EUROPEAN CENTRAL BANK

EUROSYSTEM

The macroeconomic effects of the insurance climate protection gap

Frontiers of climate and nature in macroeconomics and finance

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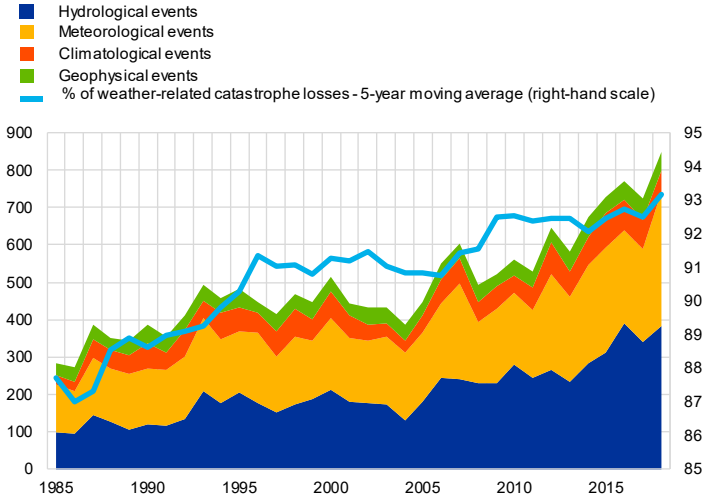
Natural hazards, but man-made disasters

- Full impact depends not just on natural trigger, but also on exposure and vulnerability
- Projecting impact of climate change means considering not just the hazard, but other factors of mitigation and exacerbation

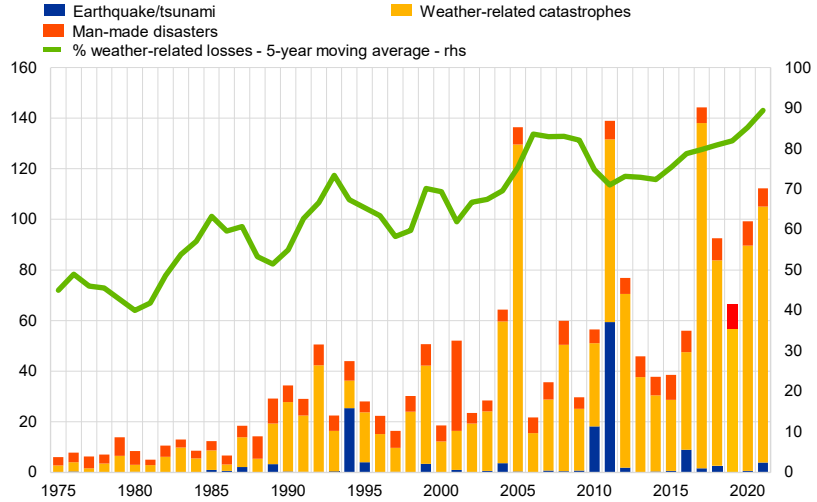
Number of relevant natural loss events worldwide

(1985-2018; left-hand scale: number of events; right-hand scale: percentages)



Global insured catastrophe losses

(1985-2021; left-hand scale: USD billions; right-hand scale: percentages)



Sources: Swiss Re Institute, Munich Re NatCatService and ECB calculations.

The role of insurance

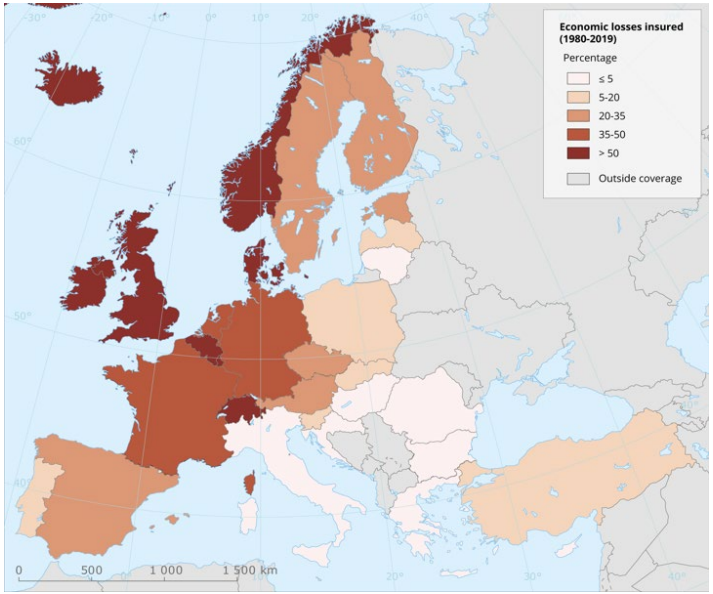
Insurance is an important source of resilience

- Insurance appears to help speed up reconstruction
- Macro and micro evidence on the benefits of insurance (Von Peter et al., 2012; Poontirakul and Noy, 2017)

Already a substantial protection gap

- Only around a third of damage insured in Europe
- Reasons to expect climate change could widen the protection gap

Average share of insured economic losses in the EU
(1980-2019; percentages)



Sources: European Environment Agency, NatCatSERVICE and EUROSTAT.

Contribution

1. Theoretical model

   Demonstrates short-term protective benefit of insurance

2. Empirical analysis

   Provides evidence of how insurance has helped mitigate impact of past disasters

3. Scenarios of future impact of disasters

   Estimates the impact of warming coincide and wider protection gap on GDP

1. Modelling output in the face of natural disasters and climate change

- We model output as a function of capital, temperatures and natural disasters
- Capital is sensitive to long-run changes in temperatures and to intermittent but highly destructive natural disasters
- Damages upon a disaster can be mitigated by insurance, which is also sensitive to changes in temperatures

$$Y = K\omega_0 e^{-\omega(T-T^*)}\left[1-\left(1-We^{-\psi(T-T^*)}\right)(1-Z)\right]$$

Symbol	Parameter	Symbol	Parameter	Symbol	Parameter
Y	Output	Z	Share of undamaged capital upon disaster	ω_0	positive constant
K	Capital	W	Share of insured damaged capital	ω	sensitivity of physical capital to climate change
T	temperature	T^*	historical norm of temperature	ψ	sensitivity of disaster probability to climate change

1. Modelling output in the face of natural disasters and climate change

Impact of natural disasters on capital

When disasters hit, output is reduced by the uninsured share of damaged capital, the protection gap

$$Y = K - (1 - W)(1 - Z)K$$

The probability of disasters is fixed.

Our findings

1. Insurance can help mitigate the macro-financial and welfare impact of catastrophes

1. Modelling output in the face of natural disasters and climate change

Impact of climate change on capital

In the long-run, capital is sensitive also to changes in climate variables like T (Kahn et al, 2021)

$$Y = K\omega_0 e^{-\omega(T-T^*)}[1-(1-W)(1-Z)]$$

We focus here on the direct impact of global warming on capital and keep the probability of disasters fixed.

Our findings

1. Insurance can help mitigate the macro-financial and welfare impact of catastrophes
2. Climate change is likely to have an increasingly negative impact on welfare

1. Modelling output in the face of natural disasters and climate change

Impact of climate change on insurance

Climate change affects also the cost and availability of insurance, and the protection gap can widen

$$Y = K\omega_0 e^{-\omega(T-T^*)}[1-\left(1-We^{-\psi(T-T^*)}\right)(1-Z)]$$

The frequency and severity of disasters depend on climate change.

Our findings

1. Insurance can help mitigate the macro-financial and welfare impact of catastrophes
2. Climate change is likely to have an increasingly negative impact on welfare
3. Impact is likely to be magnified by a reduction in insurance coverage

2. Empirical evidence on the macroeconomic impact of the protection gap

Abstracting from climate change, our model implies that the GDP growth rate of country *c* at time *t* is a function of damages from natural disasters and insurance

$$GDP\ growth\ rate_{c,t} = \beta_1 * damaged\ capital\ _{(\%GDP)c,t} + \beta_2\ *\ Share\ of\ insured\ damages_{c,t} * damaged\ capital_{(\%GDP)c,t} + CountryFE_c + TimeFE_t + \epsilon_{c,t}$$

$\beta_1 < 0$ damages from natural disasters negatively affect GDP growth
$\beta_2 > 0$ insurance mitigates this impact

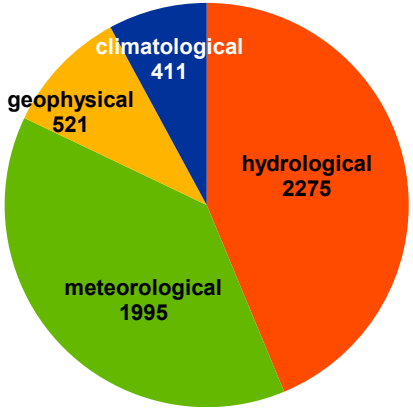
2. Empirical evidence on the macroeconomic impact of the protection gap

Dependent variable: quarterly real GDP growth rates from OECD for 45 countries

Explanatory variables: disaster data from EMDAT

- Data on over 5000 disaster events since 1996, but insured only for 657 events, on average larger
- Imputation to obtain over 2000 events with insured/uninsured split
- The average disaster cost is 0.16% of GDP, while the average share of insured losses is 47%.

	Damages	Insured	Uninsured	# events
Original dataset				
Information on (un)insured losses	$2.1 tr	$0.7 tr	$1.4 tr	657
Information on total damage only	$0.6 tr	-	-	1654
No information on damage	-	-	-	2891
Total				5202
Dataset with imputed values				
Information on (un)insured losses	$2.7 tr	$0.9 tr	$1.8 tr	2066
Information on total damage only	<$0.1 tr			245



Sources: EM-DAT, OECD and authors' calculations.
Notes: values in constant 2010 USD

2. Empirical evidence on the macroeconomic impact of the protection gap

Dependent variable	quarterly GDP growth rate (in %)			
Sample	(1) Original	(2) Imputed	(3) Original	(4) Imputed
Damage as a share of GDP (%)	-0.25*	-0.24**	-0.26*	-0.25*
	(0.07)	(0.05)	(0.07)	(0.06)
--> lag 1			0.28***	0.0040**
			(0.00)	(0.04)
Damage as a share of GDP (%) * Share of insured losses (%)	0.0037*	0.0037**	0.0042**	0.19**
	(0.05)	(0.03)	(0.05)	(0.05)
--> lag 1			-0.0043***	-0.0025
			(0.00)	(0.13)
Country fixed effects	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y
Observations	2,938	3,431	2,214	2,827
R-squared	0.203	0.188	0.224	0.206
Number of countries	45	45	45	45

Sources: EM-DAT, OECD and authors' calculations.

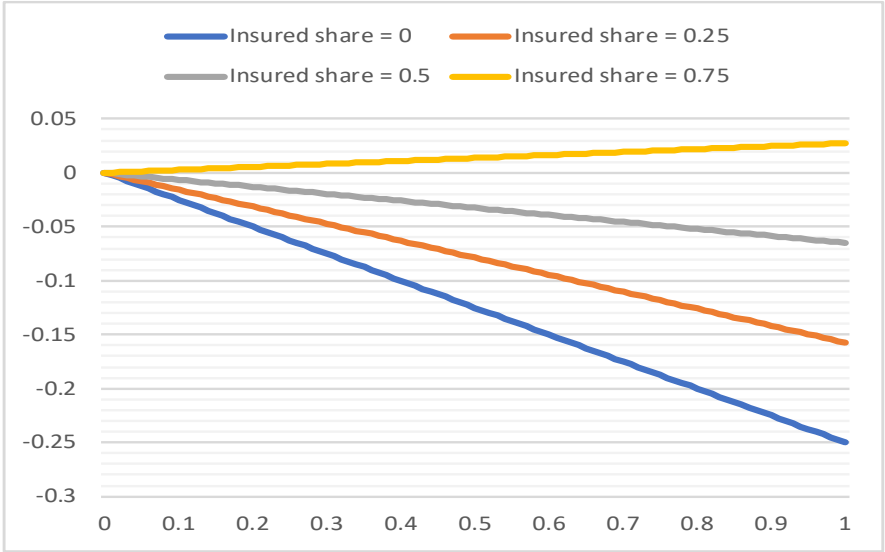
2. Empirical evidence on the macroeconomic impact of the protection gap

The higher the insurance coverage, the lower the impact of disasters on GDP growth:

- Following a disaster loss of 1% of GDP, the quarterly GDP growth rate is estimated to decline by **0.25 pp** in the absence of insurance coverage.
- If half the losses are insured, the GDP growth rate falls by **0.06 pp**.
- For unusually high shares of insured losses (75%), estimates suggest an increase in GDP growth by **0.04 pp**, reflecting swift reconstruction activity

Impact of natural disasters on quarterly GDP growth rate by size of damage and insured share

(x-axis: total damage as a share of GDP (in %); y-axis: simultaneous impact on quarterly GDP growth rate in percentage points)



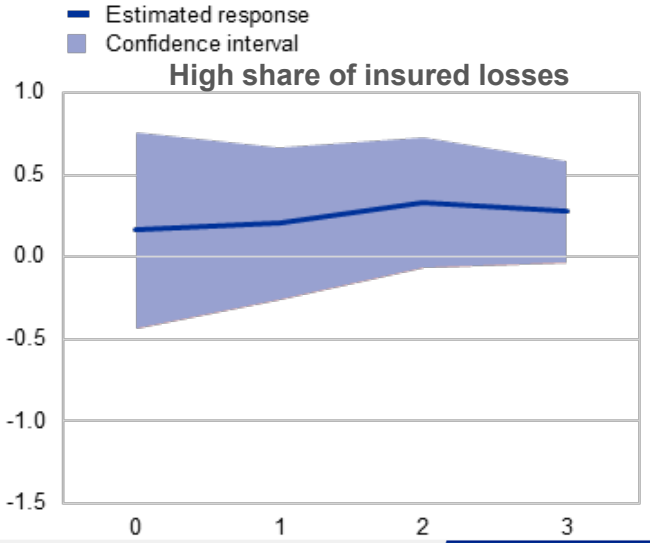
Sources: EM-DAT, OECD and authors' calculations.

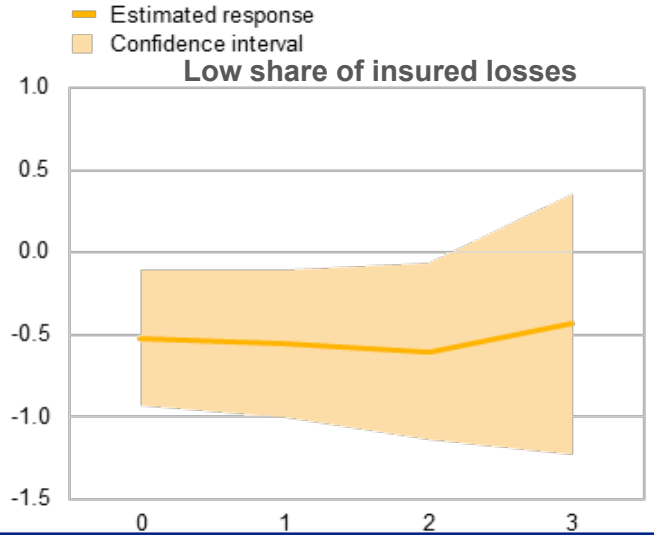
2. Empirical evidence on the macroeconomic impact of the protection gap

- GDP growth rates decrease following large-scale disasters, when insurance coverage is low.
- Insurance supports GDP growth after disasters, as (prompt) payouts support reconstruction.

Impact of insured vs uninsured losses from a large-scale disaster on annual GDP growth rate

(y-axis: impact on annual GDP growth rate (%); predictions up to three quarters ahead after a large-scale disaster)





Sources: EM-DAT, OECD and authors' calculations.

3. Impact on GDP under climate change and protection gap scenarios

Moderate and severe climate scenarios: 2 and 3-degree temperature increases by 2100

JRC PESETA IV estimates based on IPCC climate change scenario: Annual GDP losses from disasters are projected to increase by 2.5-4.5 times by the end of this century

Expected annual damages from climate-related catastrophes

EU and UK (2015 values)	Baseline (1981-2010)	2100 1.5° C	2100 2° C	2100 3° C
Windstorm	4594	11260	11393	11422
Droughts	9048	24723	31457	45380
River flood	7809	24072	33081	47824
Costal flood	1400	10900	110600	239400
Total	22851	70955	186531	344026
Total	0.17%	0.19%	0.41%	0.76%

The role of insurance protection gap

We project our empirical estimates forward to assess the future impact of natural disasters on European GDP, under different levels of insurance protection gap

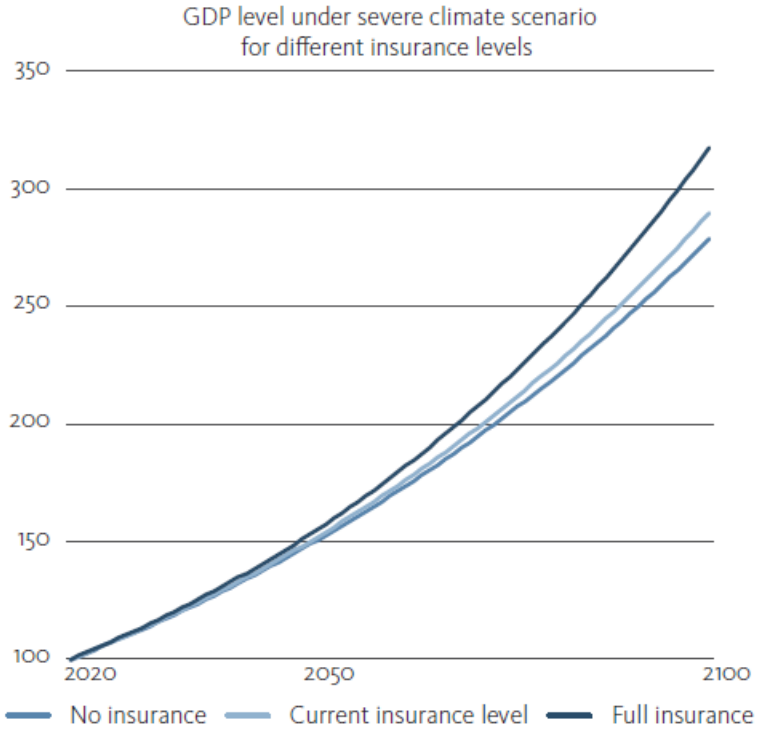
Sources: JRC PESETA IV and authors' calculations.
Notes: values in million EUR. Last row as share of GDP.

3. Impact on GDP under climate change and protection gap scenarios

Our findings

- Differences in insurance coverage could have significant economic effects
- By 2050, the difference between full insurance and no insurance is over 3% under the severe scenario
- By the end of the century, the difference widens to around 14%

Caveats: significant uncertainty around estimates 30-80 years into the future; no adaptation or mitigation measures



Sources: JRC PESETA IV and authors' calculations.

Conclusions and policy implications

- Climate change has the potential to impair the stable provision of insurance services and credit → impact on households, firms, banks and sovereigns.
- Data gaps on climate loss and (un)insured losses need to be closed.
- Policy should aim to reduce protection gap while incentivising adaptation and risk reduction from policyholders.