in the literature regarding an empirical analysis specifically focused on lower-middle-income countries that incorporates a comprehensive set of variables. While studies have included variables such as democracy, ethnic fractionalisation, and inequality, an overall good governance index has not been widely considered, particularly in cross-country comparisons. Moreover, the role of civil society organisations is often overlooked, as existing research tends to focus on developed countries due to data limitations.

Conceptual Framework

The present study utilises the IPCC risk framework to provide a comprehensive understanding on factors determining disaster impacts in LMCs. While not considering all factors outlined by the IPCC, the study aligns with its principles by examining how the quality of institutions can influence exposure and vulnerability, ultimately affecting disaster outcomes.

Figure 1: Role of Institutions in Shaping Disaster Outcomes
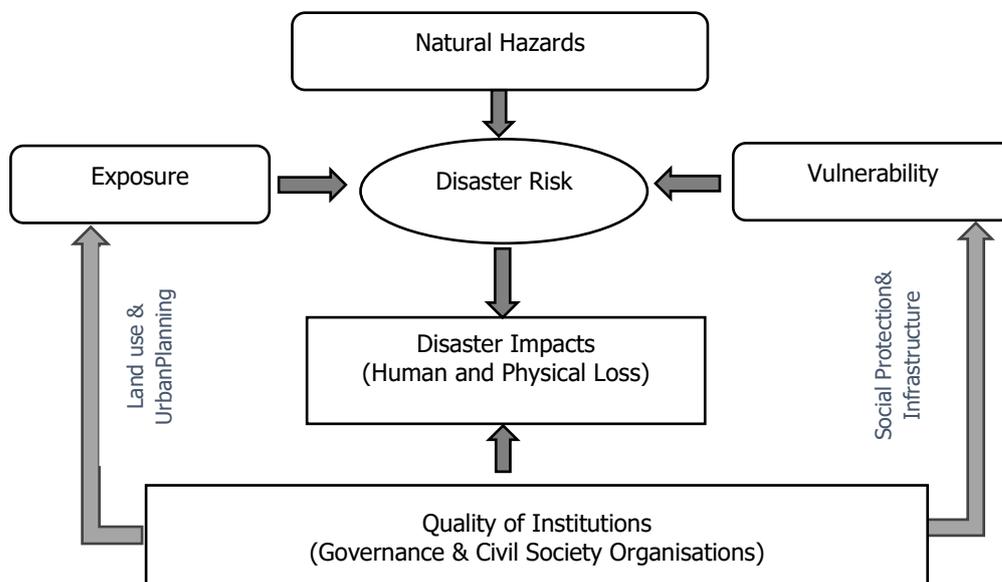
Source: Author's Construction Using IPCC AR6 Risk Framework

The IPCC has developed a comprehensive risk framework that provides a structured approach for analysing disaster impacts. It has divided the components of risk into three categories: hazard, exposure, and vulnerability, and indicates that disaster impacts are not only determined by hazardous events but also by society's exposure and vulnerability to these events. A hazard is the potential

occurrence of a natural event, while exposure and vulnerability combine to form the impacts of these events.

Institutions, particularly governance systems and civil society organisations, play a crucial role in shaping disaster outcomes by influencing the core components of risk by formulating policies, regulations, and institutional capacities. Effective governance ensures the proper implementation of land use regulations, environmental management policies and urban planning strategies that can significantly limit population and asset exposure to hazard-prone areas. Further, civil society organisations often act as an intermediary between the state and the vulnerable populations, ensuring that disaster risk reduction measures are inclusive and locally grounded. They help enhance community awareness, promote participatory planning, and deliver targeted social protection interventions. Moreover, investments in critical infrastructure, early warning systems, and social safety nets, when guided by good governance and strengthened by civil society engagement, can substantially lower vulnerability to natural disasters.

Methodology

Description and Sources of Data

This dataset comprises yearly data of 47 LMCs for the period 2000-2023[2]. The data related to natural disaster occurrence and impacts are taken from Emergency Events database (EM-DAT) maintained by the Centre for the Research on the Epidemiology of Disasters (CRED) at the Universite catholique de Louvain in Belgium. EM-DAT is a global database of natural and technological disasters. It covers more than 26000 disasters worldwide, spanning from 1900 to the present date. The database records the country level human and economic losses for disasters meeting specific criteria, such as 10 or more fatalities, 100 or more affected individuals, declarations of emergency, or a call for international assistance (EM, DAT, 2023).

Through literature review, we have found out several factors that determine a country's exposure and vulnerability to natural disasters. Factors like the frequency of natural disasters, population density, and percentage of coastal population account for a country's exposure to natural disasters. GDP per capita is taken as a measure of the country's adaptive capacity to natural disasters. We would like to introduce a model for individual disaster types. But it presents a challenge. A significant portion of our already limited sample would need to be excluded, because some countries did not experience certain types of disasters during the period we are analysing.

Our major variable of interest is the quality of institutions measured by the worldwide governance indicators and the civil society participation rate. The worldwide governance indicators include six key dimensions of governance, such as bureaucratic quality, voice and accountability, regulatory quality, rule of law, government effectiveness, and control of corruption. Given the presence of high pair-wise correlation among these variables, an overall good governance index is constructed by using principal component analysis (PCA). Descriptive statistics of the variables, the correlation matrix, and a brief

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[2] We do not consider natural disasters that occurred in these countries before 2000 because EM-DAT states that data before 2000 are considered historical data, which is subject to bias (EM, DAT, 2023).

description of the data are provided in Appendices 2, 3, and 4 respectively, while Appendix 5 presents the results of the PCA analysis.

Quantification of Natural Disasters

In the present study, we quantify the severity of natural disasters based on human loss (HL), using the following Equation 1.

$$HL_{it} = \frac{(0.3*people\ affected\ +\ 0.7*mortalities)}{population\ t-1}*100 \dots\dots\dots\dots\dots\dots Eq.1$$

Unequal weights are assigned to each indicator based on its relative importance. Greater weight (0.7) is given to fatalities, while a lesser weight (0.3) is assigned to people affected owing to the following reasons. Firstly, total people affected by natural disasters include people who are missing, injured and homeless. However, assessing injuries can be challenging, especially since the definitions are often ambiguous because it ranges from minor to severe. (Caldera & Wirasinghe, 2022; Cavallo *et al*, 2022). Secondly, mortality is easy to define and the population is more sensitive to disastrous events with high fatalities.

Although EM-DAT provides data on the damage costs of natural disasters, there is suspicion that this data may be reported with bias. EM-DAT admits that there is no standard procedure for calculating it, and it is usually recorded based on relief and recovery expenditures. Furthermore, there is a chance that very low-income countries may inflate damage costs to attract more foreign assistance. Consequently, many researchers have abstained from using this as a measure of severity, even though it could be a good indicator (Cavallo *et al*, 2022).

Empirical Methodology

We specify the following dynamic panel data model under the assumption that a country's preparedness to natural disaster is also influenced by the disaster losses from the previous year.

$$Ln\ (HL_{it}) = \alpha\ NDI_{it-1} + \beta1\ X_{it} + \beta2\ Z_{it} + \eta_i + \epsilon_{it} \dots\dots\dots\dots\dots\dots\dots\dots Eq.2$$

Here, HL_{it} denotes the human losses from natural disasters and is used as a measure of disaster severity. X_{it} represent a set of explanatory variables which includes good governance index[3], civil society participation rate, GDP per capita, income inequality and foreign aid. Further, Z_{it} represents a set of control variables used in the analysis (such as, population density, percentage of coastal population, and frequency of natural disasters). Whereas, η_i captures time-invariant individual-specific effects and ϵ_{it} accounts for random shocks that vary across time and countries.

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[3] The index is the weighted aggregate of six governance indicators, such as rule of law, political stability, voice and accountability, government effectiveness, regulatory quality, and control of corruption. Due to the high pairwise correlation, PCA assigns weights to these variables based on their contribution to total variance, capturing the key dimensions of governance quality. Based on Kaiser criterion, the study has retained the first principal component whose eigen value is greater than 1 and explains more than 70% of the data variation. Further, KMO (Kaiser-Meyer-Olkin) is used to test the sampling adequacy. In this study, the KMO index is coming greater than 0.75 indicates the data set is suitable for PCA. Appendix 5 presents the correlation matrix of these variables and the results from the PCA analysis.

Endogeneity problems will arise when lagged dependent variables are included as explanatory variables. Generalised Method of Moments (GMM) estimators offer a robust approach to address this issue. Both difference GMM and system GMM methods are designed to address short panel[4] data. However, difference GMM is not appropriate for unbalanced panels, as it widens the gaps in the data as a result of first differencing process. Whereas, system GMM by Arellano–Bover/Blundell–Bond resolve this issue by incorporating an additional assumption that the first differences of instrumental variables are uncorrelated with the fixed effects. This allows for the inclusion of more instruments, thereby significantly enhancing efficiency. Instead of subtracting the previous observation from the current one, this method subtracts the average of all future available observations. This approach ensures that the transformation is computable for all observations except the last for each individual, thereby minimising data loss (Roodman, D., 2006).

In the light of this, the present study has employed the system GMM approach suggested by Arellano, M., & Bover, O. (1995) and Blundell, R., & Bond, S. (1998). Both one-step and two-step estimations are employed to improve the reliability of parameter estimates. The one-step method provides initial estimates using a basic covariance matrix. However, it may not fully account for heteroscedasticity and autocorrelation. The two-step method builds on these initial estimates by using a refined covariance matrix, adjusted for these issues, resulting in greater efficiency and more accurate standard errors. Further, Hansen test is conducted for checking the validity of the instruments. Failure to reject the null hypothesis in the Hansen test indicates that instruments are not correlated with the error term.

Results and Discussion

Tables 1 presents the results of a series of regressions using annual data of 47 LMCs for the period 2000-2023. Columns 1 presents the estimated coefficients of Eq.2, using two-step system GMM with the key explanatory and control variables. Columns 2 and column 3 show the estimated coefficients of the same equation by incorporating certain additional variables considered in the existing literature (Kahn, 2005; Raschky 2007; Skidmore & Toya, 2007; Padli, J. *et al*, 2013) for checking the robustness of our results.

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[4]   Small T and large N, meaning few years and many countries.

Table 1: Institutions and Human Losses from Natural Disasters: System GMM Regression

Variables (Dependent variable: log (Human Losses from Natural Disasters))	Two Step System GMM Results		
	1	**2**	**3**
Log of HL$_{t-1}$	-0.0865***	-0.0337**	-0.0766***
	(0.0101)	(0.0149)	(0.011)
Good Governance Index	-0.5343***	0.4239**	-0.3847**
	(0.0936)	(0.1530)	(0.1893)
Civil Society Participation Rate	-1.2851**	-1.2566**	-1.7861*
	(0.4114)	(0.4127)	(1.1063)
Log (GDP Per Capita)	-0.5961***	-1.6998	-0.6714*
	(0.1628)	(1.1378)	(0.3952)
Log (Size of Government)	-	0.9255**	-
		(0.3740)	
Log (Trade Openness)	-	-0.8649	-
		(0.8918)	
Log (Investment)	-	-0.961***	-
		(0.510)	
Log (Years of Schooling)	-	-1.345***	-
		(1.214)	
Foreign Aid	-	-	-0.4008**
			(0.2044)
Income Inequality	-	-	0.0206***
			(0.0148)
Total count of natural disasters	0.2130***	0.1818***	0.1875***
	(0.0437)	(0.0336)	(0.0418)
Log (Population Density)	0.098	0.713* (0.227)	0.802*
	(0.318)		(0.312)
Coastal population	0.0349***	0.0870***	0.0397***
	(0.0091)	(0.0316)	(0.0118)
Number of observations	1081	1081	1081
Number of groups	47	47	47
Probability >chi2	0.000	0.000	0.000
AR (1) p- value	0.000	0.000	0.000
AR (2) p- value	0.561	0.559	0.733
Period Fixed Effect	Yes	Yes	Yes
Regional Fixed Effect	Yes	Yes	Yes
Hansen test p-value	0.354	0.262	0.492

Source: Author's Estimation by Using Secondary Data.

Notes: *, ** and *** shows 10%, 5% and 1% level of significance respectively. Robust standard errors (corrected for heteroscedasticity using White correction) are given in parentheses.

The estimated coefficients from Equation 2 establish that LMCs characterised by quality governance, high levels of civil society participation, lower income inequality, and substantial foreign aid suffer less from natural disasters. It underscores the critical role that effective governance plays in mitigating the effects of natural disasters. Better governance enhances bureaucratic efficiency, leading to improved service delivery and more effective implementation and execution of disaster management policies. Particularly in the context of less developed countries, including LMCs, infrastructure development, such as roads, transportation networks, and building standards is primarily carried out by the government. Therefore, a more effective and transparent government can successfully implement these infrastructure projects, ultimately helping to reduce human loss by natural disasters.

Apart from governments, civil society organisations and national and international aid agencies play crucial roles in disaster response and recovery. The negative and statistically significant coefficients

of the civil society participation rate and foreign aid variables support this argument, suggesting that greater involvement of these actors contributes to reducing the adverse impacts of natural disasters by mobilising resources, raising awareness, delivering timely assistance, and bridging gaps in state capacity. Moreover, the negative and significant coefficients of the one-period lag of disaster impacts indicate that countries' preparedness increases when they experience substantial disaster loss in the previous year.

Also, the analysis reveals that GDP per capita, years of schooling, investment, and trade openness exhibit negative and statistically significant coefficients. This finding adds to the argument in existing literature that safety increases with an increase in the level of income (Kahn, 2005; Horwich, 2000; Mobarak D. K., 2011; Toya, 2013). Additionally, alongside income, improved human capital and overall economic development significantly enhance disaster mitigation outcomes. The literature consistently highlights that a well-informed and educated population is better equipped to cope with disasters, as they are more responsive to early warning systems and other preventive measures (Skidmore & Toya, 2007; Padli *et al*, 2013; Mercer & Reed, 2015). This study further contributes to the existing body of research by supporting the view that safety is a natural by-product of a growing market economy (Wildavsky, 1998). In particular, greater trade openness fosters innovation and facilitates the adoption of advanced technologies, which in turn support risk reduction and disaster preparedness (Skidmore & Toya, 2007; Mercer & Reed, 2015).

Moreover, the positive and significant relationship between government size and human loss (at the 5% level) suggests that countries with smaller governments tend to experience lower disaster-related losses. Although findings in the literature remain mixed, our results align with the arguments of Skidmore and Toya (2007) and Mercer and Reed (2015), who contend that leaner governments may be more effective in managing disaster risks due to reduced bureaucratic complexity, faster decision-making, and improved coordination.

However, the positive and statistically significant coefficients of the frequency of natural disasters, population density, and the percentage of the coastal with disaster impacts signifies that a country's exposure to natural disasters significantly contributes to an increase in disaster losses. This suggests that a higher percentage of the population living in coastal areas, greater population density, and increased frequency of disasters lead to a higher exposure to natural disaster risk, thereby increasing the proportion of the population affected by natural disasters.

The results in Table 1 indicate that institutions play a significant role in reducing disaster impacts. However, exposure also plays a vital role in increasing these impacts. This raises an important question: how can the impact of governance reduce human losses in the presence of high exposure to natural disasters? To address this, the subsequent table 2 incorporates interaction terms between the frequency of natural disaster occurrences and key explanatory variables such as governance quality, foreign aid, civil society participation rate, and the Gini coefficient. These interaction terms are included to examine whether the effect of governance on disaster outcomes varies with the frequency of disaster events.

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Table 2: Institutions and Human Losses from Natural Disasters: System GMM Regression

Variables (Dependent variable: log (Human Losses from Natural Disasters))	System GMM Regression Results			
	1	2	3	4
Log HL$_{t-1}$	-0.0691***	-0.0809***	-0.0591***	-0.0800***
	(0.0126)	(0.0144)	(0.0134)	(0.0112)
Good Governance Index	-1.6237***	-0.3946**	-0.5813**	-0.5514**
	(0.4171)	(0.1944)	(0.2263)	(0.2568)
Civil Society Participation Rate	-1.6144	-2.9479	-1.1824*	-1.5511**
	(1.7503)	(2.3789)	(0.7916)	(0.9563)
Log (GDP Per Capita)	-0.3300*	-0.6766**	-1.0567**	-1.1035**
	(0.1698)	(0.4184)	(0.4581)	(0.4735)
Foreign Aid	-0.3098**	-0.3437*	-0.4138	-0.2487
	(0.0788)	(0.1758)	(0.4237)	(0.1979)
Income Inequality	0.0723***	0.0275*	0.0217*	0.0579*
	(0.0260)	(0.0151)	(0.0125)	(0.0393)
Frequency of natural disasters	0.3571*	0.8791**	3.2634	1.0145*
	(0.2079)	(0.4116)	(2.5904)	(0.5546)
Log (Population Density)	0.1031	0.0939	0.0311	0.1594
	(0.1041)	(0.1067)	(0.1279)	(0.1204)
Coastal population	0.0320*	0.0462***	0.0307*	0.0404***
	(0.0183)	(0.0156)	(0.0162)	(0.0130)
Frequency of natural disasters × Good Governance Index	-0.4997***	-	-	-
	(0.1525)			
Frequency of natural disasters × Civil Society Participation Rate	-	-0.8979*	-	-
		(0.5446)		
Frequency of natural disasters × Foreign Aid	-	-	-0.1469	-
			(0.1242)	
Frequency of natural disasters × Income Inequality	-	-	-	0.0317**
				(0.0147)
Number of observations	1081	1081	1081	1081
Number of countries	47	47	47	47
Probability >chi2	0.000	0.000	0.000	0.000
AR(1) p- value	0.000	0.000	0.000	0.000
AR(2) p- value	0.571	0.644	0.558	0.465
Period Fixed Effect	Yes	Yes	Yes	Yes
Regional Fixed Effect	Yes	Yes	Yes	Yes
Hansen test p-value	0.404	0.441	0.432	0.232

Source: Author's Estimation using secondary data

Notes: *, ** and *** shows 10%, 5% and 1% level of significance respectively. Robust standard errors (corrected for heteroscedasticity using White correction) are given in parentheses.

The negative and statistically significant coefficients of the interaction terms between civil society participation rate, good governance index, and foreign aid with the frequency of natural disasters suggest that these institutional and support mechanisms play a moderating role in reducing disaster impacts in highly exposed countries. In other words, in contexts where natural disasters occur more frequently, countries with stronger governance, active civil society engagement, and higher levels of foreign aid tend to experience lower human and economic losses. Conversely, the positive and significant coefficient of the interaction term between the Gini coefficient and disaster frequency implies that higher income inequality exacerbates the adverse effects of frequent disasters. This indicates that in more unequal societies, disaster impacts are likely to be more severe.

Conclusion

In recent years, natural disasters have become increasingly frequent and severe in LMCs. However, the underlying factors contributing to the adverse impacts of these events have received relatively limited scholarly attention, particularly the role of institutions in shaping disaster outcomes in this region. Therefore, this study examines how institutional quality, along with other socio-economic factors, influences the impacts of natural disasters in LMCs.

The empirical findings of the study reveal that LMCs characterised by quality governance, high levels of civil society participation, lower income inequality, and substantial foreign aid suffer less from natural disasters. Even though exposure to natural disasters intensifies their impacts in LMCs, these effects can be significantly mitigated by strong institutions. Effective governance, active civil society participation, and targeted foreign aid play a crucial role in reducing human losses, even in high-risk environments. Conversely, in more unequal societies, disaster impacts tend to be more severe.

In conclusion, this study highlights the crucial role of institutions in mitigating the adverse impacts of natural disasters. While emphasising the importance of economic resources for mitigation efforts, it equally underscores the critical role of governance, civil society organisations, and foreign aid. Effective disaster mitigation, therefore, requires coordinated efforts between governments and civil society organisations to implement collaborative and inclusive disaster management strategies.

Policy Implication

In the light of these findings, it is evident that addressing disaster resilience in LMCs requires a multifaceted approach. Aligned with the priorities set out in the Hyogo and Sendai Frameworks, this study underscores the need to improve institutional quality to effectively mitigate disaster impacts. Transparent and accountable institutions are essential for integrating Disaster Risk Reduction into national and local development strategies. Empowering local governments through decentralisation can enhance responsiveness and adaptability, while robust legal and regulatory frameworks, such as enforcement of building codes and risk-informed land-use planning can significantly reduce vulnerability. Additionally, early warning systems and public awareness initiatives, supported by reliable institutions, are key to improving preparedness and community resilience, particularly in regions with high disaster exposure.

Further, Effective disaster mitigation requires a coordinated effort between civil society organisations and central governments. Civil society organisations should focus on strengthening community resilience and promoting grassroots participation, while central governments play a vital role in implementing risk-informed land-use planning regulations and providing financial resources. By recognising the complementary roles of civil society and the state, and implementing collaborative policies, countries can better mitigate the impacts of disasters and support sustainable development.

Moreover, the study highlights the importance of effectively channelling foreign aid to mitigate disaster impacts. Well-targeted foreign aid can help reduce social and economic disparities, strengthen disaster response mechanisms, and support the adoption of climate-resilient practices, thereby minimising the severity of natural disasters. Furthermore, strengthening disaster response systems through external support aligned with national priorities can significantly improve a country's ability to cope with and recover from disasters.

Taken together, these recommendations emphasise that disaster resilience is not solely a technical challenge but a governance and institutional one. Building resilient communities in LMCs requires integrated efforts that combine sound economic policies, institutional reform, community engagement, and effective use of international assistance.

Limitations of the Study and Directions for Future Research

The key limitation of the study is that, we are unable to introduce model for individual disaster types, as a significant portion of our already limited sample would need to be excluded because some countries did not experience certain types of disasters during the period we are analysing. Furthermore, the scope of this study is constrained by the use of an overall governance index, due to data limitations. The lack of globally available data, particularly on fiscal decentralisation in less developed countries restricts a deeper focus on the role of local governments. Future research could examine the impact of fiscal decentralisation on disaster mitigation, provided more comprehensive data becomes available.

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Appendix 1

List of countries

Angola	India	Philippines	Pakistan
Algeria	Iran, Islamic Rep	Senegal	Zambia
Bangladesh	Kenya	Solomon Islands	Zimbabwe
Bhutan	Kyrgyz Republic	Sri Lanka	Honduras
Bolivia	Lao PDR	Tanzania	Papua New Guinea
Cabo Verde	Lebanon	Tajikistan	
Cambodia	Lesotho	Timor-Leste	
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Côte d'Ivoire	Myanmar	Vietnam	
Djibouti	Ghana	Nepal	
Egypt, Arab Rep.	Guinea	Nicaragua	
Eswatini	Haiti	Nigeria	

Source: World Bank, 2021

Appendix 2

Descriptive Statistics: *A Sample of 47 LMCs (2000–2024)*

Variables	Obs.	Mean	Std. Dev.	Min	Max
Human Loss from Natural Disasters	1,128	0.88	2.95	00000065	54.40
Good Governance Index	1128	-1.56	1.03	-1.76	1.45
Civil Society Participation Rate	1128	0.620	0.21	0.07	0.96
GDP per capita	1128	5063	3054	1082	16198
Population Density	1128	120.91	193.34	1.58	1327.76
Coastal population	1128	4.32	6.16	0.00	30.82
Frequency of Natural Disasters	1128	3.25	3.80	1	33
Gini Coefficient	1128	39.61	8.85	8.5	93.6
Foreign Aid	1128	937000000	1350000000	10380000	29300000000

Source: Author's compilation by using EM-DAT database, WDI and other secondary data sources.

Appendix 3

Correlation Matrix

	GDP	Density	Frequency	Elevation	Gini	Aid	Governance	Civil
GDP p.c.	1							
Density	0.018	1						
Frequency	0.06	0.392	1					
Elevation	-0.029	0.190	0.148	1				
Gini	-0.224	-0.189	-0.071	-0.099	1			
Aid	-0.030	0.374	0.189	0.060	-0.209	1		
Governance	0.105	-0.043	0.070	0.267	-0.054	-0.052	1	
Civil	-0.294	0.164	0.158	0.080	0.028	0.268	0.430	1

Source: Author's compilation by using EM-DAT database, WDI and other secondary data sources.

Appendix 4

A Brief Description of Variables and their Expected Effects on Disaster Impacts

Variables	Sign	Description of the variable	Data Sources
Death		Persons confirmed as death and person missing and presumed dead	EM-DAT EM-DAT
Total Affected		Those who seek immediate assistance after a natural disaster. Sum of injured, homeless, and affected	
GDP per capita	_	Gross Domestic Product per capita	WDI[5]
Frequency of N.D	+	Total number of natural disasters occurred in a country during a year	EM-DAT
Coastal Population	+	Population living in areas where elevation is below 5 meters (% of total population)	CIESIN[6]
Population Density	+	Total population of the country divided by land area	UN Population Division
Good governance Index	_	Weighted aggregate of six governance indicators, such as rule of law, political stability, voice and accountability, government effectiveness, regulatory quality, and control of corruption by using PCA	WGI[7]
Civil Society Participation Rate	_	extent to which major civil society organisations are routinely consulted by policymakers, how many people are involved in them, women can participate, and candidate nomination for the legislature within parties is decentralised or made through primaries.	V-Dem
Foreign Aid	_	Net official aid refers to aid flows from official donors to countries and territories in part II of the DAC list of recipients.	World Bank
Gini	+	Measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution.	World Bank, Poverty and Inequality Platform.

Source: Author's compilation by using EM-DAT database, WDI and other secondary data sources

Appendix 5

Principal Component Extracted to Build Governance Index

		PC1	PC2	PC3	PC4	PC5	PC6
	Eigenvalue	3.9401	0.8502	0.5438	0.3496	0.1841	0.1319
	% of variance	65.67	14.17	9.06	5.83	3.07	2.2
	Cumulative %	65.67	79.84	88.9	94.73	97.8	100
Factor Loadings Variables	Control of corruption (C)	0.4487	0.1864	-0.2217	-0.4497	-0.4838	0.5277
	Rule of law (R)	0.4739	0.0009	-0.0907	-0.1611	-0.2631	-0.819
	Regulatory Quality (RQ)	0.3718	-0.5803	0.225	0.58	-0.3249	0.1798
	Government Effectiveness(GE)	0.4129	-0.4082	-0.4105	-0.1658	0.6761	0.0992
	Political Stability (PS)	0.3473	0.6511	-0.2375	0.6041	0.1772	0.0522
	Voice and Accountability (V)	0.3805	0.1948	0.8167	-0.2074	0.3204	0.0678

Extraction Method: Principal Component Analysis.

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[5]   World Development Indicators

[6]   Centre for International Earth Science Information Network

[7]   World-wide Governance Indicators.

Correlation Matrix Governance Indicators

Variables	C	RL	RQ	GE	PS	V
C	1.0000					
R	0.8406	1.0000				
RQ	0.4885	0.6465	1.0000			
GE	0.6874	0.7567	0.6843	1.0000		
PS	0.6386	0.6124	0.2716	0.3797	1.0000	
V	0.6138	0.6592	0.5017	0.4218	0.4901	1.0000

Source: Author's Calculation based on World Wide Governance Indicators, 2024.

Appendix 6

Stationarity & Cointegration Test

	Im-Pesaran-Shin (IPS) Unit Root Test				
	(Assumes Individual Unit Root)				
Variables	**Level**		**First Difference**		**Decision**
	w- Statistics	p value	*w- Statistics*	p value	
Human Loss	-14.492	0.000	-	-	Stationary at level
Civil Society Participation	1.450	0.927	-13.940	0.000	Stationary at first difference
Population Density	-4.620	0.000	-	-	Stationary at level
Coastal Population	-2.740	0.003	-	-	Stationary at level
Frequency of N.D.	-6.687	0.000	-	-	Stationary at level
Government Size	-2.898	0.001	-	-	Stationary at level
GDP per capita	4.040	1.000	-12.630	0.000	Stationary at first difference
Governance Index	-2.998	0.001	-	-	Stationary at level
Gini Coefficient	2.963	0.998	-5.802	0.000	Stationary at first difference
Investment	-2.641	0.004	-	-	Stationary at level
Foreign Aid	-0.581	0.281	-19.402	0.000	Stationary at first difference

Source: Author's Calculation Based on WDI and EM-DAT.

*** Note: The Pedroni panel cointegration test was conducted to examine the presence of cointegration. It fails to reject the null hypothesis of no cointegration, as the Group rho-statistic = -0.646291 (p = 0.2590) and the Panel v-statistic = 1.234386 (p = 0.1085) are statistically insignificant. This indicates that there is no strong evidence of a stable long-run equilibrium relationship among the selected variables over the period 2000–2023.

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