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SPECIAL ISSUE ON LONG-TERM RISKS AND FUTURE GENERATIONS

Mitigation of Long-Term Risks and the Role of Insurance: A Behavioural Law and Economics Perspective

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Abstract

In a world of rising long-term risks and their ensuing syndromes, the mitigation and financing of long-term risks are therefore arguably some of the most critical issues facing society. However, long-term thinking involving future generations draws limited attention in current political and social systems. Private insurance has received increased attention due to its expert role in risk management and its risk transfer mechanisms, and it has played an important role in dealing with some types of long-term risk, such as floods and earthquakes. Increasingly, insurance also contributes to disaster mitigation through regulating the conduct of policyholders by creating incentives for policyholders to counter short-termism and invest in reduction measures regarding long-term risks. In addition, it has been shown that supply-side problems and behavioural anomalies make it difficult to insure against long-term risks. Innovative long-term insurance solutions and a combination of public and private partnerships are proposed to overcome these restrictions.

Keywords: long-term insurance; long-term risk; public–private partnership

I. Introduction

A famous quote from John Maynard Keynes could help us to understand why a strong presentism bias dominates the current modes of governance: "[B]ut this long run is a misleading guide to current affairs. In the long run we are all dead."[1] In a world of rising long-term risks and their ensuing syndromes, such as a lack of pandemic preparation, increasing climate change-related disasters and the ageing of the world's population, long-term thinking including future generations has become a significant issue, but it draws limited attention in current political and social systems. However, there is another saying by Confucius: "[T]hose who do not plan for the future will lose their present." The impacts of long-term risks such as pandemics have caused not only widespread sickness and death, but also financial consequences on a massive scale.[2] People worldwide have suffered, and future generations will continue to suffer losses due to long-term risks. The mitigation and

[1] JM Keynes, *The Tract on Monetary Reform* (Cambridge, Cambridge University Press 2013 edition) p 65.

[2] According to the World Health Organization (WHO), the excess mortality associated with the COVID-19 pandemic was approximately 14.9 million in 2020–2021. See "14.9 Million Excess Deaths Associated with the COVID-19 Pandemic in 2020 and 2021" <https://www.who.int/news/item/05-05-2022-14.9-million-excess-deaths-were-associated-with-the-covid-19-pandemic-in-2020-and-2021> (last accessed 2 February 2023).

financing of long-term risks are therefore arguably some the most critical societal tasks of the twenty-first century.[3]

There are many explanations for why governments have not implemented protective and mitigation measures for long-term risks. On the one hand, a high-velocity, short-term culture dominates our social and cultural systems. Empirical evidence has shown that many individuals do not even pay attention to the consequences of long-term risks until a catastrophe occurs and hence do not invest in mitigation measures.[4] On the other hand, evidence regarding dysfunctional and unresponsive political systems has shown that governments alone cannot adequately prevent or defray long-term risks.[5] Among the many solutions to the mitigation and financing of long-term risks, this article is devoted to the role of private insurance, which has received increased attention due to its expertise in risk management and its risk transfer mechanisms, and it explores the extent to which private insurance could play a role in that respect.

Long-term risks are often classified as low-probability, high-impact events (eg floods and earthquakes) or as high-probability risks that are unlikely to materialise in the near-term (eg climate change and long-term care). Insurance, as has clearly been indicated in the literature, can play an important role in dealing with some types of long-term risk, such as climate change and earthquakes.[6] Traditionally, as a mechanism for transferring risk and compensating victims of losses, insurance can act to finance the losses caused by low-probability, high-impact disasters. Increasingly, insurance also plays a role in regulating the conduct of policyholders by creating incentives for policyholders to counter short-termism and invest in reduction measures regarding long-term risks. The regulatory tools and techniques of insurance are becoming increasingly central to the constitution of long-term risk as a public problem, and they also contribute to disaster mitigation.[7] Moreover, to build a resilient society and adapt to long-term risks, insurance can be seen as a tool for recovery as well as for preparation for increased resilience.[8]

Notwithstanding the theoretically important role that insurance could play in the compensation and mitigation of long-term losses, its potential is still largely underutilised. For example, when comparing economic losses resulting from climate change-related events with insured losses, a huge insurance protection gap can be noticed. The global protection gap was approximately USD 113 billion in 2020.[9] Another example is the COVID-19 pandemic. Large financial losses resulted from the pandemic due to the interruption of

[3] M Eling and O Ghavibazoo, "Research on Long-Term Care Insurance: Status Quo and Directions for Future Research" (2019) 44 The Geneva Papers on Risk and Insurance – Issues and Practice 303–56.

[4] H Kunreuther and M Pauly "Rules Rather than Discretion: Lessons from Hurricane Katrina" (2006) 33 Journal of Risk and Uncertainty 101–16.

[5] See GL Priest, "The Government, the Market, and the Problem of Catastrophe Loss" (1996) 12 Journal of Risk and Uncertainty 219; H Kunreuther and E Michel-Kerjan, "Market and Government Failure in Insuring and Mitigating Natural Catastrophes: How Long-Term Contracts Can Help" in JR Brown (ed.), *Public Insurance and Private Markets* (Washington, DC, AEI Press 2010) pp 119–21.

[6] See SB Hecht, "Climate Change and the Transformation of Risk: Insurance Matters" (2008) 55 UCLA Law Review 1559; L Tian et al, "Perception of Earthquake Risk: A Study of the Earthquake Insurance Pilot Area in China" (2014) 74 Natural Hazards 1595–611.

[7] SJ Collier and S Cox, "Governing Urban Resilience: Insurance and the Problematization of Climate Change" (2021) 50 Economy and Society 275–96; H Kunreuther, "Reducing Losses from Catastrophe Risks through Long-Term Insurance and Mitigation" (2008) 75 Social Research 905.

[8] M Faure and T Heldt, "Resilient Compensation Mechanisms: The Role of Government Intervention in the Insurance of Catastrophic Risks" in A Herwig and M Simoncini (eds), *Law and the Management of Disasters: The Challenge of Resilience* (London, Routledge 2017) p 225.

[9] Swiss Re Institute, *Natural Catastrophes in 2020: Secondary Perils in the Spotlight, But Don't Forget Primary-Peril Risks*, Sigma, No 1 (2021).

business, which was not covered by insurance. The French financial regulator stated that "93.3% of insurance policies did not cover the pandemic".[10] Insurers largely excluded pandemics from coverage, either by *ex-ante* excluding this from cover in their policies or by *ex-post* rejecting coverage claims.[11] An explanation is required regarding the barriers that prevent insurers from underwriting such policies and that prevent consumers from purchasing such policies. This article will examine these apparent failures and the hypotheses regarding private markets adequately insuring long-term risks through a behavioural law and economics perspective, referring to concepts such as intuitive thinking, short-termism and the cognitive biases of consumers. We then propose that innovative insurance solutions, government intervention and a combination of public and private partnerships are warranted to overcome these behavioural restrictions. Potential remedies will illustrate how insurance could be redesigned and its functions improved in terms of monitoring loss trends, improving catastrophe modelling and participating in public–private initiatives to mitigate losses.

II. Insuring long-term risks: theory and practice

1. Theory

a. The basic function of insurance as compensation to finance long-term risks

On the basis of standard economic assumptions, an individual can reasonably be assumed to be risk averse when facing long-term risks "if she considers the utility of a certain prospect of money income to be higher than the expected utility of an uncertain prospect of equal expected monetary value".[12] According to expected utility theory, in a world with perfect information and no transaction costs, every risk-averse person would like to transfer risk to insurers by paying the premium and would be better off with insurance against all risks – including long-term risks.[13]

Insurers' expertise in risk management enables insurance to play a role in compensating victims of disasters if they purchase relevant insurance policies to cover themselves in the case of an insurable contingency. The process of risk management is widely discussed in the literature, including risk assessment through underwriting, risk control through claim management and risk finance through pooling.[14] There is an increasing recognition of insurance covering for long-term risks, and it has been extended to catastrophes in recent decades.[15] Through sophisticated techniques of assessment such as catastrophe modelling[16] and alternative risk transfer mechanisms such as reinsurance and insurance-linked securities,[17] the capacity of the private insurance industry has been strengthened.[18] Therefore, the mechanism of insurance could, at least theoretically, cover long-term risks through risk transfer and risk management.

[10] M del Carmen Boado-Penas et al, "COVID-19: A Trigger for Innovations in Insurance?" in M del Carmen Boado-Penas et al (eds), *Pandemics: Insurance and Social Protection* (London, Springer 2022) p 3.

[11] CC French, "COVID-19 Business Interruption Insurance Losses: The Cases For and Against Coverage" (2020) 27 Connecticut Insurance Law Journal 9.

[12] R Cooter and T Ulen, *Law & Economics* (London, Pearson 2008) p 50.

[13] T Baker and P Siegelman, "Behavioral Economics and Insurance Law: The Importance of Equilibrium Analysis" in E Zamir and D Teichman (eds), *The Oxford Handbook of Behavioral Economics and the Law* (Oxford, Oxford University Press 2014) pp 491–517.

[14] R Thoyts, *Insurance Theory and Practice* (London, Routledge 2010) pp 286–95.

[15] R Ericson and A Doyle, "Catastrophe Risk, Insurance, and Terrorism" (2004) 33 Economy and Society 135–73.

[16] SJ Collier, "Enacting Catastrophe: Preparedness, Insurance, and Budgetary Rationalization" (2008) 37 Economy and Society 224–50.

[17] T Mcmillan, "Securitization and Catastrophe Bonds: A Transactional Integration of Industries through a Capacity-Enhancing Product of Risk Management" (2002) 8 Connecticut Insurance Law Journal 131.

[18] Collier and Cox, supra, note 7.

b. A promising function of insurance as governance to mitigate long-term risks

This article contributes to a longstanding scholarly investigation of insurance as governance (also called regulation by insurance) through and outside government.[19] Increasingly, insurance is seen as a tool to "outsource" government regulation by performing behaviour control functions on policyholders.[20] Economists have examined the role of insurance that attempts to shape policyholder conduct to minimise their financial losses and manage climate catastrophes, coupled with cost-effective preventive activities.[21] Positive relationships have also been demonstrated between individuals purchasing long-term care insurance and adopting activities that reduce health risks in the USA.[22]

Moral hazard is the major concern regarding mitigation as it leads the insured to exercise less care in avoiding losses than they would have done if insurers did not cover the losses.[23] However, by applying regulatory techniques such as risk-based pricing, deductibles, exclusions and loss-reduction services, insurers give policyholders the incentive to control moral hazard and invest in prevention measures.[24] Take risk-based pricing, for example: in theory, the insurance premium is based on the expected overall losses, derived by multiplying loss probability by loss severity.[25] Reducing either the probability or the severity of loss may lower the premium. As long as such a reduction cost is lower than the discount of the premium, policyholders would be likely to undertake risk mitigation.[26] In practice, by setting higher premiums, the UK homeowner insurance covering households against floods deters the insured from choosing to live in high-risk areas compared to lower-risk areas.[27]

c. Insurance as governance and the resilient society

Two functions of insurance as compensation and governance for the long-term risks discussed above indicate that insurance could contribute to risk reduction and self-protection and constitute a resilient solution.[28] In the literature, insurance providing a resilient approach to disasters in a risk society[29] is strongly advocated. O'Hare et al argue that "insurance represents an outsourcing of resilience to the private sector, where risk management is privatized and commodified".[30] Collier et al demonstrate that insurance coverage of risks such as floods, fires and terror attacks engages with societal resilience.[31]

[19] F Ewald, "Insurance and Risk" in G Burchell, C Gordon and P Miller (eds), *The Foucault Effect: Studies in Governmentality* (Chicago, IL, University of Chicago Press 1992) pp 197–210.

[20] O Ben-Shahar and KD Logue, "Outsourcing Regulation: How Insurance Reduces Moral Hazard" (2012) 111 Michigan Law Review 197.

[21] H Kunreuther, "Linking Insurance and Mitigation to Manage Natural Disaster Risk" in G Donnie (ed.), *Handbook of Insurance* (New York, Springer 2000) pp 593–618.

[22] DM Cutler, A Finkelstein and K McGarry, "Preference Heterogeneity and Insurance Markets: Explaining A Puzzle of Insurance (2008) 98 American Economic Review 157–62.

[23] KS Abraham, *Insurance Law and Regulation* (Perry, Foundation Press 2010) p 7.

[24] T Baker and R Swedloff, "Regulation by Liability Insurance: From Auto to Lawyers Professional Liability" (2013) 60 UCLA Law Review 1412.

[25] P Molk, "Private versus Public Insurance for Natural Hazards: Individual Behaviour's Role in Loss Mitigation" in P Gardoni et al (eds), *Risk Analysis of Natural Hazards* (Cham, Springer International Publishing 2015) pp 265–77.

[26] ibid.

[27] S Surminski, "The Role of Insurance in Reducing Direct Risk: The Case of Flood Insurance" (2013) 7 International Review of Environmental and Resource Economics 264.

[28] Faure and Heldt, supra, note 8, pp 224–44.

[29] The sociologist Ulrich Beck characterised the current era as a "risk society" and defined it as "a systematic way of dealing with hazards and insecurities induced and introduced by modernisation itself". See U Beck, *Risk Society: Towards a New Modernity* (New York, SAGE Publications 1992) p 21.

[30] P O'Hare, I White and A Connolly, "Insurance as Maladaptation: Resilience and the 'Business as Usual' Paradox" (2016) 34(6) Environment and Planning C: Politics and Space 1175–93.

[31] Collier and Cox, supra, note 7.

The discussion in the previous sections indicates that insurance provides post-disaster recovery, which could improve financial resilience. Risk-based pricing could create a collective interest in directing investments towards resilience measures.[32] More importantly, insurers perform the role of "knowledge leadership" and provide educational communication with policyholders.[33] For example, the Turkish Catastrophe Insurance Pool (TCIP), which is "considered as a good example of catastrophe risk insurance for developing and middle-income countries",[34] pays great attention to education that aims to raise public awareness of catastrophe risk. The TCIP endeavours to introduce the concept of earthquake risk management and insurance in school textbooks.[35] Those efforts, and not risk transfer, are likely to be the most significant contributions of insurance to societal resilience.

2. *Insurability of long-term risks and the supply of insurance*

Classical economic theory assumes that insurance companies maximise their long-run expected profits in a competitive insurance market.[36] Long-term risks might make good business for insurers because bearing risks for money is the business of insurers. However, insurers decide to cover a long-term risk and perform compensation and governance functions to mitigate long-term risks only if the risks are insurable.

In practice, not each and every long-term risk can be insured.[37] As we defined previously, long-term risks are often classified as low-probability, high-impact events (eg floods and earthquakes) or as high-probability risks that are unlikely to materialise in the near term (eg climate change and long-term care). The long-term risks, combined with cross-section and aggregate risks, are undoubtedly considered catastrophic or systemic.[38] Of these, aggregate risk is less standard because, as we insure further and further into the future, our ability to forecast the average loss falls.[39] Catastrophic or systemic risks are often called "uninsurable risks", and insurers are likely to avoid underwriting them in practice.[40]

Regarding climate change risks, for example, extreme weather or rising sea levels present significant challenges to insurance due to their huge losses. Besides the huge losses caused by climate hazards, catastrophic or systemic risks require insurers to hold large amounts of liquid capital, but institutional factors (such as accounting, tax and takeover risk) make insurers reluctant to do this. [41] Even regarding local flood risks, which might be perfectly insurable, insurers cut back coverage after exposure to losses in flood-prone

[32] ibid.

[33] ibid; Q He and M Faure, "Regulation by Catastrophe Insurance: A Comparative Study" (2018) 24 Connecticut Insurance Law Journal 239.

[34] J Bommer et al, "Development of an Earthquake Loss Model for Turkish Catastrophe Insurance" (2002) 6(3) Journal of Seismology 431–46.

[35] E Gurenko, *Earthquake Insurance in Turkey: History of the Turkish Catastrophe Insurance Pool* (Washington, DC, World Bank Publications 2006) p xiii.

[36] H Kunreuther, MV Pauly and S McMorrow, *Insurance and Behavioral Economics: Improving Decisions in the Most Misunderstood Industry* (New York, Cambridge University Press 2013) p 8.

[37] M Faure and N Philipsen, "Insurance of Terrorism-Related Risks" in L Bergkamp et al (eds), *Civil Liability in Europe for Terrorism-Related Risk* (Cambridge, Cambridge University Press 2015) p 212.

[38] DM Cutler, "Why Don't Markets Insure Long-Term Risk?" (1996) <https://scholar.harvard.edu/cutler/files/ltc_rev.pdf> (last accessed 2 February 2023).

[39] ibid.

[40] D Jaffee and T Russell, "Catastrophe Insurance, Capital Markets, and Uninsurable Risks" (1997) 64 Journal of Risk and Insurance 206.

[41] ibid.

areas of the USA.[42] Another example is the COVID-19 pandemic, which has caused widespread business interruption disputes. Insurers in many countries refused to cover or pay pandemic-related claims. The American Property Casualty Insurance Association (APCIA) argues that insurers are not able to cover these and that the retroactive payment for COVID-19 claims would bankrupt the industry.[43] As Sean Kevelighan, CEO of the Insurance Information Institute, stated: "[P]andemics are an extraordinary catastrophe."[44] In France, the financial regulator stated that "93.3% of insurance policies did not cover the pandemic".[45] In Germany, COVID-19 was not explicitly mentioned in the Infektionsschutzgesetz (2001) (IfSG) and provoked many court disputes.[46] In China, the insurance regulator reported that, as of June 2020, insurers had only paid an accumulated RMB 490 million coverage for pandemic losses, amounting to much less than the unprecedented impact of the pandemic on the economy.[47]

Despite these concerns, however, we argue that insurability is a flexible concept and that long-term risks, to some extent, are insurable with conditions. We divide long-term risks into liability risk and property risk, and we examine the insurability of long-term risks in the line of liability insurance (covering human-made/technological disasters, such as cyberattack risk and large-scale industrial accidents with a chemical, biological, radiological, nuclear or explosive component) and property insurance (covering natural disasters such as floods, earthquakes and pandemics), respectively.

In defining whether liability risks are insurable, the insurance literature identifies certain basic requirements to be considered: (1) actuarial estimation requires that the insurers can identify, quantify and estimate the frequency and severity of risks and the resulting losses; (2) a causal relationship requires that the causes of losses must be directly assignable and allocatable to the insured as the subject of liability; and (3) randomness requires that the materialisation of the risk must be random, unintended and unexpected.[48] First, liability insurers may worry that long-term risks present uncertainty as to the intensity and the frequency of human-made disasters and that increasing litigations could cause substantial financial losses to insurers.[49] However, neither the size of the risk nor potential loss estimates have prevented successful insurance operations in the past.[50] In addition, to address the catastrophic losses of liability risk, insurers could underwrite assessment insurance, which allows insurers to collect premiums after a loss if the insurance pool runs dry and thus enables insurers not to face the same budget constraints as

[42] Flood insurance was first offered by private insurers in the late 1890s. However, the losses to insurers were so large that they left the market. In 1968, the US Congress created the National Flood Insurance Program (NFIP) as an alternative means to offer coverage subsidised by the federal government. See H Kunreuther and RJ Roth Sr, *Paying the Price: The Status and Role of Insurance against Natural Disasters in the United States* (Washington, DC, Joseph Henry Press 1998) p 40.

[43] NAIC, "Business Interruption/Businessowner's Policies (BOP)" <https://content.naic.org/cipr-topics/business-interruptionbusinessowners-policies-bop> (last accessed 2 February 2023).

[44] AG Simpson, "P/C Insurers Put a Price Tag on Uncovered Coronavirus Business Interruption Losses" <https://www.insurancejournal.com/news/nationa/2020/03/30/562738.htm> (last accessed 2 February 2023).

[45] del Carmen Boado-Penas, supra, note 10, p 3.

[46] ibid.

[47] China Banking and Insurance Regulatory Commission (CBIRC), *Practices and Experiences of China's Banking and Insurance Industry in Fighting the COVID-19 Pandemic* (archives on file 2021) p 20.

[48] See B Berliner, "Large Risks and Limits of Insurability" (1985) 10 Geneva Papers on Risk and Insurance 313–29; A Charpentier, "Insurability of Climate Risks" (2008) 33 Geneva Papers on Risk and Insurance – Issues and Practice 91–109. See also Q He, "Mitigation of Climate Change Risks and Regulation by Insurance: A Feasible Proposal for China" (2016) 43 Boston College Environmental Affairs Law Review 326–27.

[49] The uncertainty of long-term risk will significantly affect the insurability of liability relating to tort litigation. It is inevitable that liability insurers will pay enormous litigation costs for the insured. See H-C Wang, "Adaptation to Climate Change and Insurance Mechanism" (2014) 9 National Taiwan University Law Review 317.

[50] Jaffee and Russell, supra, note 40.

they used to do.[51] Second, when referring to human-made (technological) disasters, an important feature is that there is a tortfeasor who can be identified and be held liable.[52] With respect to liability for human-made disasters, terrorism-related risks might be an exception. From an insurance perspective, terrorism has many features that make it look more like a natural disaster than like a "normal" human-made disaster: in the case of terrorism, normal liability rules cannot be applied as the terrorist will usually not be identifiable, or if they are they may often be insolvent.[53] Third, the timing, magnitude or location of human-made disasters cannot be known precisely in advance. Indeed, retroactive liability, which refers to the fact that in the interval between the original tort and the claim for damages the standard of care applied by the courts may change, may endanger the insurability of long-tail risks.[54] For example, a state court might require insurers (*ex post*) to extend coverage or pay out based on retroactive liability; these are adopted in some jurisdications in the area of environment liabilities.[55] However, liability insurers could argue that in many cases it may not apply retroactive case law since many human-made tortfeasor activities are not like dumping toxic waste; this has been confirmed in a finding of liability by judges in some cases.[56]

Similarly, in defining whether the propterty risks of natural catatrophes are insurable, the insurance literature also identifies certain basic requirements to be considered: (1) ambiguity of risk, also called uncertainty, which is the inability to identify and quantify probabilities of predicted losses with sufficient precision; (2) losses and insolvency, which relate to the largest possible loss that could threaten insurers' solvency; and (3) appetite, which refers to insurers lacking the desire to underwrite risks at a price that policyholders are willing to pay.[57] First, long-term climate catastrophe risks lead to an increase in the uncertainty associated with the frequency and severity of extreme weather events. When there is "too much" uncertainty, the exposure becomes unmeasurable and unquantifiable and thus uninsurable. Nonetheless, with the steadily growing body of data on such catastrophic events and the development of climate catastrophe models that could help us to estimate the potential damages of a catastrophe, natural catastrophe risk is evolving away from a highly uncertain line of business.[58] Second, like liability insurance discussed above, natural catastrophe insurance involves similar concerns and arguments regarding the potential magnitude of natural catastrophe losses. To address the concern of insolvency, outside capital could supplement natural

[51] Take Florida's Citizens Property Insurance Corporation, for example: citizens can secure emergency funding for catastrophic losses that exceed the Citizens Property Insurance Corporation's own reserves under the assessment process. Citizens could impose a tax on all citizens' policyholders. Part of this assessment/tax is collected up front, and part is spread out over a number of years, until the deficit is paid. See O Ben-Shahar and K Logue, "The Perverse Effects of Subsidized Weather Insurance" (2016) 68 Stanford Law Review 571.

[52] Faure and Philipsen, supra, note 37, p 216.

[53] ibid, p 230.

[54] M Faure and P Fenn, "Retroactive Liability and the Insurability of Long-Tail Risks" (1999) 19 International Review of Law and Economics 490–93.

[55] MG Faure, "Insurability of Damage Caused by Climate Change: A Commentary" (2007) 155 University of Pennsylvania Law Review 1877.

[56] ibid.

[57] See C Herweijer, N Ranger and RET Ward, "Adaptation to Climate Change: Threats and Opportunities for the Insurance Industry" (2009) 34 Geneva Papers on Risk and Insurance – Issues and Practice 360–80; SB Hecht, "Climate Change and the Transformation of Risk: Insurance Matters" (2008) 55 UCLA Law Review 1580–81; HC Kunreuther and EO Michel-Kerjan, "Climate Change, Insurability of Large-Scale Disasters, and the Emerging Liability Challenge" (2007) 155 University of Pennsylvania Law Review 1813. See also He, supra, note 48.

[58] D Laster et al, *Innovating to Insure the Uninsurable* (Zurich, Swiss Re 2005) p 14.

catastrophe insurers' capacity. Reinsurance and insurance-linked securitisation (ie natural catastrophe bonds)[59] could provide additional resources to primary insurers. In addition, and as a last resort, the government could also contribute to solving this problem.[60] Third, insurers should have a willingness (often referred to as "appetite") to underwrite particular risks. Indeed, even though underwriting long-term risks could maximise insurers' long-run expected profits, they might still decline from underwriting such policies.

3. *A short summary*

In sum, long-term risks are in principle insurable; however, some (especially small) insurers still have concerns about or have less appetite for this type of risk compared with normal risks. Insurers have partially withdrawn from the market and even retreated from underwriting catastrophic disasters. Nevertheless, insurability is not a binary concept (in the sense that the risk is either insurable or not), but rather is a gradual, flexible concept explaining under which circumstances insurers would be more or less willing to provide cover for particular risks. The boundaries regarding the insurability of specific risks are not set in stone. In order to enhance insurers' role in financing and mitigating long-term risks, government intervention is needed, which could contribute to meeting the conditions of insurability.[61]

III. Demand anomalies of insurance for long-term risks

Leaving the discussion of the supply of insurance for long-term risks, we now turn to the demand side. Classical economic theory posits that individuals will make decisions under uncertainty according to the "expected utility theory of choice".[62] According to Nobel Prize-winner Kenneth J. Arrow, individuals purchase insurance because they are willing to pay a certain small premium to protect against an uncertain large loss in the future.[63] In other words, a rational potential victim will voluntarily purchase insurance if they perceive the premium to be sufficiently low in comparison to the risks. However, many people fail to purchase insurance offered even at subsidised prices against long-term risks.[64]

In May 2018, before the COVID-19 pandemic outbreak, Munich Re, in cooperation with technology firm Metabiota, captured cutting-edge information on pandemics and developed an innovative insurance policy that provided specific coverage for losses caused by epidemics and pandemics, but nobody bought it.[65] Flood insurance offered by the National Flood Insurance Program in the USA is another example of this anomaly. Many people fail

[59] Reinsurance can be understood as simply insurer's insurance. Insurers have protected themselves through private reinsurance contracts whereby portions of their losses from a catastrophic disaster are covered by some type of reinsurance arrangement. Insurance-linked securitisation could be regarded as the process of transferring insurance risks from insurers and conveying them to third parties through tradable securities. Catastrophe bonds, also called "cat bonds" or "Act of God bonds", represent the most prominent and popular form of insurance-linked securities today. See He, supra, note 48.

[60] The government has a deep credit capacity due to its ability to raise money through tax or borrow money by issuing debt far more readily than private insurers or reinsurers. See L Kaplow, "Incentives and Government Relief for Risk" (1991) 4 Journal of risk and Uncertainty 167–75.

[61] See infra, Section IV.3.

[62] This theory assumes that individuals with accurate information about risks decide on insurance purchases by making explicit trade-offs between the expected benefits and the costs of different policies. See Kunreuther et al, supra, note 36, p 8.

[63] KJ Arrow, *Essays in the Theory of Risk-Bearing* (Chicago, IL, Markham Publishing 1971) pp 199–200.

[64] Kunreuther et al, supra, note 36, p 113.

[65] PathogenRX, "An Innovative Solution for Pandemic and Epidemic Risks" <https://www.marsh.com/us/campaigns/pathogenrx.html> (last accessed 2 February 2023).

to purchase insurance offered even at subsidised prices against low-probability but high-consequence disasters.[66] The Federal Insurance Administration estimated that only about 27% of households living in high-risk flood areas were insured.[67]

In the behavioural law and economics literature, scholars have indicated that "the behavioural research is sufficiently developed to provide a well-grounded explanation for consumer behaviour and why it diverges from the predictions of expected utility theory".[68] In addition, "[b]ehavioural characteristics influence flood insurance purchases as well as the joint decision to mitigate risk".[69] Yudkowsky reviewed cognitive biases potentially affecting judgment regarding long-term risks, including but not limited to the availability bias, the hindsight bias, the conjunction fallacy, the confirmation bias, the affect heuristic, scope neglect, overconfidence and bystander apathy.[70] In this article, we will review and apply theories of behavioural economics to explain why there are demand anomalies of insurance for long-term risks.

1. Intuitive thinking versus deliberative thinking

Nobel Prize-winner Daniel Kahneman has categorised thinking into two systems: System 1 and System 2. System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control. This is often described as intuitive thinking.[71] System 2 allocates attention to effortful and intentional mental activities including simple or complex computations or formal logic. This is often described as deliberative thinking.[72]

Facing long-term risks, if, as classical economic theory posits, consumer behaviour would follow expected utility theory, then consumers (the decision-makers) would use System 2 to make deliberative choices. In reality, much human behaviour conforms to the more automatic and less analytic System 1, which results in many behavioural biases. When consumers face low-probability, high-impact disasters or high-probability risks that are unlikely to materialise in the near term, System 1 (intuitive thinking) does not work well and results in many anomalies in demand for insurance and failure to buy insurance optimally.

2. Prospect theory

Prospect theory, which was developed by psychologists Daniel Kahneman and Amos Tversky, is a descriptive choice model that predicts actual behaviour better than expected utility theory and shows that people may *ex ante* prefer uncertain losses to the certain loss of paying a premium.[73] This tendency to treat a certain loss as more painful than the pleasure of uncertain gains is also termed "myopic loss aversion".[74] It makes even actuarially fair insurance unattractive, let alone low-probability, high-damage catastrophe insurance, for which it is difficult to charge accurate premiums. For long-term risks, consumers may

[66] Kunreuther et al, supra, note 36, p 113.

[67] Kunreuther and Roth, Sr, supra, note 42, p 55.

[68] Baker and Siegelman, supra, note 13, p 493.

[69] WJW Botzen, H Kunreuther and E Michel-Kerjan, "Protecting against Disaster Risks: Why Insurance and Prevention May Be Complements" (2019) 59 Journal of Risk and Uncertainty 151–69.

[70] E Yudkowsky, "Cognitive Biases Potentially Affecting Judgement of Global Risks" in N Bostrom and MM Cirkovic (eds), *Global Catastrophic Risks* (Oxford, Oxford University Press 2011) pp 91–119.

[71] D Kahneman, *Thinking, Fast and Slow* (New York, Farrar, Straus and Giroux 2011) pp 20–21.

[72] ibid.

[73] D Kahneman and A Tversky, "Prospect Theory: An Analysis of Decision under Risk" (1979) 47 Econometrica 263–92.

[74] S Benartzi and R Thaler, "Myopic Loss Aversion and the Equity Premium Puzzle" (1995) 110 Quarterly Journal of Economics 73–92.

just ignore the risk. Prior to a disaster, they contend that such a disaster will not happen to them. As a result, they will not spend money to invest in protective measures.[75]

In addition, excessive discounting could be expected based on this theory, where an irrational individual has a high preference for money today over money tomorrow, underestimates risks in the future and thus pays less money for long-term risk prevention.[76]

3. Goal-based model of choice

The goal-based model of choice developed by David H. Krantz and Howard Kunreuther is another theory of decision-making based on pre-set goals rather than on maximising expected utility.[77] Potential victims may fail to purchase insurance against long-term risks because of the observed behavioural anomaly of individuals to *underestimate* or *overestimate* the expected costs of extreme hazards.

Take flood insurance, for example: before a flood strikes, residents seldom buy flood insurance to protect themselves. At this stage, they have concerns that buying flood insurance is not a good investment in view of the anticipated benefits. But after suffering flood damage, they purchase insurance to satisfy their emotional goals. Following flood damage, anxiety is high, and reducing it by purchasing insurance is a salient goal.[78] However, when several consecutive years pass with no floods, many people cancel their flood policies. At this stage, avoiding anxiety is not that important, and reducing burdensome premiums becomes more important.[79] Earthquake insurance is another example. After the Northridge earthquake in California in 1994, many citizens bought earthquake insurance in reaction to the damages that they suffered. However, one month later, when daily life took over again, many new insurance policies were cancelled.[80]

4. A short summary

In sum, behavioural law and economics studies show that individuals do not take insurance against long-term risks such as low-probability, high-loss events, even if it increases their utility.[81] Behavioural problems such as bounded rationality even cause individuals to take an "it will not happen to me" attitude and hence not purchase insurance coverage.[82] To solve the demand anomalies and to enhance insurers' role in financing and mitigating long-term risks, government intervention is also required, but this needs careful designing. Governments should promote but not distort a robust insurance market.

[75] Kunreuther and Michel-Kerjan, supra, note 5, pp 126–30.

[76] Baker and Siegelman, supra, note 13, pp 491–517.

[77] DH Krantz and H Kunreuther, "Goals and Plans in Decision Making" (2007) 2 Judgment and Decision Making 137–68.

[78] Kunreuther et al, supra, note 36, p 103.

[79] E Michel-Kerjan, SL de Forges and H Kunreuther, "Policy Tenure under the U.S. National Flood Insurance Program" (2012) 32 Risk Analysis 644–58.

[80] RL Rabin and SA Bratis, "United States" in MG Faure and T Hartlief (eds), *Financial Compensation for Victims of Catastrophes: A Comparative Legal Approach* (Vienna, Springer 2006) pp 330–31.

[81] H Kunreuther, MV Pauly and S McMorrow, "Behavioral Economics and Insurance: Principles and Solutions" in D Schwarcz and P Siegelman (eds), *Research Handbook on the Economics of Insurance Law* (Cheltenham, Edward Elgar Publishing 2017) pp 15–35.

[82] M Faure and V Bruggeman, "Catastrophic Risks and First-Party Insurance" (2008) 15 Connecticut Insurance Law Journal 21–27.

IV. Long-term insurance for long-term risks

1. Government bailout and Samaritan's Dilemma

Assuming that capacity on the private insurance market is indeed severely falling behind and demand anomalies widely exist, it can be assumed that, without government intervention, insurance coverage for long-term risks would simply not have developed.[83] In addition, scholarship criticisms have also been formulated on the facilitative role of a government stimulating insurance markets.[84]

Normally, the government plays the central role in the governance of long-term risks and crises because it has the authority and emergency powers to create and enforce laws and regulations.[85] However, ad hoc government bailouts in the form of lump sum payments make it more difficult to take preventive measures for the victims. They therefore would not adopt resilient behaviour against disasters. Epstein defines ad hoc government bailouts nicely by qualifying them as "catastrophic responses to catastrophic risks".[86]

People may fail to purchase insurance against long-term risks due to repeated government bailouts. In contrast to the findings from behavioural economics, relying on a government bailouts rather than purchasing insurance against long-term risks looks rational. Why pay for this coverage via insurance premiums if the government would provide compensation regardless?[87] A comparative overview in European countries showed that the degree of insurance coverage was low in countries where state compensation was generously (and almost automatically) provided after a disaster (eg Germany or Italy). In contrast, the degree of insurance coverage was substantially higher in countries where the state takes a principal attitude of not providing any compensation after a disaster (eg the UK).[88]

Relying on government bailouts leads to a problem called the "Samaritan's Dilemma". Governments providing relief will lead to a "charity hazard" and reduce residents' incentives to invest in protective measures such as buying insurance and mitigation.[89] Empirical research on crop insurance for natural disasters in the Netherlands has shown that the incentive to purchase insurance is severely undermined due to government disaster compensation.[90]

2. Mandatory coverage?

To solve the demand anomalies, mandatory coverage is suggested as the solution. Several countries, including France, Belgium, Norway and Spain, have introduced such a mandatory compensation system for (particular) natural catastrophes. A well-known example is

[83] This is a point strongly made by H Kunreuther, "Mitigating Disaster Losses through Insurance" (1996) 12 Journal of Risk and Uncertainty 171–87; SE Harrington, "Rethinking Disaster Policy" (2000) 23(1) Regulation 40–46.

[84] A Gron and AO Sykes, "A Role for Government?" (2002) 25(4) Regulation 44–51; MJ Trebilcock and RJ Daniels, "Rationales and Instruments for Government Intervention in Natural Disasters" in RJ Daniels, DF Kettl and H Kunreuther (eds), *On Risk and Disaster – Lessons from Hurricane Katrina* (Philadelphia, PA, University of Pennsylvania Press 2006) pp 89–107.

[85] O Gross and F Ní Aoláin, *Law in Times of Crisis: Emergency Powers in Theory and Practice* (Cambridge, Cambridge University Press 2006) pp 1–14.

[86] R Epstein, "Catastrophic Responses to Catastrophic Risks" (1996) 12 Journal of Risk and Uncertainty 287–308.

[87] L Kaplow, "Incentives and Government Relief for Risk" (1991) 4 Journal of Risk and Uncertainty 172–73.

[88] M Faure, "Comparative and Policy Conclusions" in M Faure and T Hartlief (eds) *Financial Compensation for Victims of Catastrophes: A Comparative Legal Approach* (Vienna, Springer 2006) p 390.

[89] Faure and Bruggeman, supra, note 1.

[90] MAPM van Asseldonk et al, "Belief in Disaster Relief and the Demand for a Public–Private Insurance Program" (2002) 24 Review of Agricultural Economics 196.

the Catastrophes Naturelles (Cat.Nat) insurance system in France, in which all individuals who have taken out property damage insurance policies are required by law to pay an additional premium for mandatory coverage for natural disasters.[91] In the literature, some behavioural law and economics scholars support mandatory coverage, which has been advocated to deal with low demand for such coverage due to cognitive and informational issues.[92] They argue that when disaster insurance is sold along with insurance against likely losses (such as housing insurance) at a reasonable extra cost, more people will purchase insurance against the low-probability loss for which they would otherwise show no demand.[93] In addition, mandatory coverage has the advantage of curing adverse selection by including all risks (good risks and bad risks) in the mandatory system; the moral hazard problem could be also be overcame through premiums and risk differentiation.[94] The literature concludes that if it is in society's best interest for people to insure themselves against unlikely calamities (such as weather-related events), adding protection against a small but likely loss might help us to accomplish this purpose.

However, the model of mandatory coverage poses potential dangers as well. When introducing mandatory coverage, there is always a danger that the legislature in fact forces potential victims to purchase an insurance policy even if there would be no demand. The problem is that the behavioural literature not only shows a lack of information, but also demonstrates that even when potential victims are well informed about the risks they prefer not to purchase insurance because they perceive the policy as an investment.[95] In the case of low-probability, high-loss events, there is a great likelihood that people will be paying a large premium without ever experiencing any return during their lifetime. Hence, this research shows that it is not primarily poor information given to potential victims that causes the low demand, but rather the unwillingness of victims (even if they are well informed) to purchase coverage against low-probability, high-loss events. If this is the case, there is always a danger that the mandatory insurance would in fact amount to paternalism.[96]

Perhaps government intervention should take the form of a nudge rather than paternalism.[97] Disclosure and (debiasing) education about long-term risk will be viable approaches to protecting imperfectly rational individuals, as "doing so poses relatively few problems for a preference-based, welfare approach to policy making: by assumption, the consumer will use the new, accurate information to make the appropriate (subjectively welfare-maximizing) choice to buy the insurance".[98]

[91] For a description of the French system, see Q He and M Faure, "Regulation by Catastrophe Insurance: A Comparative Study" (2018) 24 Connecticut Insurance Law Journal 189.

[92] For example, Kunreuther already proposed mandatory insurance several decades ago. See H Kunreuther, "The Case for Comprehensive Disaster Insurance" (1968) 11 The Journal of Law & Economics 133. Telesetsky treats mandatory catastrophe insurance as a risk-sharing mechanism serving the goals of both corrective and distributive justice. See A Telesetsky, "Insurance as a Mitigation Mechanism: Managing International Greenhouse Gas Emissions through Nationwide Mandatory Climate Change Catastrophe Insurance" (2010) 27 Pace Environmental Law Review 691.

[93] P Slovic et al, "Preference for Insuring against Probable Small Losses: Insurance Implications" in P Slovic (ed.), *The Perception of Risk* (London, Earthscan 2000) p 71.

[94] Telesetsky, supra, note 92.

[95] P Schoemaker and H Kunreuther, "An Experimental Study of Insurance Decisions" (1979) 46 Journal of Risk and Insurance 610.

[96] Faure, supra, note 55.

[97] R Thaler and C Sunstein, *Nudge: Improving Decisions About Health, Wealth, and Happiness* (New York, Penguin Books 2009).

[98] Baker and Siegelman, supra, note 13, p 502.

3. Long-term insurance and public–private partnerships

Behavioural anomalies might be solved by long-term insurance in which policies are sold for consecutive years rather than only for one year and are tied to the property as opposed to the property owner, as in the traditional annual policy.[99] It satisfies a fundamental objective better than annual policies: providing financial protection against losses caused by long-term risks.[100] Individuals generally like to purchase insurance after suffering catastrophic damage, such as floods, to reduce their anxiety. When several consecutive years pass without any flood, however, many people cancel their natural catastrophe policies. Long-term insurance has the potential to deal with this problem, while annual policies do not, because under annual policies an insured person can cancel the next year's coverage easily.[101] What is more, offering residents and businesses long-term insurance policies coupled with long-term home improvement loans might not only overcome short-sighted biases, but also induce individuals to invest in cost-effective mitigation measures in exchange for premium reductions or other bonuses.[102]

To overcome the supply-side challenges of long-term insurance, public–private partnerships need to be developed, whereby the government intervenes to facilitate rather than to crowd out private insurance. Empirical evidence shows the decreases in flood risk reduction measures and insurance demands due to government disaster assistance.[103] This facilitative role of government means that such intervention should not take the form of replacing insurance models, but rather should stimulate the insurability of natural catastrophes to prevent the subsidising effects of full government compensation.[104] The government could act as a reinsurer of last resort by helping to fill the "capacity gap" of primary insurers in underwriting long-term risks. In addition, governments as reinsurers would not interfere with a private insurer's business, thus ensuring that the private insurance market can continue to play a regulatory role in long-term risk mitigation. In practice, models of reinsurance by the government have been developed in many countries for dealing with earthquake and flood risks.[105] It is reasonable to assume that such public–private partnerships could feasibly deal with long-term risks.

V. Conclusion

There are several different approaches to mitigating and financing catastrophic losses caused by long-term risks: (1) mitigation that can only be achieved by governments through collective action (building dykes); (2) mitigation that can be achieved by individuals (living in less flood-prone areas or building flood-proof housing); (3) compensation after such catastrophes for unforeseeable or principally uninsurable risks (eg large flooding from the sea), which can be considered a governmental task; and (4) compensation on an individual basis for risks that are in principle insurable (eg floods from a local river).[106]

[99] H Kunreuther and EO Michel-Kerjan, *At War with the Weather: Managing Large-Scale Risks in a New Era of Catastrophes* (Boston, MA, The MIT Press 2009) pp 333–50.

[100] Kunreuther et al, supra, note 36, pp 228–32.

[101] ibid.

[102] H Kunreuther, R Meyer and E Michel-Kerjan, "Overcoming Decision Biases to Reduce Losses from Natural Catastrophes" in E Shafir (ed.), *The Behavioral Foundations of Public Policy* (Hoboken, NJ, Princeton University Press 2013) pp 398–413.

[103] Botzen et al, supra, note 69.

[104] Faure and Heldt, supra, note 8, p 225.

[105] Examples include but are not limited to Japan (Japan Earthquake Reinsurance Co.), the UK (Flood Re; insurers can cede the riskiest properties to the Flood Re pool at a discounted price) and the USA (the Terrorism Risk Insurance Program and the Florida Hurricane Catastrophe Fund, an example of state-level reinsurance).

[106] Thank you to Bas Heerma van Voss for useful feedback on disentangling conceptually the different types of mitigation and compensation.

In this article, we discussed how private insurance plays a role in addressing long-term risks, especially for those that are in principle insurable.

We have presented theoretical and empirical insights into the approach insurers take with respect to long-term risks. Through *ex ante* insurance, policyholders could take protection and mitigation measures following the incentives offered by risk-based premiums and other regulatory tools. However, it has been shown that particular problems make it difficult to insure long-term risks. One problem relates to the supply side, which causes reluctance on the side of insurers to engage in the coverage of long-term risks. The other problem is that demand for these types of insurance may be relatively limited due to behavioural anomalies. The solution to these problems, not only given in the literature but also observed in practice, is a role for government intervention to facilitate insurability and to nudge imperfectly rational individuals. A public–private partnership, where government intervention contributes to overcoming both the supply and demand barriers of long-term insurance development, would be an optimal choice in practice.

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