The Prevention Cycle: State Investments in Preventing System Risks over Time*

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Abstract

The policy drivers for preventing system risks – risks that threaten vital parts of society – represent an as-yet understudied subject. A fundamental characteristic of an effective prevention policy for system risks is long-term investment. This article presents evidence that long-term investment in prevention follows a cyclical rather than a stable pattern, which implies large costs to the welfare of future generations. This cycle is usually triggered by a shock that shifts the set of preventive policies that are acceptable to or even demanded by society. After a rapid rise in preventive investment, however, attention often wanes, and the downturn of the prevention cycle sets in. While policy shocks from crises and disasters are commonly studied, their policy legacies rarely have been. This article offers a theoretical framework for this "prevention cycle", demonstrates its applicability in understanding policy investment in several system risks and offers suggestions for its fundamental causes.

Keywords: future generations; optimal preventive policy; prevention cycle; system risks

I. Introduction

For future generations to be protected adequately from the negative consequences of system risks – risks that threaten vital parts of society – policy investments in domains such as financial regulation, public health and climate are necessary.[1] However, preventive policy investments are usually constrained at suboptimal levels, and their burden is therefore more often than not transferred onto future generations, even when the cost–benefit ratio of preventive measures is clearly favourable.[2] This happens in part because preventive policies are often considered wasteful when successful: the risk never materialises because of the preventive measures taken, and it appears that money was thrown at a non-existent

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*This paper has been updated since first publication on 07.06.23 to remove a duplicate figure.

[1] R Krznaric, *The Good Ancestor: How to Think Long Term in a Short Term World* (London, W. H. Allen 2020); T Ord, *The Precipice: Existential Risk and the Future of Humanity* (London, Bloomsbury Academic 2020); W MacAskill, *What We Owe the Future: A Million-Year View* (London, Oneworld 2022).

[2] B Depoorter, "Horizontal Political Externalities: The Supply and Demand of Disaster Management" (2006) 56 Duke Law Journal 101; C Cohen and ED Werker, "The Political Economy of 'Natural' Disasters" (2008) 52 Journal of Conflict Resolution 795; A Healy and N Malhotra, "Myopic Voters and Natural Disaster Policy" (2009) 103 American Political Science Review 387; I Gough, "The Political Economy of Prevention" (2015) 45 British Journal of Political Science 307; World Bank, "From Panic and Neglect to Investing in Health Security: Financing Pandemic Preparedness at a National Level" (*World Bank*, 2017); A Boin et al, *The Politics of Crisis Management: Public Leadership under Pressure*, 2nd edition (Cambridge, Cambridge University Press 2016).

problem. This limits both available budgets and preventive legislative action. After the threat of the H1N1 pandemic passed, for example, governments were criticised by parliaments for their overreaction.[3] Similarly, when financial system crises fade from memory, tight financial regulation comes to be considered an excessive noose on economic development and is relaxed again.[4] When the ensuing crises hit, the damage to society and the costs of responses can far outweigh the costs of preventive investments. In other words, underinvestment in prevention in the present has large negative consequences for the well-being of future generations.

Under very specific conditions, however, there appears to be an opportunity for large-scale public investment to prevent system risks. After the occurrence of disasters that receive widespread media coverage and are focal points of the public sphere for some time, investment in the prevention of the next occurrence of this type often rises.[5] This phenomenon is exemplified by rising expenditure on the prevention of nuclear disasters following the Fukushima, Chernobyl and Three Mile Island crises, on counterterrorism following 9/11 and on flood prevention following Hurricane Katrina. However, with time our recollection of such disasters fades and preventive expenditure falls again. In this paper, we shall call this waxing and waning of preventive policy investment the *prevention cycle*. As more policy investment in the prevention of future risks could have potentially large benefits for future generations, this article posits that the existence of a prevention cycle invites careful investigation.

In this paper, the prevention cycle will be introduced as a theoretical concept, its existence across domains of public policy demonstrated and its causes explored. Section II will explore how aspects of the prevention cycle have been recognised in domain-specific literatures on public policy (eg on the panic and neglect cycle following epidemic episodes or the cycle of financial regulation following financial crises) but never integrally as a general problem of governance. In addition, this paper will explore related concepts in the political science literature. Using insights from these literatures, a formal framework will be established. In Section III, data are presented on preventive policy investment during prevention cycles following three focal disasters: counterterrorism following 9/11, flood prevention following Hurricane Katrina and nuclear risk prevention following Fukushima. In Section IV, several causes of this pattern are proposed. Some causes, such as updated risk estimates and countercyclical economic policy, might be more benign than others, such as political opportunism and short-sightedness. Section V concludes and gives suggestions for policy.

II. What explains patterns of expenditure on prevention? A view from the literature

In this section, we will first look at the literature on cycles of preventive expenditure on public health and financial regulation in order to identify generalisable lessons. Secondly, we will look at related concepts in the social sciences, such as Kingdon's policy window and

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[3] P Flynn, "The Handling of the H1N1 Pandemic: More Transparency" (Parliamentary Assembly, European Parliament, 23 March 2010); "Reconstruction of a Mass Hysteria: The Swine Flu Panic of 2009" (*Der Spiegel*, 12 March 2010); Tweede Kamer der Staaten-Generaal, "Verslag van een algemeen overleg, gehouden op 29 september 2011, inzake evaluatie Mexicaanse griep" (28 October 2011) <https://zoek.officielebekendmakingen.nl/kst-22894-302.html> (last accessed 4 January 2023).

[4] CM Reinhart and KS Rogoff, *This Time Is Different: Eight Centuries of Financial Folly*, first paperback print (Princeton, NJ, Princeton University Press 2011).

[5] TA Birkland, *After Disaster: Agenda Setting, Public Policy, and Focusing Events* (Washington, DC, Georgetown University Press 1997).

the risk–regulation reflex. Thirdly, we will use the insights from these literatures to formalise our framework.

1. Policy cycles in public health and financial regulation

Within risk-specific literatures, preventive policy cycles have been recognised. For example, prior to the outbreak of COVID-19, there was already recognition of the problem of "panic and neglect" in global public health.[6] Panic is triggered by the outbreak of an infectious disease, such as the flu epidemics of 1918, 1957 and 1968 or SARS in 2004. For a short period, there is a spike in preventive policy investment. However, as the outbreak fades from memory, so the preventive measures are reversed through budget cuts and reforms. In the last decade, there was wide recognition of the issue of underinvestment in epidemic preparedness, with several academics in the field of public health trying to estimate expected annual losses to call attention to this problem.[7] In the absence of recent global scares, all countries seemed to lack adequate epidemic preparedness prior to COVID-19.[8] Following COVID-19, we are currently at the stage where countries still have sound memories of the panic and are therefore increasing preventive investment.[9] The cycle of "panic and neglect" continues to govern our epidemic preparedness policies.

The literature on the preventive policy cycle in the case of financial risk is significantly larger and more elaborate than that on epidemic prevention, but the cyclical pattern in preventive policies as found by academics is similar. As is convincingly demonstrated by Reinhart and Rogoff in their 2009 book *This Time Is Different*, financial regulation tends to be procyclical: we loosen the reigns during booms and tighten them during contractions. Part of the reason for this procyclicality is that we tend to respond to financial crises by tightening the noose of regulation, only to relax policy as the most recent crisis fades from memory. Financial deregulation is a strong predictor of financial crises.[10] In turn, financial crises are strong predictors of tighter regulation.[11] McDonnell highlights the New Deal financial regulation following the first great contraction in 1929, the Sarbanes–Oxley act following the burst of the dot-com bubble in 2000 and the Dodd–Frank act following the second great contraction in 2008.[12] Time and again societies conclude that financial risk has been overcome – by financial or regulatory innovation, by newly achieved levels of wealth or by improvements in institutional trust. They then turn out to be wrong, and thus we enter a new prevention cycle.

[6] World Bank, supra, note 3; E Cameron, J Nuzzo and J Bell, "Global Health Security Index" (*Nuclear Threat Initiative*, 2019) <https://www.ghsindex.org/wp-content/uploads/2019/10/2019-Global-Health-Security-Index.pdf> (last accessed 4 January 2023); T Ord, A Mercer and S Dannreuther, "Future Proof: The Opportunity to Transform the UK's Resilience to Extreme Risks" (*Centre for the Study of Existential Risk*, 2021).

[7] P Sands, C Mundaca-Shah and VJ Dzau, "The Neglected Dimension of Global Security – A Framework for Countering Infectious-Disease Crises" (2016) 374 New England Journal of Medicine 1281; VY Fan, DT Jamison and LH Summers, "Pandemic Risk: How Large Are the Expected Losses?" (2018) 96 Bulletin of the World Health Organization 129.

[8] Cameron et al., supra, note 6.

[9] "G20 Hosts Official Launch of The Pandemic Fund" (*World Bank*, 2022) <https://www.worldbank.org/en/news/press-release/2022/11/12/g20-hosts-official-launch-of-the-pandemic-fund> (last accessed 4 January 2023); "European Health Union: First State of Health Preparedness Report Shows EU's Strong Progress" (*European Commission*, 2022) <https://health.ec.europa.eu/latest-updates/european-health-union-first-state-health-preparedness-report-shows-eus-strong-progress-2022-11-30_en> (last accessed 4 January 2023); The White house, "Statement by President Biden on Pandemic Preparedness, Prevention and Response Fund at the World Bank" (*The White House*, 1 July 2022).

[10] Reinhart and Rogoff, supra, note 4.

[11] S Banner, "What Causes New Securities Regulation? 300 Years of Evidence" (1997) 75(2) Washington University Law Review 849.

[12] B McDonnell, "Dampening Financial Regulatory Cycles" (2013) 65 Florida Law Review 1597.

2. What determines preventive expenditure? Policy windows and the risk–regulation reflex

While theories on what ultimately determines the agenda of state-level policymakers abound,[13] it is beyond dispute that financial crises, epidemics and natural disasters change the set of options that are available to policymakers.[14] They can therefore be seen as a type of "focusing event", as described by Kingdon in his book *Agendas, Alternatives, and Public Policies*.[15] Focusing events bring a policy problem or agenda that was lurking in the shadows to the fore. When the attention of all parties necessary to the solution (eg experts, financiers, lawmakers and civil society) has been gathered, the problem becomes solvable. In the words of Baumgartner and Jones, the policy equilibrium has been punctuated. The strength of focusing events is enhanced by an accompanying "crisis rhetoric", both in media and public leadership.[16] Focusing events can take the shape of technological breakthroughs, cultural symbols or, as is relevant to our present topic of interest, societal distress. Kingdon calls the period following a focusing event in which new policy options are available a "policy window". Financial crises, epidemics, floods and other disasters can be forceful shocks to political systems, shifting political attention as a focusing event and opening (and closing) policy windows through their impact.[17] Preventive measures that were unthinkable prior to the disaster become palatable.

Materialisations of system risk not only open up new possibilities; in democracies, they can also force the policymaker's hand. This has come to be known as the "risk–regulation reflex"[18]: public outcry following an accident or a disaster can lead to rash decisions and excessive regulations that do more harm than good.[19] Unlike the framework proposed by Kingdon, which is largely neutral, the risk–regulation reflex is a normative concept that is only applied to cases in which the regulatory response is deemed to be suboptimally harsh.

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[13] PA Sabatier (ed.), *Theories of the Policy Process*, 2nd edition (Boulder, CO, Westview Press 2007); Boin et al, supra, note 2.

[14] JTS Keeler, "Opening the Window for Reform: Mandates, Crises, and Extraordinary Policy-Making" (1993) 25 Comparative Political Studies 433; A Boin and P 't Hart, "Institutional Crises and Reforms in Policy Sectors" in H Wagenaar (ed.), *Government Institutions: Effects, Changes and Normative Foundations* (Alphen aan den Rijn, Kluwer Academic Publisher 2000) pp 9–32; TA Birkland and M Warnement, "Defining, Explaining, and Testing the Role of Focusing Events in Agenda Change: 30 Years of Focusing Event Theory" (*APSA 2013 Annual Meeting Paper*, 2013); SPM Mackintosh, "Crises and Paradigm Shift" (2014) 85 The Political Quarterly 406; C Ansell, A Boin and S Kuipers, "Institutional Crisis and the Policy Agenda" in N Zahariadis (ed.), *Handbook of Public Policy Agenda Setting* (Cheltenham, Edward Elgar Publishing 2016) pp 415–32.

[15] JW Kingdon, *Agendas, Alternatives, and Public Policies*, 2nd edition (Harlow, Longman 2003).

[16] FR Baumgartner and BD Jones, "Agenda Dynamics and Policy Subsystems" (1991) 53 The Journal of Politics 1044.

[17] Keeler, supra, note 14; Birkland, supra, note 5; M Pelling and K Dill, "Disaster Politics: Tipping Points for Change in the Adaptation of Sociopolitical Regimes" (2010) 34 Progress in Human Geography 21; MO Ensor (ed.), *The Legacy of Hurricane Mitch: Lessons from Post-Disaster Reconstruction in Honduras* (Tucson, AZ, University of Arizona Press 2022).

[18] I Helsloot and A Schmidt, "The Intractable Citizen and the Single-Minded Risk Expert – Mechanisms Causing the Risk Regulation Reflex Pointed Out in the Dutch Risk and Responsibility Programme" (2012) 3 European Journal of Risk Regulation 305; M Trappenburg and M-J Schiffelers, "How to Escape the Vicious Circle: The Challenges of the Risk Regulation Reflex" (2012) 3 European Journal of Risk Regulation 283.

[19] E Stern, "Crisis and Learning: A Conceptual Balance Sheet" (1997) 5 Journal of Contingencies and Crisis Management 69; A Boin, P 't Hart and A McConnell, "Conclusions: The Politics of Crisis Exploitation" in A Boin, A McConnell and P 't Hart (eds), *Governing after Crisis*, 1st edition (Cambridge, Cambridge University Press 2008) pp 285–316; Boin et al, supra, note 2; J Mueller and MG Stewart, "Evaluating Counterterrorism Spending" (2014) 28 Journal of Economic Perspectives 237.

As learning from crisis situations is constrained by a host of psychological and institutional factors,[20] such errors in response are common.[21]

The immediate policy response to the materialisation of system risks has been researched extensively and is well understood. However, little is known from the general risk literature as to whether regulations, be they appropriate or excessive, last over time. As Boin et al note, studies of the long shadows that crises cast on political systems are rare.[22] A sole exception may be Birkland, who has looked at different responses between policy communities to disasters, focusing on the learning effects from focal events over time.[23] However, no attention has been given to the ebb and flow of actual regulatory measures and the measurable policy investments involved in prevention. In the following sections, a framework will be proposed to fill this gap.

3. *The prevention cycle: theory and concepts*

To analyse risk policy over time, this subsection introduces a simple framework that captures a consistent and suboptimal outcome of preventive policies following disasters. This subsection draws on the conceptual framework introduced by Kingdon, makes it specific to risks and adds a temporal dimension.

This framework will abstract from different forms of policy investments, be they regulatory, budgetary, communicative or otherwise. All forms of preventive policies that carry any societal costs (including traditional economic costs but also costs in other forms of well-being) are included in the broad concept of policy investment in prevention. Let us assume that for every risk there are preventive policies available. As benign and capable governments want to take those measures first that have the highest societal cost–benefit ratios, the framework assumes a decreasing cost–benefit ratio as expenditure increases. For every risk, this would mean that there is an optimal level of policy investment in prevention at which marginal benefits equal marginal returns. At the optimal level, both an increase and a decrease in preventive expenditure will have a negative societal cost–benefit ratio. All else equal, the greater the impact and odds of a risk, the greater the optimal level of preventive expenditure. Figure 1 provides an illustration of this simple model, with l^o as the optimal level of expenditure and c^o equal to the marginal cost and benefit of preventive expenditure at the optimal level. Note that Figure 1 assumes both the function of the marginal cost and that of the marginal benefit of preventive policies to be continuous and linear and that their slopes have opposite signs at all points of the graph. These highly unrealistic assumptions are made here for the sake of simplicity of our stylised framework, as they do not affect its main conclusions and predictions.

Next, let us introduce constraints to the set of policy options available. Let us assume that consensus in the public sphere will always demand very clearly cost-efficient policies (eg in the case of epidemic prevention in developed countries, having a lab that allows for the testing of new pathogens). These are *obliged policies*, captured by the green area in Figure 2. However, other policies are deemed inefficient and therefore disallowed to

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[20] BA Turner, "The Organizational and Interorganizational Development of Disasters" (1976) 21 Administrative Science Quarterly 378; LS Etheredge, *Can Governments Learn? American Foreign Policy and Central American Revolutions* (Oxford, Pergamon Press 1985); DP Moynihan, "Learning under Uncertainty: Networks in Crisis Management" (2008) 68 Public Administration Review 350; E Deverell, *Crisis-Induced Learning in Public Sector Organizations* (Stockholm, Elanders Sverige 2010).

[21] ER May, *Lessons of the Past: The Use and Misuse of History in American Foreign Policy* (Oxford, Oxford University Press 1979); RE Neustadt and ER May, *Thinking in Time: The Uses of History for Decision-Makers*, 1st paperback edition (New York, Freedom Press 1988).

[22] Boin et al, supra, note 2, p 142.

[23] Birkland, supra, note 5; TA Birkland, *Lessons of Disaster: Policy Change after Catastrophic Events* (Washington, DC, Georgetown University Press 2006).
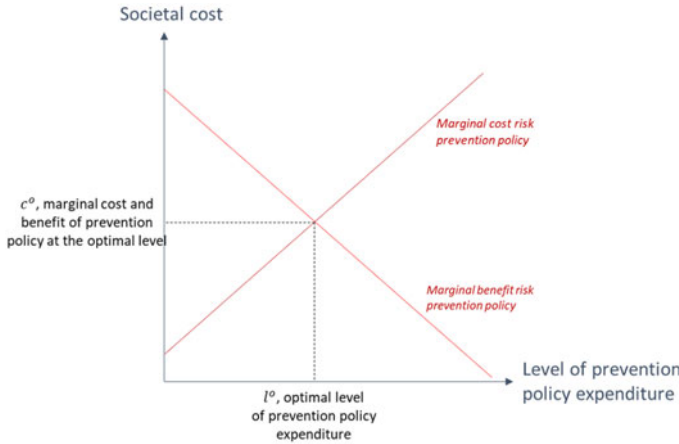
Figure 1. Optimal level of prevention policy expenditure.

decision-makers (eg maintaining slack in hospital capacity that leads to higher short-term health expenditure). These are the disallowed policies, captured by the red area in Figure 2. Of course, there does not need to be public consensus on all available policy options, leaving the government some room to manoeuvre. This creates *policy space*, captured by the blue area in Figure 2. Note that the *policy space* here is related to but different from the *policy window* as introduced by Kingdon. Kingdon's policy window referred to a window in time at which a new policy could be introduced. The policy space in our framework refers to the set of policies over which the government can effectively decide technocratically, without immediate constraints from preferences that are dominant in the public sphere.

Note that the red area in Figure 2 overlaps with the optimal level of prevention policy. This is the case if there is a strong bias against preventive policies for system risks such as large natural disasters and epidemics in the public sphere, which we have some reason to
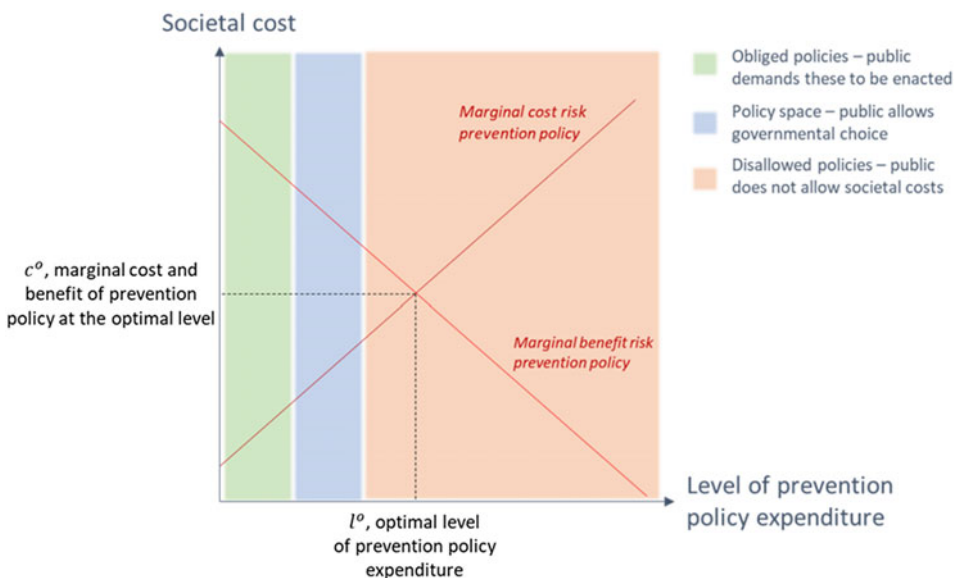

Figure 2. Constraints on prevention policy: obliged policies, policy space and disallowed policies.

believe is the case.[24] However, for certain risks it is quite possible that there is public consensus on a level of policy expenditure that is *higher* than the optimal level. This means that the obliged policies include policies with an unfavourable cost–benefit ratio. This is the case, for example, when the risk–regulation reflex leads to excessive regulation. It has been argued that counterterrorism following 9/11 offers an example of such an excessive response as demanded by the public on the basis of a highly salient risk.[25] Of course, it is also possible that public preferences are well attuned to the cost–benefit ratios of the available options. In that case, the policy space of the government will be narrow and will overlap with the optimal level. It may also be the case that the public fully trusts technocratic decision-making, in which case the policy space will be wide.

The constraints imposed by public opinion, as introduced above, are unlikely to remain constant over time. One of the reasons for why preferences may shift is because of the materialisation of a system risk. A salient disaster can capture public attention to the extent that it constitutes a focus event in Kingdon's terms.[26] Let us call those *focal disasters*. Focal disasters can lead to a sentiment among the general public, in media and in parliaments that they could and should have been prevented, that they must never happen again and that policy investment is necessary to prevent future such instances. Following a focal disaster, therefore, the constraints on governmental preventive policies move. The disallowed policies may decrease, as there is now more societal willingness to incur short-term costs to prevent future such instances (Figure 3a). The set of obliged policies may increase, as the general public now demands more immediate action (Figure 3b). Of course, a combination of both of these constraints leading to a shifting of the policy space is also perfectly possible (Figure 3c). However, in all cases, the level of expenditure on preventive policies is likely to go up.

Let us now consider what happens over long time periods. Generally speaking, the sentiment in the public sphere that has led to a shift in the policy space has an expiration date: even large disasters fade from public memory after a number of years.[27] As they do, we expect to see the policy space shift back, and preventive policy expenditure is likely to decrease again. Budget cuts and reversals of regulatory measures lead
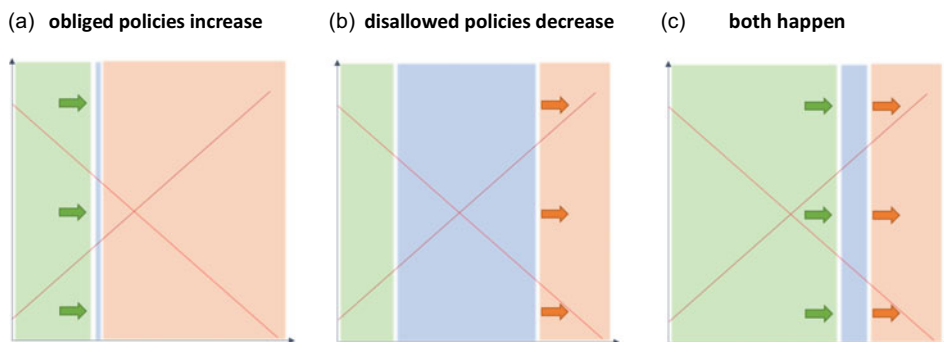
(a) **obliged policies increase**   (b) **disallowed policies decrease**   (c)   **both happen**

Figure 3. Changes to constraints on prevention policy following a focal disaster: (a) obliged policies increase, (b) disallowed policies decrease and (c) both happen simultaneously.

[24] Healy and Malhotra, supra, note 2; Gough, supra, note 2.
[25] Mueller and Stewart, supra, note 19.
[26] Birkland, supra, note 5.
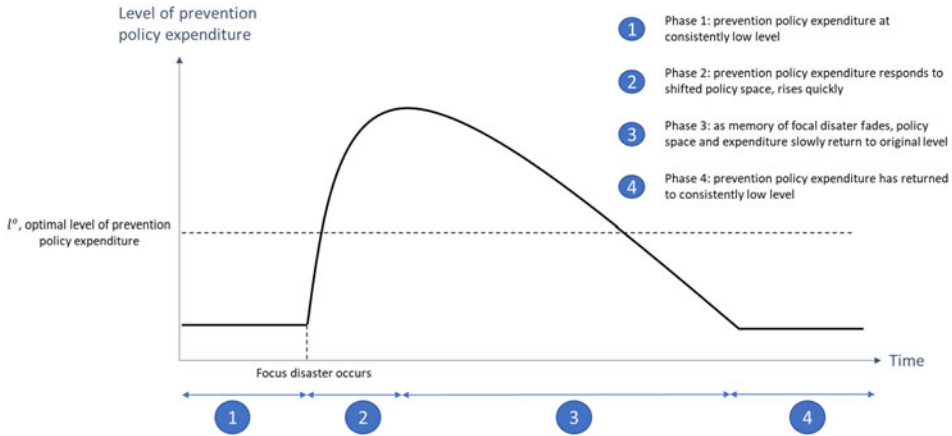[27] Birkland, supra, note 23; Healy and Malhotra, supra, note 2.

Figure 4. The prevention cycle.

to disinvestments regarding preventive policies. Overall, this leads to a cyclical pattern in which disasters first trigger a (generally short) period of preventive investments, followed by a (generally longer) period of disinvestments. Let us call this the *prevention cycle.*

Figure 4 provides an illustration of the full prevention cycle. In the first phase, the policy space is constant and there is little fluctuation in the level of preventive policy expenditure. Then a focal disaster occurs. This leads to phase 2, in which the government hurries to increase preventive policy expenditure to match the shifted preferences of the general public or its own updated risk estimates. However, over time, the memory of the focal disaster recedes and the attention paid to the risk falls again. This leads to phase 3: a gradual reversal of the policy investments. Of course, both the timing of the onset of a decline in public attention and the period before the disaster is forgotten (*if* it is ever completely forgotten) depend on the intensity of the original trauma – we will see such differing timelines in the case studies in Section III. Finally, in phase 4, the level of preventive policy expenditure returns to stable and low levels – perhaps the same as or perhaps slightly different from the original level of phase 1.

We can speak of a prevention cycle if we can find the pattern illustrated by Figure 4 in preventive policy expenditure. We may find such a pattern in budgetary expenditure from states, or in regulatory steps taken, or in the reduced supply of goods and services when such products imply risks, or in other forms of policy that imply social costs.

Having established this simple framework for understanding the temporal shifts in policy investments in the prevention of system risks, we will now move on to three case studies of the prevention cycle.

III. Three case studies of focal disasters and the ensuing prevention cycles

In this section, we will see how three focal disasters have led to prevention cycles in public policy. The first is 9/11, which triggered a wave of governmental expenditure on counterterrorism, both in the USA and across the world. The second case will be that of nuclear power, where we see the focal disaster of Fukushima leading to a geographically and temporally limited decrease in the production of nuclear power. The third case is that of Hurricane Katrina, which, like all major flooding events in the USA, led not only to large relief expenditure, but also to a spike in preventive investments.

1. Counterterrorism: 9/11 and the prevention cycle

The 9/11 terrorist attacks form a clear example of a focal disaster. The attacks were highly salient, captured the public sphere for years and drew societal attention to a specific risk. While terrorism was not a new risk and there is no clear trend in terrorist deaths worldwide around this time,[28] the 9/11 attacks shifted the policy space to the point that civil liberties previously deemed untouchable became expendable, and hundreds of billions of dollars in the US federal budget were spent on preventive measures. For these reasons, Birkland labelled 9/11 a "historical turning point in policy change related to homeland security".[29]

Figure 5 shows the remarkable increase in expenditure of the USA on counterterrorism that followed 9/11. In 2001, prior to the 9/11 terrorist attacks, a total of USD 16 billion, or less than 1% of the federal budget, was spent by the US government domestically and abroad on the prevention of terrorism. In 2008, the peak year for overall expenditure, the figure was USD 260 billion, or 8.7% of overall federal expenditure. The effects of terrorism on military expenditure had previously been studied by Carter and Fay, who found a positive effect for three years after a one-year lag following a terrorist attack.[30] Even if we include only domestic expenditure, we see a peak in 2008 (as a percentage of the total budget, 2.2%) and 2009 (in absolute expenditure, USD 74 billion[31]) at roughly five times 2001 levels. After 2009, expenditure fell again, and by 2017 it was down to 1.8% of the federal budget, with a falling trend. While the level of expenditure on counterterrorism has not (yet, perhaps) returned to pre-2001 levels, expenditure has dropped considerably as more time has passed since 9/11. There appears to be a link here with the terrorism risk perception of the US public, which peaked right after 9/11, only to decline and return to
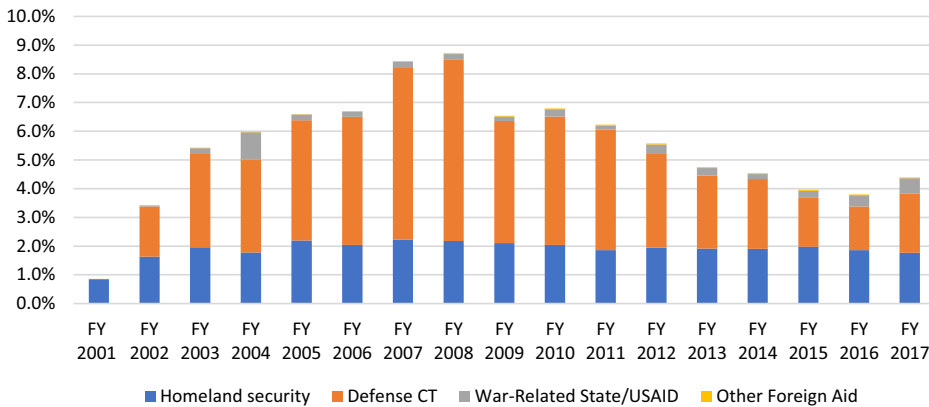

Figure 5. US counterterrorism spending as a percentage of total federal budget, 2001–2017.
Source: Stimson Study Group, "Counterterrorism Spending: Protecting America while Promoting Efficiencies and Accountability" (2018). CT = counterterrorism; FY = financial year.

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[28] Our World in Data, "Our World in Data – Terrorism" (2022) <https://ourworldindata.org/terrorism> (last accessed 6 January 2023).

[29] Birkland, supra, note 23.

[30] B Carter and EM Fay, "Responding to Terror: An Empirical Analysis of U.S. Military Activity, Public Opinion, and Transnational Terrorism" (2019) 14 Journal of Applied Security Research 140.

[31] The timing of the peak depends on whether we look at the figure relative to the total federal budget (peak in 2008) or at absolute expenditure (peak in 2009). The year 2009 was extraordinary because of the expenditure observed during this fiscal year to contain the financial crisis.
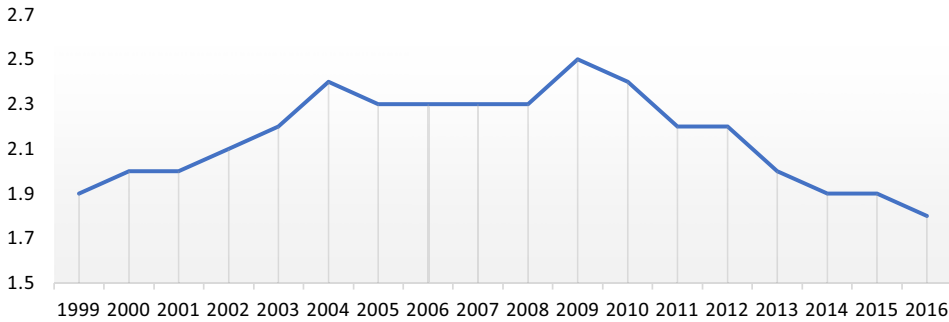
Figure 6. UK expenditure on safety and order as a percentage of gross domestic product, 1999–2016.
Source: Eurostat, "Government Expenditure on Public Order and Safety" (2022) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_on_public_order_and_safety> (last accessed 1 June 2023).

the long-term trend over the following decade.[32] In short, we see the elements of the prevention cycle: a focal disaster, followed by a sharp rise in prevention policy expenditure, followed by a slower decline as the salience of the focal disaster in the public sphere diminished. We are, of course, yet to see whether expenditure will level off at pre-9/11 levels or perhaps remain higher, or whether a new attack will give salience to the threat of terrorism again and set off a new prevention cycle.

The effect of 9/11 as a focal disaster transcended US borders. It triggered a prevention cycle in counterterrorism expenditure in many developed countries.[33] This is perhaps not surprising if we consider the salience of the 9/11 attacks in the media in all Western countries. Figure 6 shows British domestic governmental expenditure on order and safety as a proportion of gross domestic product (GDP).[34] Again, we see a rise following the attacks in 2001 and a peak in 2009, followed by a decline in the period 2010–2016. This cycle is more pronounced than but similarly shaped to that for the European Union (EU) over the same period, which saw average expenditure rise from 3.4% of GDP to 3.6% in 2007 and 2008, to subsequently level off again at 3.4–3.5% of total governmental budgets.[35]

2. Nuclear energy: Fukushima and the prevention cycle

In our framework, a focal disaster is followed by a period in which greater investments in prevention leading to higher social costs than were previously acceptable become palatable or even obligatory. Here, "social costs" may take the form of direct budgetary expenditure by states, as we saw in the case of counterterrorism. However, "social costs" may also take the form of civil liberties foregone, limitations to productivity or the reduced

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[32] J Mueller and MG Stewart, "American Public Opinion on Terrorism since 9/11: Trends and Puzzles" (*National Convention of the International Studies Association*, 2016).

[33] Interestingly, the scholarly publications on terrorism follow an almost identical cycle to these budgetary cycles. See Silke's contribution in A Silke (ed.), *Routledge Handbook of Terrorism and Counterterrorism* (London, Routledge 2019).

[34] There is no direct measure for counterterrorism spending in most national-level budgets, and in looking at expenditure on public order and safety as a proxy we follow the literature. See K Drakos and PT Konstantinou, "Terrorism Shocks and Public Spending: Panel VAR Evidence from Europe" (*Economics of Security Working Paper*, 2011) Working Paper 48; OE Danzell and S Zidek, "Does Counterterrorism Spending Reduce the Incidence and Lethality of Terrorism? A Quantitative Analysis of 34 Countries" (2013) 29 Defense & Security Analysis 218.

[35] Eurostat, "Government Expenditure on Public Order and Safety" (2022) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_on_public_order_and_safety> (last accessed 1 February 2023).

supply of a good or service. We can illustrate this with the case of the prevention cycle regarding electricity supply from nuclear plants following a nuclear disaster.

On 11 March 2011, an earthquake 130 km off the coast of Sendai, Japan, caused a tsunami over fourteen metres high that struck the nuclear plant of Fukushima. Several failures at the nuclear site occurred. Although 100,000 people were evacuated from the region as part of the emergency response, thus far no deaths due to radiation have been attributed to the event, with model-based estimations of total mortalities showing perhaps 130 cancer-related mortalities globally as stemming from the incident.[36] Fukushima illustrates that it is not necessary for an event to cause many (or even any) deaths for it to function as a focal disaster and trigger a prevention cycle. It is enough for the disaster to capture public attention and focus it on a specific risk. Public acceptance of nuclear energy dropped worldwide following the Fukushima accident, but far more strongly in Japan than anywhere else.[37] As a consequence of Fukushima, nuclear plants in Japan and elsewhere were temporarily shut off, leading to increased costs compared to a business-as-usual scenario. In May 2012, none of the thirty-seven Japanese nuclear plants that were active in the year before produced electricity, with only some resuming production in the summer. If we take a global perspective, 439 plants were active worldwide for at least part of 2012, whereas seventeen more had been active for at least part of 2011, the year of the incident (Figure 7). Produced electricity fell by over 10% globally between 2010 – the last full year of production before Fukushima – and 2012. Less than eight years later, however, the amount of electricity produced from nuclear plants was back at pre-Fukushima levels, and the number of active plants had returned to the rising pre-Fukushima trend, mostly due to East Asian production bouncing back.

We see, again, all elements of the prevention cycle: a focal disaster sets off a sharp rise in prevention policy expenditure (in this case the cost of reduced electricity supply, mostly
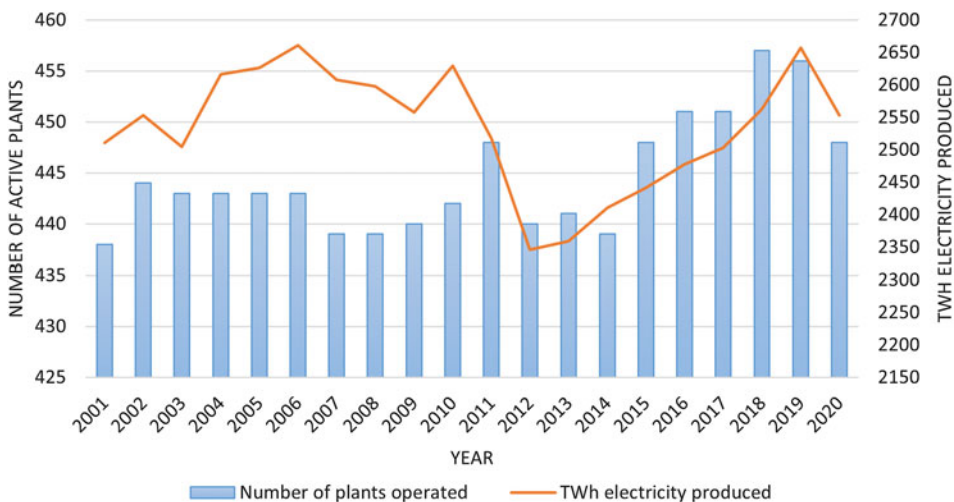

Figure 7. Number of active nuclear plants and terawatt-hours (TWh) of nuclear electricity produced, 2001–2020.
Source: IAEA PRIS, "Database on Nuclear Power Reactors" <https://pris.iaea.org/pris/home.aspx> (last accessed 6 January 2023).

[36] JE Ten Hoeve and MZ Jacobson, "Worldwide Health Effects of the Fukushima Daiichi Nuclear Accident" (2012) 5 Energy & Environmental Science 8743.

[37] Y Kim, M Kim and W Kim, "Effect of the Fukushima Nuclear Disaster on Global Public Acceptance of Nuclear Energy" (2013) 61 Energy Policy 822.

in Japan), which is followed by a slow return to lower levels of expenditure. Although the social costs here did not take the form of direct governmental expenditure, they were only too real. Setting aside the fundamental debates regarding the benefits and downsides of nuclear power generation, shocks to electricity supply come at a high cost to the population. Within fourteen months of the Fukushima accident, nuclear production of electricity came to a complete standstill in Japan. On average, regional electricity prices in Japan rose by 37% over four years, with significant regional variability.[38] Higher electricity prices, in turn, led Japanese households to lower their usage of electric heating in winter. According to Neidell et al, perhaps as many as 4,500 additional people died from the cold because these nuclear plants were shut down.[39] In addition, He and Tanaka confirm a strong increase in mortality, but they focus on reduced use of air conditioning leading to heat-stroke in the summer.[40] Of course, rising electricity prices have many other knock-on effects (eg through unemployment, which also increases mortality). As the eventual restoration of nuclear power in Japan shows, societies were only temporarily willing to bear such high costs. As the salience of Fukushima faded, the preventive shutdown of nuclear plants ended and the prevention cycle ran full circle.

Fukushima is no exception: previous episodes of nuclear scares have also triggered their own prevention cycles. This is clearly visible from the historical data on active nuclear capacity per region (Figure 8). We can see the prevention cycle triggered by Fukushima in the East Asian production of nuclear electricity starting in 2011. Similarly, we see a sharp break in the trend in Eastern European production of nuclear electricity following the Chernobyl disaster in 1986. The cycle here was less sharp and more prolonged than that triggered by Fukushima, with regional nuclear capacity going through a full decade of
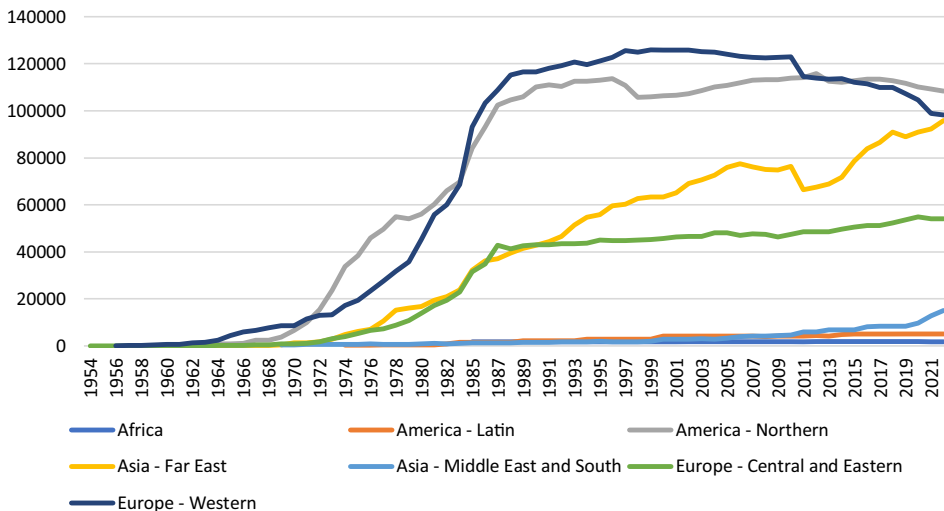

Figure 8. Regional active capacity of nuclear electricity in megawatts, 1954–2022.
Source: IAEA PRIS, "Database on Nuclear Power Reactors" <https://pris.iaea.org/pris/home.aspx> (last accessed 6 January 2023).

[38] HR Chan, T Kiso and Y Arino, "The Effect of Electricity Prices on Residential Solar Photovoltaic Panel Adoption: Fukushima as a Natural Experiment" (*SSRN Electronic Journal*, 2017).

[39] M Neidell, S Uchida S and M Veronesi, "The Unintended Effects from Halting Nuclear Power Production: Evidence from Fukushima Daiichi Accident" (2021) 79 Journal of Health Economics 102507.

[40] G He and T Tanaka, "Energy Saving May Kill: Evidence from the Fukushima Nuclear Accident" (15 April 2022) <https://papers.ssrn.com/abstract=3451021> (last accessed 25 March 2023).

stagnation (which, of course, coincided with the end of the Soviet Union, the ensuing economic contraction and the end of Soviet nuclear programmes) and never quite returning to trend. Another sharp and brief prevention cycle was triggered by the Three Mile Island nuclear scare in the USA in 1979. While both the duration of the prevention cycle and the break from the trend in nuclear production appear to be functions of the salience of the focal disaster and the institutional setting in which the response is formulated,[41] and while there are other, more structural factors determining overall nuclear capacity, all major public incidents and near-incidents in the history of nuclear electricity generation appear to have triggered their own prevention cycles.

3. Flood risk: Hurricane Katrina and the prevention cycle

The counterterrorism and nuclear disaster prevention cycles described above are triggered by focal disasters of a type that are rare in their scale (9/11) or rare in their very occurrence (nuclear incidents). The ensuing prevention cycles took years or even decades to unwind. Other prevention cycles take place on a much more limited timescale. Below we will see an example of a short prevention cycle in the case of flood risk mitigation in the USA.

Figure 9 shows expenditure on the Pre-Disaster Mitigation (PDM) federal grant programme in the USA between 2004 and 2017. The PDM grant programme is meant to help states "implement sustainable cost-effective measures designed to reduce the risk to individuals and property from future natural hazards".[42] The PDM grant programme is separate from post-disaster response and relief, which dwarfs the PDM grant programme in size, as illustrated by the unprecedented USD 90 billion spending package following Hurricane Katrina in 2005. Nevertheless, in spite of its name and specific purpose, most of the grant allocation from the PDM programme still follows rather than precedes disasters. The focal disaster of Hurricane Katrina is clearly visible: it represents a record year in terms of PDM grant allocation. In general, there is a strong relationship between PDM expenditure and the severity of a hurricane season. For example, the second most severe
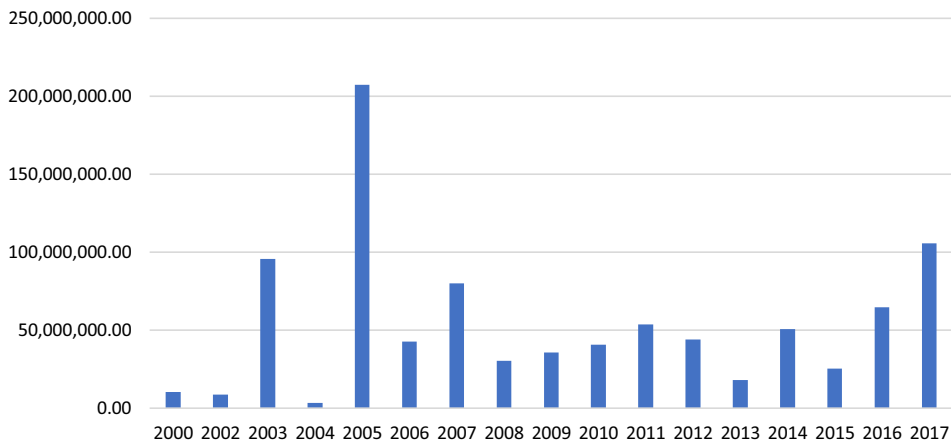
Figure 9. US federal expenditure through the Pre-Disaster Mitigation grant programme in USD, 2004–2017.
Source: FEMA (2022).

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[41] Birkland, supra, note 23.

[42] FEMA, "Pre Disaster Mitigation Program" <https://www.fema.gov/grants/mitigation/pre-disaster> (last accessed 6 January 2023).

hurricane season in terms of deaths was 2017, which included Hurricane Irma and Hurricane Harvey. The year 2016 represents the fifth most deadly season. These facts explain the spikes in expenditure in those years.

At a first glance, this appears to be another straightforward example of a prevention cycle: a focal disaster increases public awareness of a specific type of risk and government spending on prevention of the next occurrence spikes, only to fade over time. However, flood prevention in the USA fits a very particular form of prevention cycle: rather than being the result of the interplay between politics and the news cycle, as in the cases of counterterrorism spending or preventive nuclear plant shutdowns, it is an explicitly institutionalised phenomenon. Because of the importance of presidential declarations of disaster to release congressional funds for programmes run by the Federal Emergency Management Agency (FEMA), including the PDM grant programme, it follows that there is a positive relationship between PDM expenditure and the severity of disasters in any given year. Such electoral declarations are, in themselves, partly determined by political factors, such as political affiliations to state-level ruling politicians, rather than being determined solely by the severity of the disaster.[43] Overall, this does not seem to be a rational risk-mitigation approach, considering the lack of a relationship between disasters in previous and coming years, the fairly constant (or, as a consequence of climate change, consistently moderately rising) risk from natural disasters and the lags before the allocated budgets lead to concrete mitigation. The resultant pattern is one of a prevention cycle – albeit over the span of a year rather than a decade, as we saw to be the case with counterterrorism and nuclear power risk.

Interestingly, this highly volatile budgetary cycle for flood prevention in the USA is matched by equally volatile enthusiasm for prevention among citizens. A 2006 survey found that 30% of New Orleans residents considered flood prevention to be one of two main rebuilding priorities; in 2008, only 2% of New Orleans voters ranked preventive measures as their top concern.[44] As Healy and Malhotra find that half of US disaster spending is directly politically motivated, such rapidly fading interest on the public's behalf does not bode well for future consistency in terms of preventive spending.[45]

IV. The prevention cycle and its origins

Now that we have demonstrated the prevention cycle in several forms and following different types of focal disaster, it is time to look at the underlying factors that give rise to this cycle. Although we have generally discussed the occurrence of the prevention cycle here as a suboptimal outcome of current socio-political institutions, there are potentially several welfare-optimising or "good" factors that contribute to the existence of the prevention cycle as well. In this section, we will discuss both the malign and the benign causes of the prevention cycle.

1. "Bad" factors: electoral opportunism, political short-sightedness and human biases

The most intuitive reason for the existence of the prevention cycle is perhaps electoral opportunism. Politicians want to show an active response to events that capture the public

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[43] MW Downton and RA Pielke, "Discretion without Accountability: Politics, Flood Damage, and Climate" (2001) 2 Natural Hazards Review 157; A Reeves, "Political Disaster: Unilateral Powers, Electoral Incentives, and Presidential Disaster Declarations" (2011) 73 The Journal of Politics 1142.

[44] Kaiser Family Foundation, "Giving Voice to the People of New Orleans: The Kaiser Post-Katrina Baseline Survey" (*Kaiser Family Foundation*, 2007).

[45] Healy and Malhotra, supra, note 2.

imagination and that dominate news cycles – such as focal disasters.[46] They therefore invest to show that they care – but only as long as their electorate cares. This is why, after a number of years, expenditure on prevention drops again. Healy and Malhotra demonstrate that voters are much more responsive to relief measures than to prevention measures, and that politicians have become increasingly aware of this over time.[47] Depoorter sheds light on one of the underlying mechanisms: from the point of view of political economy, preventive measures carry positive externalities as benefits accrue to all responsible units of government, whereas relief carries negative externalities as it makes other governmental actors look worse by comparison.[48] Not only in the balance between preventive and relief spending, but also in the allocation of post-disaster relief, political factors play an important role.[49] Eisensee and Strömberg demonstrate that foreign disasters during "competitive" periods in news cycles (eg during the Olympics) will receive the same amount of state relief as disasters with only a sixth of the casualties during low-competitiveness periods of news cycles.[50] While their research concerns foreign relief rather than national prevention, this is another indication that political opportunism is at play in governmental responses to disasters. This appears to be a malfunction of institutional arrangements in democracies in developed countries, leading to suboptimal results in terms of the balance between mitigation and response.

A second and related factor is the bias towards the short term that is built into democratic institutions. First and foremost, this is a result of the four-year parliamentary cycle that is dominant among democracies.[51] Political incentives for longer-term investments are limited, as the population is not perfectly informed of all investments made by the government, and wise preventive spending, especially regarding larger and more rare disasters, will not become salient during most parliamentary cycles. In addition, lobbying for spending by beneficiaries in the present is likely to be stronger than that for future beneficiaries, as the latter group generally lacks lobbying power in the present. Both factors, elaborated upon by Jacobs, lead to a significant short-term bias in policy.[52] This short-term bias in turn leads to pressure on budgets for preventive purposes, meaning that budgets will generally dwindle when focal disasters fade from memory.

A third and more fundamental factor lies in the human psyche. We know from cognitive psychology that our decisions and judgments are partly governed by biases and heuristics.[53] These cloud our judgment when it comes to risk in general.[54] However, the so-called "availability bias" specifically is reflected in the prevention cycle.[55]

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[46] Birkland, supra, note 5; Birkland, supra, note 23.

[47] Healy and Malhorta, supra, note 2.

[48] Depoorter, supra, note 2.

[49] For the US case, see Healy and Malhotra, supra, note 2; for the German case, see V Bruggeman and M Faure, "The Compensation for Victims of Disasters in Belgium, France, Germany, and the Netherlands" (2019) 31 Loyola Consumer Law Review 259; and for an overview, see G Dari-Mattiacci and MG Faure, "The Economics of Disaster Relief" (2015) 37 Law & Policy 180.

[50] T Eisensee and D Strömberg, "News Droughts, News Floods, and U.S. Disaster Relief" (2007) 122 The Quarterly Journal of Economics 693.

[51] AM Jacobs, Governing for the Long Term: Democracy and the Politics of Investment (Cambridge, Cambridge University Press 2011); MK MacKenzie, "Institutional Design and Sources of Short-Termism" in I González-Ricoy and A Gosseries (eds), Institutions For Future Generations (Oxford, Oxford University Press 2016) pp 24–46.

[52] Jacobs, supra, note 51.

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

[54] P Slovic, The Perception of Risk (Oxford, Earthscan Publications 2000); WK Viscusi, "Jurors, Judges, and the Mistreatment of Risk by the Courts" (2001) 30 The Journal of Legal Studies 107; E Yudkowsky, "Cognitive Biases Potentially Affecting Judgement of Global Risks" in M Cirkovic and N Bostrom (eds), Global Catastrophic Risks (Oxford, Oxford University Press 2008) pp 91–119.

[55] CR Sunstein, "The Laws of Fear" (2002) 115 Harvard Law Review 1119.

The availability bias as a concept describes our tendency to judge the likelihood of an event by the ease with which a past instance comes to mind. For example, in years of incidents involving industrial waste, people are likely to overestimate waste-related risks vis-à-vis other risks.[56] It follows that expenditure to prevent a disaster of which we have seen a recent occurrence on the news will appear more rational to us, as the chances of such a disaster occurring will appear higher – even though such chances may well be perfectly constant over time. The availability bias not only occurs among the public at large, but also among experts. Therefore, the availability bias is reinforced at different stages of the policy process, a phenomenon that Kuran and Sunstein have termed the "availability cascade".[57]

2. "Good" factors: updated risk estimates, synergies with recovery spending and public sentiment

There are, however, some more benign factors that could also (partly) explain the prevention cycle. Firstly, it can be efficient to combine relief with prevention. Following a hurricane or a flood, for example, buildings and infrastructure will need to be rebuilt. It might be efficient to utilise those opportunities to invest in "proofing" them against future instances of the same or similar disasters. This appears to be an important part of the strategy of FEMA in the USA, which indeed spends significantly on concerted relief and prevention.

Secondly, one can argue that our risk estimates for large disasters depend strongly on the historical record. For most societal risks, it is clear that they are not perfectly constant over time. Nuclear risk depends on the number and size of active plants, as well as the safety measures in place and technological progress. Epidemic risk is impacted by globalisation and our proximity to wildlife. Even natural disasters such as floods and hurricanes are impacted by climate change and therefore not constant over time. Therefore, estimating precise levels of risk at any point in time is in many cases not possible,[58] as the historical record dating back several decades may not give us accurate information. In such a world, recent occurrences of a disaster carry strong informational value: the chance of a terrorist attack occurring today may indeed be a strong predictor of one occurring tomorrow. If we update our beliefs in a Bayesian fashion, an increase in spending following a focal disaster followed by a cool-off phase if no new instances occur could be the most rational pattern.

Thirdly, even if the prevention cycle is not optimal from the point of view of harm reduction, it may still be optimal for governments to follow public sentiment and increase spending after a focal disaster, only to wind it down a few years later. This is argued by, for example, Slovic, who suggests that we should not rely solely on objective risk measures in designing optimal risk policy, but also on subjective risk measures.[59] Fear on the part of the population as well as trust in a government that is responsive to those fears might be considered ends in themselves. If fear can be reduced and trust improved by spending on preventive measures when a focal disaster has just occurred, this may be a worthwhile investment. However, it is presently unclear whether preventive expenditure actually reduces rather than raises fear among the population.

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[56] Slovic, supra, note 54.

[57] T Kuran and CR Sunstein, "Availability Cascades and Risk Regulation" (1999) 51 Stanford Law Review 683.

[58] NN Taleb, *The Black Swan: The Impact of the Highly Improbable*, Random House trade paperback edition (New York, Random House 2016); JA Kay and MA King, *Radical Uncertainty: Decision-Making beyond the Numbers*, 1st edition (New York, W. W. Norton & Company 2020).

[59] P Slovic, supra, note 54.

V. Conclusions, options for policy improvement and future research

In this paper, a framework for explaining large variations over time in preventive policies for system risks has been proposed. Such expenditure follows a cycle, driven by the responses of the media and electorates to large disasters. We have seen evidence for such cycles in the cases of counterterrorism, nuclear shutdowns and flood prevention. While each of the described cycles has idiosyncratic features that depend on the type of risk and the institutional structure of the risk response, there are also clear similarities. Preventive expenditure generally rises rapidly following a focal disaster, only to fall back again over a longer period. The associated movements in preventive expenditure carry high costs (eg a large share of federal and national budgets in the case of counterterrorism and many thousands of lives in the case of the nuclear shutdown in Japan).

There are multiple causes of the prevention cycle, some of which are associated with sound policy formation and others less so. Political opportunism, democratic short-termism and cognitive biases may all contribute; on the other hand, so may synergies between prevention and relief spending, updated risk estimates and fear reduction. This paper does not investigate the causes of the prevention cycle in depth. However, considering the magnitude of the prevention cycles in terms of its costs, it seems unlikely that *all* of the variation can be explained by benign factors and none by such features as political opportunism. Future research could try to disentangle the relative contributions of the different causes of the prevention cycle.

Depending on the analysis of the causes of the prevention cycle, different policy solutions could be considered fitting. Cognitive biases can be countered by active debiasing in different parts of the policy formation process, such as risk analysis and parliamentary budget allocation and execution. Research has suggested many effective debiasing techniques,[60] which have thus far only received limited uptake.[61] However, if political opportunism or short-termism are root causes, fundamental changes to the institutional setting in which risk policies for system risks are formed will be necessary. The responsiveness of political leaders to the whims of the electorate will need to be countered or reduced. In such a case, some less drastic measures could involve a stronger role for technocrats in the policy formation process. This may involve increasing the power of existing technocratic institutions, such as the National Risk Assessments commonly caried out by Organisation for Economic Co-operation and Development (OECD) Member States, or the formation of new technocratic bodies, such as independent risk committees that report to parliaments. Such measures are incremental yet potentially impactful.

Considering the importance of the prevention cycle to state budgets and societal welfare, however, fundamental changes cannot be considered disproportionate *a priori* either. Such fundamental changes can involve changing the democratic setting in which long-term risk policy is formed, either by democratic reform that breaks the present stranglehold between media and parliaments or by more traditional technocratic institutionalisation. The model for the latter is offered by central banks, which are in large part a technocratic answer to the risks of short-sightedness in monetary policy. Danish energy policy has also followed this model, with a strong role given to the technocratic Danish Energy Agency within the framework of long-term broad political accords. There are other success stories of countries that have managed to break the prevention cycle for system risks and mitigate risks efficiently over the long term, such as the cases of earthquakes in

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[60] B Fischoff, "Debiasing" <https://apps.dtic.mil/sti/citations/ADA099435> (last accessed 6 January 2023); CK Morewedge et al, "Debiasing Decisions: Improved Decision Making with a Single Training Intervention" (2015) 2 Policy Insights from the Behavioral and Brain Sciences 129; H Yoon, I Scopelliti and C Morewedge, "Debiasing Decision Making through Observational Learning" (2020) 2020 Academy of Management Proceedings 16703.

[61] I Belton and M Dhami, "Cognitive Biases and Debiasing in Intelligence Analysis" in R Viale (ed.), *Routledge Handbook of Bounded Rationality* (London, Routledge 2021) ch 37.

Japan, flood management in the Netherlands and Finland's general approach to societal resilience. Therefore, while the prevention cycle is a common response pattern to a focal disaster, it is not universal, and it would be useful to further understand what separates those political systems or moments in which the prevention cycle was not triggered from those in which it was. Before conclusions on the appropriateness of institutional change can be reached, more must be understood about the prevention cycle and its root causes, as well as these success stories. This is a fruitful line for future research.