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High Level Risk Forum

OECD Risk Management Policy Issues Paper: Governing Effective Prevention and Mitigation of Disruptive Shocks

Expert meeting on "Governing Effective Prevention and Mitigation of Disruptive Shocks"

12-13 September 2013
OECD Conference Centre
Paris, France

This paper frames the discussion for the OECD High Level Risk Forum expert meeting on "Governing Effective Prevention and Mitigation of Disruptive Events", to take place on 12-13 September 2013. Discussions will focus on why and how reforms to current governance mechanisms for risk prevention and mitigation could unlock greater stakeholder engagement. The results of the experts meeting will provide inputs for an analytical paper to be presented at the OECD High Level Risk Forum in December 2013.

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TABLE OF CONTENTS

Tables

Figures

Boxes

1. Introduction

1. *This issues paper outlines why there is a need for better governance of risk prevention and mitigation in OECD countries.* OECD countries have experienced significant negative impacts from major disruptive events in the past, a trend that has been pointing upwards. Although OECD countries have invested vast sums in risk prevention and mitigation, extreme events continue to produce harmful impacts for directly affected regions, their citizens and affected economic sectors. Recent disruptive events in some OECD countries reveal significant gaps in existing prevention and mitigation measures. At the same time these events result in costly rehabilitation and reconstruction projects. Fiscal constraints may be an important barrier to scaling up prevention and mitigation measures for OECD governments, but shortcomings in risk governance also inhibit the attainment of higher protection levels. The awareness and willingness of individuals to contribute to increasing their protection against disruptive events is relatively low. In some countries many individuals who have been directly affected by past events continue to believe that it is the sole responsibility of the State to protect them against extreme events. In such cases individuals and even businesses might not contribute an optimal share to achieving society's acceptable level of risk. Better governance instruments could both encourage and facilitate a greater engagement from stakeholders. The following issues paper presents background on the exposure of risks as well as examples of risk prevention and mitigation *across OECD countries. It frames discussion for the OECD High Level Risk Forum experts meeting on "Governing Effective Prevention and Mitigation of Disruptive Events",* to take place on 12-13 September 2013. Discussions will focus on why and how reforms to current governance mechanisms for risk prevention and mitigation could unlock greater stakeholder engagement. The results of the experts meeting will provide inputs for an analytical paper to be presented at the OECD High Level Risk Forum in December 2013.

2. The rationale for risk prevention and mitigation

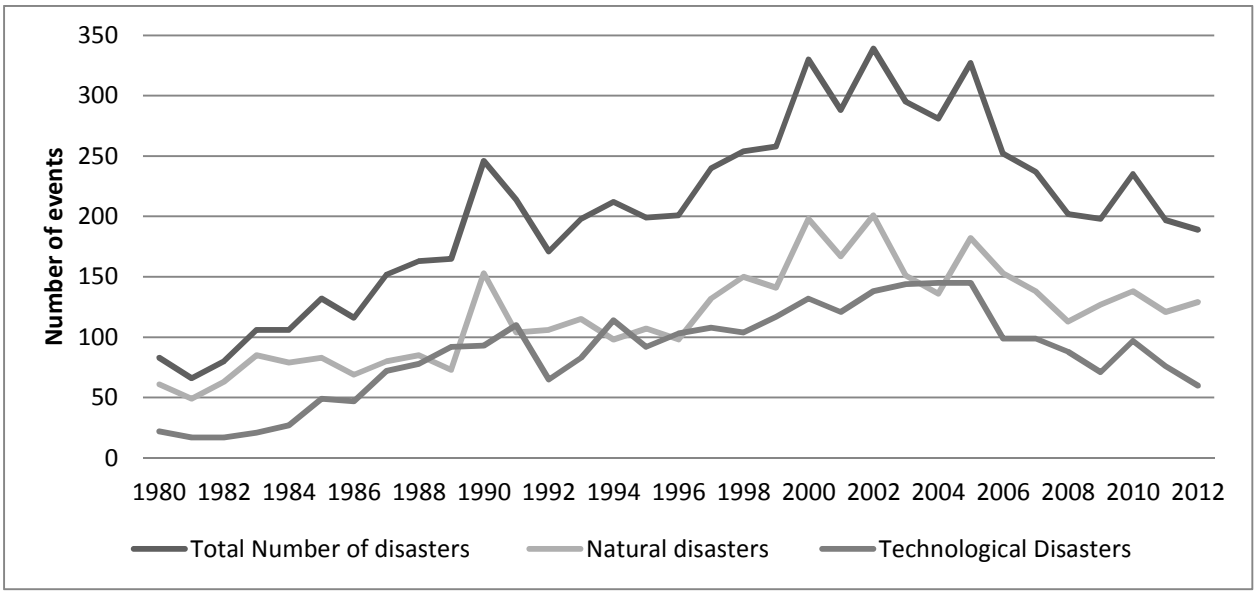
2.1 How has risk exposure evolved across OECD countries?

2. *OECD countries have experienced significant negative impacts from past disruptive events, a trend that has been pointing upwards.* In the last 30 years disruptive events[1], including natural and man-made causes, have increased across OECD countries (Figure 1). Adverse impacts have led to hundreds of billions of dollars in economic losses[2] (Figure 2). Even though early figures need to be interpreted with some caution, given previous reporting inconsistencies, a general upwards trend in the severity of impacts can be observed especially in the number of affected people, which increased from an average of around 30 million in the 1980's to 140 million people per year during the last 10 years, and in the economic losses associated with disruptive events, which reached a total annual USD 300 billion in 2011. This increasing trend in adverse impacts may not necessarily be associated with more frequent or more intense catastrophes, as compared to some decades ago, but it points to the fact that human and physical capital is increasingly accumulated in areas affected by disruptive events. Among OECD countries, the United States, Japan and Italy have been the most affected by large-scale disruptive events over the past 40 years.

1. Disruptive events cause serious damage to human welfare, the economy, the natural environment or national or (inter)national security. Serious damage is defined as: loss of human life; human illness or injury; damage to property or infrastructure; homelessness; business interruption; service interruption (including health, transport, water, energy, communication); disruption in the supply of money, food or fuel; and contamination or destruction of the natural environment.

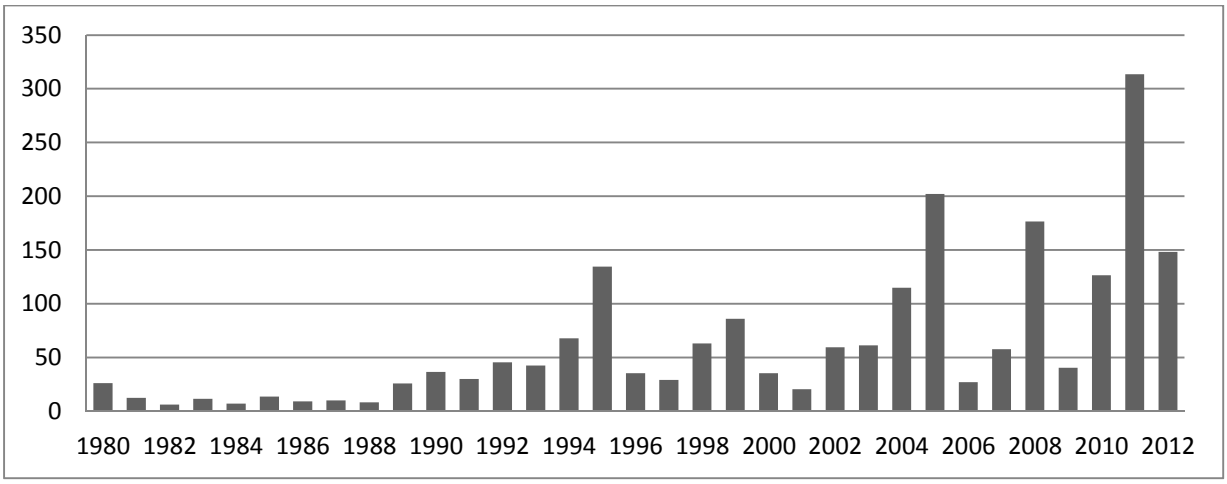
2. Economic losses in the EM-Dat database are defined as direct (e.g. damage to infrastructure, crops, housing) and indirect (e.g. loss of revenues, unemployment, market destabilisation) consequences of a disaster on the local economy (http://www.cred.be/ emdat/).

Figure 1. Number of annual disasters in OECD and BRIC countries 1980-2012 (Technological, Natural and total)



Source: EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels – Belgium; includes OECD members plus BRIC (Brazil, Russia, India, China)[3]

Figure 2. Economic Losses across OECD and BRIC countries 1980-2012 - annual total in USD billions, indexed to 2010)



Source: EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain - Brussels - Belgium". Data for OECD countries plus Brazil, China, India and Russia (1973-2012).

Note: For each disaster, the registered figure corresponds to the damage value at the moment of the event, i.e. the figures are shown true to the year of the event**.**

3. The frequency of certain types of disasters (such as storms) does not necessarily reflect the overall risk exposure associated with that source of risk. Storms account for almost 30 percent of

3. Disasters in the CRED database include events where: ten or more people were killed; 100 or more people were affected, injured, or homeless; significant damage was incurred; a declaration of a state of emergency and/or an appeal for international assistance was made (http://www.cred.be/ emdat/).

disruptive events across OECD countries over the past 40 years, but, on average, human and economic losses are over four times higher for earthquakes (Table 2).

Table 1. Human and economic losses across disaster types 1973-2012

Type of Event	Average[1] economic losses (in '000 US$)	Average people affected	Average people killed	Total Number of Events
Earthquake	2,571,453	63,836	338	210
Drought	1,278,942	285,000	0	55
Storm	659,870	28,190	17	1,138
Flood	261,554	34,150	13	711
Wildfire	208,949	6,318	5	183
Extreme temperature	166,144	26,301	458	184
Industrial Accidents	136,681	3,250	16	261
Insect infestation	60,000	0	0	2
Mass Movement We	36,544	1,580	26	86
Volcano	32,373	10,011	8	33
Miscellaneous	5,943	58	29	212
Transport Accidents	49	8	34	679
Epidemic	0	55,674	13	47
Mass Movement Dry	0	333	94	3

Source: EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain - Brussels - Belgium". Data for OECD countries (1973-2012)
[1] Average values per event

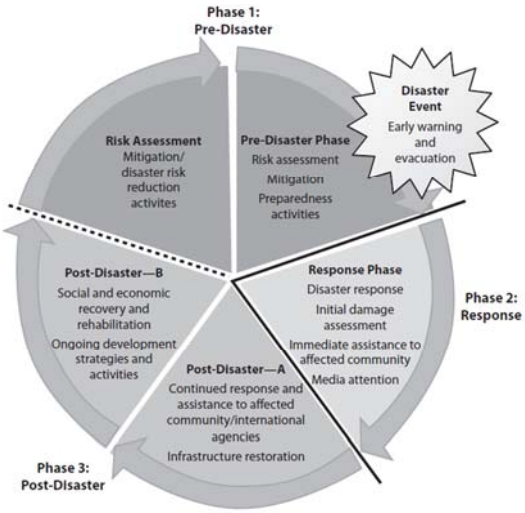
4. *Aggregate impacts conceal considerable vulnerabilities concentrated in specific local economic areas, their citizens and sub-national governments.* On average OECD members suffer higher economic losses than lower income countries, but taken in aggregate these losses are a much lower percentage of their GDP, which has until recently made their economies more capable of absorbing disaster losses. Economic losses due to disasters in OECD countries reach an average of 0.2 percent of GDP annually compared to an average of 4.8 percent (2006-2011) in lower income countries (OECD, 2012a). Recently however, specific major disruptive events have had large-scale economic impacts also in OECD countries. Damages from the Chile earthquake in 2010 and the Christchurch earthquake in New Zealand in 2011 were the equivalent of around 10 percent of annual GDP, which is considerable given the relatively small sizes of the countries. From a national perspective, storms like Katrina may have led to only 0.1 percent of national GDP in damages, but the estimated USD 125 to USD 250 billion in economic losses were felt disproportionately by the impacted geographic area, its population, and related economic activities. For example, 19 percent of American oil production was affected by the destruction of 113 offshore oil and gas platforms and 457 oil and gas pipelines (Amadeo 2012). One year after the event, approximately 100.000 jobs were lost and USD 2.9 billion in wages (Dolfam 2007). Such disruptive events equally have severe impacts on sub-national liquidity needs in the financial sector, sectoral imbalances and consumer and business confidence, with detrimental knock-on effects on the economy (OECD 2004). For example, the Kobe earthquake in 1995 resulted in a fall of 74 percent of sales in department stores in that year. Of the 6000 small businesses that were destroyed in the Marmara earthquake in 1999 in Turkey, the majority had little or no insurance coverage. To finance the aftermath, personal, corporate, income, property and vehicle taxes increased. The value-added tax (VAT), for example, rose from 15 to 17 per cent (OECD 2004).

5. *Impacts of disruptive events in one location or country may spread much more widely, across territorial borders and economic sectors.* Economic integration through international trade, FDI, international migration, cross-border knowledge and technology flows, as well as the emergence of global value chains allow for local disruptive events to become global ones. An example of how such an event has had cascading impacts is the financial and economic crisis that started to unfold in the United States in 2008. By the end of the year exports declined in most OECD countries, and imports declined in some countries as well. By 2009 this trend was recorded in all OECD countries (Araujo and Oliveira Martins 2009, OECD 2013a). Global value chains have acted as a vector for propagating risks globally. Supply chain shocks have been rising during the last years, whereby lean manufacturing and just-in-time logistics have facilitated vulnerability to such shocks. Surveys among companies indicated that they may have limited preventive or mitigating capacity (OECD 2013b). The Great East Japanese Earthquake in 2011 caused disastrous impacts not only in Japan, it led to slowdowns in the automotive and electronics industries relying on Japan for inputs to their value chain. Single sourcing of some elements in car production is likely one cause for why cascading effects were felt so strongly: car paint produced in a factory in North East Japan supplied 100% of global demand, leading to major disruptions in car supply chains worldwide due to the suspension of the plant's production. Following the floods in Thailand in 2011 inundated areas of Bangkok accounted for 45 % of the world's manufacturing capacity of computer hard disk drives and led to global disruptions in computer and automotive industries (OECD 2013b).

2.2 How can we define risk prevention and mitigation?

6. *There is a general understanding of what constitutes the key phases of the risk management cycle.* Though many organisations use slightly different schema, most include the identification and assessment of risks, their mitigation and prevention, preparedness in the case of a disruptive event, emergency response, recovery and rehabilitation (Figure 3). Some organisations differ in the precise terminology they use and the activities undertaken throughout different phases of this cycle. For example, some organisations include the prediction and early warning of disruptive events as a specific step in the cycle (see the Food and Agriculture Organization or the World Meteorological Organization (FAO 2004, WMO 2005)), or add the analysis of the distributional impacts of a health or safety threat as part of the risk assessment in the United Kingdom (UK HSE 2011).

Figure 3. The Risk Management Cycle



Source: D. Todd & H. Todd (2011), Natural Disaster Response, Lessons from Evaluations of the World Bank and Others, Evaluation Brief 16, Independent Evaluation Group World Bank/IFC/MIGA, 2011

7. *Similar to the observed deviations from the general schema used to describe the risk management cycle, slightly different definitions of risk prevention and mitigation are used across different countries and organisations.* Box 1 summarises a few examples. This report follows a working definition provided in OECD (2003) that defines risk prevention and mitigation as activities that avoid exposure to hazards, or reduce vulnerability to their consequences before they occur. It distinguishes two types of prevention measures: "protective strategies" that aim to put in place protection against specific hazards or at reducing the vulnerability of particular systems, and "framework conditions" which encompass the way risk prevention measures are implemented (such as e.g. the attitude toward risk and safety at all levels of decision making).

8. *Prevention and mitigation measures are therefore distinguished from risk identification and assessment activities as well as emergency and preparedness planning.* It could be argued that risk identification and assessment, early warning systems, emergency supplies, or evacuation plans are equally preventative or mitigating measures. Indeed, the objective of each of them is to reduce the negative impacts of future disruptive events, but they are nevertheless distinct in the way they are planned, implemented, and take effect, as well as the stakeholders included. Preparedness measures include knowledge and capacities developed by various stakeholders to "anticipate, respond to, and recover from the impacts" of disruptive events. Prevention and mitigation aim at the "outright avoidance of adverse impacts" or, in case they cannot be avoided, significantly displacing or decreasing the intensity of the hazard, or reinforcing the robustness of exposed people and assets. They thereby ensure "the survival and function" of communities, assets and economic activities (UNISDR 2009). For the purpose of this paper risk identification and assessment are activities that create the basis for and precede the planning of prevention and mitigation as well as preparedness measures. Similarly early warning systems, preparedness and emergency planning are part of strategic crisis management (Baubion, 2013) and hence follow (in terms of taking effect, but not necessarily in terms of actions and planning) prevention and mitigation activities.

Box 1. Approaches to risk prevention and mitigation across countries and organisations

There a number of different definitions of risk prevention and mitigation used across different organisations and countries, and frequently risk reduction can be found as an encompassing term:

- The Italian civil protection service defines prevention activities as measures designed to eliminate or mitigate the effects on the ground. Prevention measures may be structural or non-structural. Structural interventions consist of active or passive arranging works, which aim to reduce the danger of the event, lowering the probability of occurrence or mitigating its impact. Structural interventions can be for example the consolidation of slopes, and non-structural measures consist of actions that for example prevent or limit the urban expansion in areas at risk, emergency planning, the establishment of early warning systems and monitoring networks.
- In France, prevention policies are defined as policies that eliminate the hazard or reduce its consequences on both people and assets. It includes knowledge of the phenomena, hazards and risks; surveillance/early warning; preventive information and education; taking into account risks in urbanization and spatial planning; vulnerability reduction; preparedness; and learning from experience.
- According to UNISDR prevention is "the outright avoidance of adverse impacts of hazards and related disasters through action taken in advance" (which includes structural measures such as dams and non-structural measures such as land-use regulations) and mitigation is "the lessening or limitation of the adverse impacts of hazards and related disasters" (which includes for example engineering techniques and hazard-resistant construction).

Box 1. Approaches to risk prevention and mitigation across countries and organisations *(cont.)*

- The US Department of Homeland Security uses the encompassing risk reduction term and defines this as "the decrease in risk through risk avoidance, risk control or risk transfer. Risk avoidance are strategies or measures taken that effectively remove exposure to a risk. Risk Control is a deliberate action taken to reduce the potential for harm or maintain it at an acceptable level. Finally, risk transfer is an action taken to manage risk that shifts some or all of the risk to another entity, asset, system, network or geographic area".
- OXFAM defines disaster risk reduction as "the practice of reducing disaster risks through systematic efforts to analyse and reduce the causes of disasters. Decreasing people's exposure to hazards, for example, or reducing vulnerability of people and property, are two ways this might be done. Wise management of land and the environment, and improving preparedness for adverse events are other typical preventative measures."
- Similarly FAO defines disaster risk reduction (DRR) as "the systematic development and application of policies, strategies and practices to avoid (prevention) or limit (mitigation and preparedness) the adverse effects of hazards."

Source: Italian Civil Protection Service (2013). (http://www.protezionecivile.gov.it/jcms/en/attivita_idrogeologico.wp). MEDDTL (Ministère de l'Ecologie, du Développement Durable, des Transport et du Logement), (2011), La Démarche Française de Réduction du Risques des Catastrophes, République Française, 2011 UNISDR (2009). *UNISDR Terminology on Disaster Risk Reduction*. United Nations International Strategy for Disaster Risk Reduction (UNISDR), Geneva. *www.preventionweb.net/english/professional/publications/v.php?id=22460*. US Department of Homeland Security (2008). *DHS Risk Lexicon*. Risk Steering Committee. September 2008, USDHS, Washington, DC. *www.dhs.gov/xlibrary/assets/dhs_risk_lexicon.pdf* OXFAM (2013). Disaster risk reduction. Oxfam, UK. *www.oxfam.org.au/explore/emergencies/disaster-risk-reduction/.* FAO (2013). *FAO's role in Disaster Risk Reduction*. FAO, Rome. *www.fao.org/fileadmin/templates/tc/tce/pdf/faoroledisasterriskreduction.pdf*

2.3 Risk prevention and mitigation in a fiscally constrained environment

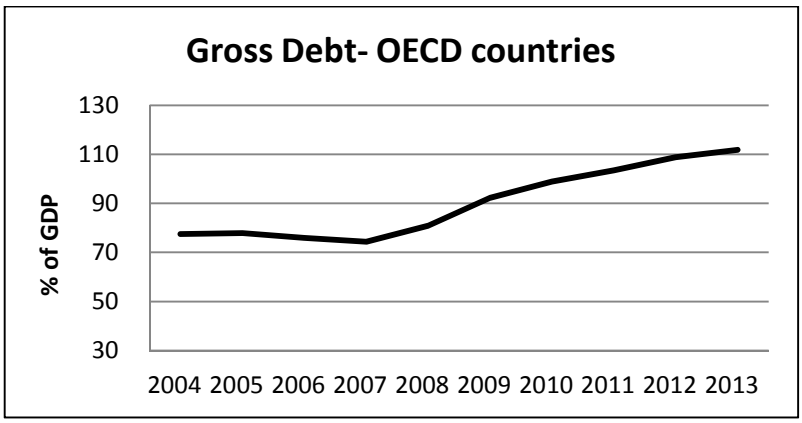
9. Investment in prevention may be difficult to argue for in a fiscally constrained environment. The financial and economic crisis that unfolded in 2008, and affected all OECD economies, had a detrimental impact on public budgets, as economic activities slowed down and tax revenue decreased substantially, while demand for public safety net compensations increased. Gross debt[4], increased from an average 80 percent in 2004 to an estimated 112 percent across OECD countries in 2013 (Figure 4). The fiscal balance[5] was down at -9 percent in 2009 (Figure 5), whereby the GDP growth average was negative from 2008 until 2010. Economic growth will reduce countries deficits and debt to GDP ratio in the short and medium term, but will not be sufficient in many countries to overcome current debt dynamics. Further fiscal consolidation[6] may be needed still for some time. It is estimated that the OECD area requires a consolidation of 3.9% of GDP to stabilize debt by 2030 (OECD, 2013a).

4 . Gross debt entails the general government financial liabilities as a percentage of nominal GDP.

5 . The fiscal balance is defined as the difference between government revenues and spending. Fiscal balances include a structural and a cyclical component. A structural deficit arises when a given economy is running at full capacity and the government still spends more than its revenue. A cyclical deficit occurs when due to an economic downturn the actual output is lower than the potential output of the economy (OECD 2011).

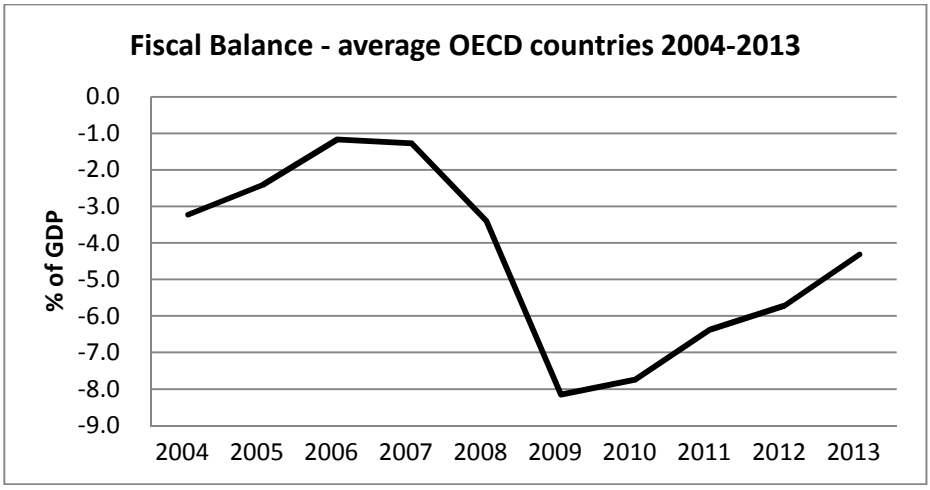
6 . In the OECD (2012b) report fiscal consolidation is defined as concrete policies aimed at reducing government deficit and debt accumulation, e.g. active policies to improve the fiscal position.

Figure 4. Government gross debt - average OECD countries 2004-2013



Notes: Gross debt is general government financial liabilities as a percent of nominal GDP; weighted averages; Source: calculation based on OECD Economic outlook OECD (2013a), *OECD Economic Outlook*, Vol. 2013/1, OECD Publishing. doi: 10.1787/eco_outlook-v2013-1-en (Statistical Annex No. 93)

Figure 5. Fiscal balance - average OECD countries 2004-2013



Notes: Fiscal balance is the general Government financial balance; weighted averages; Source: calculation based on OECD Economic outlook OECD (2013a), *OECD Economic Outlook*, Vol. 2013/1, OECD Publishing. doi: 10.1787/eco_outlook-v2013-1-en (Statistical Annex No. 93)

10. *In such tight fiscal environments disruptive shocks become difficult to handle for public treasuries, especially in countries that rely on state budgets for post-disaster loss financing and where insurance coverage remains relatively low.* Since June 2010, Japan has aimed at reducing its primary budget deficit of central and local governments. The Fiscal Management Strategy (FMS) aimed at creating a surplus by 2020 at latest. However, the programme was severely disrupted by the Great East Japan Earthquake in March 2011, the most expensive natural disaster in Japan's post-war history. The damages from this disaster have been estimated at 3.5 percent of the national GDP which do not include the costs of the accident at the Fukushima nuclear plant. The Japanese economy contracted by 0.70 percent in real GDP and its fiscal deficit increased to 9.5 percent in 2011. As a result of 18 consecutive years of budget deficits and recent disastrous events, gross public debt in Japan rose to 200% of GDP (OECD 2012b). The Japanese case highlights that countries that already face economic and public financial difficulties may have to implement measures that could disproportionately affect the economy and a country's welfare in case of a coincidental disruptive event.

Key issues the OECD project seeks to address:

- What are the key sources of risks, their drivers, as well as the key social and economic vulnerabilities that create risk ' hot spots' across OECD countries and that should be prioritised in risk prevention and mitigation policies?
- Is the working definition of risk prevention and mitigation adequate or should it be changed or complemented with other elements?
- What is the state of the art of OECD countries' public management for disruptive events and their prevention and mitigation policies? Has the financial and economic crisis had an impact on prevention policies and the context in which strategic choices are made?

3. How and to what extent can risks be prevented or mitigated?

3.1 What do prevention and mitigation measures entail?

11. *In risk prevention and mitigation usually a broad distinction is made between structural and non-structural measures. Structural* measures refer to "any physical construction or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems" (UNISDR 2013). In return, *non-structural* measures are any other measures not involving "physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education" (UNISDR 2013). This is similar to this report's notion of protective strategies (i.e. structural measures) and framework conditions (i.e. non-structural measures). Table 2 presents a list of examples.

Table 2. Structural vs. Non-Structural Prevention and Mitigation Measures

Risk Reduction Measure
Non-Structural Measures: • Land-use regulation and planning measures (triangulation of hazard maps and land-use regulation) • Building codes regulation • Fire safety regulation • International agreements on safety standards to prevent industrial risks (e.g. airline and pharmaceutical industries) • International cooperation to prevent terrorist attacks (e.g. exchange of security information among countries; agreeing on security standards across countries) • Risk awareness measures (e.g. public information campaigns, risk sensibilisation instruments, school curricula, health and safety awareness, etc.) • Strategies to diversify supply chains (e.g. reduce risk from disruptive shocks by avoiding single source suppliers) • Provide disincentives for measures that can potentially increase vulnerability (e.g. require building permits for making entryways of houses in concrete, whereas not requiring it if natural material is used that is better suited to withstand floods) • Financial incentives that encourage prevention (e.g. provide tax credits or insurance premium reductions for individual or private sector investment in prevention and mitigation measures)

Structural Measures:

- Technical (engineering) measures (e.g. dikes, flood gates, rock fall or landslide barriers)
- Biological measures (e.g. creation of forests that act as natural barrier against hazards, creation of biological landmass that has greater flood resistance, etc.)
- Retrofitting of buildings and infrastructure to withstand hazardous events
- Establishment of facilities to contain the spread of epidemics
- Developing critical infrastructure (e.g. electricity, transport, water) to withstand disruptive events (e.g. by sinking transmission lines to protect against hurricanes, to build walls around power stations to protect against tsunami waves)

12. *The majority of measures are designed to tackle a specific source of risk; however some measures can be applied to tackle different sources of risks.* For example, the construction of barriers against avalanches is a measure that serves to address one risk only, namely to impede avalanches from harming activities and man-made developments. Land-use regulation can be an instrument to tackle natural and industrial sources of hazards. Table 2 provides some examples of the potential application of measures across different types of risk. National prevention and mitigation strategies should seek to establish a set of complementary measures that address existing risks together and evaluating the benefits from synergies and positive spill-over effects of prevention measures in tackling different sources of risks.

Table 3. Sources of risks and their prevention and mitigation measures

Risk prevention or mitigation measure	To address the following types of risk
Land-use regulation and land use planning measures (Prescriptions, Hazard maps)	Natural disasters (e.g. planning based on expected risks to floods, landslides or other natural hazards); industrial hazards (e.g. factories close to rivers whose products could potentially get into and contaminate waters);
Building codes regulation	Building codes can be strengthened not only for natural disasters, but also for example high risers that can incorporate precautionary measures to minimise fatalities from a similar terrorist attack as 9/11
Business continuity plans for critical infrastructure services	Can be established in the event of disruptions stemming from multiple risks (natural, financial, supply chain, etc.)
Risk Awareness raising measures (such as communication campaigns)	All types/sources of risk
Biological measures: stabilizing effect of plants/forests	Can address risks for example against landslides, avalanches, flooding, rock fall.

13. *Continuously adapting structural measures to withstand ever greater disruptive events may neither be economically feasible nor socially viable, instead, complementary non-structural measures should be considered.* Recent disruptive events have demonstrated that existing structural measures may not withstand actual impacts of major disruptive events: during the floods in Central Europe in 2013 a number of dikes and dams burst, and retention measures proved to not have been built high enough. The earthquake in Japan saw 190km of its 300km long dike structure along the coast destroyed, with the tsunami twice as high as the dikes were estimated to withstand (World Bank 2012). This does not necessarily demonstrate a planning weakness and an underestimation of the potential impacts preventative measures are to withstand, but simply a convolution of triggers that had never happened before and that no model would have envisaged as a worst case scenario. Building structural measures ever stronger may not only be unfeasibly expensive, but also encounter significant resistance from environmental groups and citizens in disfavour of high-impact structural measures. Instead, they should be complemented with less costly and potentially more effective non-structural measures that can address highly uncertain and

unlikely consequences of disruptive events in complement with the provided structural measure. For example, following the Great East Japanese Earthquake, a number of volunteers and fire fighters put floodgates and inland lock gates into operation once it became clear that the existing dikes and walls were not going to withstand the impacts. Even though a number of people that helped install these complementary mobile structural measures were killed in the process, as they could not finish their tasks in time (which was addressed in the aftermath of the disaster), it proved a flexible instrument when an event with largely unexpected consequences unfolded (World Bank 2012).

3.2 Is there an optimal risk reduction level?

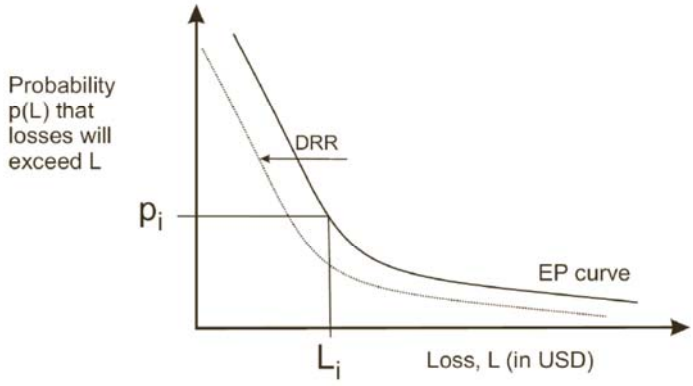
14. *Past disruptive events have triggered debates about whether higher protection levels could have been achieved to avoid the degree of impact certain events have had.* In some cases, the impacts of past major disruptive events led to legal prosecutions of citizens against their governments for having neglected their responsibility of providing adequate protection levels (such as in Austria after the 2003 floods). The key difficulty of risk management is that it operates under private and public resource constraints. In the case of severe disruptive events, it is neither technically nor financially feasible for governments, but also for individual companies or households to aim at achieving a "zero risk" level, as there are usually competing demands and more productive allocation choices for available resources.

15. *Provided that "zero-risk" cannot be feasibly obtained under given resource constraints, the question turns to what level of residual risk individuals and society choose to accept.* The concept of "acceptable risk" is usually defined as the level of risk a society is prepared to accept without any specific risk management options. The term "tolerable risk" defines the level of risk a society is prepared to live with as long as that risk is monitored and risk management options are taken to reduce it (Bell et al. 2005).

16. *To help individuals and society determine the level of risk they seek to tolerate or accept a number of decision support tools are available.* Technical decision support tools include Cost Benefit or Cost Effectiveness Analyses, Multi Criteria Analyses or models such as ALARP (As Low As Reasonable Practicable). All methodologies identify the marginal cost of achieving additional levels of risk protection (Gamper et al. 2006, Manuele 2010, Bell et al. 2005, Liu and Wie 2008). This allows public and private decision makers to make trade-offs between competing resource allocation decisions and to determine to which level they are willing to pay for additional levels in risk reduction. All models usually have an identification of risks in common that are valued against their probability of occurrence and potential damage. Based on that the cost for avoidance is calculated.

17. *The standard cost benefits analysis model is based on the exceedance probability (EP) curve*. An EP curve indicates the probability *p* that *at least* $X is lost in a given year, where loss in US dollars is shown on the x-axis and the annual probability that losses will exceed this level on the y-axis. The area under the EP curve is the average annual loss (AAL). Disaster prevention and mitigation measures are meant to reduce the expected loss and consequently the EP curve will shift to the left reducing the AAL value (Figure 7). When comparing different prevention and mitigation measures the most attractive ones are the ones with the highest benefit-cost ratio (Hochrainer-Stigler, 2010).

Figure 6. Exceedance Probability Curve



Source: S. Hochrainer-Stigler et al. (2010), "The Costs and Benefits of Reducing Risk from Natural Hazards to Residential Structures in Developing Countries," Wharton University of Pennsylvania

18. *A number of countries have established a common framework for determining acceptable levels of risks.* In the UK, for example, the British Health and Safety (HSE) Committee advices on how to determine acceptable levels of risk with regard to work related hazards[7]. Decision-making on risk management is explicitly based on the criteria elaborated by the HSE (Liu and Wie, 2008). In Iceland, following two catastrophic snow avalanches, acceptable risk levels for snow avalanches and landslides were defined and implemented in national law (The Ministry of the Environment 2000 cited in Bell 2005). Liu and Wie (2008) use this methodology to propose different acceptable earthquake risk levels in China. Based on the size of a city and probable earthquake intensity, they calculate the level of fatalities caused by an earthquake that are acceptable with little repercussions.

Key issues the OECD project seeks to address:

- What are the key risk prevention and mitigation measures and shortcomings related to them that the OECD should look at?
- What do national prevention and mitigation strategies look like? Do they address multiple risks or risks in multiple government sectors, or are they confined to sectoral units? What makes good practice national risk prevention and mitigation strategies?
- How are risk prevention and mitigation measures decided upon? Are decision support tools used or mandated and how successful have they been in informing policy making? How do OECD countries manage the discussion of optimal or acceptable risk levels? How can we build a typology and a comparison of countries' approaches in this field?

[7] UK Health and Safety Execputive: *www.hse.gov.uk*

4. Addressing the challenges of good governance and policy implementation: the key to effective risk prevention and mitigation

4.1 What is the state of the art of prevention and mitigation across OECD countries?

19. *There are potentially high returns to ex-ante investments in preventive measures that reduce negative impacts of disruptive events, and yet much more is spent on ex-post disaster relief.* Taking into account not only the financial losses, but also the losses in terms of human life in calculating the total economic impacts of disasters, the benefits of risk reduction measures could far outweigh their costs (World Bank 2010). In spite of this some indicative figures on government expenditure from Colombia, Indonesia, Mexico and Nepal[8] suggest that ex-post spending is up to three times higher than preventative, ex-ante spending (de la Fuente 2009).

20. G*overnments are not alone in underestimating the economic benefits of risk reduction investments*. Individuals and businesses may disregard the benefits of investing in greater protection of their lives and belongings. A household survey conducted in Turkey after the major Marmara earthquake in 1999 showed that only a fifth of Istanbul's population had taken some preventive action as a result of this event (World Bank 2010). A study conducted after the major floods in Germany in 2002 revealed that 30 percent of the directly affected citizens would still not consider purchasing flood insurance for a better individual protection in the future (DKKV 2003). In 2007, floods in the United Kingdom led to 13 fatalities and left half a million people without water or electricity. A survey conducted within a study of the flooding event highlighted that 84 percent of the affected residents believe there is nothing they can do to protect their homes better in the future, and 50 percent of the respondents firmly believe that is not their responsibility to invest in making their homes safer (Pitt 2008). New York suffered storm floods in 2004 and damages from heavy rain in 2007, yet Hurricane Sandy in 2012 revealed persistent under-investment by individuals: most New York property owners affected by Sandy did not have flood insurance at all (City of New York 2013). Another issue is related to joint collaboration: barriers to cooperation between the public and the private sector, but also among public bodies (such as between municipalities or districts and regions), and between countries internationally have also inhibited increased protection. For example, if hazard zone mapping is conducted on a municipal level, coordination problems may arise with one and the same exposure characteristics resulting in different land-use plans, undermining each other's risk reduction objectives.

21. *Persisting governance shortcomings can have another detrimental impact: it can undermine trust in the government's ability to protect their societies and economies against disruptive events.* Even though risk prevention and mitigation engagement may not be as rewarding for policy makers in terms of popular visibility, ex-ante non-action made apparent in the event of a disaster may in turn disproportionately negatively affect trust in governments. The Tohoku earthquake and tsunami in Japan in 2011, for example, has raised serious concerns among citizens on whether the government did enough to identify the potential knock-on risks on nuclear power stations and to install necessary protective measures. Re-instating such a trust may come at a high political and administrative cost, including the dismissal of public officials.

8. It is difficult to make a general assertion on this trend across OECD countries at this point, since data on disaster spending in general, but moreover distinguishing ex-ante and ex-post expenditure items are neither readily available nor easily discerned in general budget items.

4.2 Why is not more being prevented?

22. *Key impediments exist that hinder important actors responsible for risk prevention from investing more and more effectively in risk prevention and mitigation.* The brief discussion above shows that there is significant room for scaling-up prevention and for realising the benefits of risk prevention and mitigation across OECD countries. A number of impediments exist though that would need to be overcome if higher protection levels were to be achieved. Generally speaking, in a resource-constrained environment there is a limited amount that governments, individuals and the private sector can allocate to risk prevention and mitigation. The current fiscal environment, as discussed earlier, puts further strain on available financing and makes the justification of scaling up prevention ever more difficult. The fact that there is a considerable degree of uncertainty regarding the incidence and the level of impact of adverse events further increases complexity. This leads to actors either underestimating the risks, or having difficulties as to how to judge probabilities and make concrete investment decisions today regarding probable disruptive events in the future. However, recent events have often demonstrated the scale of impacts that events can have that far exceeded the probable risk that built the basis for initial decision making. And yet protection levels are not increased to the extent possible. There are underlying market, government, and collective action failures that inhibit an increased engagement for risk prevention and mitigation as well:

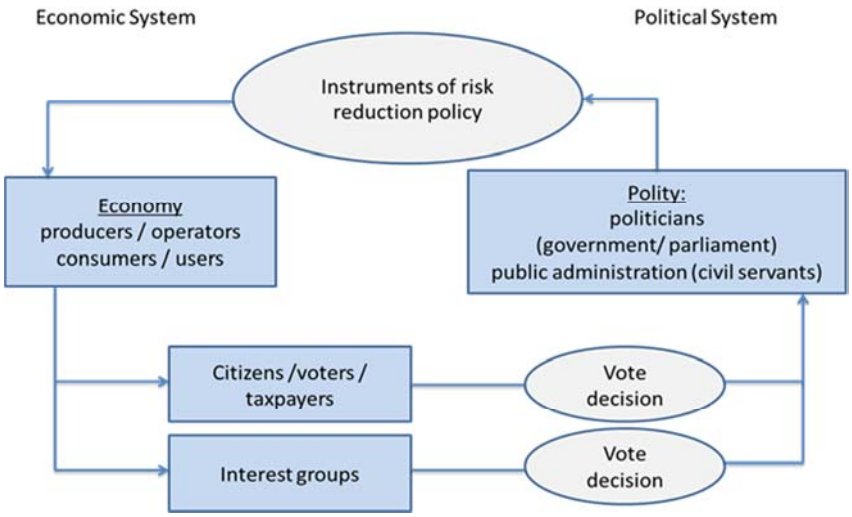
- *Market failures* can occur for example in the market for risk insurance or a financial risk transfer mechanism for citizens or businesses. Only those citizens or businesses will purchase insurance that are particularly exposed to the risk (adverse selection), which makes it unattractive for insurers to offer their products. Insurers may be further reluctant to offer their products if they have significant concerns that customers would tend to more risky behaviours (moral hazard). Governments can help overcome such failures for example by reducing information asymmetries, by providing flood risk maps that allow for differentiating flood risk premiums according to varying levels of risk exposure (Raschky and Weck-Hannemann, 2008). Another way for governments to correct for this failure could be to introduce mandatory insurance.
- *Collective action problems* may arise for example when communities have disincentives to co-finance protective measures. Take for example the construction of a protective dam against flood risks. A community upstream a large river decides to build such a dam to reduce their exposure to flood risk, while equally exposed downstream communities choose to free-ride and not to contribute to financing them. This could discourage such investments and lead to an under-provision of collective risk protection measures. Reversely, the same issue could arise when downstream communities are the ones that would need to build dams further upstream to protect themselves against immanent hazards. The upstream communities that are not threatened could stall such a project or demand significant compensation for potentially harmful environmental impacts stemming from the dam construction. Such collective action issues can be resolved by majority votes that can oblige everyone to contribute financially to a protective measure (such as can be done in flood affected communities in Austria).
- *Government interventions* may not always be the key to solving market or collective action problems. They too can lead to very inefficient results, such as through "charity hazard", when risk affected communities fail to protect themselves in expectation of government compensation in case of an adverse impact. Governmental relief assistance in Germany and Austria, as is likely also in other countries, has demonstrated to be a strong crowding out effect on the uptake or the willingness to pay for insurance as the expectation of government relief in the event of a disaster is high (Raschky *et al.* 2010). The EU's solidarity fund or the Austrian catastrophe fund are examples of widely known financial resources that are tapped in the event of a disaster. While in other countries charity hazard may be a less prominent problem, disaster relief is still a political instrument. For example in the United States the Federal Emergency Management Agency (FEMA) spending is significantly higher in election years than in others (Garret and Sobel 2003),

which may not be an economically efficient way of spending public resources for lowering a society's vulnerability to risks.

4.3 What can a better understanding and an improvement of governance mechanisms do to improve policy implementation?

23. *To overcome existing market or government failures it is key to understand how the political and the economic systems influence their actors' behaviours.* To understand the complexity of the political and economic environment in shaping actors' individual decisions, looking at the provision of risk reduction measures can serve as a starting point. On the demand side for risk reduction measures one finds for example critical infrastructure providers, citizens as voters, or members of interest groups (e.g. insurance associations). On the supply side there are politicians and members of government, as well as bureaucrats in sub-national, national or supra-national administrations. The links between those actors are illustrated, in a simplified way, in Figure 8. Risk reduction policies decided upon by the government influence if, or to which extent, critical infrastructure providers or individual households invest in risk reduction measures. A deeper understanding in how these mechanisms drive the adoption or non-adoption of needed risk reduction measures can be key to unlock greater ex-ante investments, both public and private.

Figure 7. A simplified political economy model of disaster risk reduction



Source: adapted from Weck-Hannemann, 2000

24. *Risk prevention and mitigation roles and responsibilities need to be identified and clarified, and governance mechanisms designed accordingly.* To ensure different actors contribute their expected part to achieve the overall risk reduction objectives, it is paramount to define these roles and to communicate them. Once the roles for each risk prevention and mitigation actor is specified, the governance framework can be set so as to facilitate the contribution of each actor's share to a socially acceptable risk level, but also the collaboration among the actors to achieve this common objective.

25. *The key analytical question this issues paper and the experts meeting is seeks to address is therefore organised around the analysis of the state of the art of different actor's contribution to reducing risk exposure, notably the role of the government, the private sector, sub-national governments, and international collaboration, and the extent to which the existing institutional framework facilitates or hampers their engagements.*

Key questions the OECD project seeks to address:

- Who are the key actors on the supply and the demand side that influence the level of risk reduction a society achieves?
- What options for reducing risks are there and by whom are they provided?
  - Various risk reduction measures will be identified, including structural and non-structural measures.)
- What are the institutions governing the actors for providing the risk reduction measures? What are their incentives or potential disincentives to engage?
- Looking at specific cases the final report will ask whether and how past disasters have led to policy change? Did they facilitate a positive change and if so how? Who were the drivers of this change?
- What recommendations can the workshop participants make to improve governance mechanisms for effective risk reduction and prevention?

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