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The Insurance Gap in natural catastrophe risks. Challenges for the market

Climate change poses a serious risk to (re)insurers and society in the future. The gap in coverage is a global problem, affecting all countries and having an impact on the entire uninsured population. Insurance is one way to reduce the intensity of post-natural catastrophe losses. This is because insurance provides timely financial assistance in the aftermath of the shock associated with extreme events, thereby reducing the long-term impact of natural catastrophes . This article presents the essence of the insurance gap in the context of the increasing intensity of catastrophic risks. The insurance gap in catastrophic risks is presented against the background of empirical data in global terms. An important part of the study is to show the categories and challenges for the insurance market in the face of these risks.

Keywords: insurance gap; catastrophic risk; insurance; natural catastrophe; climate change

Introduction

Natural *catastrophes* have caused significant economic and human losses for millennia. Natural catastrophes, when they affect people and thus society, make one realize how inadequate the scale of insurance for public and private property is. This is because, only after the realization of catastrophic risks of, for example, flood, drought, the passage of a tornado or fire, etc., does the question arise as to why private and public property was so poorly insured or not insured at all.

Natural catastrophes caused an economic loss of USD 291 bn in 2023. The global catastrophe protection gap in 2023 was USD 174 bn; and, in 2022, USD 155 bn with a ten-year average of USD

136 bn[1]. Economic losses from catastrophes in 2024 amounted to USD 318 bn of which 57% were uninsured. This still left a large global protection gap of USD 181 bn. According to Aon, economic losses from natural catastrophe events reached USD 368 bn in 2024 driven by Hurricanes Milton and Helene, severe convective storms in the U.S., and flooding across Europe[2].

In addition, reported losses from extreme weather events have increased by 250% over the past two decades[3].

In theory, insurance can play a key role in promoting resilience to natural catastrophe risks. It provides financial protection to the insured in situations of economic hardship after a natural catastrophe. Insurance can thus accelerate asset recovery by providing financing and liquidity after a natural catastrophe soon after the event[4].

As regards the insurance market, the authors of this article define insurance companies, reinsurance companies, government authorities, customers of insurance companies, and insurance market institutions including the European Insurance and Occupational Pensions Authority (EIOPA) and the Polish Insurance Chamber (PIU). In an insurance contract, risk averse individuals confronted with risk are willing to pay a fixed price to a less risk averse or more diversified insurer who offers to bear the risk at that price. Since both parties agree to the contract, they both benefit from this arrangement[5].

The purpose of this article is to examine the insurance gap in catastrophe insurance. To achieve the above goal, the article poses the following research questions:

1. What is the scale of, and consequences for, the economy of natural catastrophes?
2. What is the scale of the insurance gap in catastrophic risks?
3. What is the role of natural catastrophe insurance in the process of asset restoration?
4. What are the challenges facing the insurance market?

The research questions and the realization of the stated goal were verified on the basis of a critical analysis of the literature on the subject, and an analysis of secondary data provided in reports and publications of Swiss Re, Munich Re, the EIOPA, the European Central Bank (ECB), PIU, and Aon Climate and Catastrophe Insight.

Literature review

The literature reviewed provides a rich and coherent body of evidence regarding the insurance gap for catastrophic risks. In all studies, this gap is described as significant, persistent and widening as a result of supply – and demand-side constraints, the intensification of climate change-related

1. Swiss Re, *Natural Catastrophes in 2023: Gearing up for Today's and Tomorrow's Weather Risks*, Sigma no. 1 /2024, p. 5.
2. Aon, *Climate and catastrophe insight*, London 2025, p. 3.
3. S. Vyas, T. Dalhaus, M. Kropff, P. Aggarwal, M.P.M. Meuwissen, *Mapping Global Research on Agricultural Insurance*, Environmental Research Letters" 2021, vol. 16, No. 10, https://doi.org/10.1088/1748-9326/ac263d.
4. C. Kousky, *The Role of Natural Disaster Insurance in Recovery and Risk Reduction*, "Annual Review of Resource Economics" 2019, vol. 11, no. 1, p. 400, https://doi.org/10.1146/annurev-resource-100518–094028.
5. G. Dionne, S.E. Harrington, *Insurance and insurance market*, in: Handbook of the Economics of Risk and Uncertainty, ed. M. Machina, K. Viscusi, North-Holland 2014, pp. 203–261, https://doi.org/10.1016/B978-0-444-53685-3.00005-2.

risks, and behavioral factors. The analysis conducted has enabled the identification of three main thematic categories addressed in the reviewed literature: supply and demand constraints, the consequences of the insurance gap, and government actions and insurance market responses (see Tables 1–3).

Table 1. Supply-Side Drivers and Demand-Side Drivers of Insurance Cover

Factor	Evidence
Rising insurer risk aversion post-natural catastrophe and undiversifiable climate and loss uncertainty	Increases premiums and reduces supply, raises insurer capital costs and reinsurance prices[6].
Tail dependence, fat tails, micro-correlations	Undermine traditional risk pooling and insurability[7, 8].
Insurer insolvency concerns under heavy tails	Necessitate high premiums or exclusions[9].
Affordability challenges	Households unable to pay premiums, especially in low-income contexts[10].
Behavioural biases	Risk underestimation, optimism bias, and narrow framing reduce demand[11, 12].
Low risk awareness / lack of information	Lower uptake of earthquake and flood insurance[13, 14].

Source: Author's elaboration based on a critical analysis of the literature.

In analyzing the consequences of the insurance gap in relation to catastrophic risks, the impact was categorized into macroeconomic, fiscal, social and distributional, and market effects.

6. M. Giuzio, L. Rousová, S. Kapadia, H. Kumar, L. Mazzotta, M. Parker, D. Zafeiris, *Climate change, catastrophes, insurance and the macroeconomy*, "European Economic Review" 2026, vol 182, https://doi.org/10.1016/j.euroecorev.2025.105210.
7. F. Billimoria, J. Mays, R. Poudineh, *Hedging and tail risk in electricity markets*, "Energy Economics" 2025, vol. 141, https://doi.org/10.1016/j.eneco.2024.10813.
8. Q. Tang, Z. Tong, L. Xun, *Portfolio risk analysis of excess of loss reinsurance*, "Insurance: Mathematics and Economics" 2022 vol. 102, https://doi.org/10.1016/j.insmatheco.2021.11.004.
9. B.Y. Külekci, R. Korn, A.S. Selcuk-Kestel, *Ruin probability for heavy-tailed and dependent losses under reinsurance strategies*, "Mathematics and Computers in Simulation" 2024, vol. 226, https://doi.org/10.1016/j.matcom.2024.06.018.
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11. F. Wang, Z. Liang, Y. Zhang, *Stackelberg equilibrium strategies between insurance demand and government interventions*, "Journal of Economic Dynamics and Control" 2025, vol. 179, https://doi.org/10.1016/j.jedc.2025.105179.
12. Y. Chi, J. Zheng, S. Zhuang, *S-shaped narrow framing, skewness and the demand for insurance*, "Insurance: Mathematics and Economics" 2022, vol. 105, https://doi.org/10.1016/j.insmatheco.2022.04.005.
13. H. Meral, B. Ersoy, I. Dilek, *Insights into earthquake insurance demand in high-risk regions: A case study of Turkey*, "International Journal of Disaster Risk Reduction" 2024, vol. 111, https://doi.org/10.1016/j.ijdrr.2024.104725.
14. Q. Li, W. Liu, *Impact of government risk communication on residents' decisions to adopt earthquake insurance: Evidence from a field survey in China*, "International Journal of Disaster Risk Reduction" 2023, vol. 91, https://doi.org/10.1016/j.ijdrr.2023.103695.

Table 2. Consequences of the Protection Gap

Impacts	Key insight
Macroeconomic	– Lower insurance penetration increases macroeconomic losses from natural catastrophes, reducing growth and increasing public debt[15].
Fiscal	– Extreme events lead to spikes in public expenditure where compensation is widely expected[16]. – Climate-related natural catastrophes can cause persistent adverse effects on GDP and debt when uninsured losses stress fiscal capacity[17].
Social and Distributional	– Underinsurance disproportionately affects low-income and vulnerable communities[18, 19]. – Psychological distress and delayed recovery are amplified when households lack insurance[20, 21].
Market	– Insurers face liquidity strain and premium volatility after catastrophes[22]. – Underinsurance and exclusions in cyber markets create systemic vulnerabilities[23, 24].

Source: Author's elaboration based on a critical analysis of the literature.

With regard to government measures and the insurance market's response, the following key areas discussed in the analyzed literature have been identified: government interventions, market-based solutions, new technologies and data.

15. M. Giuzio, L. Rousová, S. Kapadia, H. Kumar, L. Mazzotta, M. Parker, D. Zafeiris, *Climate...,* op. cit.
16. M. Tesselaar, W.J. Wouter Botzen, P.J. Robinson, J.C.J.H. Aerts, F. Zhou, *Charity hazard and the flood insurance protection gap: An EU scale assessment under climate change*, "Ecological Economics", 2022, vol. 193, https://doi.org/10.1016/j.ecolecon.2021.107289.
17. A. Mazzocchetti, I. Monasterolo, N. Dunz, A.H. Essenfelder, *Breaking the economy: How climate tail risk and financial conditions can shape loss persistence and economic recovery*, "Ecological Economics" 2025, vol. 237, https://doi.org/10.1016/j.ecolecon.2025.108685.
18. N. Amornsiripanitch, S. Biswas, J. Orellana-Li, D. Zink, *Measuring flood underinsurance in the USA*, "*Nat. Clim. Chang*" 2025, vol. 15, https://doi.org/10.1038/s41558-025-02396-w.
19. Y. Gurtner, D. King, *Socio-economic Vulnerabilities to Natural Disasters and Social Justice*, „Economic Effects of Natural Disasters. Theoretical Foundations, Methods, and Tools" 2021, pp. 493–509, https://doi.org/10.1016/B978–0–12–817465–4.00029–7.
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21. Y. Gurtner, D. King, *Socio-economic...*, op. cit.
22. J.M. Montero-Lorenzo, V. Naimy, N.A. Farraj, R. El Khoury, *Natural disasters, stock price volatility in the property--liability insurance market and sustainability: An unexplored link*, "Socio-Economic Planning Sciences" 2024, vol. 91, https://doi.org/10.1016/j.seps.2023.101791.
23. B. Bace, E. Dubois, U. Tatar, *Resilience against Catastrophic Cyber Incidents: A Multistakeholder Analysis of Cyber Insurance*, "*Electronics*" 2024, vol. 13(14), https://doi.org/10.3390/electronics13142768.
24. F. Cremer, B. Sheehan, M. Fortmann, M. Mullins, F. Murphy, *Cyber exclusions: An investigation into the cyber insurance coverage gap*, Cyber Research Conference – Ireland (Cyber-RCI) 2022, https://doi.org/10.1109/Cyber-RCI55324.2022.10032678.

Table 3. Government measures and the insurance market

Impact	Key insight
Government Interventions	– Premium subsidies may improve penetration but need better targeting[25]. – Ambiguous or partial compensation reduces charity hazard and improves private demand[26]. – Risk communication campaigns can raise uptake of earthquake insurance[27]. – Regulatory reforms improve competition and solvency, enabling broader coverage[28].
Market-based solutions	– CAT bonds can reduce the gap but face pricing inefficiencies and segmentation[29]. – Risk-based premiums incentivize mitigation but create affordability concerns[30].
New technologies and data	– Machine learning can identify ESG-related determinants of underinsurance, including governance quality and infrastructure access[31]. – Catastrophe modelling advancements (vulnerability modules, censored distributions) improve accuracy of pricing and protection assessment[32].

Source: Author's elaboration based on a critical analysis of the literature.

A review of the literature indicates that the protection gap in catastrophe insurance is a significant and steadily growing phenomenon, both within the EU and globally, where the majority of losses remain uninsured. Forecasts suggest that this gap will continue to widen, particularly in the context of flood risks, unless comprehensive systemic reforms are implemented. The causes of this phenomenon are multifaceted and include both supply-side factors, such as rising reinsurance costs and climate uncertainty, and demand-side factors, including limited affordability and behavioral factors. Systemic conditions, such as expectations regarding state support or the lack of mandatory insurance mechanisms, also play a significant role. The consequences of the protection gap are serious and include increased fiscal burdens on states, a slower pace of economic recovery and greater vulnerability of financial systems. At the same time, the social impacts affect the most vulnerable groups, exacerbating inequalities and prolonging the process of returning to normality.

25. J. Chen, D. Fang, B. Chen, S. Wang, *Can premium subsidies for agricultural insurance promote risk protection on natural disasters? Evidence from China*, "*Environmental Impact Assessment Review*" 2024, vol. 108, https://doi.org/10.1016/j.eiar.2024.10761.
26. M. Tesselaar, W.J. Wouter Botzen, P.J. Robinson, J.C.J.H. Aerts, F. Zhou, *Charity...*, op. cit.
27. Q. Li, W. Liu, *Impact...*, op. cit.
28. H.D. Skipper, R.W. Klein, *Insurance Regulation in the Public Interest: The Path Towards Solvent, Competitive Markets*, "Geneva Papers on Risk and Insurance: Issues and Practice" 2000, vol. 25, https://doi.org/10.1111/1468-0440.00078.
29. A. Cappiello, E. Vannucci, *Is the climate-linked CAT bond market efficiently priced? A risk–return analysis*, „Research in International Business and Finance" 2025, vol. 79, https://doi.org/10.1016/j.ribaf.2025.103080.
30. D. Hazra, P. Gallagher, *Role of insurance in wildfire risk mitigation*, "*Economic Modelling*" 2022, vol. 10, https://doi.org/10.1016/j.econmod.2022.105768.
31. H. Meral, S.H. Çavga, *The role...*, op. cit.
32. M. Raschke, *Distribution Models for Damage Ratios in Vulnerability Modules of Catastrophe Models*, "ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems" 2025, vol. 12, https://doi.org/10.1061/AJRUA6.RUENG-1633.

Research methods

Verification of the research questions and achievement of the stated objective was made on the basis of a critical analysis of the source literature, an analysis of trends and solutions in relation to catastrophe risks and insurance, and an analysis of secondary data. The study was based on data available in national and international reports published by Swiss Re, Munich Re, EIOPA, ECB, and PIU, among others. The study covered the period 2000–2026.

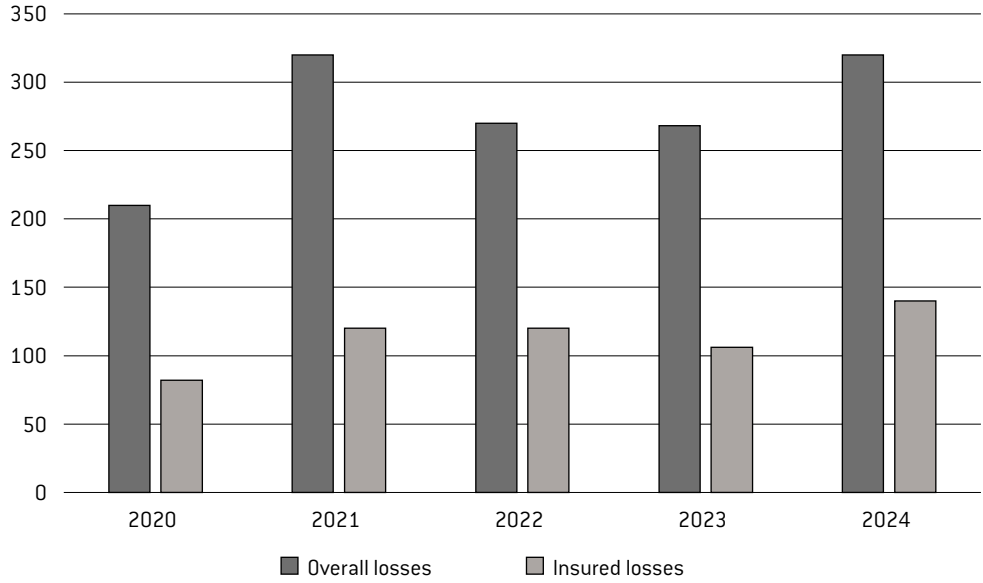
The analysis was based on numerous consistent and mutually corroborating sources from the fields of economics, risk management, catastrophe modelling and research into natural catastrophes.

Results of the research

Munich Re[33] estimates that the average of total losses over the ten-year period (2014–2023) from natural catastrophes worldwide was USD 236 bn, while insurers' losses were USD 94 bn. The average of total losses over the past 30 years (1994–2023) was USD 181 bn, with insurers' losses of USD 61 bn. The development of natural catastrophe losses worldwide from 2020–2024 is presented in Figure 1. Munich Re collects data from government agencies, scientific institutes, associations, the insurance sector, the media and other publicly available sources to present loss information[34].

33. See Munich Re, *Natural disasters* reports for 2020–2024, Munich.
34. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-2024.html#-1537950557 (10.06.2025).

Figure 1. Losses from natural catastrophes in 2020–2024 (USD bn)



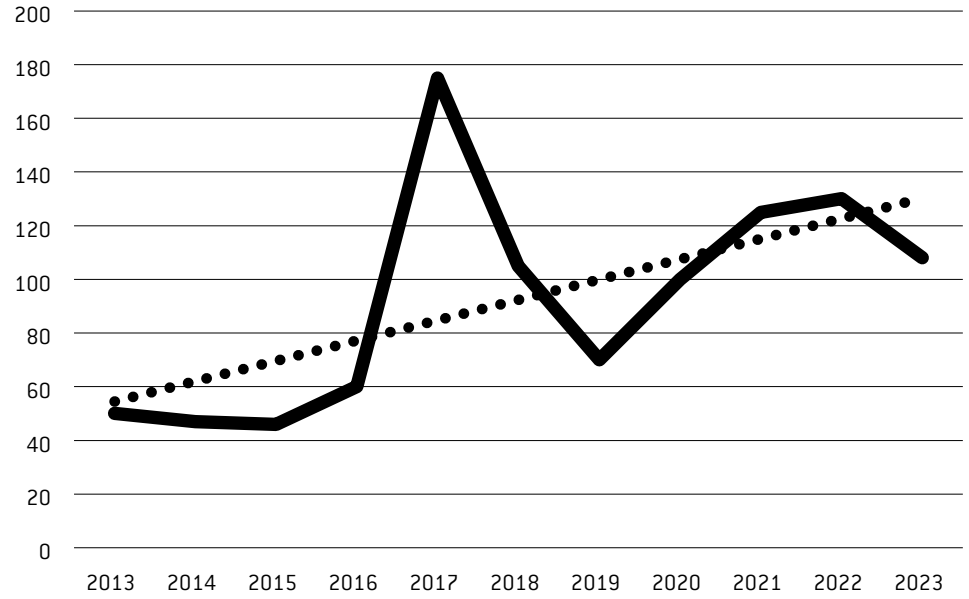
Source: Author's study based on Munich Re, *Natural disasters in 2020*, München 2021, p. 1. https://www.munichre.com/content/dam/munichre/mrwebsiteslaunches/natcat-2021/2020_Jahresuebersicht_Welt_e.pdf/_jcr_content/renditions/original./2020_Jahresuebersicht_Welt_e.pdf (12.01.2025)
Munich Re, *Natural disasters in* 2021, München 2022, p. 1.
https://www.munichre.com/content/dam/munichre/mrwebsiteslaunches/natcat-2022/2021_Figures-of-the-year.pdf/_jcr_content/renditions/original./2021_Figures-of-the-year.pdf (12.01.2025)
Munich Re, *Natural disasters in 2022*, München 2023, p. 1. https://www.munichre.com/content/dam/munichre/mrwebsitespressreleases/natcat_stats_2022_factsheet.pdf/_jcr_content/renditions/original./natcat_stats_2022_factsheet.pdf (12.01.2025)
Munich Re, *Natural disasters in 2023*, München 2024, p. 1.
https://www.munichre.com/content/dam/munichre/mrwebsitespressreleases/MunichRe-NatCAT-Stats2023-Full-Year-Factsheet.pdf/_jcr_content/renditions/original./MunichRe-NatCAT-Stats2023-Full-Year-Factsheet.pdf (12.01.2025)
Munich Re, *Natural disasters in 2024,* München 2025, p. 1.
https://www.munichre.com/content/dam/munichre/mrwebsitespressreleases/MunichRe-NatCAT-Stats2024-Full-Year-Factsheet.pdf/_jcr_content/renditions/original./MunichRe-NatCAT-Stats2024-Full-Year-Factsheet.pdf (12.01.2025)

According to Swiss Re[35], the term "natural catastrophe" refers to an event caused by forces of nature. Such an event usually results in a large number of individual losses covering multiple insurance policies. The scale of catastrophe losses depends not only on the severity of the natural forces involved, but also on man-made factors such as the design of a building or the effectiveness of natural catastrophe control in the affected region. Swiss Re divides natural catastrophes into the following categories: floods, storms, earthquakes, droughts/forest fires/heat waves, cold/freeze waves, hail, tsunamis and other natural catastrophes. However, Swiss Re[36] estimates that in 2023, some 62% of total catastrophe losses were uninsured, and global economic losses of USD 280 bn exceeded insurance claims. The average losses over the past five and ten years were USD

35. Swiss Re, *Natural catastrophes in 2023...*, op. cit., p. 34.
36. Ibidem, p. 6.

105 bn and USD 89 bn, respectively. Figure 2 presents the development of insurance losses from natural catastrophes worldwide from 2013 to 2023.

Figure 2. Global natural catastrophe insured losses (USD bn)

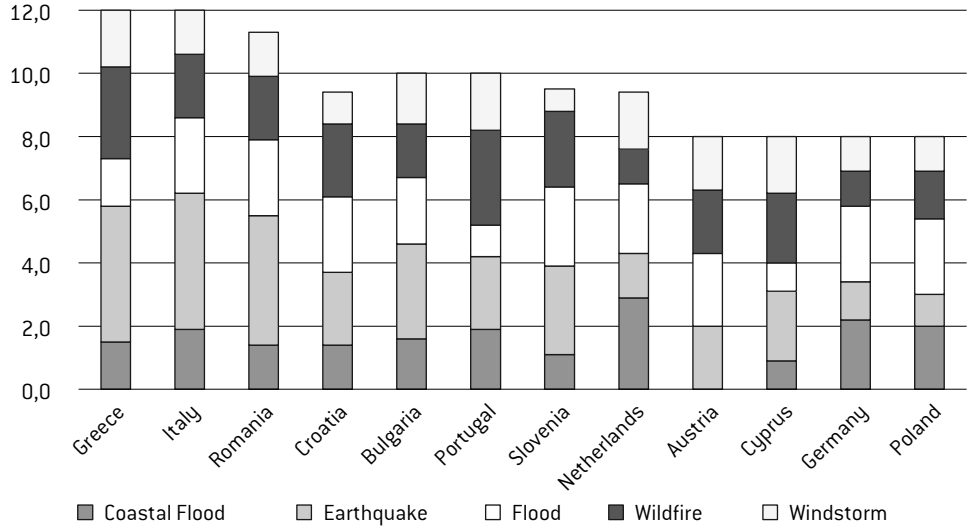


Source: Author's elaboration based on *Gearing up for today's and tomorrow's weather risks*, Sigma 1/2024, Swiss Re Institute, p. 6.

Very often, catastrophes affect areas with relatively low insurance penetration, another reminder of the large gaps in protection that exist in many regions around the world. The development of the insurance market is usually measured by the value of gross premiums written, the insurance density rate and the insurance penetration rate[37]. For example, the Polish insurance market is not well developed relative to most European Union countries, as evidenced by low penetration and density levels[38]. Among the countries with very low levels of insurance penetration and highly exposed to catastrophic risks, especially in the case of earthquakes, are Greece and Italy[39]. At the same time, these are the countries with the highest level of insurance coverage gaps for natural catastrophes in Europe (see Figure 3).

37. I. Laskowska, *Regionalne zróżnicowanie poziomu rozwoju rynku ubezpieczeń w Polsce – wielowymiarowa analiza porównawcza w przekroju województw*, „Wiadomości Ubezpieczeniowe" 2024, nr 3, p. 63. doi.org/10.33995/wu2024.3.4.
38. Polska Izba Ubezpieczeń (PIU), *Raport roczny 2022*,Warszawa 2023, pp. 54–55.
39. EIOPA, *The Dashboard on Insurance Protection Gap for Natural Catastrophes in a Nutshell*, Frankfurt 2024, p. 8.

Figure 3. Total current protection gap in selected EU countries score for coastal flood, earthquake, flood, wildfire and windstorm (0 – now, 1–1.5 – low, 2–2.5 – medium, 3–3.5 – high, 4 – very high)



Source: Author's elaboration based on EIOPA, *The Dashboard on Insurance Protection Gap for Natural Catastrophes in a Nutshell*, Frankfurt 2024, p. 8.

Climate change will widen the insurance gap for natural catastrophes in the future[40]. According to EIOPA[41], only a quarter of losses in Europe were insured between 1980 and 2023. In absolute terms, three risk regions show the highest uninsured losses: earthquakes in Italy (9% of uninsured losses, 1980), flooding in Germany (77% of uninsured losses, 2021) and flooding in Italy (97% of uninsured losses, 2023), accounting for nearly 48% of all uninsured losses in Europe. According to Swiss Re[42], the residents of France, Denmark, the UK, Norway, Australia and New Zealand were the most protected against natural catastrophe risk in 2023 (see Table 4). The Natural Catastrophe Insurance Resilience Indices (I-RI) were chosen to present the data. The global I-RI is weighted based on the share of protection gap for each peril in total protection gap. The value of I-RI ranges from 0–100%. The higher the value, the greater the protection relative to the needs and the higher the resilience. Protection gaps are measured in premium equivalent terms, which indicate the uninsured or unprotected portion of total protection needs. Countries with low levels of resilience include India, China and Greece (rates below 10%).

40. Polska Izba Ubezpieczeń (PIU), *Klimat Rosnących Strat. Rola Ubezpieczeń w Ochronie Klimatu i Transformacji Energetycznej*, Warszawa 2023, p. 14.
41. EIOPA, *The Dashboard on Insurance* …, op. cit., p. 9.
42. Swiss Re, *Resilience Index 2024: Encouraging Resilience Gains, but More Is Needed*, Swiss Re Institute, Zurich 2024, p. 15.

Table 4. SRI Natural Catastrophe Insurance Resilience Indices: scores, rankings and protection gaps by selected countries

	Natural Catastrophe I-RI Index (%)	Protection gap (USD bn)
France	83	0.9
Denmark	82	0.1
Australia	76	1.1
Switzerland	61	1.2
Poland	50	0.4
Germany	47	4.9
US	39	120
Japan	25	29.6
Italy	16	8.1
Philippines	7	19.1
China	5	59.8

Source: Author's elaboration based on *Resilience Index 2024: encouraging resilience gains, but more is needed*, Swiss Re Institute, Zurich 2024, p. 15.

Based on existing national solutions, there are five main categories of changes that, if implemented, could contribute to making societies more resilient to natural catastrophe risks[43]:

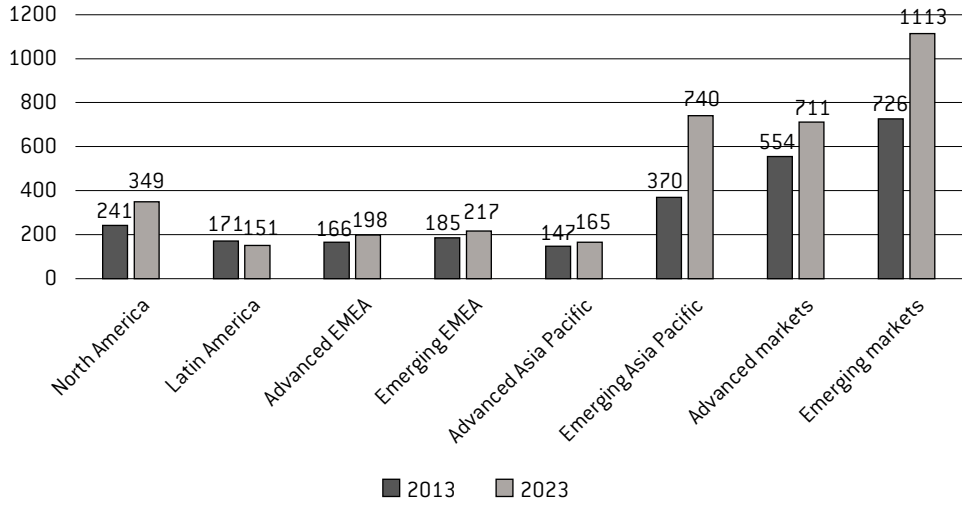
1. **Scope**: most national insurance schemes have a broad scope of coverage, which allows them to pool risks across multiple perils and assets. The majority also incorporate a mandatory element, requiring either mandatory offers or a mandatory take-up of insurance by law. An example is Italy, which, from April 2025, has made it compulsory for micro-, small – and medium-sized enterprises to take out insurance against natural catastrophes[44].
2. **Structure**: the prevalent structure of national schemes is that of a public (re)insurance scheme. Most schemes offer complementary direct (re)insurance and are of a permanent nature. One example is SACE (IT), which acts as a reinsurer allowing insurance companies to access the guarantees of the state-owned insurance and advisory group SACE.
3. **Payouts and premiums**: national schemes are typically indemnity-based (i.e. payouts are based on actual losses rather than quantitative/parametric catastrophe thresholds). Premiums are mostly risk-based. Examples include the Natural Disaster Insurance Pool (RO) and Japan Earthquake Reinsurance (JP), which simplify the calculation of insurance premiums. They take into account only a relatively small set of risk characteristics, such as broad hazard areas or postcode zones.
4. **Risk transfer and financing**: the use of reinsurance by the schemes depends on the availability and the cost of reinsurance, with national schemes increasingly facing issues relating to affordability. Public financing of the scheme is not an essential design feature. Most national schemes transfer some risks to the private reinsurance market. For example: Consorcio de Compensación de Seguros (ES), Norwegian Natural Perils Pool (NO).
5. **Risk mitigation and adaptation measures**: initiatives to ensure proper coordination between the public and private sectors on risk identification and prevention are now emerging in response

43. ECB, EIOPA, *Towards a European system for natural catastrophe risk management*, Frankfurt am Main 2024, p. 17.
44. https://www.reuters.com/business/finance/italy-postpones-requirement-firms-insure-against-natural-disasters-2025-03-28/ (09.06.2025).

to climate change. Private and public sector responsibilities are typically divided, with the private market contributing its insurance expertise and modelling capacity, while the public sector provides the legal basis and operating conditions. In some countries, homeowners receive a subsidy to implement measures to increase resilience to the risk of natural catastrophes, for example, Caisse Centrale de Réassurance (FR), Danish Storm (DK).

It is estimated that between 2013 and 2023, the global insurance gap recorded a cumulative increase of 43%. Over the years, there has been a noticeable increase in the insurance gap with economic development and inflation[45]. Emerging regions are still significantly less resilient than developed regions, at 35% compared to 70% (see Figure 4).

Figure 4. Total Protection Gaps, by Region in 2013 and 2023 (USD bn)



Source: Author's elaboration based on Swiss Re, *Resilience Index 2024: Encouraging Resilience Gains, but More is Needed*, Swiss Re Institute, Zurich 2024, p. 9.

Global resilience to natural catastrophes has improved over the past ten years. However, this is due to a strong increase in the resilience of developed markets, which rose to more than 38% in 2023 from approximately 35% in 2013. In emerging markets, resilience tends to remain very low, and some regions are almost completely unprotected against natural catastrophes risks.

Discussion

One of the factors that can affect insurance revenues is the occurrence of natural catastrophes. Being unpredictable, they increase uncertainty. In order to be better prepared to absorb the potentially very large economic losses caused by catastrophes, and thereby strengthen societal resilience,

45. Swiss Re, *Resilience Index...,* op.cit., p. 10.

the insurance industry must constantly adapt to changing risk landscapes, such as, for example, urbanization and the associated accumulation of asset values, as well as the effects of climate change[46].

Insurance is a key protective tool in the face of sudden and adverse weather events. Countries where insurance is widespread have the ability to rebuild public infrastructure, businesses or private property more quickly. It is particularly important to conduct educational activities to prevent the problem of underinsurance. Insurers should provide incentives for risk reduction and adaptation, for example by promoting risk awareness and providing risk-based incentives linked to premiums[47]. Lack of knowledge regarding the protection they have and the products offered by insurance companies confirms the low level of insurance awareness[48].

Table 5 indicates the most important categories of challenges facing the insurance market in terms of catastrophic risk.

Table 5. Insurance market categories and challenges in the face of catastrophic risks

Category	Challenge
Increasing frequency and intensity of catastrophic events	– increase in the number and extent of damage; – forecasting and risk modeling become more difficult as historical weather and environmental data changes.
Increase in compensation costs	– the rising value of property, urbanization and increasingly developed infrastructure mean that claims are increasing in value; – insurance companies face the challenge of setting affordable insurance premiums and maintaining profitability.
Difficulties in risk analysis	– risk models based on historical data may be inappropriate in the face of dynamic climate change; – the need to take into account data from multiple sources (e.g., meteorological, geological) and the development of more accurate risk models.
Insufficient reinsurance coverage	– an increase in catastrophic claims leads to increases in reinsurance prices; – insurance companies have to build larger financial reserves.
Low insurance awareness of the public	– the need for insurance education of customers; – lack of awareness regarding the purchase of adequate insurance coverage.
Regulation and legislative policy	– lawmakers are introducing increasingly stringent solvency and capital insurance regulations (e.g., Solvency II); – cooperation between insurance companies and governments on catastrophic insurance (e.g., insurance premium subsidies, public funds for reconstruction); – combatting the exclusion of people who cannot afford to buy insurance.

46. Swiss Re, *Natural Catastrophes in 2023...,* op. cit., p. 34.

47. J. Linnerooth-Bayer, S. Surminsky, L.M. Bouwer, I. Noy, R. Mechler, *Insurance as a Response to Loss and Damage?*, in: *Loss and Damage from Climate Change Climate Risk Management, Policy and Governance*, eds. R. Mechler, M.L. Bouwer, T. Schinko, S. Surminsky, Linnerooth-Bayer J., Springer International Publishing, 2018, pp. 483–512, https://doi.org/10.1007/978-3-319-72026-5_21.

48. D. Pauch, *Jak Błędy w Komunikacji Prowadzą Do Braku Zaufania*, „Gazeta Ubezpieczeniowa" 2024, nr 46 (1321), p. 21.

Category	Challenge
New technologies	– the need to invest in new technologies (e.g., real-time data analysis, artificial intelligence) to improve the claims handling process; – the development of parametric insurance (based on predetermined indicators, such as rainfall amounts). – preventive measures, such as technologies that monitor natural catastrophe risk in real time.

Source: Author's elaboration based on the analysis carried out.

One of the challenges facing insurance companies is how to adequately compensate losses incurred as a result of extreme weather events. The catastrophic phenomena (regardless of their nature) that we have been experiencing in recent years are driving the need for more effective risk management measures. The needs could primarily be met with measures of a systemic nature, with a particular focus on insurance.

EIOPA is developing a plan to raise awareness of natural catastrophe risks and encourage consumers to take preventive measures to reduce losses. In addition, EIOPA is actively working with regulators and public authorities to determine how best to address gaps in protection at the regional or EU level. These initiatives demonstrate the importance of addressing not only the offer but also the demand for insurance.

EIOPA's proposals on the challenges ahead for insurers[49]:

- EU public-private reinsurance program: to increase insurance coverage of natural catastrophe risks. Pooling private risks and perils across the EU, this program would take advantage of economies of scale and diversify coverage of high risks at the European level. It would be financed by risk-based premiums from (re)assurers or national insurance programs.
- EU Public Disaster Fund: to strengthen public disaster risk management in member states. Financed by contributions from member states, this fund would help rebuild public infrastructure after natural disasters, provided that member states have implemented agreed upon pre-event risk mitigation measures to minimize moral hazard.

In 2024, the World Bank and Insurance Development Forum identified key aspects in this area, such as[50]:

- Disaster risk financing and insurance solutions must be tailored to the country's context and constraints.
- The availability and quality of data is critical for better climate risk financing and insurance solutions.
- Better coordination between government ministries is essential to improve the country's financial protection.

Reinsurers and insurance companies can contribute to climate change mitigation by using their data, expertise and risk assessment capabilities to encourage policyholders to reduce

49. ECB, EIOPA, *Towards...*, op. cit. p. 46.

50. Insurance Development Forum, *Reducing the Protection Gap Against Climate Shocks and Disasters Through Stronger Public Private Knowledge Partnership*, https://www.insdevforum.org/knowledge/idf-materials/reducing-the-protection-gap-against-climate-shocks-and-disasters-through-stronger-public-private-knowledge-partnership/ (19.01.2025).

insured risks through risk-based pricing and contract terms, and include measures that contribute to climate change mitigation in their insurance strategy. Premium reductions can provide incentives to implement adaptation and mitigation measures that minimize the physical risk of exposure to climate-related hazards. For example, premium reductions could be contingent on homes meeting certain standards for flood protection in flood-prone areas or storm protection, as well as the use of real-time weather data. The cost of implementing a risk-reducing measure could be offset by lower premiums[51]. Such an example is the insurance and pricing strategy, impact underwriting, which aims to encourage policyholders to implement ex ante measures and reduce the risk of natural catastrophes[52].

Preparing a country for the effects of climate change is primarily the responsibility of the government. However, it is the insurance industry, with its specific risk management operations, that can support the government in creating regulations and programs that promote environmental protection and create conditions to protect local communities.

Conclusions

The estimated global insurance gap relating to catastrophic risks is around 60%. This shows that catastrophic risks are still covered through insurance at a fairly low level. The current strategy to fill this gap is a two-pronged approach, which should involve, in addition to private reinsurers, national governments creating a regulatory framework. In this area, the authors of this article take the view that the market alone cannot cope. Possible solutions for increasing the resilience of society are outlined in this article.

The increasing frequency and intensity of climate-related events mean that effectively insuring against them will remain a priority for many stakeholders in the near future. At the same time, the growing scale of catastrophic risks means that insurance in this area will become more expensive. Raising insurance awareness also remains crucial, particularly through institutions in the insurance market ecosystem, which should foster among customers the habit of insuring against catastrophic risks as an investment in financial security. The insurance gap is a systemic challenge requiring the involvement of both insurers and the state to reduce the financial burden on society and local governments following natural catastrophes.

The above aspects can be achieved by:

- providing incentives or implementing regulations to encourage risk prevention measures and campaigns to improve financial literacy and risk awareness;
- participating in the development and/or implementation of public-private initiatives to address gaps in natural catastrophe insurance coverage.

The attitude of insurers is also significant here: they should adapt their offerings to new climate challenges. In summary, the challenge lies in the need to map risks and address the insurance gap in a systematic manner.

51. ECB, EIOPA, *Policy Options to Reduce the Climate Insurance Protection Gap. Discussion Paper*, Frankfurt am Main 2023, p. 31. https://www.ecb.europa.eu/pub/pdf/other/ecb.policyoptions_EIOPA~c0adae58b7.en.pdf.
52. EIOPA, *On Non-Life Underwriting and Pricing in Light of Climate Change*, Frankfurt 2021, p. 14.

It is also a priority for policymakers to recognize the critical role of insurance in the natural catastrophe resilience paradigm and to ensure the future of the industry so that it can continue to provide risk transfer mechanisms for vulnerable citizens, businesses and governments[53].

A limitation of the study was the varying approaches to catastrophe risk depending on the country or legislation. However, given the increasing severity of natural catastrophes, the issues raised in the article could form the basis for developing systemic solutions.

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53. B. Sheehan, M. Mullins, D. Shannon, O. Mccullagh, *On the Benefits of Insurance and Disaster Risk Management Integration for Improved Climate-Related Natural Catastrophe Resilience*, "Environment Systems and Decisions" 2023, Vol. 43, No. 4, https://doi.org/10.1007/s10669–023–09929–8.

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Luka ubezpieczeniowa w ryzykach katastroficznych. Wyzwania dla rynku

Zmiany klimatyczne stanowią poważne ryzyko dla (re)asekuratorów i społeczeństwa w przyszłości. Luka w ochronie jest problemem globalnym, dotykającym wszystkie kraje i odnoszącym się do całej populacji nieubezpieczonych. Ubezpieczenie jest jednym ze sposobów ograniczenia intensywności strat po skutkach katastrof. Ubezpieczenia zapewniają bowiem terminową pomoc finansowa w następstwie wstrząsów związanych ze zdarzeniami ekstremalnymi, a tym samym pozwalają zmniejszyć długoterminowe skutki katastrof. Artykuł prezentuje istotę luki ubezpieczeniowej w kontekście rosnącej intensywności występowania ryzyk katastroficznych. Luka ubezpieczeniowa w ryzykach katastroficznych zaprezentowana jest na tle danych empirycznych w ujęciu globalnym. Ważną częścią opracowania jest ukazanie kategorii i wyzwań rynku ubezpieczeniowego w obliczu tych ryzyk.

Słowa kluczowe: luka ubezpieczeniowa; ryzyko katastroficzne; ubezpieczenie; klęska żywiołowa; zmiana klimatu

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