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Mainstreaming of Climate Extreme Risk into Fiscal and Budgetary Planning

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Motivation

- 89 countries have adopted fiscal rules (IMF, 2015)
  - Debt, budget balance, expenditure, revenue…
- EU monetary union: Stability and Growth Pact
  - Annual government deficit < 3% GDP
  - Debt-to-GDP ratio < 60% (Austria 2016: 83.6%)
- **Demographic concerns** considered a major driver for fiscal pressure (EC, 2015)
  - Ageing, unemployment & health care expend.
- Medium Term Budgetary Objective (MTO) requires **‘front loading’ approach to demographic contingent liabilities**

Climate risk in public balance sheets

- Concerns over **contingent climate-related public costs have received little attention** so far but
  - Research shows that **future climate-related fiscal liabilities will not be negligible** (e.g. for AT: APCC, 2014; Steininger et al., 2015; Schinko et al., 2016)
  - 2014-2020 EU budget: at least **20% of the European budget (Euro 1.7 billion) to be allocated for climate-related expenses** (EC 2013)
  - **Triannual longer term budget forecast for Austria** qualitatively highlights importance of climate risk (BMF, 2016)

Background - Methodology

- Most modeling exercises have used **non-probabilistic approaches**
  - Potential consequences under “average” conditions
  - Little insight how societal trajectories might deviate from average projections if extreme events occur
  - High uncertainties regarding climate and socioeconomic development paths
  - → **probabilistic approaches**

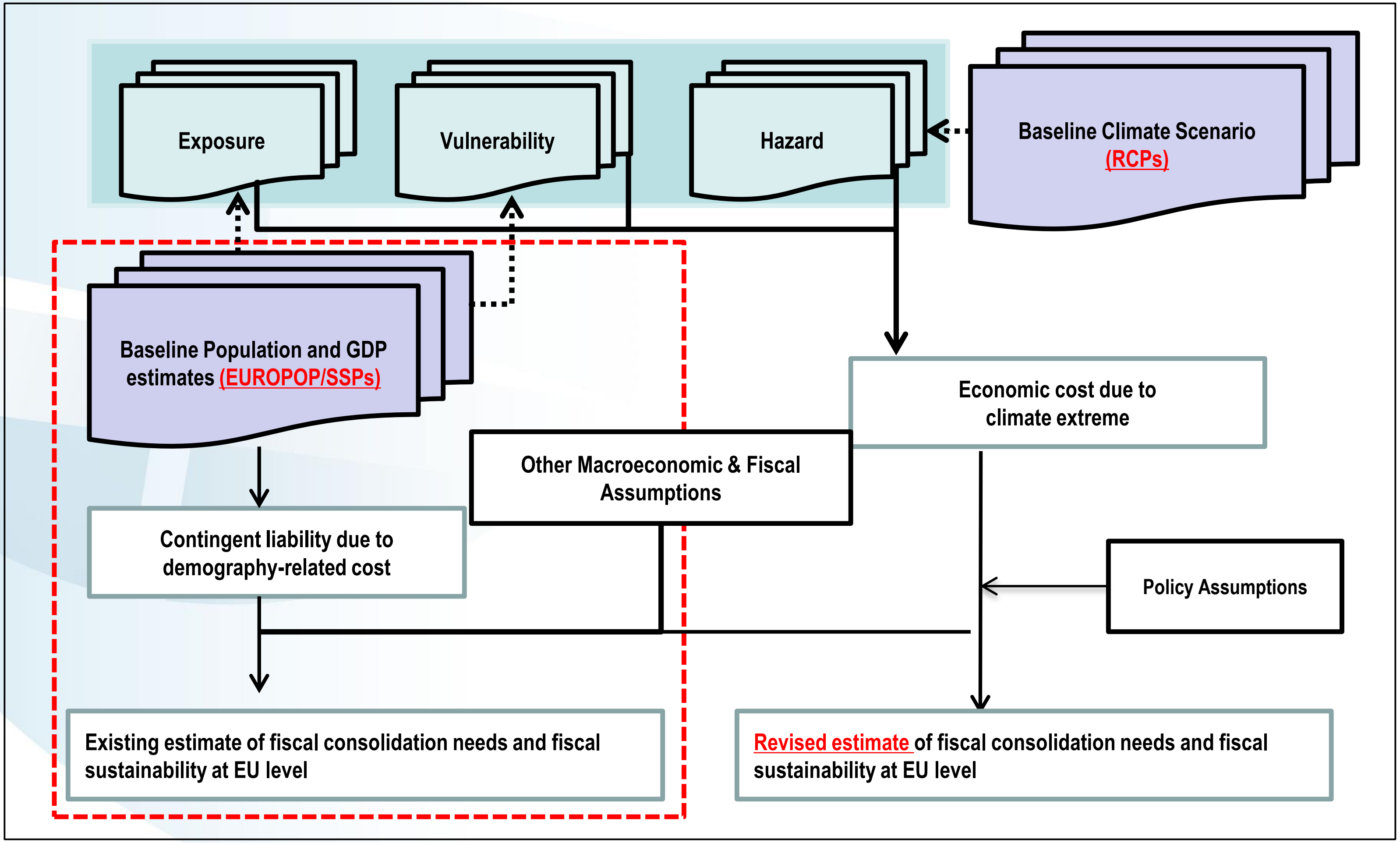
Aim and focus

- Aim
  - **Design and test a mainstreaming methodology** to integrate climate risk into longer-term fiscal planning and governance
- Focus
  - **Climate-related extreme events**
  - **Public sector**
  - Case study for **Austria**
    - Public costs of current & future **riverine flood risk**

Methodology – Mainstreaming framework

- Based on existing EU fiscal sustainability assessment tools (EC, 2006; Barta, 2015)
  - Ageing Working Group (AWG) method
  - Integrate climate-risk into established methodology
  - Easier to communicate and mainstream results
- **Shared socioeconomic pathways** (SSPs; IIASA, 2015)
  - harmonize assumptions in assessing demographic and climate contingent liabilities (Cuaresma, 2017)

Methodology – Mainstreaming framework



Source: Mochizuki et al. (forthcoming)

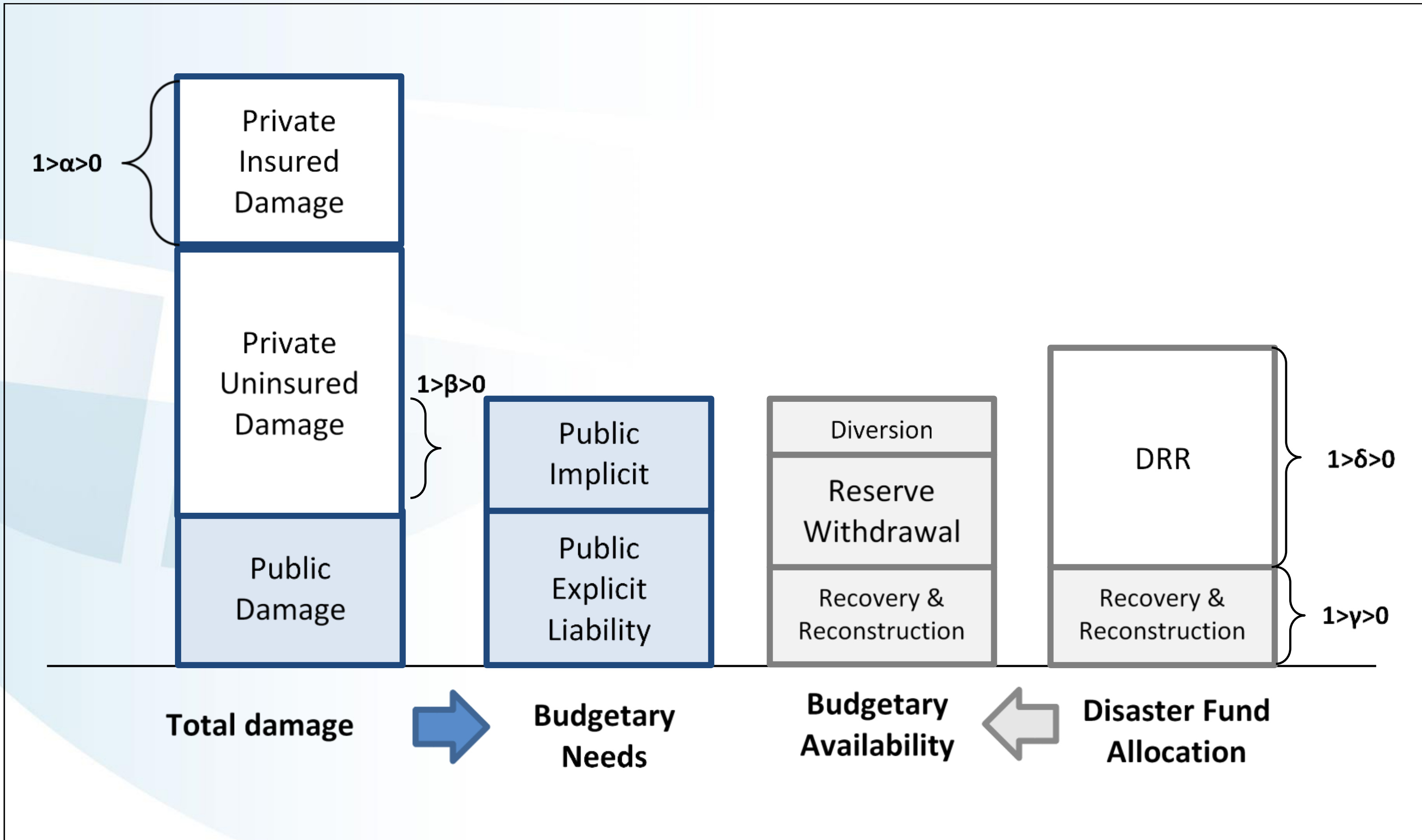
Stochastic debt model

$$d_t = d_{t-1}\frac{1+\boxed{i_t}}{1+\boxed{g_t}} - \boxed{b_t} + c_t + \boxed{j_t} + f_t \qquad \ldots(1)$$

d_t	=	Debt to GDP ratio in year *t*
i_t	=	Real implicit interest rate at year *t*
g_t	=	Real GDP growth rate at year *t*
b_t	=	Structural primary balance over GDP in year *t*
c_t	=	Change in age-related costs over GDP in year *t* relative to base year
j_t	=	Residual public contingent liability due to climate extreme events over GDP in year *t*
f_t	=	Stock flow adjustment over GDP in year *t*

…Stochastic variables

Budgetary needs vs. available resources



Source: Mochizuki et al. (forthcoming)

Stochastic scenarios

- Two types of stochastic shocks up to 2050
  - Macroeconomic variability
    - Monte-Carlo simulation of historical (2002-2015) variance-covariance matrix of GDP & short-/long-run interest rates (Berti, 2013)
  - Flood damages (i.e. direct economic flood risk)
    - Structured coupling of (LISFLOOD) loss distributions at basin scale employing Copula approach (e.g. Jongman et al., 2014; Timonina et al., 2015)

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Results: Baseline scenario SSP2

Table 3. Fiscal Consolidation Needs, Ageing related Costs and Climate Extreme Costs

	EC 2012	EC 2016	Present Study
Annual changes in primary balance needed to stablize debt at 60% in 2030 (p.p. of GDP)	0.40[a]	0.30[b]	0.07[c]
Average annual changes in age-related expenditure[d] (p.p. of GDP)	0.09	0.08	0.19
Average annual flood losses 2015 (% of GDP)	n.a.	n.a.	0.10
Average annual flood losses 2030 (% of GDP)	n.a.	n.a.	0.12
Average annual flood losses 2050 (% of GDP)	n.a.	n.a.	0.14
100 year flood damage in 2015 (% of GDP)	n.a.	n.a.	2.80
100 year flood damage in 2030 (% of GDP)	n.a.	n.a.	3.30
100 year flood damage in 2050 (% of GDP)	n.a.	n.a.	3.80

Source: Mochizuki et al. (forthcoming) based on EC (2012), EC(2016) and own estimation

Note: [a] constant adjustment needed for period 2014-2020 to stablize debt at 2030;[b] constant adjustment needed for period 2018-2022 for stablization at 2030; [c]constant adjustment needed for period 2015-2022 for stablization at 2030. [d] excluding unemployment related costs.

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Results: Stochastic debt trajectories
Flood risk

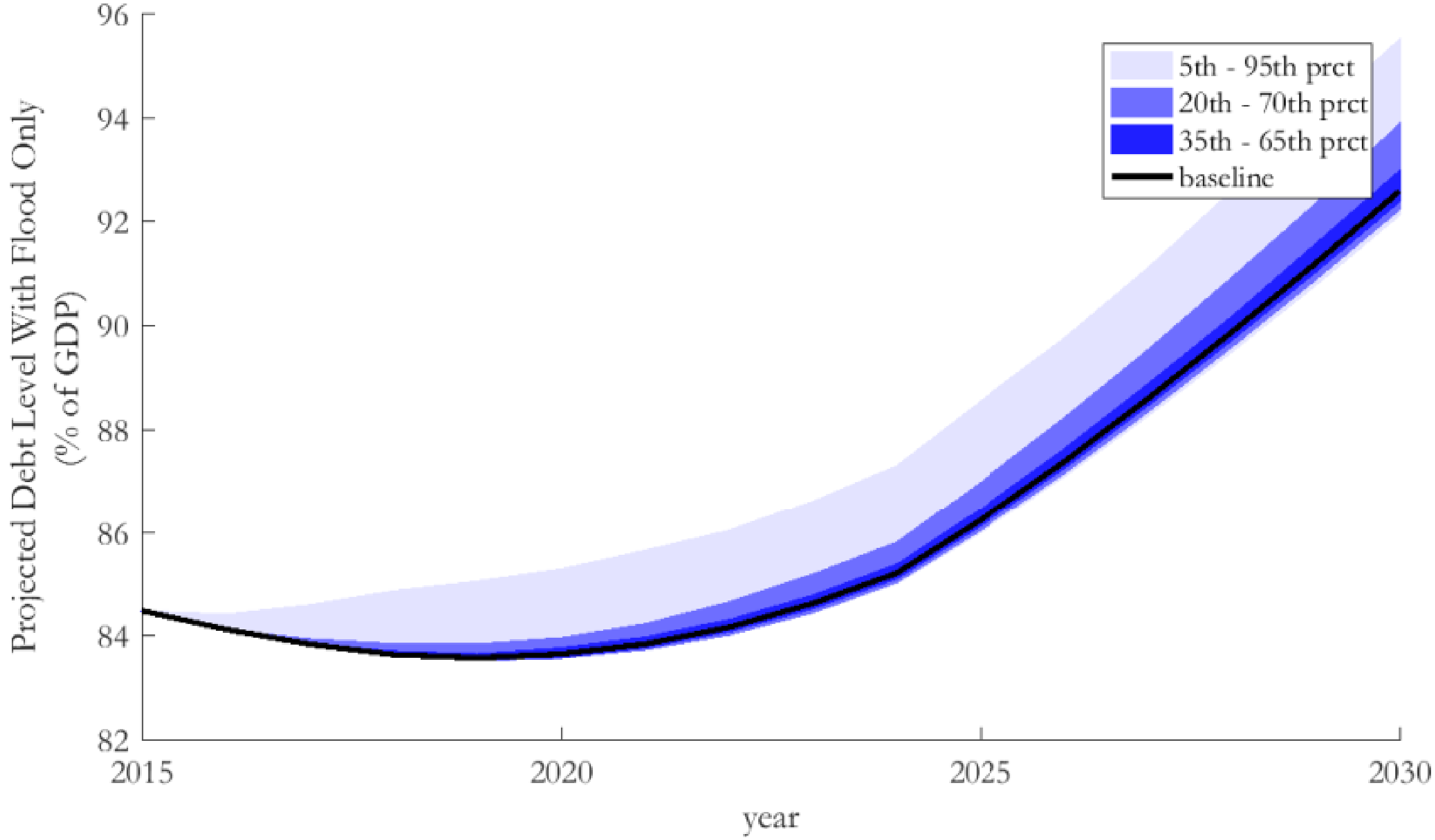

Fig 4a: Stochastic debt trajectories for Austria under SSP2 scenario up to 2030, flood risk only. Showing 5th to 95th percenties. Source: Mochizuki et al. (forthcoming)

Results: Stochastic debt trajectories Flood risk and macroeconomic variability

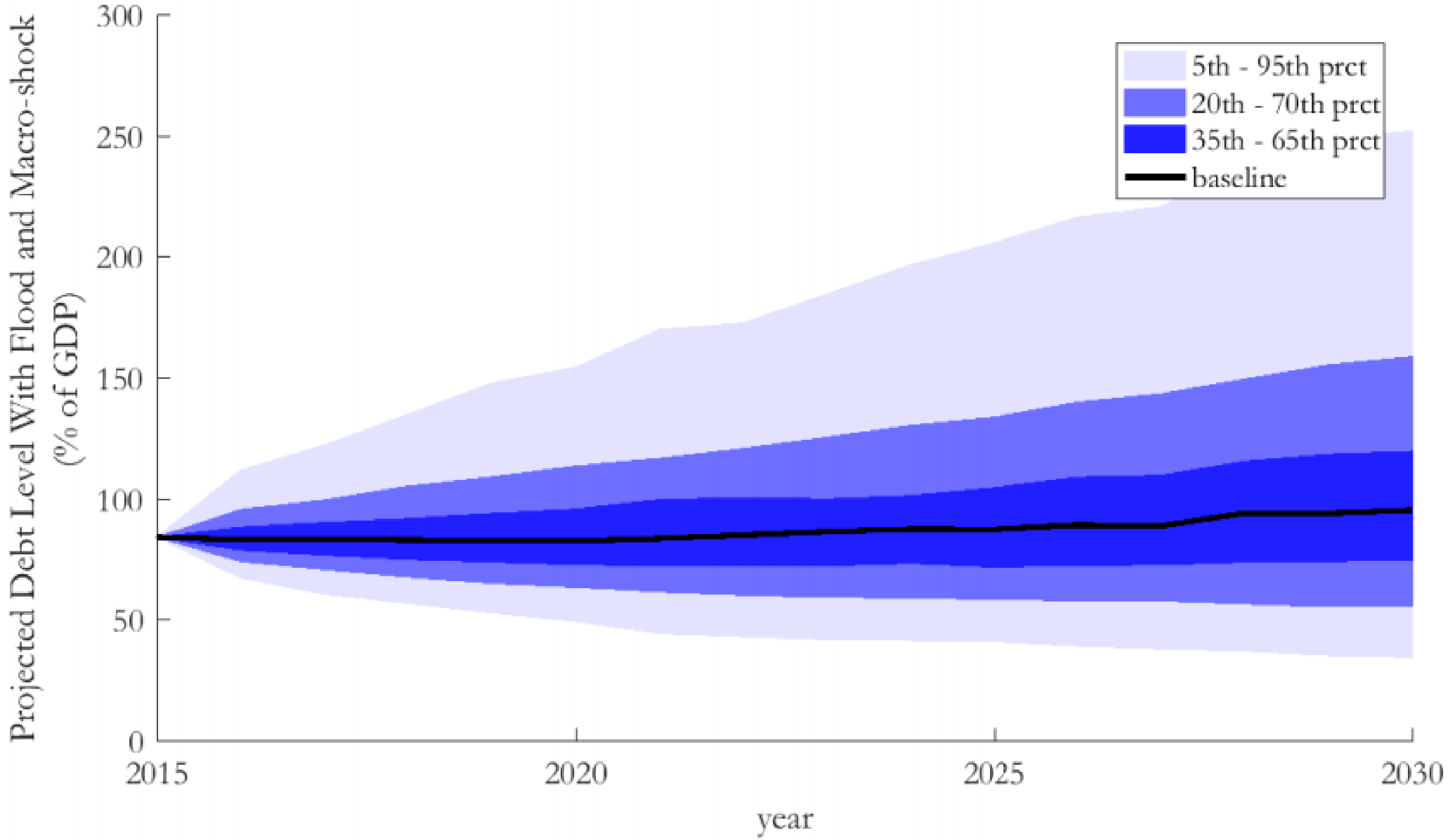

Fig 4b: Stochastic debt trajectories for Austria under SSP2 scenario up to 2030, flood risk and macroeconomic variability. Showing 5th to 95th percentities. Source: Mochizuki et al. (forthcoming)

Results: The Austrian Disaster fund

Table 4. Disaster Fund Simulation

	2015-2030	2031-2050
Probability of disaster fund depletion	Under B/C ratio of 1: 15 % Under B/C ratio of 4: 4.0%	Under B/C ratio of 1: 14% Under B/C ratio of 4: 2.9%
Magnitude of fund depletion (in million EUR 2015)	Under B/C ratio of 1: Median: 280 SD: 1,750 Under B/C ratio of 4: Median: 470 SD: 2,640	Under B/C ratio of 1: Median: 380 SD: 2,780 Under B/C ratio of 4: Median: 1,840 SD: 4,460

Source: Mochizuki et al. (forthcoming)

Discussion & Conclusions

- Expected flood damages small compared to macro-economic variability and ageing costs
- Extreme event risk (e.g. RP100) > annual changes in age-related expenditure
- Flood risk alone unlikely to impact Austria’s budgetary stance in the future
- Current disaster fund arrangements not sufficient & have to be reconsidered by allowing for
  - Building back better; Private ex-ante risk reduction; Streamlining with NatCat insurance; Public risk reduction beyond physical measures; fat tail risks
- Requires climate risk mainstreaming
  - E.g. within Climate Change Adaptation Strategies

Next steps

- Incorporate further natural hazards (e.g. drought)
- Expand to other climate change (policy) related expenditure (mitigation, adaptation, stranded assets etc.)
- Link to macroeconomic assessment methods (e.g. CGE)

Thank you for your attention.

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Based on forthcoming publication:

Mochizuki, J., Schinko, T., Hochrainer-Stigler, S. (forthcoming). Mainstreaming of Climate Extreme Risk into Fiscal and Budgetary Planning: Application of Stochastic Debt and Disaster Fund Analysis in Austria. *Regional Environmental Change*