

The Global Risks Landscape 2018

<http://reports.weforum.org/global-risks-2019/explore-the-survey-results/>

Top 5 Global Risks in Terms of Likelihood

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1st	Asset price collapse	Asset price collapse	Asset price collapse	Storms and cyclones	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict with regional consequences	Large-scale involuntary migration	Extreme weather events	Extreme weather events
2nd	Middle East instability	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Flooding	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events	Extreme weather events	Large-scale involuntary migration	Natural disasters
3rd	Failed and failing states	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment and underemployment	Failure of national governance	Failure of climate-change mitigation and adaptation	Major natural disasters	Cyberattacks
4th	Oil and gas price spike	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber attacks	Water supply crises	Climate change	State collapse or crisis	Interstate conflict with regional consequences	Large-scale terrorist attacks	Data fraud or theft
5th	Chronic disease, developed world	Retrenchment from globalization (emerging)	Global governance gaps	Climate change	Water supply crises	Mismanagement of population ageing	Cyber attacks	High structural unemployment or underemployment	Major natural catastrophes	Massive incident of data fraud/theft	Failure of climate-change mitigation and adaptation

Top 5 Global Risks in Terms of Impact

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1st	Asset price collapse	Asset price collapse	Asset price collapse	Fiscal crises	Major systemic financial failure	Major systemic financial failure	Fiscal crises	Water crises	Failure of climate-change mitigation and adaptation	Weapons of mass destruction	Weapons of mass destruction
2nd	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Climate change	Water supply crises	Water supply crises	Climate change	Rapid and massive spread of infectious diseases	Weapons of mass destruction	Extreme weather events	Extreme weather events
3rd	Slowing Chinese economy (<6%)	Oil and gas price spike	Oil price spikes	Geopolitical conflict	Food shortage crises	Chronic fiscal imbalances	Water crises	Weapons of mass destruction	Water crises	Water crises	Natural disasters
4th	Oil and gas price spike	Chronic disease	Chronic disease	Asset price collapse	Chronic fiscal imbalances	Diffusion of weapons of mass destruction	Unemployment and underemployment	Interstate conflict with regional consequences	Large-scale involuntary migration	Major natural disasters	Failure of climate-change mitigation and adaptation
5th	Pandemics	Fiscal crises	Fiscal crises	Extreme energy price volatility	Extreme volatility in energy and agriculture prices	Failure of climate-change mitigation and adaptation	Critical information infrastructure breakdown	Failure of climate-change mitigation and adaptation	Severe energy price shock	Failure of climate-change mitigation and adaptation	Water crises

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological

Insurance

- Random impacts on income, health, productivity etc.
- Risk aversion:
 - certain X is preferred to a lottery featuring expected income lower than X

Risk aversion

- Income: W
- damage (d) with probability p .
- Two states of the world:
 - Negative: Prob. = p – $W-d$
 - Positive: Prob. = $1-p$ – W
- Expected income: $p(W-d)+(1-p)W$
- Expected utility: $pU(W-d)+ (1-p)U(W)$

Example

- W : 100
- (d) : 64
- Utility: $U(W)=W^{1/2}$
 - Negative state: Prob. = $1/2$ – 36
 - Positive state: Prob. = $1/2$ – 100
- Expected income: $18+50=68$
- Expected utility: $3+5=8 < 8,25=U(68)$.

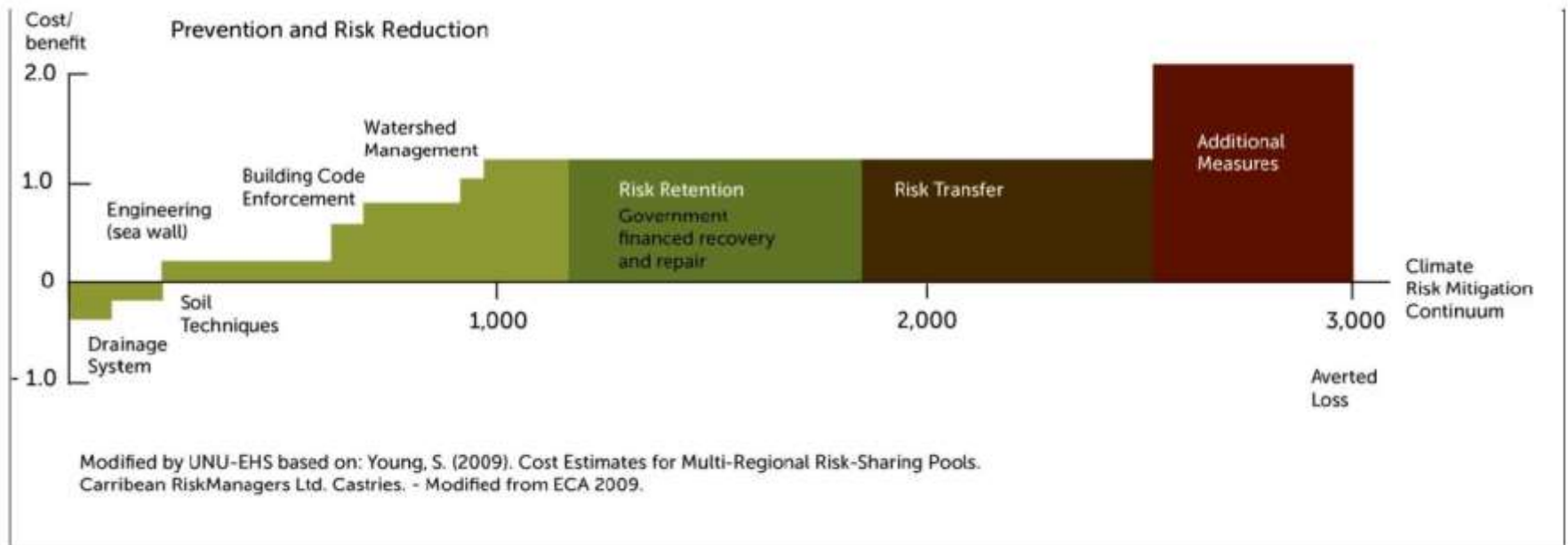
Bounded Rationality

- Kahneman & Tversky show how “rules of thumb” (“heuristics”) guide decisions.
- Common mistakes may arise.
 - Losses and Gains are not treated equally (Prospect theory)
 - Knetsch 1989: 89% of undergraduates given a mug will refuse to trade mug for chocolate bar of equal value; 90% of undergraduates given a chocolate bar will refuse to trade it for mug of equal value.
 - Events that are easier to recall or salient are likely to weigh heavily on decision makers; events that are harder to recall or less salient will weigh less heavily.
 - People may have attitudes towards risk that violate “standard” expected utility

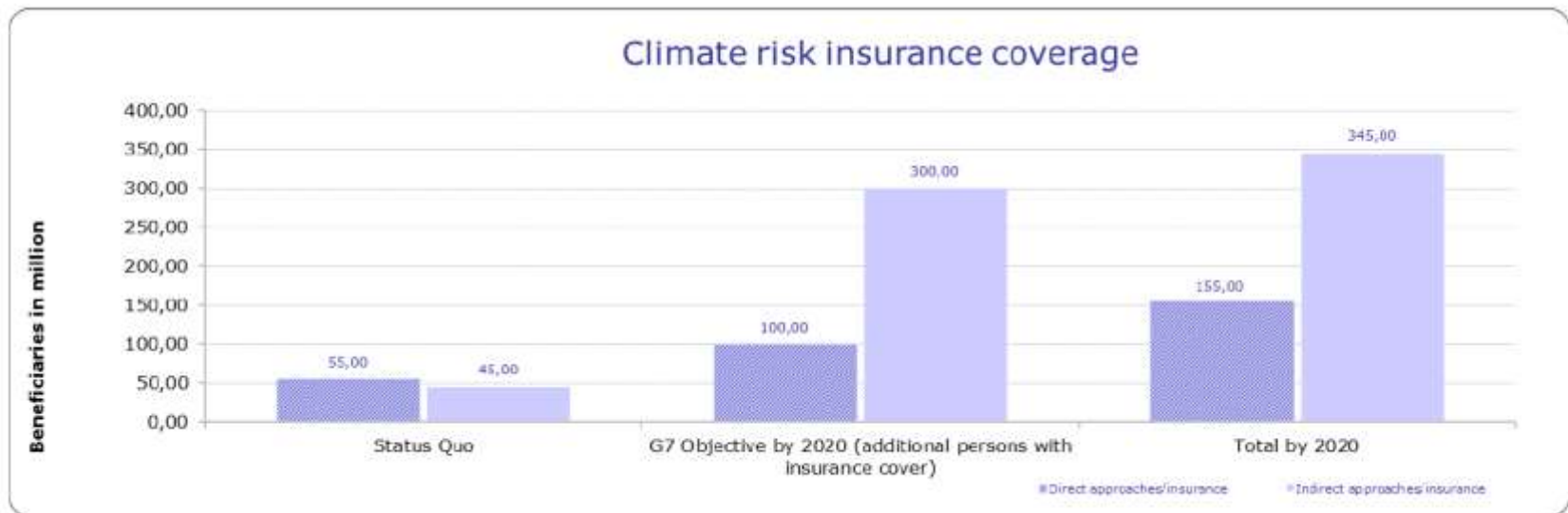
TFCD – Miller and Swan, 2016

1. Physical Risks: that arise from climate-related weather disasters and impacts on productivity, employment etc.
2. Transition Risks primarily related to the ability of economies to adjust (or “transition”) to future conditions in such a way that economic and financial shocks are minimized. A key aspect of transition risk is the possibility of a carbon tax or price, which can help smooth the transition and prevent “stranded assets”—primarily in fossil industries—from accumulating for investors. In particular, stranded-asset risk manifests for two major, but interconnected, actors: (i) fossil-fuel companies themselves, which must consider the forward-looking value of their business and fossil reserves, and (ii) investors and lenders with financial stakes in those businesses. Policies and technological innovations both have the potential to negatively impact the value of these assets.
3. Liability Risks refer to the increasing potential for companies to be exposed to legal liabilities as a result of corporate mismanagement of climate risks or environmental impacts of operations. This may be relevant for insurance companies, engineering firms responsible for design of infrastructure, or manufacturers of products that fail to perform in hot weather.

Role of insurance



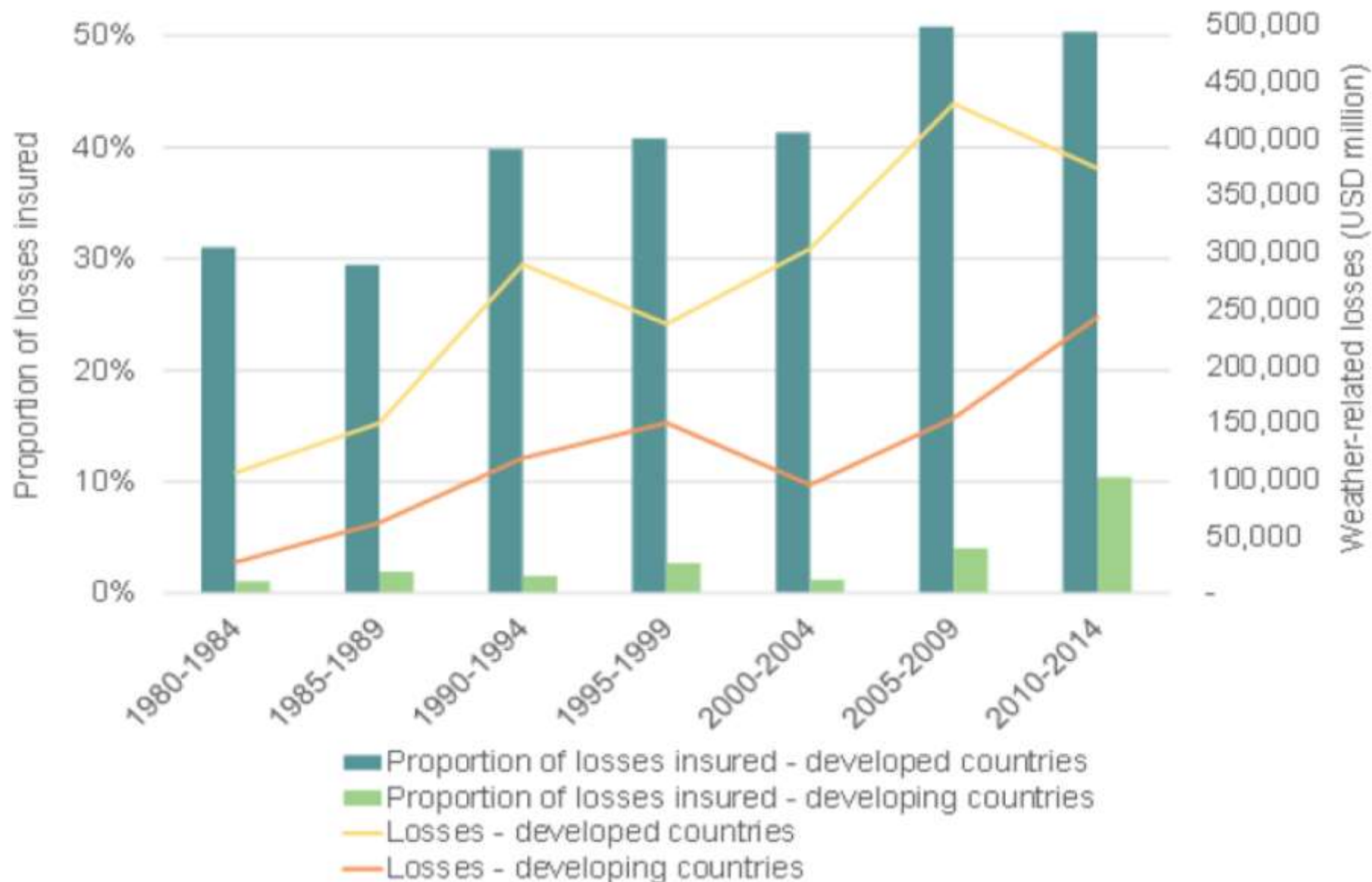
Accesso alle assicurazioni



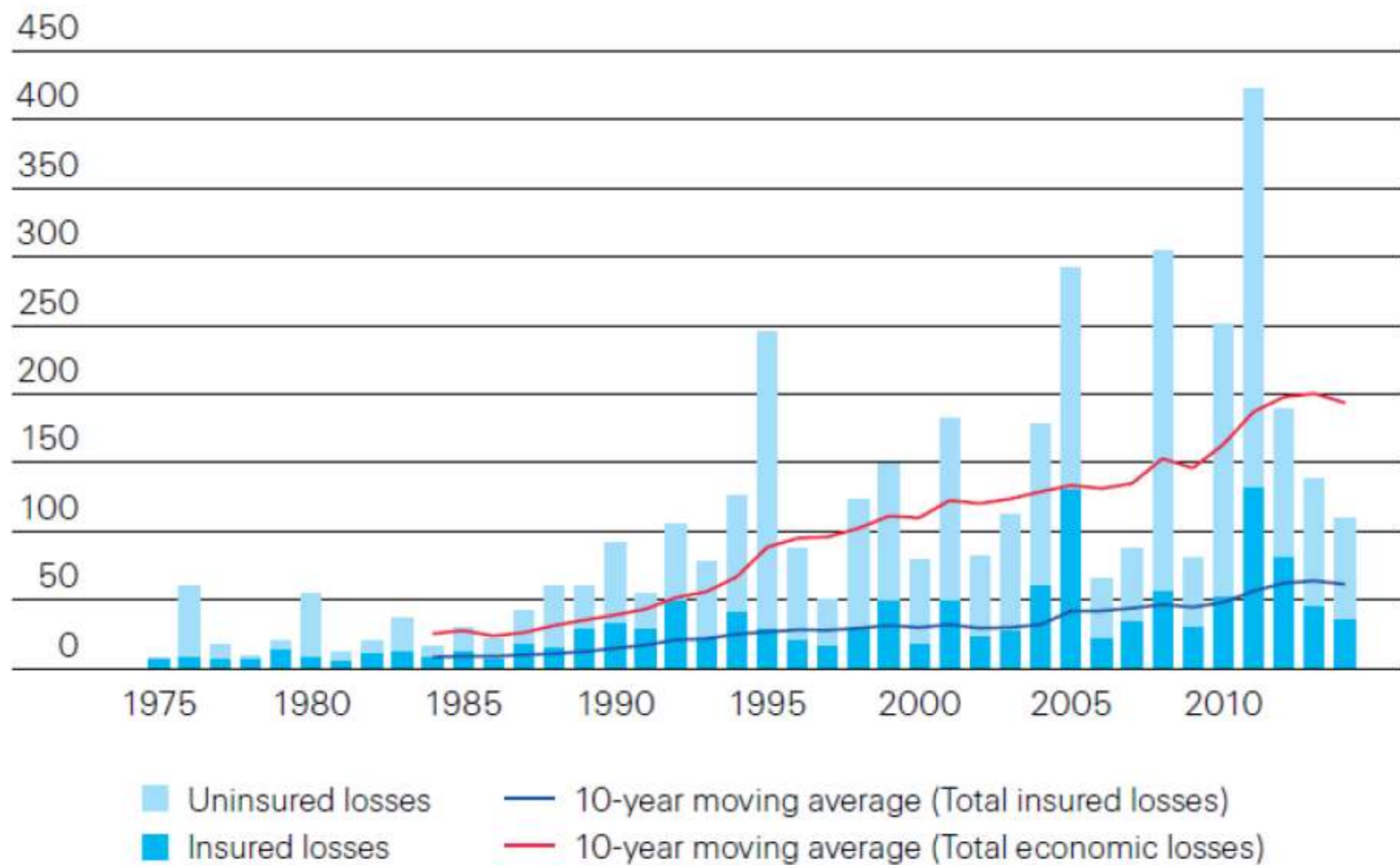
Role of insurance

- Social costs of «uncovered» losses may be substantial
- Insurance takes place «ex post»
 - How do
- Catastrophic damages may be huge
 - Market structure (e.g. firms dimension)
 - Insurance structure (e.g. risk diversification)

Despite Growth, the proportion of insured weather-related losses in developing countries is lower than in developed countries.



Natural Catastrophes Losses: Insured vs Uninsured losses, 1975–2014 (in 2014 dollars, \$ billions)



Source: Swiss Re, Underinsurance of Property Risks: Closing the Gap, 2015.

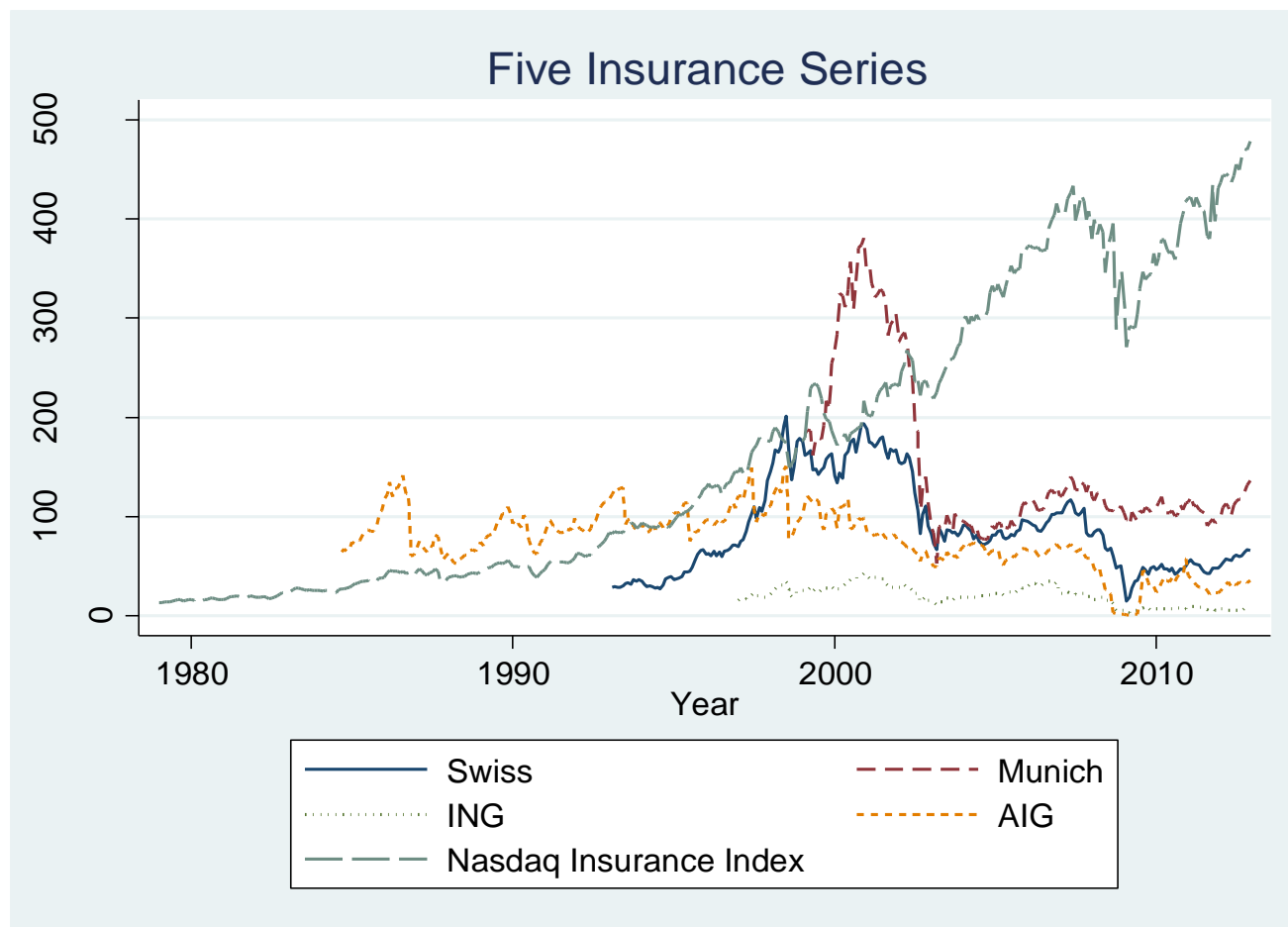


Figure1. Atlantic Accumulated Cyclone Energy Index (AACE)

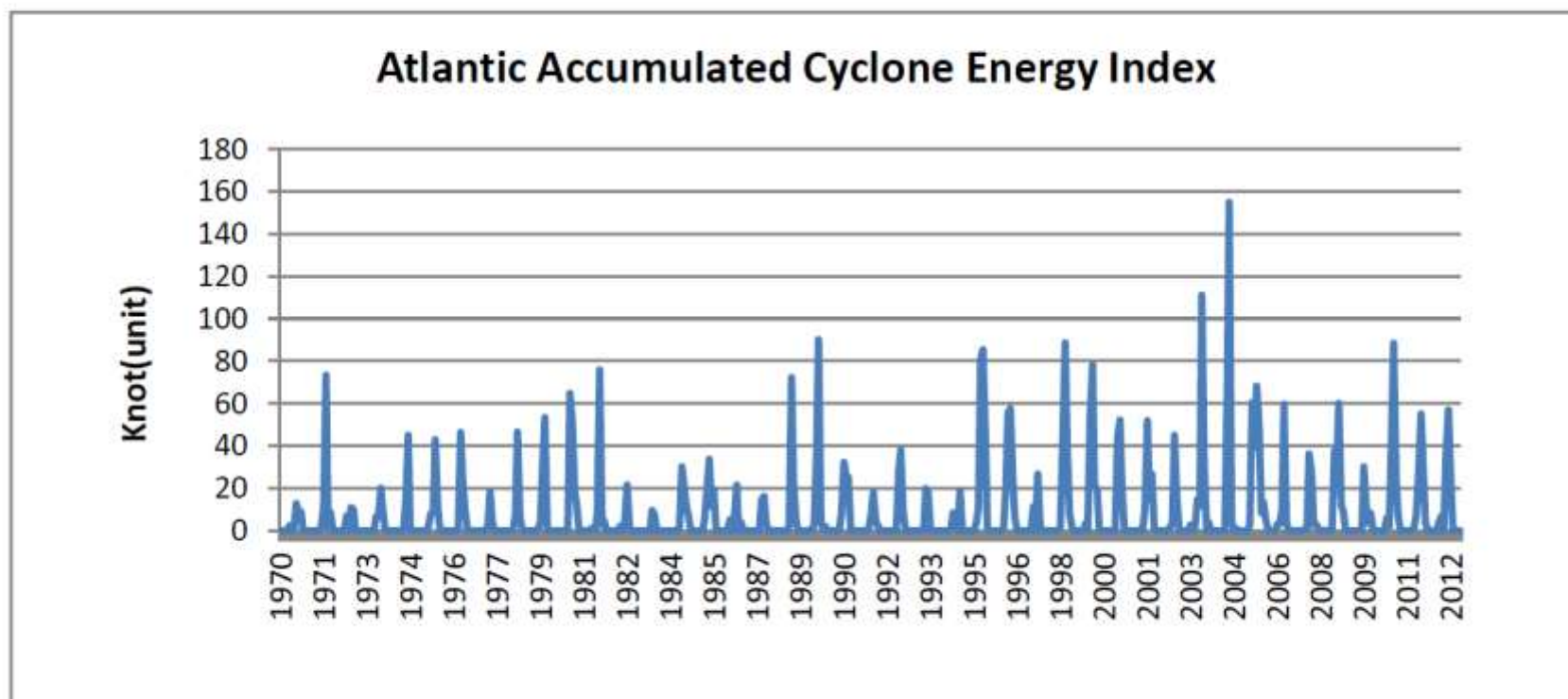


Figure 2. US Climate Extremes Index (CEI)

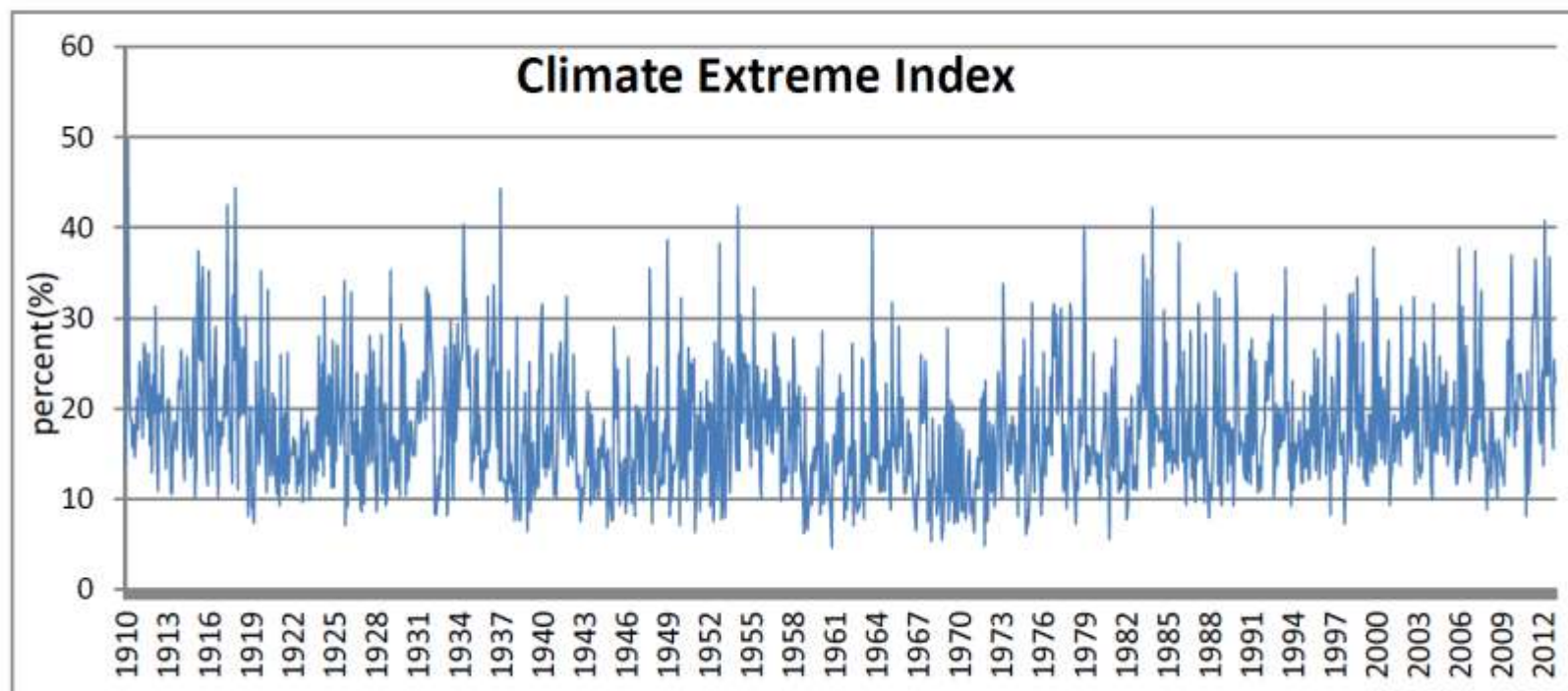


Table 2 OLS estimation of the impact of climate variability on the monthly excess return of share prices of insurance companies (Atlantic Accumulated Cyclone Energy index as independent variable)

	Swiss Re	Munich Re	ING	AIG	Index
CEI		0.078* (7)	0.092* (2)	0.042*	0.073(1) 0.071 (2) 0.076*(3) 0.094*(9)
AACE		0.003(9)	0.005(4)		0.004 (2)
ER _{MKT}	0.525**	0.411**	0.638**	0.480**	0.618**
SMB	- 0.194**	- 0.278**	- 0.104*	0.002	0.177**
HML	0.155*	- 0.016	0.173**	0.235	0.255**
CONS	0.176	0.115	- 0.263**	0.006	-0.024
R ²	0.43	0.28	0.61	0.21	0.43
AIC	550	425	374	887	915
BIC	574	453	403	906	951
Obs	238	166	191	339	399
Month	1993.02	1999.02	1997.01	1984.09	1979.01

Marginal effects

CEI	0.078*	0.092*	0.042*	0.314**
AACE	0.003	0.005		0.004

POSSIBLE SOLUTIONS: FINANCIAL MARKETS

- Low probability high value losses.
- Traditional solutions:
 - Internal fund accumulation
 - Debt financing
 - Insurance (re-insurance – problems)
 1. Market power;
 2. Small firms, insufficient capitalization
 3. Need for state intervention
- Financial markets as an innovative solution

Industry Loss Warranties

- Insurance contract such that the operative trigger is an industry loss rather than the company's own loss
- Implies some risk that there could be a loss to the reinsured portfolio without triggering the ILW if the corresponding industry loss is smaller than the industry trigger amount. ('basis risk'). This risk is higher for companies whose exposure concentrations are farther away from the industry averages.
- Therefore ILW covers are typically bought by companies whose portfolios closely follow the market.
- The trigger amount can vary by geography, level, and the kinds of events that contribute to it.

Industry Loss Warranties

- A hurricane with industry-wide insured loss in Florida in excess of \$15 billion but less than \$25 billion.
- A winter freeze with industry-wide insured loss in North America in excess of \$20 billion.
- An earthquake with industry-wide insured property loss in excess of \$35 billion anywhere in the world.
- Second wind loss with industry-wide insured loss in excess of \$10 billion anywhere in the US and territories.

Pricing ILW: the issue of risk profile

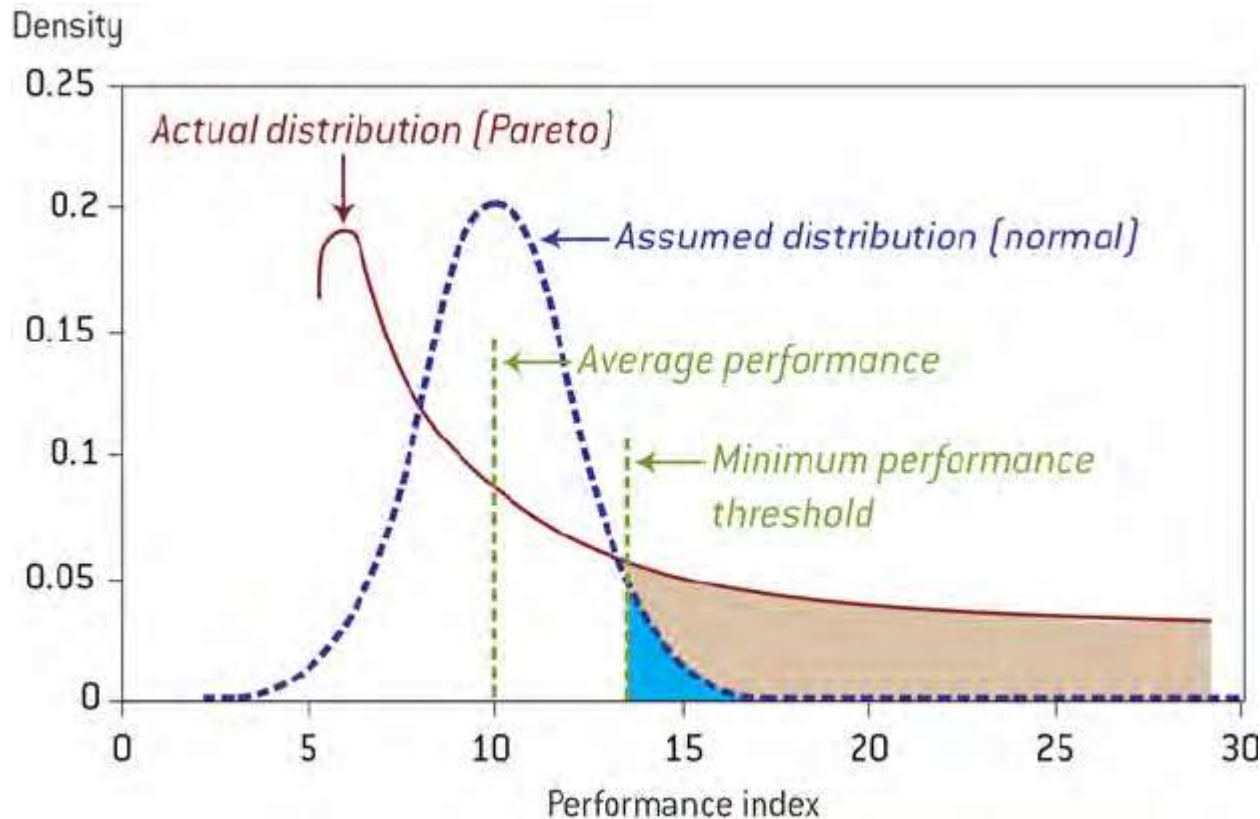


Table I $\text{Prob}[S \geq \hat{S}]$ for fat-tailed Pareto and thin-tailed Normal distributions

$\hat{S} =$	3°C	4.5°C	6°C	8°C	10°C	12°C
$\text{Prob}_P[S \geq \hat{S}]$	0.5	0.15	0.06	0.027	0.014	0.008
$\text{Prob}_N[S \geq \hat{S}]$	0.5	0.15	0.02	0.003	7×10^{-7}	3×10^{-10}

Pricing ILW – determining probability (SIMPLE!)

Expected losses over 100 years; 10 historical losses above 20 million €; assume 10% probability.

Year Number	Industry Loss (Millions)	Catastrophe Description
4	4,679	FL Hurricane
4	2,586	FL Hurricane
5	2,948	Winter Storm
7	19,000	FL Hurricane
8	3,438	FL Hurricane
10	9,242	CA EQ
10	3,304	FL Hurricane
12	3,293	FL Hurricane
14	5,234	Winter Freeze
15	4,636	FL Hurricane
16	2,949	FL Hurricane
17	26,424	CA EQ
17	7,532	FL Hurricane
17	5,419	NY Hurricane
17	4,426	FL Hurricane
19	24,939	CA EQ
20	2,739	FL Hurricane
20	2,603	FL Hurricane
20	2,165	Winter Freeze
23	3,912	FL Hurricane
24	2,441	FL Hurricane
26	20,638	FL Hurricane
26	5,507	FL Hurricane
27	2,573	CA Landslide
28	4,946	FL Hurricane
29	9,626	CA EQ

Come calcolare il prezzo di ILW?

Prima di tutto calcoliamo quando il “trigger” minimo (assumiamo sia 20000) è superato (assumiamo anche un Massimo di 100000) e assumiamo che la zona di riferimento sia la Florida.

$$PayoutTrigger_{event, year} = \begin{cases} 1 & \left\{ \begin{array}{l} \text{if } Loss_{event, industry} > Trigger_{min} \\ \text{and} \\ \text{if } Loss_{event, industry} < Trigger_{max} \end{array} \right\} \\ 0 & \text{otherwise} \end{cases}$$

Year Number	Industry Loss (Millions)	Catastrophe Description
26	20638	FL Hurricane
42	24801	FL Hurricane
63	24323	FL Hurricane
153	20977	FL Hurricane
179	30669	FL Hurricane
205	22307	FL Hurricane
232	23976	FL Hurricane
288	27315	FL Hurricane
343	34381	FL Hurricane
431	33108	FL Hurricane
438	20223	FL Hurricane
467	28063	FL Hurricane
467	26904	FL Hurricane

Come calcolare il prezzo di ILW?

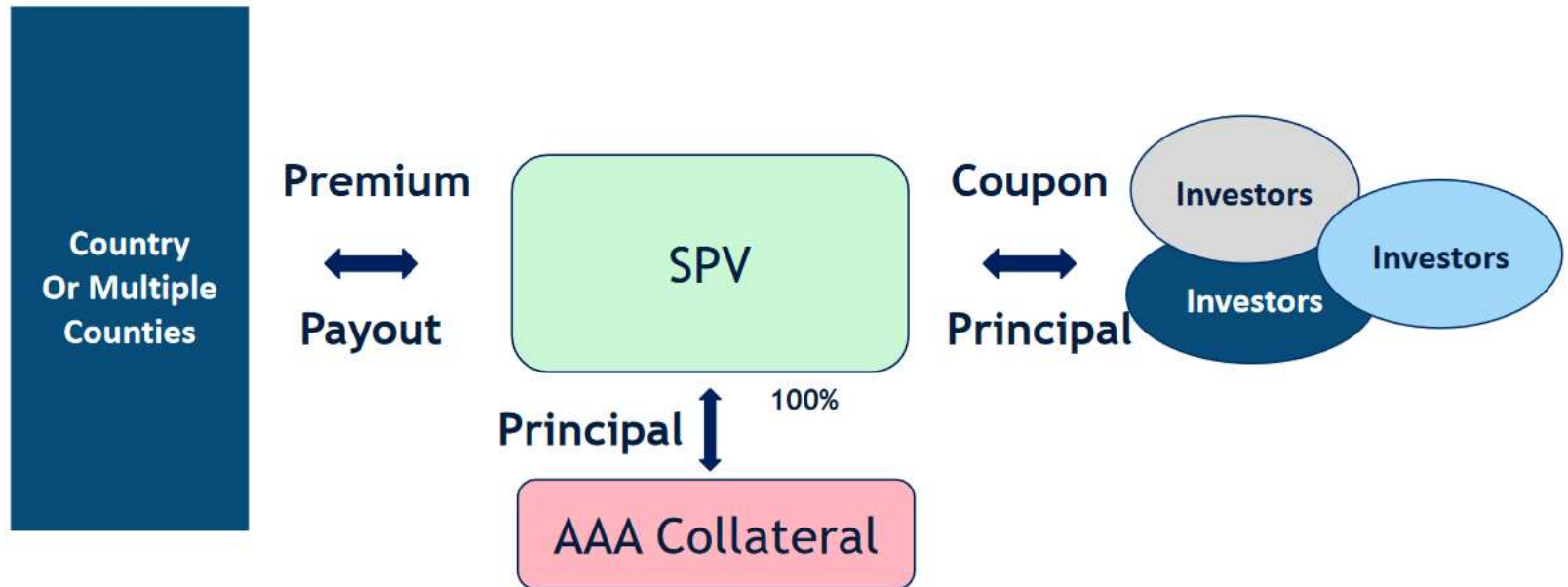
Se il limite di risarcimento è 100 milioni, se assumiamo che le spese di gestione siano il 20% del premio, e con un premio del 5% del valore assicurato, avremo questo profile di rendimenti netti.

Year Number	ILW loss	Premium	Profit/ Loss
1	0	5	4
2	0	5	4
3	0	5	4
4	0	5	4
5	0	5	4
6	0	5	4
7	0	5	4
8	0	5	4
9	0	5	4
10	0	5	4
.	.	.	.
.	.	.	.
.	.	.	.
26	100	12.5	-90
.	.	.	.
.	.	.	.
.	.	.	.
467	200	12.5	-190

CATASTROPHE BONDS (Edesses, 2015)

- The purpose of CAT bonds is to collect reinsurance coverage from the market.
- They feature a risk that is uncorrelated with other risks such as equity market risk, interest rate risk, and credit risk.
- The investor purchases the bond with a principal payment then receives regular periodic payments;
- Maturity which ranges from one year to five years but is typically three years.
- If a covered catastrophe exceeding the “trigger” point defined in the bond’s contract occurs then the bond defaults and a portion or all of the principal paid for the bond by the investor may not be returned
- The investor’s principal payment is invested in risk free assets (e.g. government bonds). The related interests *plus* a spread are paid.

Catastrophe bonds

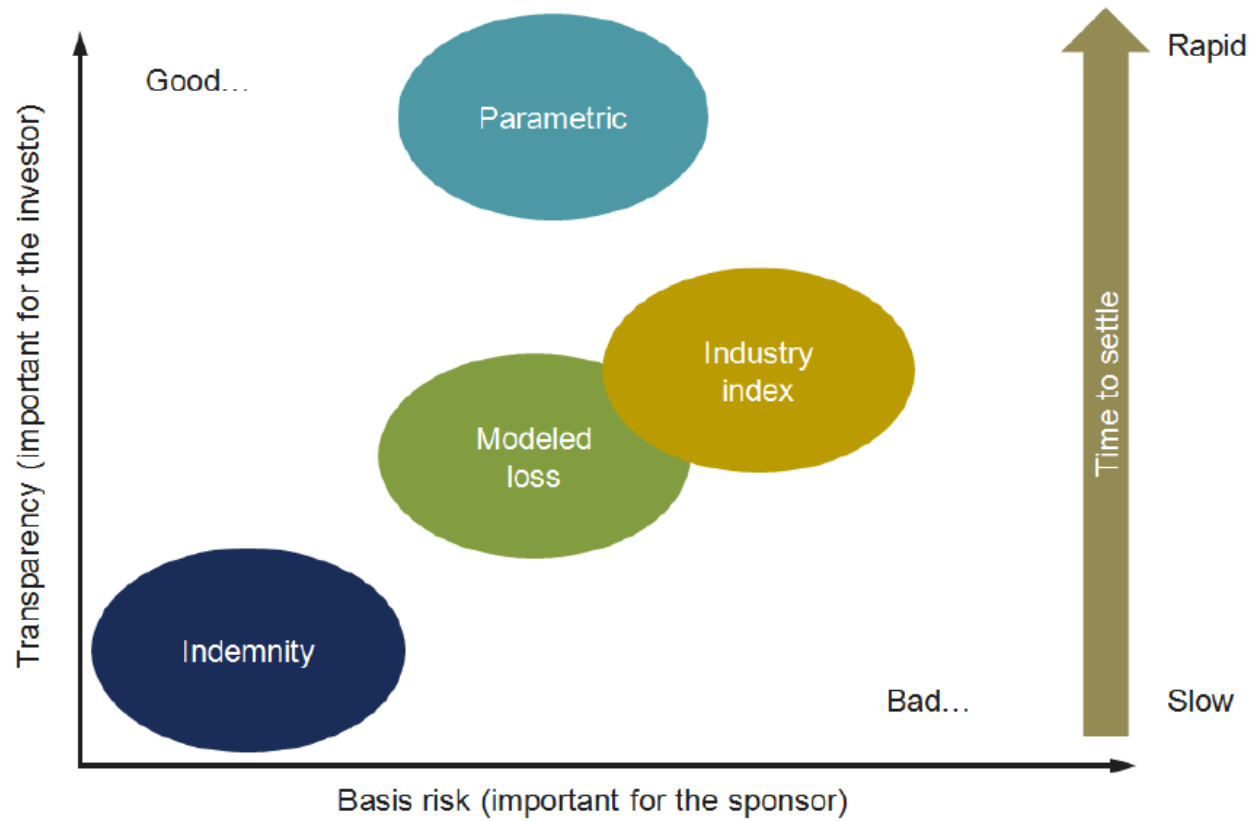


Types of triggers

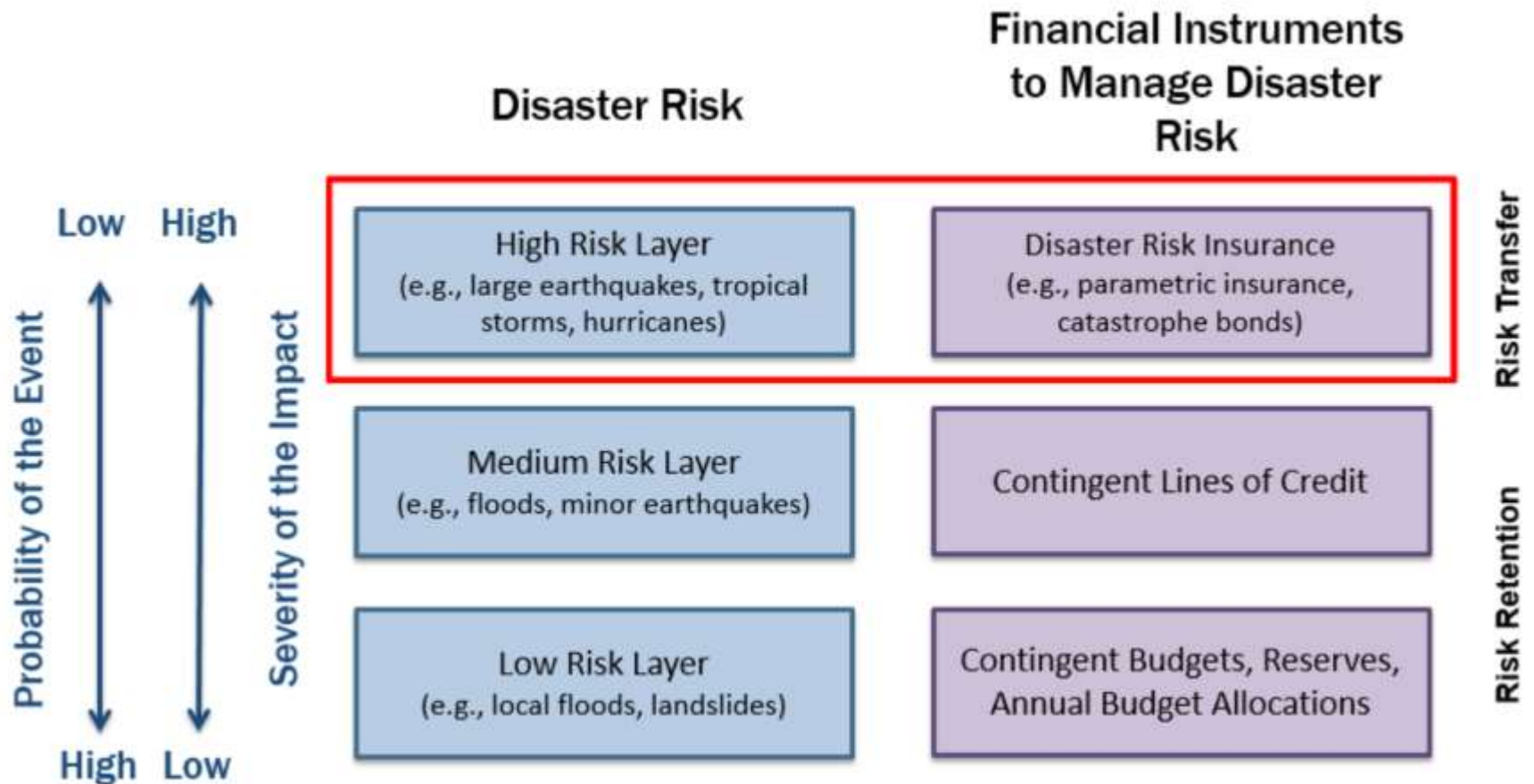
The most complicated aspect of the creation of a CAT bond is defining what triggers loss of principal. Four basic trigger types are possible:

- a) Indemnity trigger: covers actual excess claims paid by issuer
- b) Industry loss trigger: coverage based on whole-industry losses on the extreme event
- c) Parametric trigger: coverage based on exceedance of specified natural parameters
- d) Modeled trigger: coverage based on claims estimated by a computer model

TRIGGERS: Trade offs (WB, 2018)



(World Bank, 2018)



CATASTROPHE BONDS

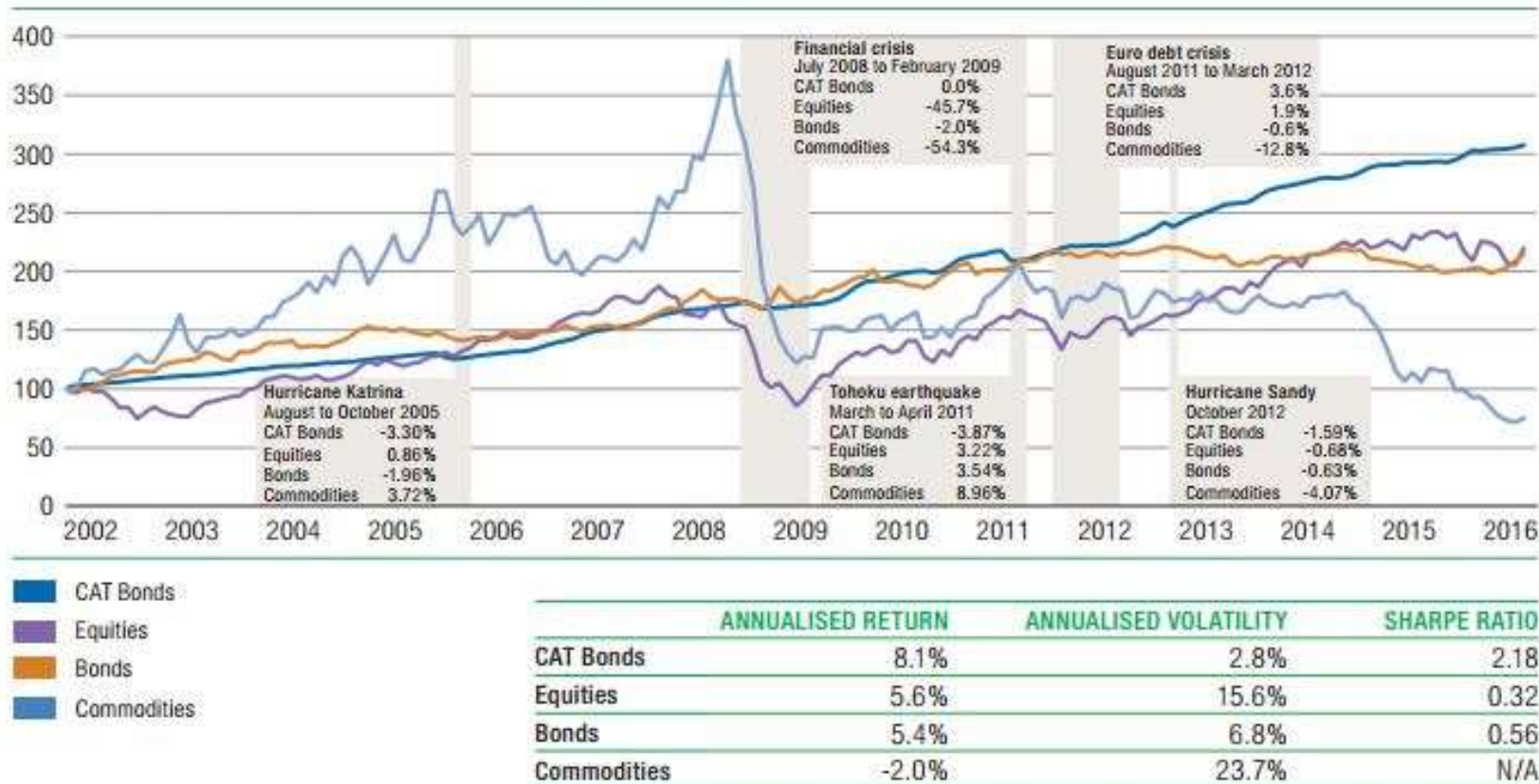
	CAT BONDS	INDUSTRY LOSS WARRANTIES	COLLATERALISED REINSURANCE
Description	"Securities structured as floating rate notes that transfer insurance risks tied to natural events and extreme mortality or morbidity to capital markets"	Contracts based on the total industry loss for a given event, paying off when the total loss exceeds a predetermined amount	Privately structured customised transactions enabling investors to gain exposure to the traditional reinsurance market
Return profile	Money market return plus spreads of 3% to 20%, with most issuance in the range of 5% to 10%	Money market return on collateral plus spreads of 5% to 40%, with most transactions occurring in the 10% to 15% range	Money market return on collateral plus spreads of 5% to 40%, with most transactions occurring in the 10% to 25% range
Maturity	Typically 3 years	Typically 12 months	Typically 12 months
Liquidity	Active secondary market	Limited secondary market	No organised secondary market
Avg. Transaction	USD 150 million	USD 10 million	USD 5 to 200 million
Min investment	USD 250'000	USD 2 to 3 million	USD 5 million
Market volume	USD 25 to 30 billion	USD 3 to 15 billion	USD 30 to 35 billion

Private transactions

Source: Aon Bentfield, LOIM, Q2 2015.

CATASTROPHE BONDS

FIG. 3 – STABLE PERFORMANCE OF CAT BONDS OVER A LONG TIME PERIOD

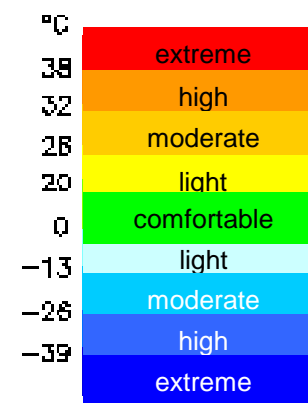


Source: Bloomberg. Observation period: 1 January 2002 to 31 March 2016. CAT Bonds: Swiss Re CAT Bond Index, Equities: MSCI World Total Return Index (Net), Bonds: Citigroup World Government Bond Total Return Index, Commodities: S&P GSCI Total Return Index. For illustrative purposes. Past figures are not a guarantee of future results.

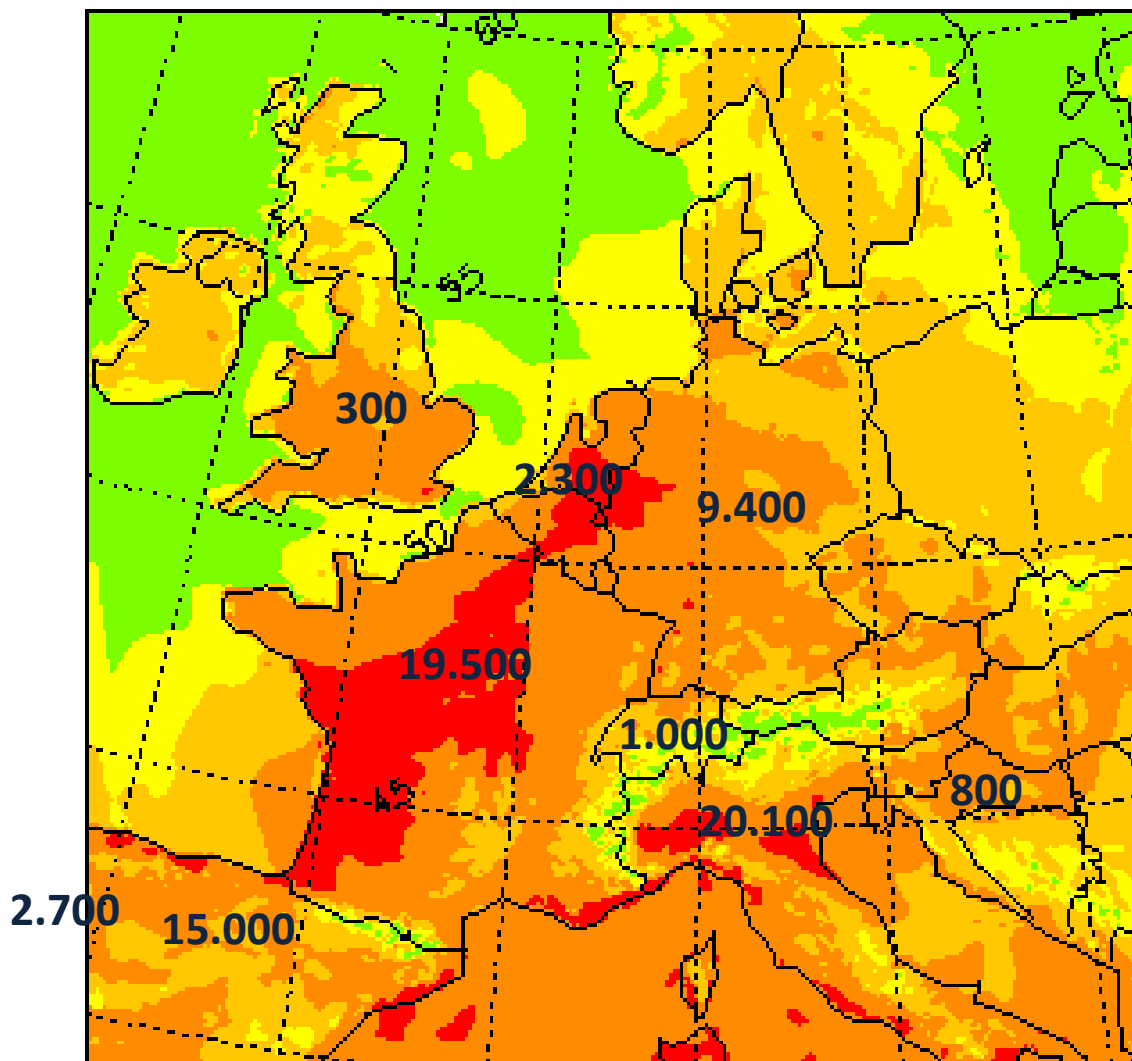
Munich RE (1): heat wave 2003.

Temperatura percepita e
eccesso mortalità

Heat stress



Cold stress



Munich RE (2): Agosto 2005 – Katrina Hurricane



25.-30.8 Hurricane Katrina, USA (1.322 fatalities)

Economic losses (US\$ m): 125.000

Insured losses (US\$ m): 61.000 (NFIP included)

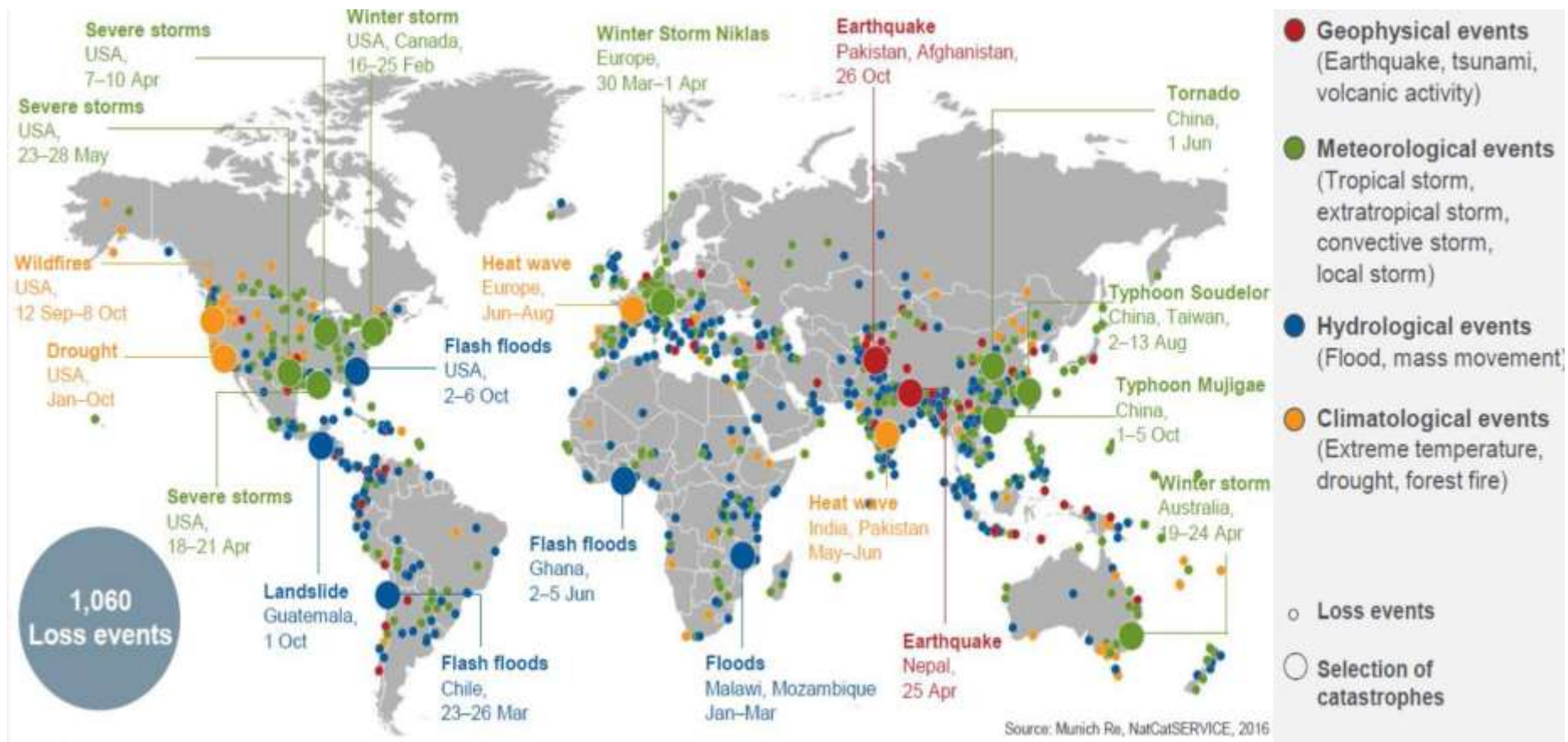
Munich RE (3) Luglio 2005 – Mumbai flooding

On 26th July 2005 the meteorological station at Santacruz in North Mumbai (India) recorded 944 mm of rainfall within 24 hours, the highest ever in the history of precipitation recordings in India.

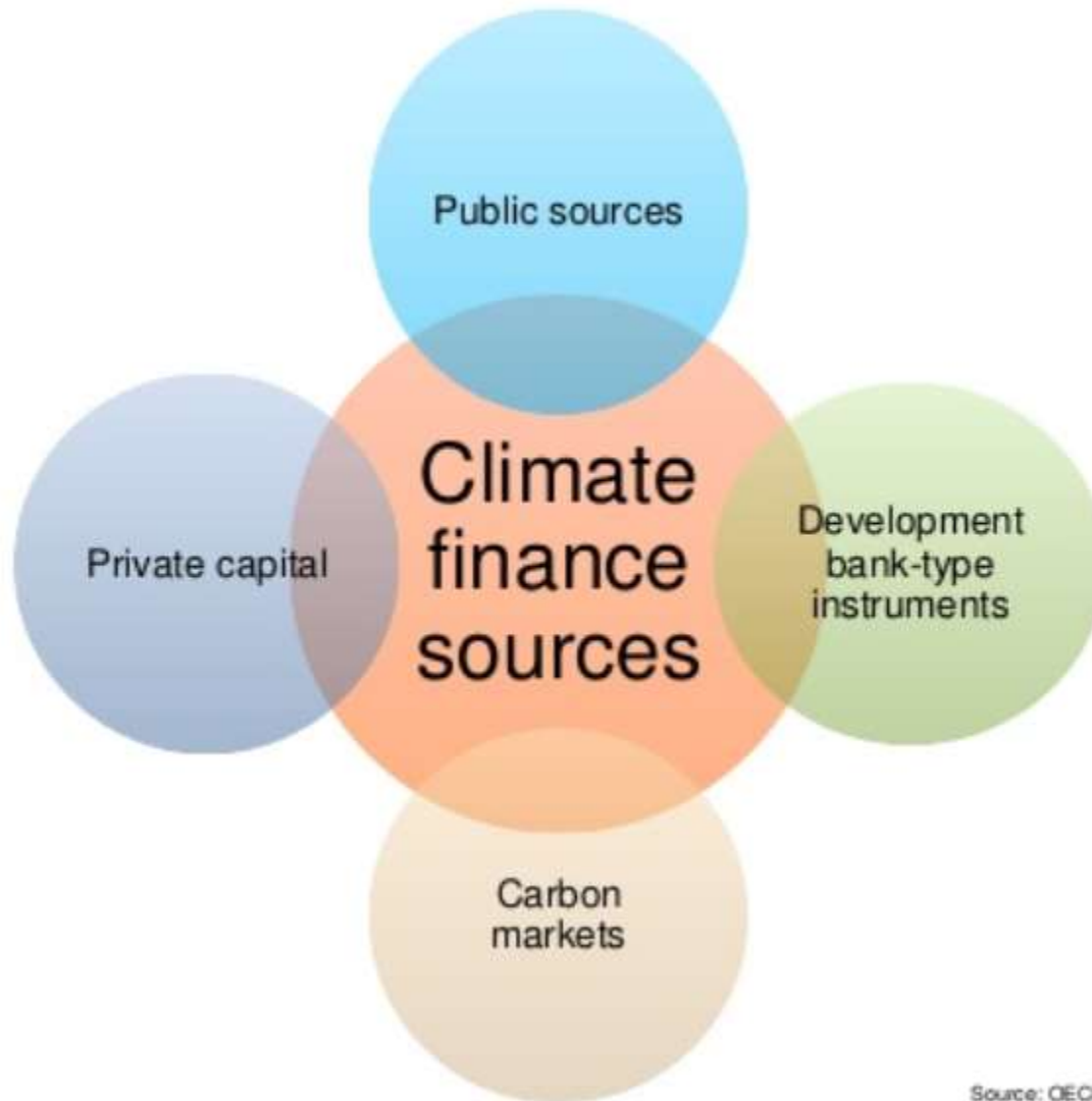


Economic losses (US\$ m):	5.000
Insured losses (US\$ m):	750
Fatalities:	1150

(EMCOMPASS 2016): NOT ONLY CLIMATE CHANGE

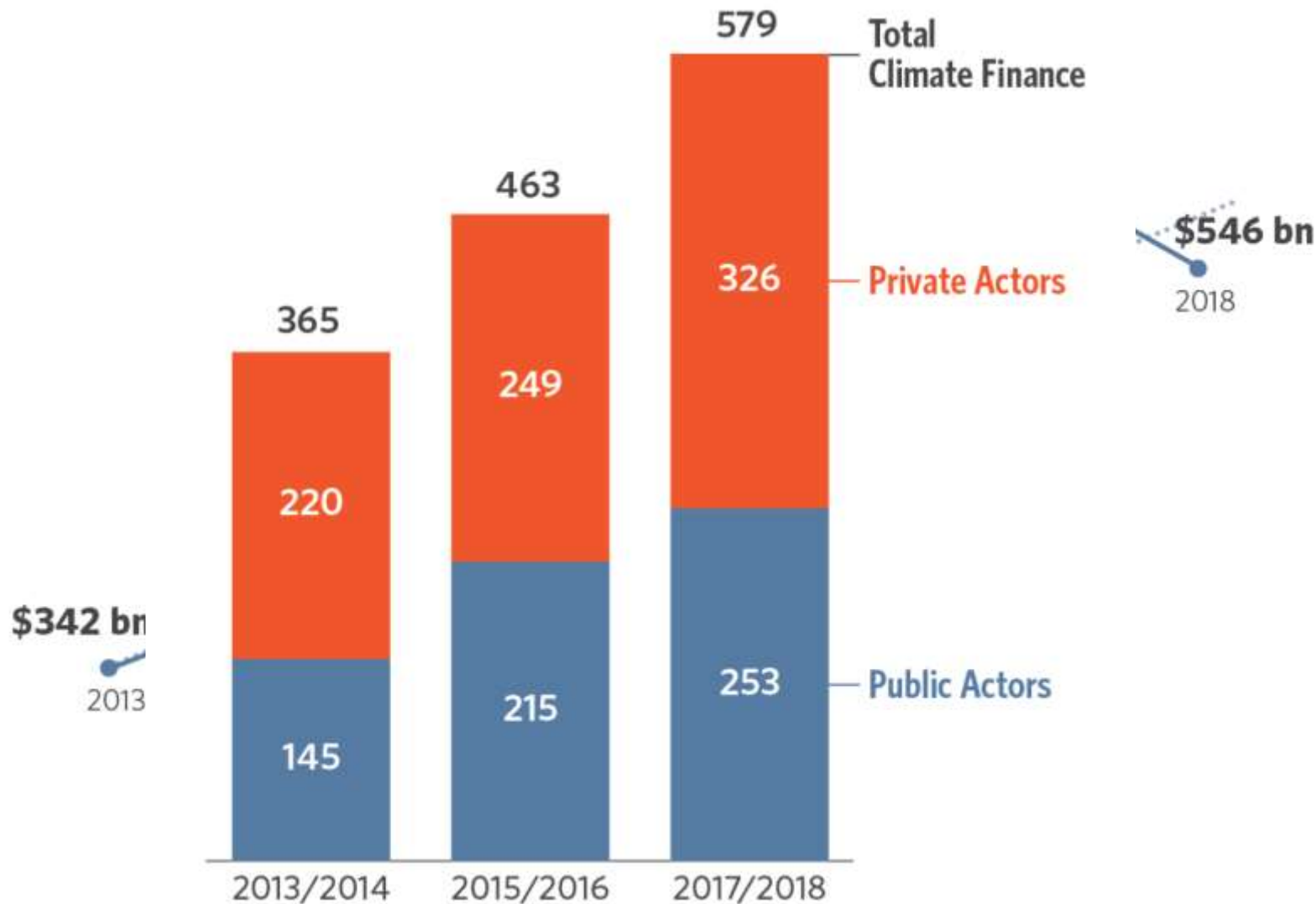


CLIMATE FINANCE



Source: OECD, 2014.

CLIMATE FINANCE (CPI, 2019)



LANDSCAPE OF CLIMATE FINANCE IN 2017/2018

Global climate finance flows along their life cycle in 2017/2018. Values are average of two years' data, in USD billions.

579 BN USD ANNUAL AVERAGE



SOURCES AND INTERMEDIARIES

Which type of organizations are sources or intermediaries of capital for climate finance?

INSTRUMENTS

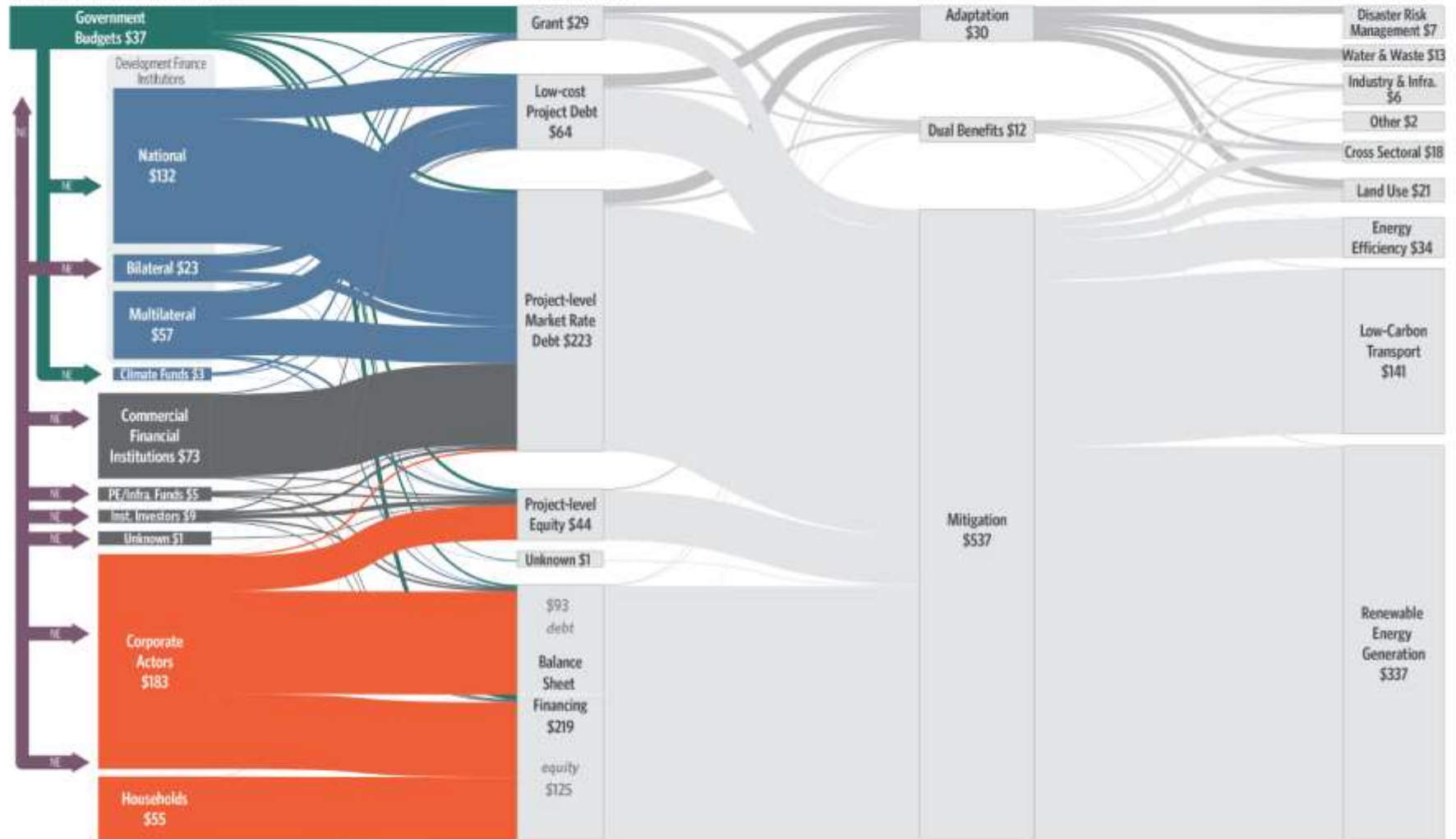
What mix of financial instruments are used?

USES

What types of activities are financed?

SECTORS

What is the finance used for?



KEY

PUBLIC MONEY

PUBLIC FINANCIAL INTERMEDIARIES

PRIVATE FINANCIAL INTERMEDIARIES

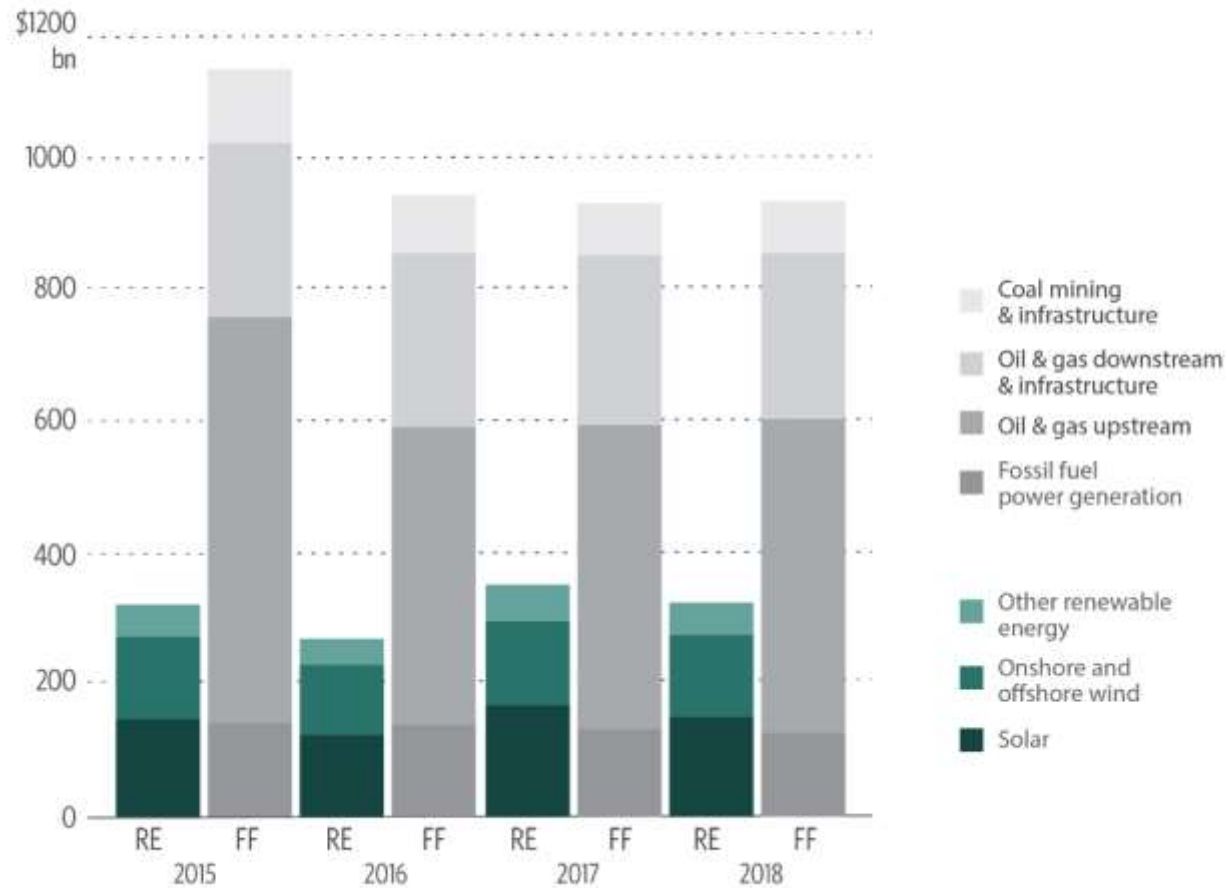
PRIVATE MONEY

FINANCE FOR INVESTORS & LENDERS

NE: NOT ESTIMATED

Figure 3: Global climate finance flows along their life cycle in 2017 and 2018. Values are average of two years' data, in USD billions

Finance composition (CPI, 2019)



Climate finance needs (Trinomics, 2017)

Table 2-1 Estimated investment needs for Europe (in billion EUR'13), with sectoral decomposition

		Investment needs (replacement of ageing infrastructure, etc.) under BAU conditions continued until 2030	Total investment needs for achieving the EU's 2030 climate and energy targets
	Associated scenario Mitigation action area	REF2016 ⁴⁵	EUCO30
Cumulative investment need, 2021-2030		9 380	11 150
(Average) annual investment needs		938	1 115
<i>Sectoral decomposition of (average) annual investment needs</i>			
Demand side ⁴⁶	Industry	15	19
	Buildings - households	127	214
	Buildings - tertiary sector	23	68
	Transport ⁴⁷	705	736
Supply side ⁴⁸	Grid	34	36
	Power generation (total) [*]	33	42
	- RES	25	34
	- Conventional	8	8

[Source: own development based on SWD (2016) 405, Impact Assessment on Energy Efficiency accompanying the EC Communication 'Clean Energy for All Europeans', Table 22 (p. 66)]

[* Power generation percentage split between RES and conventional sources based on IEA WEO 2014: 75% RES in NPS (reference) scenario; 80% RES in 450 (decarbonisation) scenario. Similar shares have also been reported in EC (2014) Impact Assessment scenarios.]

Finance

- Given the picture for fiscal sustainability, private and institutional finance (institutional banks and investors) are called into the fore to sustain the green economy transition
- Three areas of 'green finance' directing resources towards a GE transition: Green Bonds; green attributes of companies (stock markets); Socially Responsible Investments (SRI).
- Underlying issue: defining 'green finance' in a reliable way,
 - European Commission 'High-Level Expert Group (HLEG) on Sustainable Finance'

Figure 4.35. Market-Driven Sustainable Finance



Source: UN Environment/World Bank (2017, Table 2.1, p. 28)

Open processes in ‘green finance’

- **Green finance an open, evolving setting**
- In several cases, data availability on ‘green finance’ is scattered and guidelines are still “voluntary”
- EU level, ‘European Commission **‘High-Level Expert Group (HLEG) on Sustainable Finance’** (2016): a step on the path towards a credible “sustainable finance” sector
- Recommendations from the HLEG fundamental for the **‘Action Plan on Sustainable Finance’** of 2018
- A **Technical Expert Group (TEG)** has been appointed to assist the EC along the lines to be developed in the context of the Action Plan.

The High-Level Expert Group (HLEG) on Sustainable Finance

- Final Report issued in January 2018. Main topics include:
- A “sustainable” taxonomy/classification system
- Clarification of investors' duties in the process of promoting sustainable finance
- Disclosure by financial institutions and companies on the way in which their decision-making embeds sustainable development
- EU label for green investment funds
- European standard for green bonds.

Action plan on sustainable finance

- The Action plan, adopted in May, 2018, is part of the evolving Green Finance process in Europe, and is one of the main results related to the HLEG activities.
- It includes several regulation proposals, including the following lines of intervention:
 - Gradual creation of a unified classification system on which economic activities can be defined as “environmentally sustainable”.
 - Introduction of disclosure obligations on the integration by institutional investors and assets managers of environmental, social and governance factors in their decision making and risk-related processes.
 - Introduction of new benchmarks in relation to low carbon performances.
 - Inclusion of environmental, social and governance factors into the advice that investment firms and insurance distributors offer to individual clients.

Technical Expert Group on Sustainable Finance (TEG)

- Open consultation process in 2018-2019
- Organized in subgroups according to objectives of the Action plan
- Consultation topics example (from the EU Green Bonds standards subgroup [progress report](#)):
 - MS Consultation in February/March 2019; questions include:
 - ❖ Would Member States have ideas or recommendations on the best ways to incentivise the green bond market, both at European and national level?
 - ❖ Do Member States have any recommendations to further facilitate sovereign green issuance or plan to issue sovereign green bonds (if yes, when)?