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INSURANCE IN MITIGATING THE FINANCIAL CONSEQUENCES OF NATURAL DISASTERS

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ABSTRACT: The objective of the article is to delineate the role of insurance in alleviating the financial ramifications of natural disasters. To achieve this objective, two research questions were formulated: 1) What are the magnitude and economic implications of natural disasters? 2) How does disaster insurance contribute to the process of asset reconstruction? In preparing the article, the authors conducted a review of literature pertaining to the subject matter and analysed secondary data sourced from reports and publications of international institutions and organisations involved in addressing the financial impact of natural disasters. Limitations of the conducted research include variations in the scale and impact of disasters across different countries, leading to a lack of uniform legal frameworks regarding the utilisation of insurance in mitigating the financial fallout of natural disasters.

KEYWORDS: natural disasters, insurance, financial ramifications, climate change

Introduction

Natural disasters have inflicted significant economic and human tolls throughout history (Kousky, 2014). In 2022 alone, these catastrophes resulted in economic losses amounting to PLN 275 billion (Banerjee et al., 2023). Insurance theoretically holds the potential to play a pivotal role in bolstering resilience against the risks posed by natural disasters. By furnishing the insured with financial protection in the aftermath of such events, insurance can expedite asset reconstruction by furnishing funding and liquidity swiftly post-disaster (Kousky, 2019). Consequently, insurance coverage against natural disasters can represent an efficacious remedy to the issue of losses incurred both at the community level (such as households) and on a broader scale, encompassing the state.

The aim of the article is to delineate the role of insurance in alleviating the financial ramifications of natural disasters. The article seeks to address the following research questions:

1. What are the magnitude and economic implications of natural disasters?
2. How does disaster insurance contribute to the process of asset reconstruction?

The verification of the research questions and the fulfilment of the stated goal were conducted through a critical examination of the literature pertaining to the subject matter. Additionally, secondary data analysis was carried out utilising reports and publications from reputable sources such as Munich Re, Swiss Re, the World Bank, the Polish Chamber of Insurance (PIU), the United Nations Office for Disaster Risk Reduction (UNDRR), and the Global Federation of Insurance Associations (GFIA).

An overview of the literature

A disaster is an unpredictable event that can be triggered by natural phenomena or human activities (Chaudhary & Piracha, 2021; Sweileh, 2019). It is commonly defined as 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 one or more of the following: human, material, economic and environmental losses and impacts (Chmutina & von Meding, 2019; UNDRR, 2010). Natural disasters, in particular, can result in economic losses such as livelihoods and infrastructure damage, as well as social impacts such as injuries, fatalities, and psychological trauma.

The types of natural disasters vary depending on the region of the world (Kourtit et al., 2023). In continental Europe, floods occur almost annually (Koks et al., 2019; Paprotny et al., 2018), resulting in economic losses due to damages incurred and the expenses associated with managing these events. Furthermore, climate change is exacerbating the frequency and intensity of disasters, posing threats to Europe's economic and social infrastructure (Sheehan et al., 2023). In South America, common disasters include floods, earthquakes, tornadoes, and landslides (Buszta et al., 2023). The United States is a country where tornadoes are common, representing one of the most dangerous and frightening types of disasters due to their potential for human casualties, destruction of settlements, and economic losses. In 2022, the United States experienced 18 climate disasters, resulting in over \$1 billion in damages and 474 deaths (Gusner & Masterson, 2023). Meanwhile, on the Asian continent, flash floods, landslides, earthquakes, and tsunamis are prevalent disasters (Reliefweb, 2017). Among these, flash floods, earthquakes, and landslides are the types of disasters that incur the greatest material and economic losses.

In Poland, the National Crisis Management Plan identifies 19 threats (Rządowe Centrum Bezpieczeństwa, 2022), with key ones including floods (caused by melting snow, thaw-embolism, or heavy rainfall), fires, industrial accidents, epidemics, droughts, hurricanes, landslides (triggered by intense rainfall), and frosts (posing threats to both people and infrastructure). Over the past two decades, floods have been responsible for the most significant losses. However, regardless of the specific type of natural disaster, they invariably result in unavoidable losses, encompassing damage to infrastructure and socio-economic impacts.

Insurance plays a crucial role in mitigating the financial impact of natural disasters. The level of insurance penetration is particularly crucial when assessing the impact of natural disasters on the economy (Sheehan et al., 2023). While insurance cannot prevent loss of life or property, it can significantly reduce the economic impact of natural disasters and catastrophes. Insurance serves as a

safety net for individuals, businesses, and governments, enabling them to recover and rebuild after a disaster (Botzen, 2021; Zhao et al., 2020). Without insurance, the financial burden of a natural disaster can be overwhelming, leading to long-term economic consequences.

Private insurance of the effects of natural disasters, often supported by the state, remains the most common method of protection against the destructive impacts of natural forces (Breckner et al., 2016). While insurance products offered by private insurers are typically more flexible than those provided by the public sector, they are still subject to relatively rigid and limited regulations. These products often take the form of “disaster riders” attached to existing policies and are seldom available as standalone insurance. Only in recent years, spurred by the increasing frequency of natural disasters, has there been a dynamic expansion in this area of insurance.

Natural disaster insurance may offer coverage for the risks associated with reconstruction and recovery, as well as coverage for pre- and post-disaster hazards. However, implementing this approach necessitates a comprehensive management system supported by governments and other public organisations. Nonetheless, the assessment of state intervention in catastrophe insurance varies (Charpentier & Le Maux, 2014).

Disaster insurance is expanding globally and is being embraced by communities and governments as a crucial resource in the aftermath of natural disasters. In certain countries, the private insurance system for natural disasters is subject to stringent regulation (Paleari, 2019). Examples of such countries include Belgium, France, and the Netherlands. In Belgium, storm insurance is widespread and is a mandatory component of the standard insurance package, covering damages caused by hail, ice, and snow. Additionally, flood insurance has its own distinct regulations, later expanded to cover additional types of disasters such as earthquakes, landslides, or subsidence, although it remains a component of fire insurance.

Comprehensive insurance against the effects of natural disasters is rare and typically focuses on specific types of disasters depending on the conditions in each country. One exception to this is Iceland, where insurance coverage extends to all types of natural disasters.

Research methods

The research question and the stated goal were verified through a critical analysis of source literature, an examination of trends and digital solutions in the insurance sector, as well as an analysis of secondary data. Data from national and international reports, including those published by Munich Re, Swiss Re, the World Bank, PIU, UNDRR and GFIA, were utilised in the study. The research covered the years 1980 to 2023, with analysis conducted between January and February 2024.

Results of the research

Natural disasters can have significant and enduring macroeconomic repercussions that necessitate effective management. According to the World Bank, extreme weather events rank among the top five threats to the global economy in 2024 (World Bank, 2024). An escalation in the frequency of extreme weather occurrences could exacerbate poverty through various channels, such as deteriorating health conditions and rising food prices (Jafino et al., 2020). Major disasters not only impact short-term economic growth but also have lingering effects on long-term economic prospects (Acevedo, 2016). Moreover, they exacerbate social and economic disparities, as the most vulnerable individuals lack the financial means to cope with incurred losses. Furthermore, in the absence of adequate social safety nets, the reconstruction of damages is often delayed, further exacerbating the impact of disasters (Cebotari & Youssef, 2020). For instance, Dominica experienced losses equivalent to over 220% of its GDP due to a hurricane in 2017, leading to a 9% annual contraction in the country's economy from 2017 to 2018 (International Monetary Fund, 2018).

According to the United Nations, direct economic losses from 2015 to 2022 averaged 0.37% of global GDP (United Nations, 2015). However, analysts note that the presented data significantly understates and underestimates the actual losses. This discrepancy is particularly noticeable in global databases. Analyses of the International Disaster Database (EM-DAT) by the Center for

Research on the Epidemiology of Disasters (CRED) confirm these concerns, revealing substantial gaps, especially regarding economic losses (UNDRR, 2023). The percentage of missing data on disaster impacts from 1990 to 2022 was 96% for reconstruction costs and 42% for total damage estimates (see Figure 1).

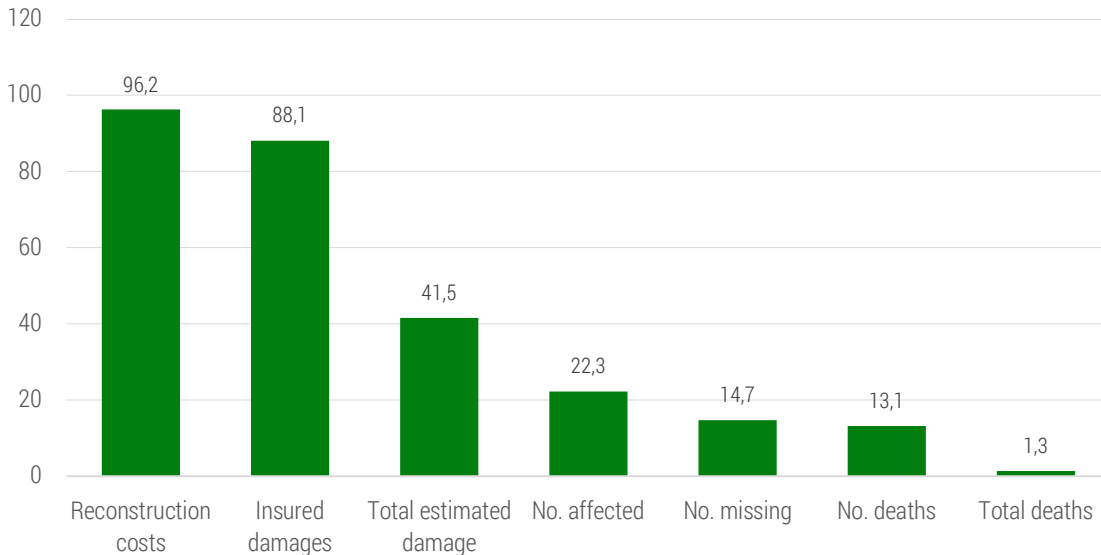


Figure 1. Percentages of missing impact data for natural hazard disasters in EM-DAT, 1990–2022 (in %)

Source: UNDRR (2023).

The insurance industry has been grappling with the repercussions of climate change for several decades (Stahel, 2009), drawing insights from various reports, studies, and scientific literature. Munich Re issued the inaugural caution to the insurance sector regarding the burgeoning threat of climate change as early as 1973 (Munich Re, 2024). It underscored the imperative for additional research, highlighting the escalating temperatures year after year, potentially resulting in glacier and polar ice cap retreats, diminishing lake areas, and rising sea temperatures.

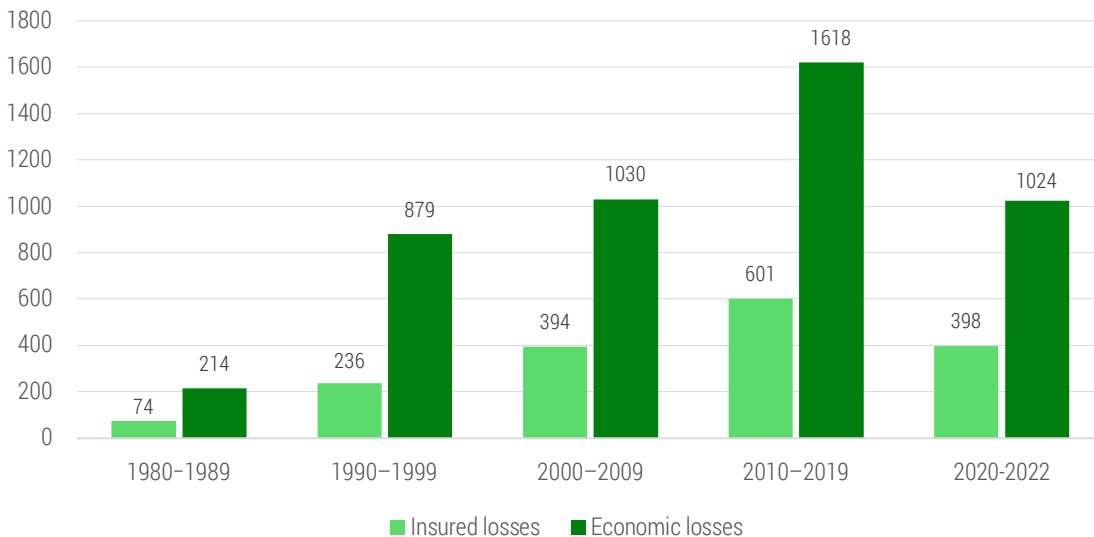
The insurance protection gap is further underscored by data from Munich Re, which reports that natural disasters between 2019 and 2023 resulted in annual losses of USD 150-280 billion globally. However, in certain instances, insurers covered only 1.5% of the total damage incurred. Higher climate change scenarios lead to larger insurance protection gaps, and more ambiguity aversion causes a higher degree of charity hazard; stronger risk aversion generates higher insurance uptake, and higher probabilities and amounts of government compensation cause more crowding out of demand for coverage (Tesselaar et al., 2022). Table 1 illustrates examples of selected natural disasters worldwide, considering losses borne by insurance firms and the proportion of these losses relative to the total losses over the past five years.

Over the last forty years, economic losses stemming from climate-related disasters have surpassed insured losses. The figure 2 contrasts the real (inflation-adjusted) rise in global economic losses attributed to weather events with the corresponding insured losses from 1980 to 2019. As illustrated, while the protection gap, denoting the variance between insured losses and total losses, has expanded in absolute terms from decade to decade, it has diminished proportionately. This underscores society's enduring under-insurance and suggests that insurance continues to hold substantial potential for bridging the gap and fostering resilience (Bevere et al., 2020). The evaluation of existing insurance continues to be carried out, including the level of gaps that occur and the adjustment of insurance premiums (Ivčević et al., 2021; Kalfin et al., 2022).

Table 1. Examples of the largest natural disasters on a global scale in 2019-2023

Natural catastrophe	Overall losses (US\$ bn)	Insured losses (US\$ bn)	Relation of losses of insurance companies to total losses to (in %)
Typhoon Lekima (6 – 14 Aug 2019, China, Taiwan, Japan, Malaysia)	8.1	0.84	10,4
Flood (9 Mar – 1 Ap 2019, United States)	4	0.06	1,5
Flood (21 May – 30 Jul 2020, China)	17	0.4	2,4
Hurricane Eta (2 – 12 Nov 2020, North and Central America, Caribbean)	5	0.8	16
Flood (12 – 19 Jul 2021, Germany, Netherlands, Belgium)	54	13	24,1
Earthquake (13 Feb 2021, Japan)	7.7	2.3	29,9
Floods (May 2022, China)	5	0.3	6
Earthquake (16 Mar 2022, Japan)	8.8	2.8	31,9
Typhoon Doksuri (24 Jul–4 Aug 2023 China, Philippines, Taiwan, Vietnam)	25	2	8
Earthquake (8 Sep 2023 Morocco)	7	0.3	4,3

Source: authors' work based on Munich Re (2021a, 2021b, 2022, 2023a, 2023b).

**Figure 2.** Global economic versus insured losses resulting from weather-related catastrophes, 1980-2022 (billion USD)

Source: authors' work based on Bevere et al. (2020) and Statista (2024).

The escalating damage wrought by natural disasters and the underestimated potential losses underscores the imperative of comprehensively understanding all risk factors (Banerjee et al., 2023). The underestimation of losses and subsequent underinsurance can be attributed, at least in part, to

the diverse array of damage natural disasters can inflict. This damage extends beyond mere property to encompass environmental harm. Moreover, certain environmental damages, such as those caused by earthquakes, may remain uninsurable due to their catastrophic nature (Feldman, 2013).

Insurers worldwide play a pivotal role in offering coverage for losses stemming from natural hazards and offering guidance to policymakers regarding the formulation of disaster risk management and financing strategies. However, the extent of their involvement and responsibilities differs depending on the relevant legal framework and exposure to the risk of catastrophic damage. The management system for catastrophe insurance is diverse, ranging from voluntary to compulsory insurance solutions, including the establishment of insurance pools to mitigate the impacts of natural disaster risks (GFIA, 2021). Table 2 illustrates selected countries where obtaining insurance against natural disasters is either mandatory or voluntary.

Table 2. Examples of natural disaster risks subject to compulsory insurance in selected countries around the world. From significant catastrophic risks

Peril	Australia	France	Switzerland	Morocco	Japan	United States
Windstorm	-	+	+	-	-	-
Hailstorm	-	-	+	-	-	-
River flooding	-	+	+	+	-	-
Torrential rain	-	+	+	-	-	-
Storm surge	-	+	-	-	-	-
Earthquake	-	+	-	+	-	-
Avalanche	-	+	+	-	-	-
Volcanic eruption	-	+	-	-	-	-
Tsunami	-	+	-	+	-	-

„+“ – compulsory cover; „-“ – optional cover

Source: authors' work based on GFIA (2021).

Catastrophe risk insurance is not mandatory in the majority of countries globally. Typically, protection against the risk of natural disasters is provided as part of the standard coverage under property insurance policies, such as those for real estate, or as optional extensions. The basic protection usually includes risks like lightning, hail, avalanches, windstorms, and earthquakes. Insurers commonly do not offer standalone products specifically for natural disaster risks, except in cases of dedicated insurance for certain industries.

Discussion/Limitation and future research

Climate change is leading to an increase in the frequency and intensity of disasters, posing threats to both economic and social infrastructure (Botzen et al., 2019; Coronese et al., 2019; Vellinga & Wood, 2002). As highlighted, multi-billion-dollar losses due to disasters occur annually. However, it is crucial to recognise that impacts extend beyond economic terms; social and environmental costs are equally significant. Therefore, the role of catastrophe insurance in natural disaster risk management planning remains a subject of ongoing research, given its potential to mitigate substantial socio-economic losses. Hazell examined the potential of insurance in developing countries and found it could significantly alleviate the financial burden on governments post-disaster and foster coordinated societal development on a national scale (Hazell, 1992). Zhao emphasised that disaster insurance serves as a crucial pre-disaster risk management tool, alleviating undue financial burdens on homeowners after an impending event and expediting the recovery of disaster-affected buildings and the communities residing within them (Zhao et al., 2020). Cordella and Yeyati (2015) highlighted that insurance could act as a catalyst for external finance.

Such an effect is particularly strong in low and middle-income countries, which face financial constraints in the event of a shock or in anticipation of one (Cordella & Yeyati, 2015). Attention must also be drawn to the risks arising from the nature of catastrophic events for insurers. Inappropriate risk assumptions or improper reinsurance may – in the event of such an occurrence – pose a threat to their solvency (Amendola et al., 2000). This makes the issue of the role of insurance in mitigating the financial effects of natural disasters even more challenging to analyse, yet simultaneously more significant for countries, economies, the environment, etc.

Numerous studies have indicated that catastrophe insurance can significantly shorten the reconstruction time of buildings and affect the recovery curve of communities after a disaster, as it provides much faster payouts for insured properties than government aid. In countries where the scale of natural disasters is increasing year by year, it seems that there is a need for governments to be more involved in the regulation aspect concerning the expansion of the basic scope of insurance to cover natural disaster risks. In this regard, cooperation with insurance companies will be required, which will need to adjust their insurance offerings to encompass the most significant risks, and the insurance premium should be acceptable to customers. Therefore, insurance against natural disaster risks should be a standard feature in property insurance policies rather than an extension of coverage purchased for an additional fee.

It should be noted that the limitations of the conducted research primarily arise from the fact that the scale and impact of disasters vary significantly across countries, leading to a lack of uniform legal solutions. Additionally, the role of the state varies depending on the country. The state may leave everything to the market or, as indicated in the study, mandate certain insurances. However, due to the magnitude of catastrophic damages and their impact on the common good, such as the environment, in the case of some events or catastrophic damages, the state must assume the role of guarantor, insurer, or at least reinsurer (Bruggeman et al., 2010). The research challenges are further studies that will enable the development of solutions to effectively mitigate the financial consequences of disasters.

Conclusions

Climate change has become an alarming reality with devastating consequences for people, the environment, and finances. However, the involvement of insurance companies in environmental initiatives remains insufficient. For example, progress in reducing the use of fossil fuels, which is crucial for accelerating the energy transition, has been slow. The insurance industry could play a significant role in this regard by facilitating the phase-out of fossil fuels and supporting the transition to a low-carbon economy. Unfortunately, insurers have been too conservative in this aspect, as they continue to provide insurance coverage for most new coal, oil, and gas projects. It is important to recognise that without insurance coverage, many new projects cannot proceed, and existing ones may be forced to shut down (Bosshard, 2022). Therefore, the role of insurance companies extends beyond mitigating the financial impacts of natural disasters to mitigating the increase in risk.

People are aware of the adverse impact of catastrophic risks, but despite this awareness, they often do not take any precautions. The reason for this is a passive approach to risk and a lack of knowledge of the available instruments. The market's answer is insurance, which allows risk management and contributes to the effectiveness of compensation mechanisms for the consequences of catastrophic events.

The insurance market plays an important role in this by developing a system for settling claims (determining the size of damages and the amount of compensation to be applied) and by directing funds to preventive measures. However, due to the potential risk of huge indemnities, the state should initiate the creation of insurance pools or participate in part in the payment of indemnities. Insurance products play a crucial role in fostering financial resilience. It is widely acknowledged that the frequency and severity of natural disasters are on the rise, potentially hindering access to insurance and its affordability. Addressing the gap in insurance coverage for natural disaster risk presents a multifaceted social challenge that necessitates the collaboration of various stakeholders, including governments, the insurance industry, consumers, and insurance regulatory authorities.

The contribution of the authors

Conceptualization, D.P., A.B. and D.W.; designed the analysis, D.P., A.B. and D.W.; literature review, D.P. and A.B.; methodology, D.P. and A.B.; formal analysis, D.P. and A.B.; writing, D.P., A.B. and D.W.; conclusions and discussion, D.P., A.B. and D.W.

The authors have read and agreed to the published version of the manuscript.

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UBEZPIECZENIA W ŁAGODZENIU FINANSOWYCH SKUTKÓW KATASTROF NATURALNYCH

STRESZCZENIE: Głównym celem artykułu jest wskazanie na rolę ubezpieczeń w łagodzeniu finansowych skutków katastrof naturalnych. Aby zrealizować cel postawiono dwa pytania badawcze: 1) Jaka jest skala i konsekwencje dla gospodarki katastrof naturalnych? 2) Jaka jest rola ubezpieczeń od klęsk żywiołowych w procesie odtworzenia majątku? Przygotowując artykuł, Autorzy wykorzystali analizę literatury przedmiotu, analizę danych wtórnych zamieszczonych w raportach i publikacjach międzynarodowych instytucji i organizacji zajmujących się problematyką łagodzenia finansowych skutków katastrof naturalnych. W ramach ograniczeń przeprowadzonych badań należy wskazać na skalę i oddziaływanie klęsk w zależności od kraju, co wpływa na brak jednorodnych rozwiązań prawnych w aspekcie zastosowania ubezpieczeń w łagodzeniu skutków finansowych katastrof naturalnych.

SŁOWA KLUCZOWE: katastrofy naturalne, ubezpieczenia, konsekwencje finansowe, zmiany klimatyczne