POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Searching for the weak spot

A comprehensive investigation of climate change impacts and macroeconomic growth

Franziska Piontek

Elmar Kriegler, Marian Leimbach, Anselm Schultes, Nico Bauer, Ottmar Edenhofer

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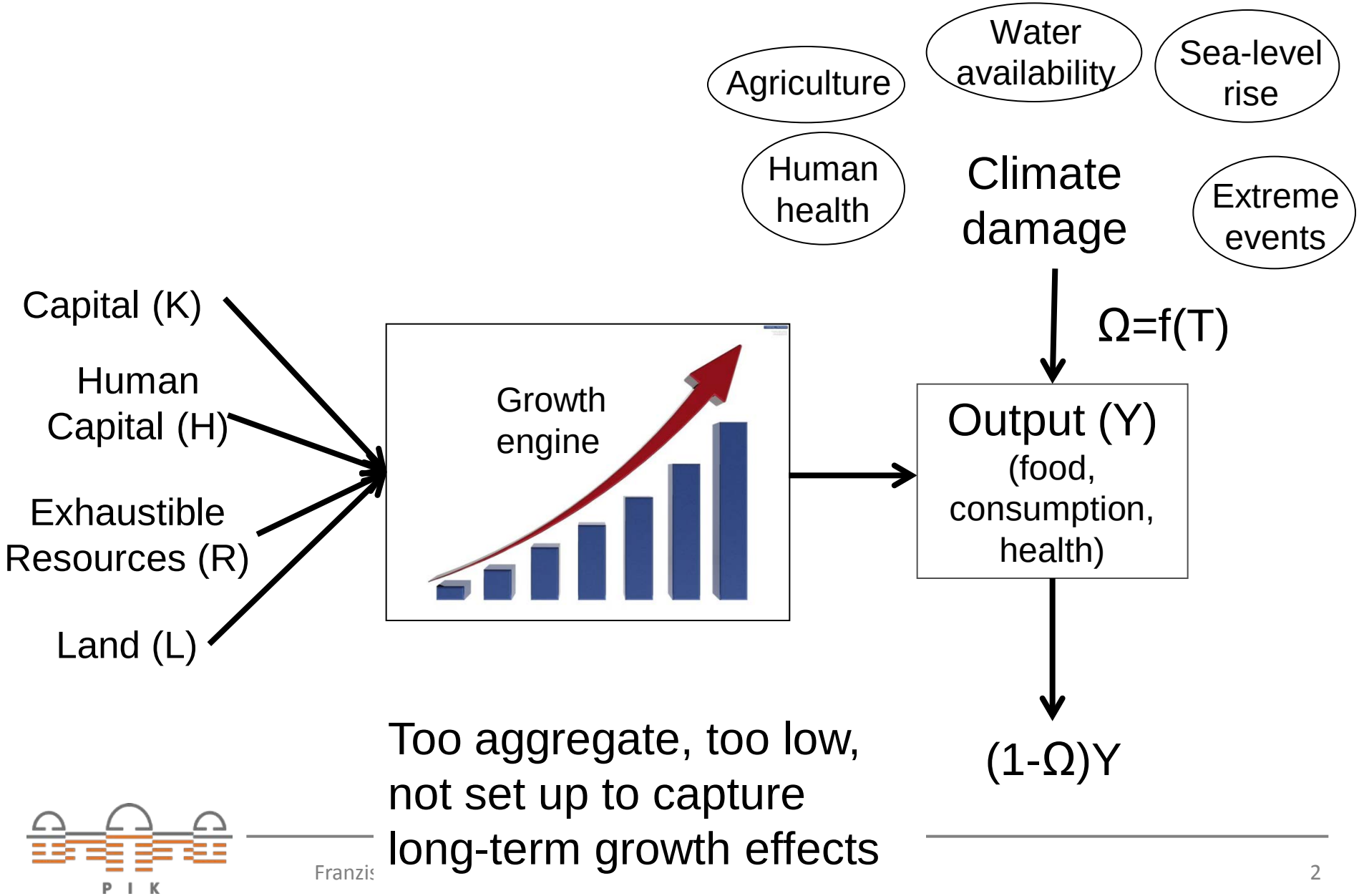
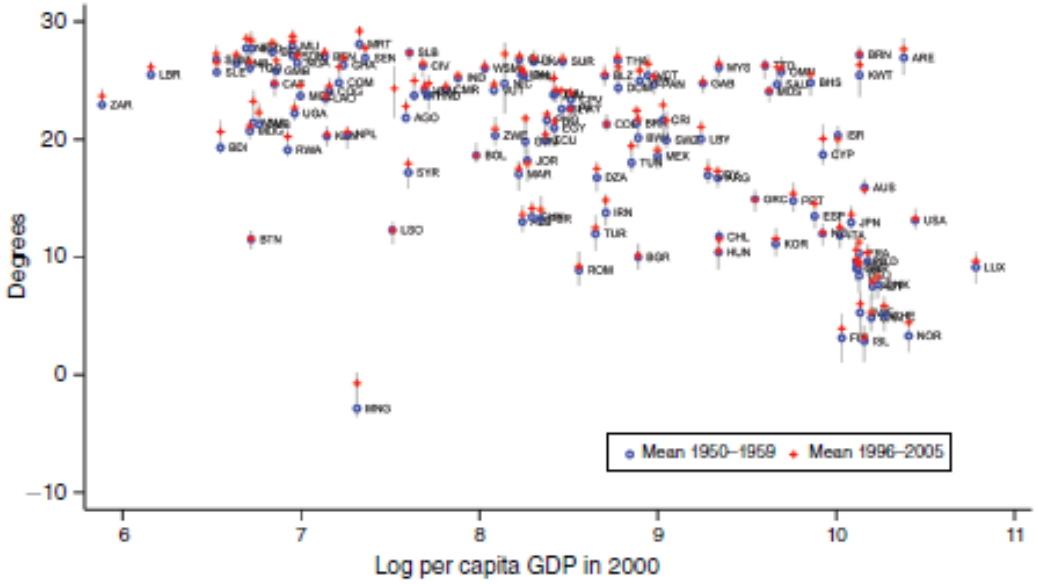
Leibniz Association

Traditional treatment of damages in IAMs



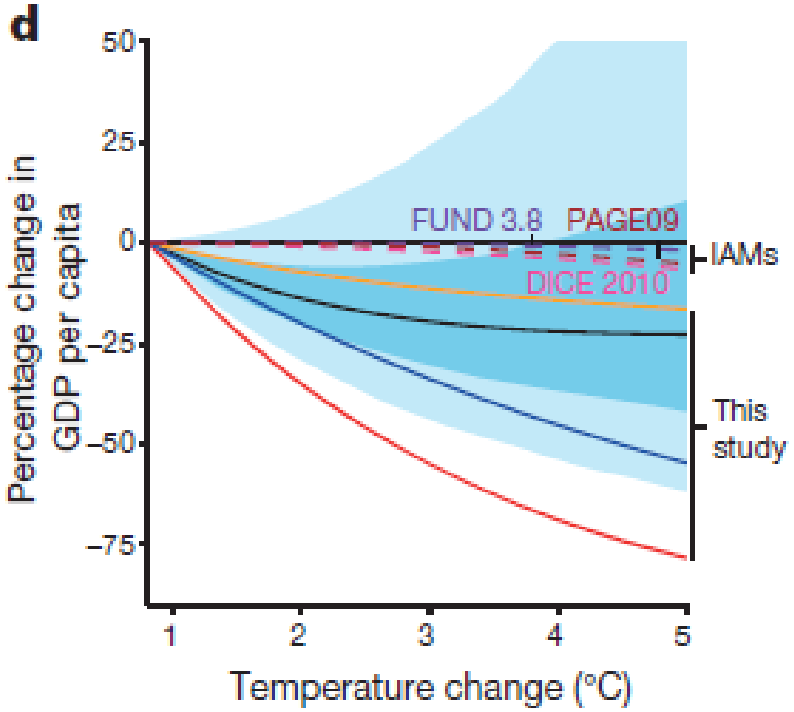
Too aggregate, too low, not set up to capture long-term growth effects

Observed relations between temperature & GDP

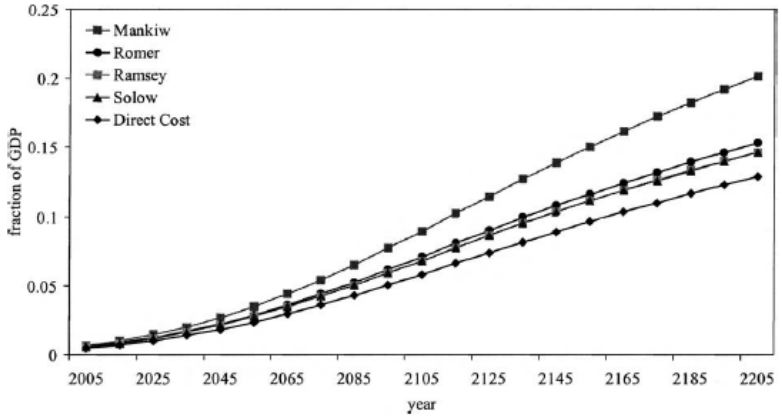


Dell et al. 2012: temperature affects growth level and rate in poor countries

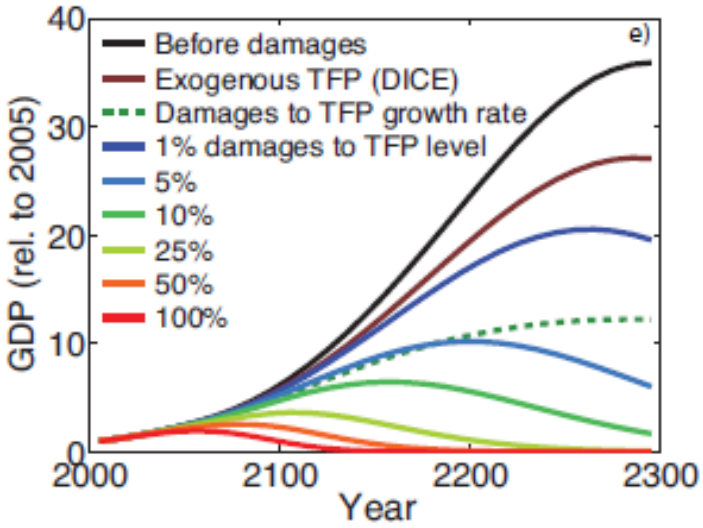
Burke et al. 2015: strongly non-linear relationship between GDP and temperature



Growth effects in IAMs via alternative damage channels



Fankhauser & Tol 2005: endogenous growth increases long-term effects



Weisbach et al. 2013: TFP

Also:
Dietz & Stern 2014: TFP & δ_{kap} with endogenous growth
Moore & Diaz 2015: TFP & δ_{kap} parameterized following Dell et al. 2012

Our study

Goals:

- **Where are the weak spots in the growth engine?**
- **How can we link to specific impact dynamics?**

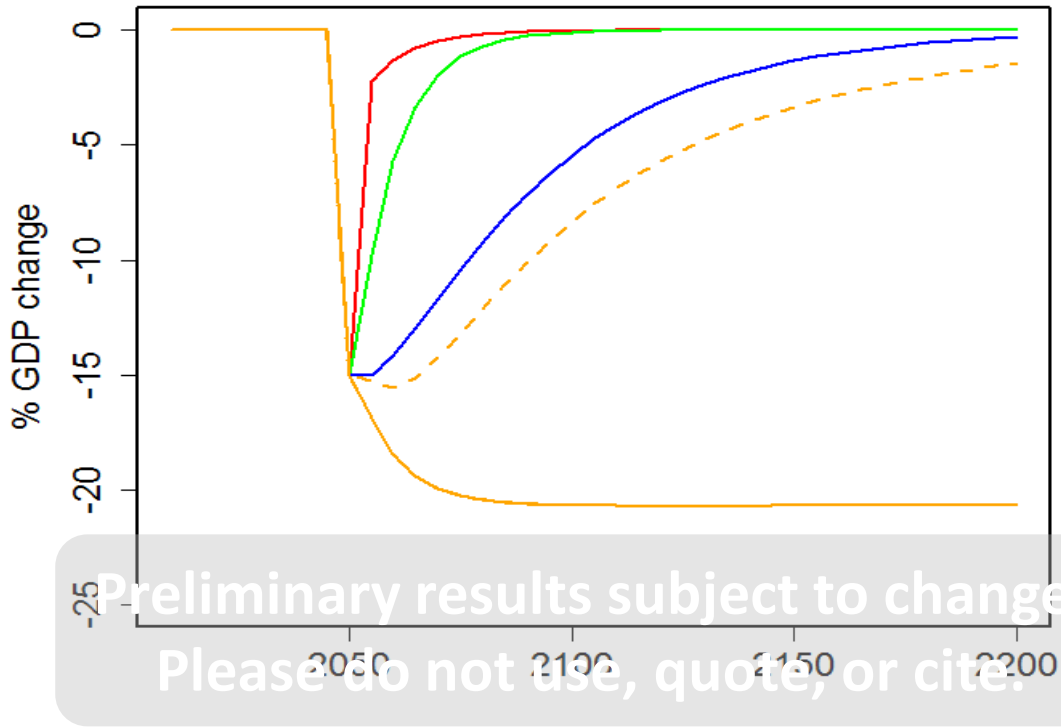
Methods:

- **Comprehensive investigation of damage channels and growth dynamics**
- **Comparable impacts in all settings via shock approach**

Means:

- **DICE2013, baseline only**
- **Different damage channels: Y, TFP, K, L**
- **Different macro-economic dynamics: standard DICE, capital adjustment costs, endogenous growth**

Single shock experiments (-15% GDP in 2050): different channels lead to different long-term effects



Y shock K shock L shock

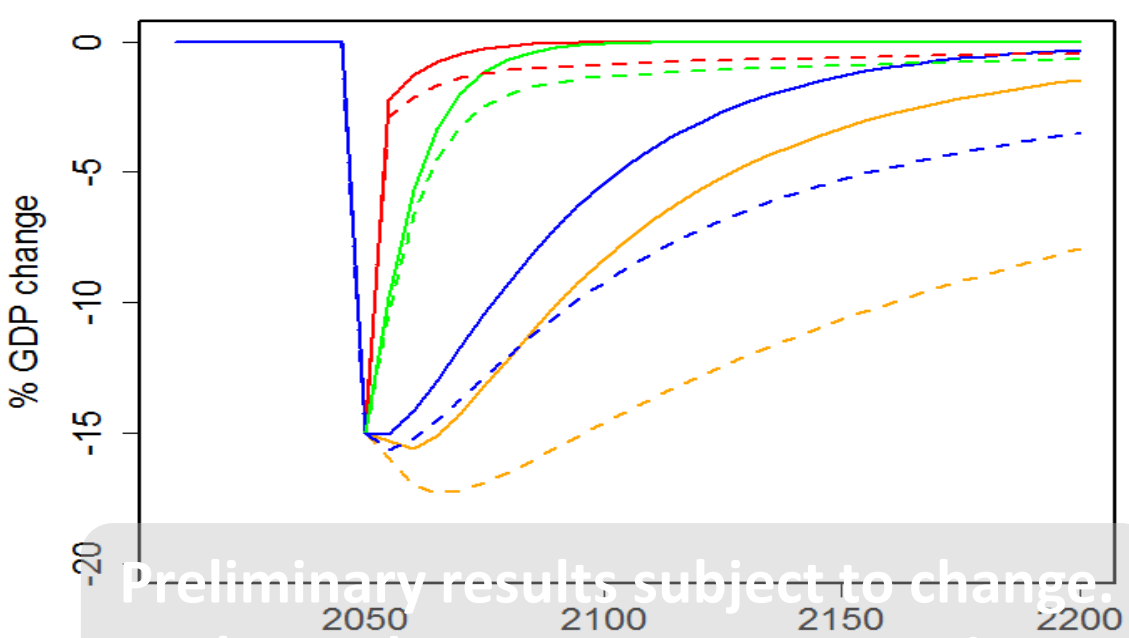
TFP shock, DICE TFP:

$$A_{t+1} = (1 - \Omega_{A,t}) \frac{A_t}{(1 - g_{A,t})}$$

TFP shock, D&S TFP:

$$A_{t+1} = (1 - \Omega_{A,t})[(1 - \delta^A)A_t + g_{A,t}]$$

Single shock experiments: effect of endogenous growth (following Dietz & Stern)



Y shock

K shock

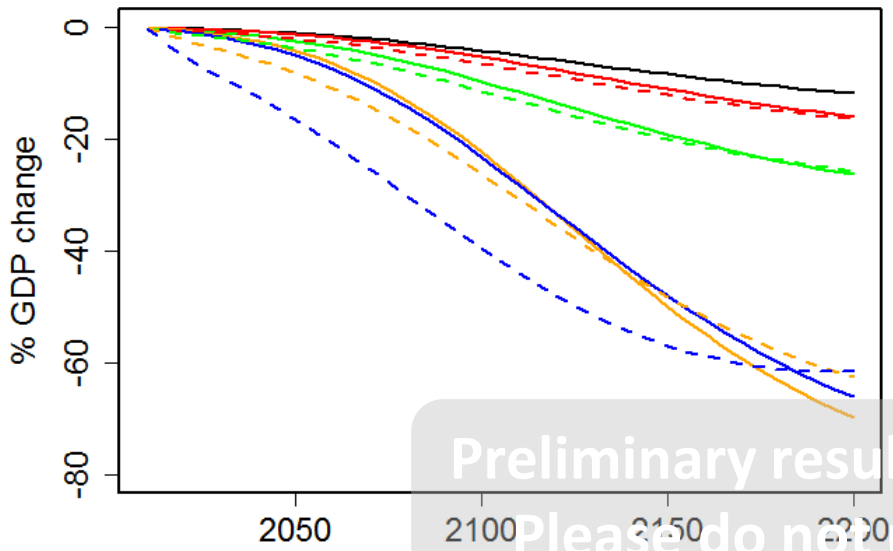
L shock

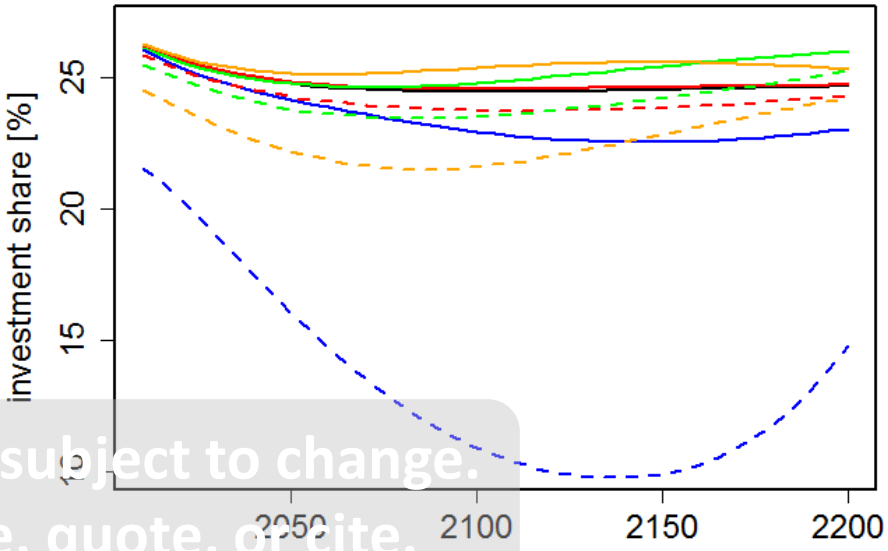
TFP shock

Same for endogenous growth version

Continuous damage (baseline runs only)

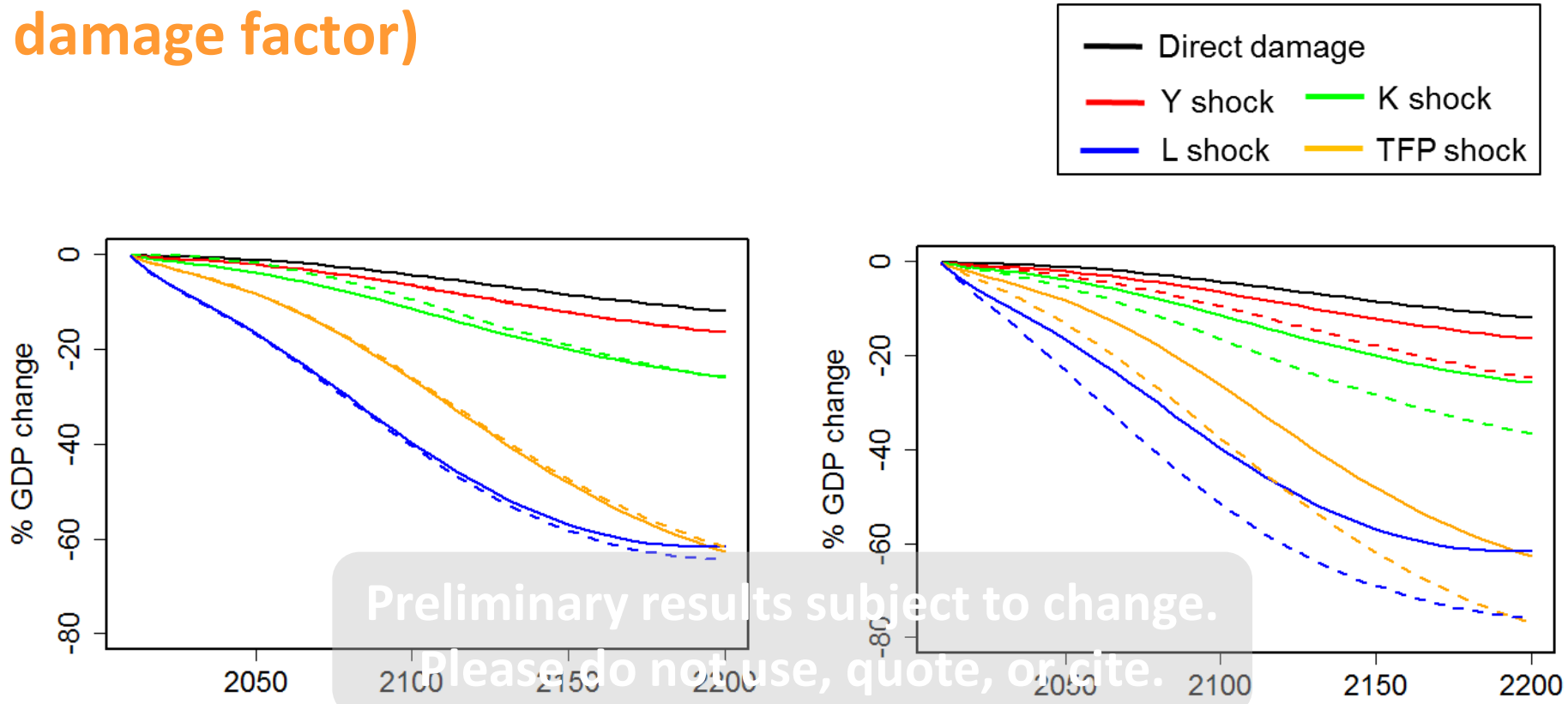
- Damage in different channels still converted as above, but now indirect effects accumulate over time
- Different behavior for exogenous (solid lines) or endogenous (dashed lines) damage factors (endogenous damage = endogenous link between GDP, emissions, temperature and damage)
- Endogenous Ω: behavior à la Fankhauser et al. (2005) – immediate decrease in investment to reduce capital stock → larger damages





Direct damage
Y shock
K shock
L shock
TFP shock

Continuous damage – effects of capital adjustment costs (CAC) & endogenous growth (EG) (endogenous damage factor)

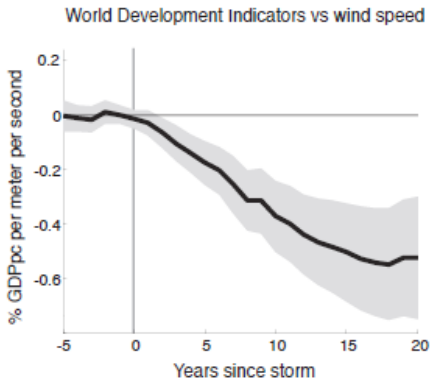


Regular vs. CAC version (dashed lines)

Regular vs. EG version (dashed lines)

Outlook: The shock approach as a way to link to impact data

- **Damages from hurricanes (Hsiang & Jina 2014)**



Country	PDV using 5% discount rate*		
	Estimate (†billion US$)	95% confidence interval bounds	
Japan	-4,461.1	-1,813.6	-7,108.5
China	-1,364.5	-554.7	-2,174.3
South Korea	-1,026.4	-417.3	-1,635.6
Taiwan	-991.9	-403.2	-1,580.5
United States	-855.0	-347.6	-1,362.4
Total losses	**-10,159**	**-4,130**	**-16,188**
Total gains	**455**	**185**	**725**
Net PDV (global)	-9,704	-3,945	-15,463

*Value of income stream under A1B less control scenario. †Values are PPP adjusted and based on 2010 income.

Long-term growth effects of hurricanes

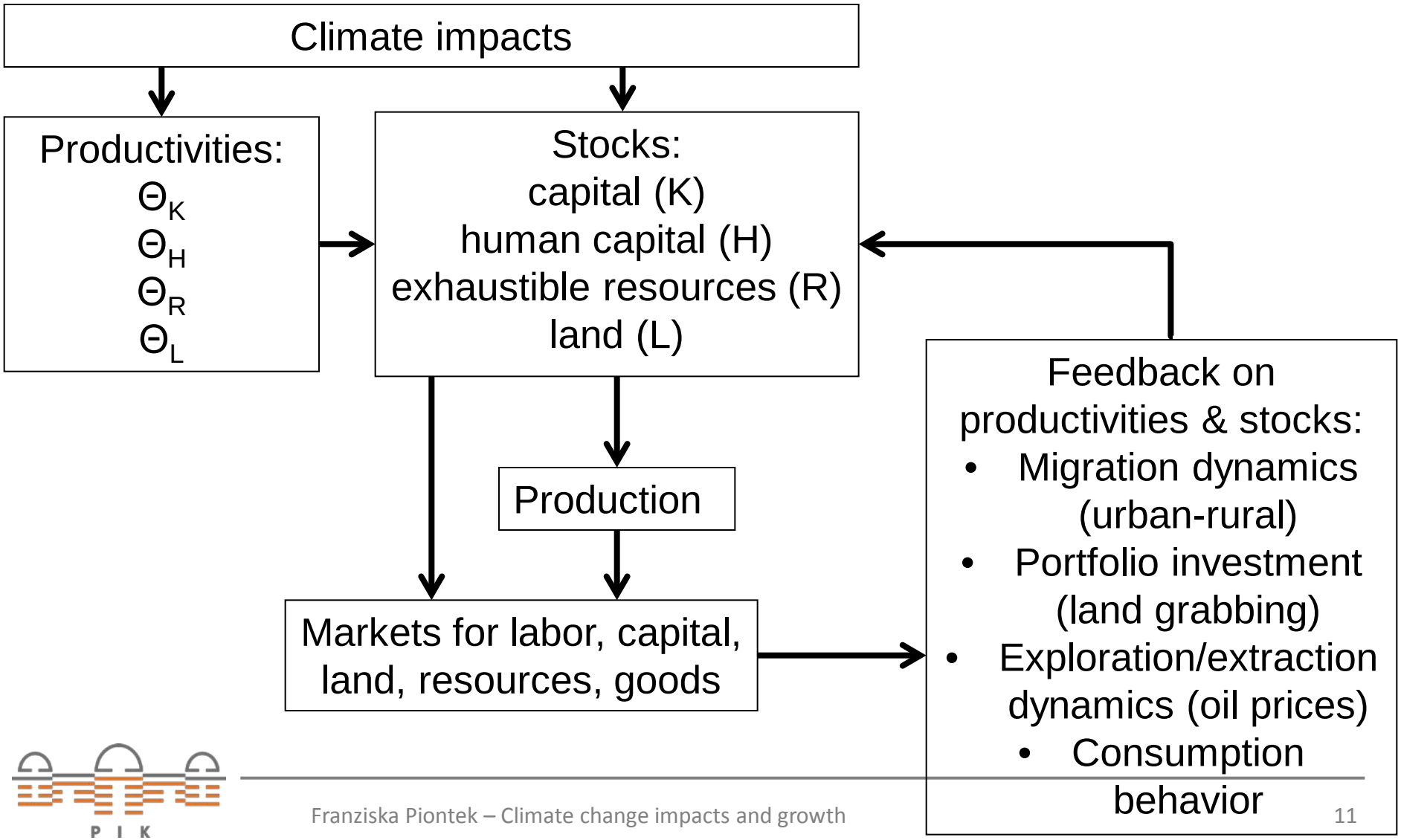
⇒

Present discounted value (5% discount rate) for changes in income trajectories from hurricanes under A1B scenario

→ Identify appropriate damage channel(s) for this effect and apply impact projections

→ Cooperation with ISI-MIP project for impact input

Vision for future economic impact research: comprehensive assessment of effects on all levels



Thank you!