European Commission

Climate protection gap: evidences for public finances and insurance premiums

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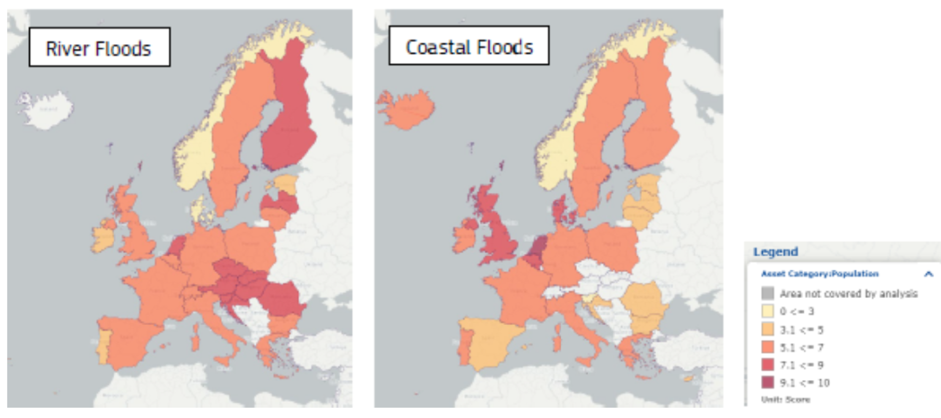
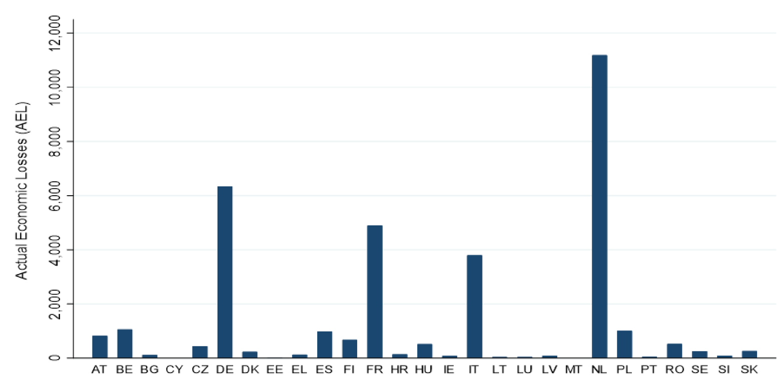
Combining data from EIOPA, and JRC Risk Data Hub , **we estimate**:

- The potential **increase in (gross) insurance premiums written** to reach an **insurance penetration** for river and coastal floods of at least **50%** or **75**% in all MS.
- The **potential public finance losses** (in a worst-case scenario) at EU level, considering losses from a **compound disaster** including uninsured climate-related losses and potential defaults stemming from the insurance sector, and **its reduction** when increasing the insurance penetration.

Data

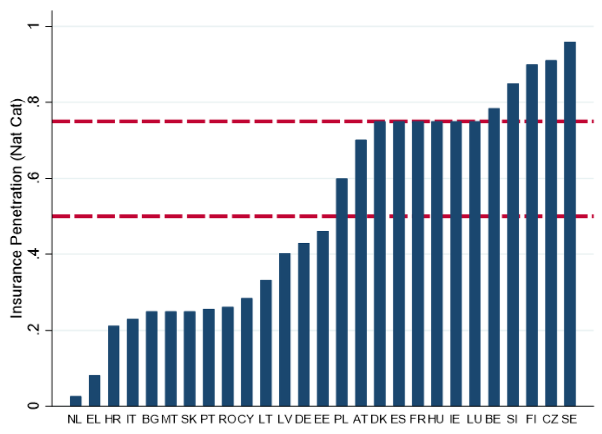
1. Distribution of losses from floods (Risk Data Hub)

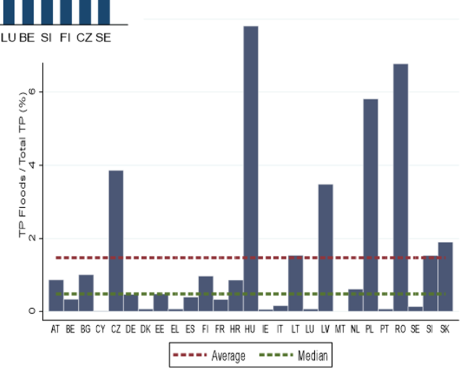




- Risk Data Hub includes estimates of probability of exceedance and area/population exposed to river floods and coastal floods (and other natural disasters)
- From these it is possible to calculate probability of occurrence of different events and expected exposure over different periods
- Vulnerability allows move from exposure to "annual expectes loss" (AEL) for each MS and peril
- Losses in area/population transformed in economic loss

2. Insurance Penetration and Technical Provisions (EIOPA)





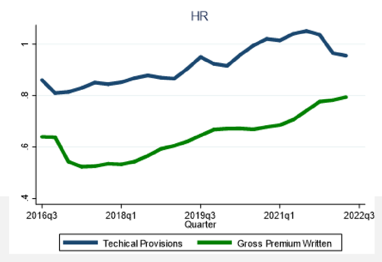
- EIOPA provides data on Insurance Penetration Rate for Flood "peril"
- EIOPA provides data on Total Technical Provisions and Gross Premiums Written for non-life insurance (a superset including property insurance)
- Make use of expected loss from RDH and penetrations rata to estimate theoretical Technical Provisions to insure all flood risks
- Calculate share of non-life TP due to flood risks

$$TP_{\text{flood},i} = IP_{\text{flood},i} \times AEL_i$$

Methods

3. Estimating additional premiums needed to harmonize the insurance penetration

- TP and Gross Premium move together (see an example for HR) and are non-stationary. Their relationship can be estimated using a Vector Error Correction Model (VECM), a special case of a VAR(p) model.



- Considering a VAR with p lags:

$$y_t = v + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t$$

where v is a $K \times 1$ vector of parameters, A_1 - A_p are $K \times K$ matrices of parameters, and ε_t being i.i.d normal over time, with zero mean and covariance matrix Σ. The VAR(p) can be rewritten in a VECM form. Its representation is:

$$\Delta y_t = v + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t$$

where $\Pi = \sum_{i=1}^{p-1} A_j - I_k$ and $\Gamma_i = -\sum_{j=i+1}^{j=p} A_j$.

- The final expected gross premium written for Member State i, EGP_i are obtained multiplying the AEL_i by the value of the orthogonalized impulse response function for Member State i, $OIRF_i$ in the last step.

$$EGP_i = AEL_i \times (1 + OIRF_i)$$

- To evaluate the amount of EGP_i that need to be written in order to harmonize the penetration rate at 50% (EGP_i^{50}) or 75% (EGP_i^{75}) for each Member State:

$$EGP_i^{50} = \frac{EGP_i \times 0.5}{IP_{flood\,(i)}} \qquad EGP_i^{75} = \frac{EGP_i \times 0.75}{IP_{flood\,(i)}}$$

4. Economic losses from insurance defaults

- We do not model single insurance undertaking, but **all insurance companies at individual country level** (or even at the aggregate EU27 level).The loss rate distribution can be seen as the loss rate on a portfolio of exposures to several insurance undertakings.
- We use the **Vasicek (2002)** model to define the event of default, as occurring when the insurer's asset value falls below a predetermined threshold. **The maximum loss L_i** for country i that cannot be exceed in one year with a probability level α is given by:

$$L_i = EAD_i \times LGD \times N\left[\frac{\sqrt{\rho + \delta(1-\rho)}\, N^{-1}(1-\alpha) + N^{-1}(PD)}{\sqrt{1 - \rho - \delta(1-\rho)}}\right].$$

- EAD_i of TP_i, our best estimate of liabilities and risk margin and SRC_i as the total amount of funds that an insurer is required to hold to ensure that the company will be able to meet its obligations with a probability of at least 99.5%

$$EAD_i = SCR_i + TP_i$$

- We apply this modelling framework under a worst−case scenario, where flood events happen together with insurance defaults. We do so by considering **uninsured catastrophic losses, besides those stemming from defaults in the insurance sector**
- Final losses on public finances are then computed as **the sum of uninsurable losses and leftover from the insurance sector**:

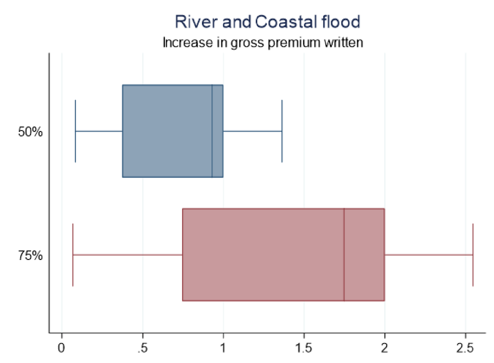
$$FL_i = L_i + (1 - IP_{\text{flood},i}) \times AEL_i$$

Results

5. Results - Additional premiums needed to harmonize the insurance penetration

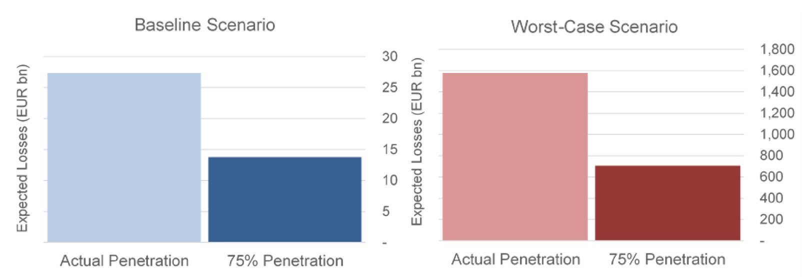
Member State	$IP_{flood\,(i)}$	$OIRF_i$	EGP_i^{50} (EUR Mn)	EGP_i^{75} (EUR Mn)
AT	70%	2.83%		631.70
BG	25%	4.30%	57.21	85.82
CY	28%	1.93%	0.56	0.84
DE	43%	1.77%	3,224.13	4,836.19
EE	46%	4.42%	6.93	10.39
EL	8%	1.64%	63.05	94.58
HR	21%	2.38%	70.61	105.91
IT	23%	2.14%	1,936.61	2,904.91
LT	33%	2.11%	20.40	30.60
LV	40%	4.87%	43.67	65.51
MT	25%	7.29%	0.01	0.01
NL	3%	3.46%	5,784.46	8,676.68
PL	60%	3.18%		779.86
PT	26%	2.07%	23.74	35.61
RO	26%	3.12%	270.22	405.32
SK	25%	2.91%	131.34	197.00
		Total	11,632.92	18,860.93

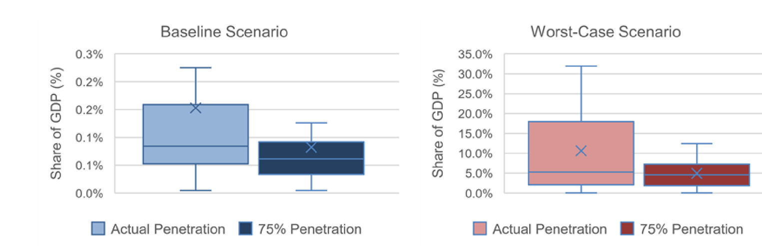
Note: Sensitivity of Gross Premium written w.r.t. technical provisions and Estimation of the Expected Gross Premiums



- Harmonise penetration at 50% : EUR 11.6 billion
- Harmonise penetration at 75% : EUR 18.7 billion
- Actual (estimated) premiums from EIOPA for flood events is roughly EUR 10.06 billion (a proxy since for the non-life insurances, multiple risks are bundled)
- **Premiums written for flood events should be at least doubled to reach a minimum 50% penetration across the EU**

6. Results - Economic losses on public finances





- **In a baseline scenario, expected losses** from both sources of risk (floods and insurance defaults) **decrease by about 50% when insurance penetration is increased to 75%.**
- In the baseline scenario, the decrease in losses measured in Eur bn is slightly lower than the increase in gross premiums written (as it should be expected).
- **In a compound disaster worst-case scenario,** where insurances default at the same time as the risk is realized, **losses are vastly reduced in the countries in the countries with the lower penetration rates**
- Compound disaster worst case scenario shows that increasing IP would have a positive impact even in case of only partly effective insurance in case of natural disaster

Bellia Mario, Di Girolamo Francesca Erica, Pagano Andrea, Petracco Giudici Marco, *Climate protection gap: evidences for public finances and insurance premiums*, JRC Working Papers in Economics and Finance (forthcoming)

Joint Research Centre