Hazards, Growth and Institutions

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Effects of Natural Hazards on Economic Welfare

Natural Hazards=*f(Natural Process, Human behaviour)*

$\Downarrow$

Human "economic" behaviour determined by institutional framework (rules, laws, culture, decision mechanisms . . .)

$\Downarrow$

Analysis of "societal exposure" or "institutional resilience"

Objective

- "Institutions matter" in Natural Hazard Management
- Provision of a theoretical and empirical framework
- Application to economic growth
- Institution: **social risk-transfer mechanisms**

Objective

- More comprehensive results on Hazards-growth-nexus
- Benefit Transfer:
  - Comparability with single case studies
  - Simulation studies (e.g. climate change)
- Empirical tool for institutional comparison
- Identification of more efficient institutional settings

1. I-O modells and Computable general equilibrium (CGE) analysis (e.g. Rose & Liao 2005)

2. Aggregate econometric analysis

- Human capital: Death toll + (e.g. Kahn 2005) and Migration + (Halliday 2006)
- Individual well-being - (Luechinger & Raschky 2006)
- Economic growth: - (Tavares 2004, Rasmussen 2004) + (Skidmore & Toya 2002)

Natural Hazards and Economics

- Balance of Trade: Deteriation (Auffrett 2003), general negative effect (Gassebner et al 2006)
- Investment: - (Auffrett 2003), Foreign lending, FDI and remittances + (Yang 2005)
- Technology and TFP: + (Crespo et al. 2007 and Skidmore & Toya 2002)

Disasters in an endogenous growth model

1. Solow growth model and
2. Economics of disaster management
3. Cobb-Douglas production function
4. Introduction of disaster function in capital dynamics $D\left(F_t, \phi_t\right) k_t$
5. Derivation of panel-econometric growth function (Islam 1995)

Institutions and Natural Hazards

- Proposition: Ex-ante risk transfer mechanisms (e.g. mandatory insurance) are more efficient than ex-post policies (e.g. ad hoc governmental relief) (Kunreuther 2006)
- Anecdotal evidence (e.g. Flooding 2005 in alpine regions in Austria, Germany and Switzerland)
- Empirical evidence missing!

Basic econometric equation

$$\ln(y_{it}) = \gamma_t \ln(y_{i,t-1}) + \beta_1 \ln(s_{it}) + \beta_2 Agricult_{it} + \beta_3 Service_{it} + \beta_4 Flood_{it} + \beta_5 F_{it} * Ins_{it} + \mu_i + \eta_t + \epsilon_{it} \quad (1)$$

$\ln(y_{it})$	Europe	GDP p.c. (€1995 PPP)
	USA	Personal income p.c. ($ 2001)
$\ln(s_{it}$	Europe	Investment p.c. (€1995 PPP)
$Agricult_{it}$	Europe & USA	Fraction primary sector
$Service_{it}$	Europe	Fraction tertiary sector
$Popdensity$	USA	Population density
$Flood_{it}$	Europe & USA	Flood dummy (0,1)
$F_{it} * Ins_{it}$	Europe & USA	Flood and risk transfer mechanism
μ_i	Europe & USA	Region-specific effects
η_t	Europe & USA	Year-specific effects

Empirical strategy

- Panel units: Country vs. Regions - "The smaller the better"
- e. g. Flood with the same spatial extent in France and Austria - different economic extent

Economic data

- 199 European regions (NUTSII) (EU15 + CZ, H, N, PL & CH)
- Yearly data 1980-2004
- European Regional Database, Cambridge Econometrics
- Eurostat

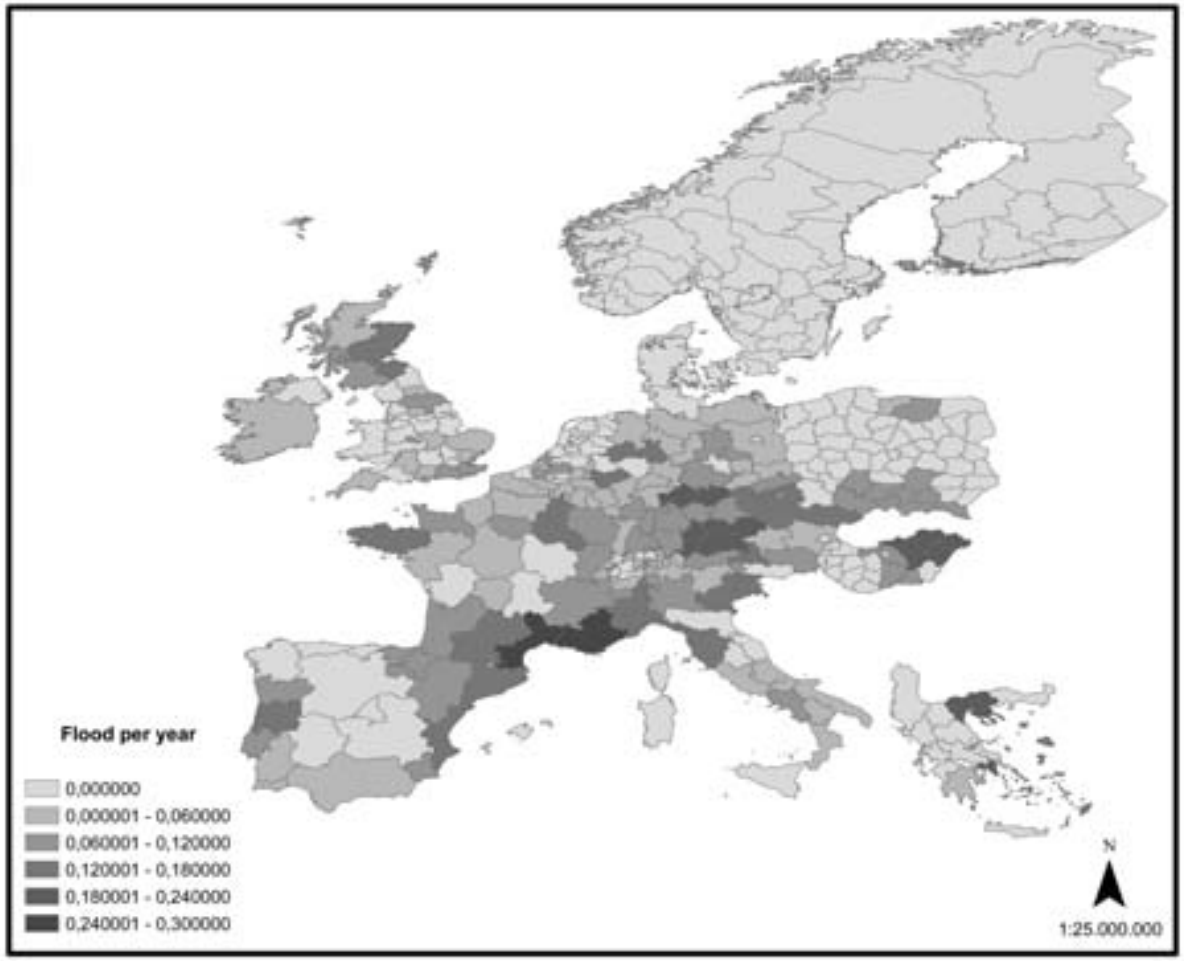
- 3,050 U.S. counties
- Yearly data 1970-2003
- Regional Economic Information System, BEA, U.S. Department of Commerce

Hazard data

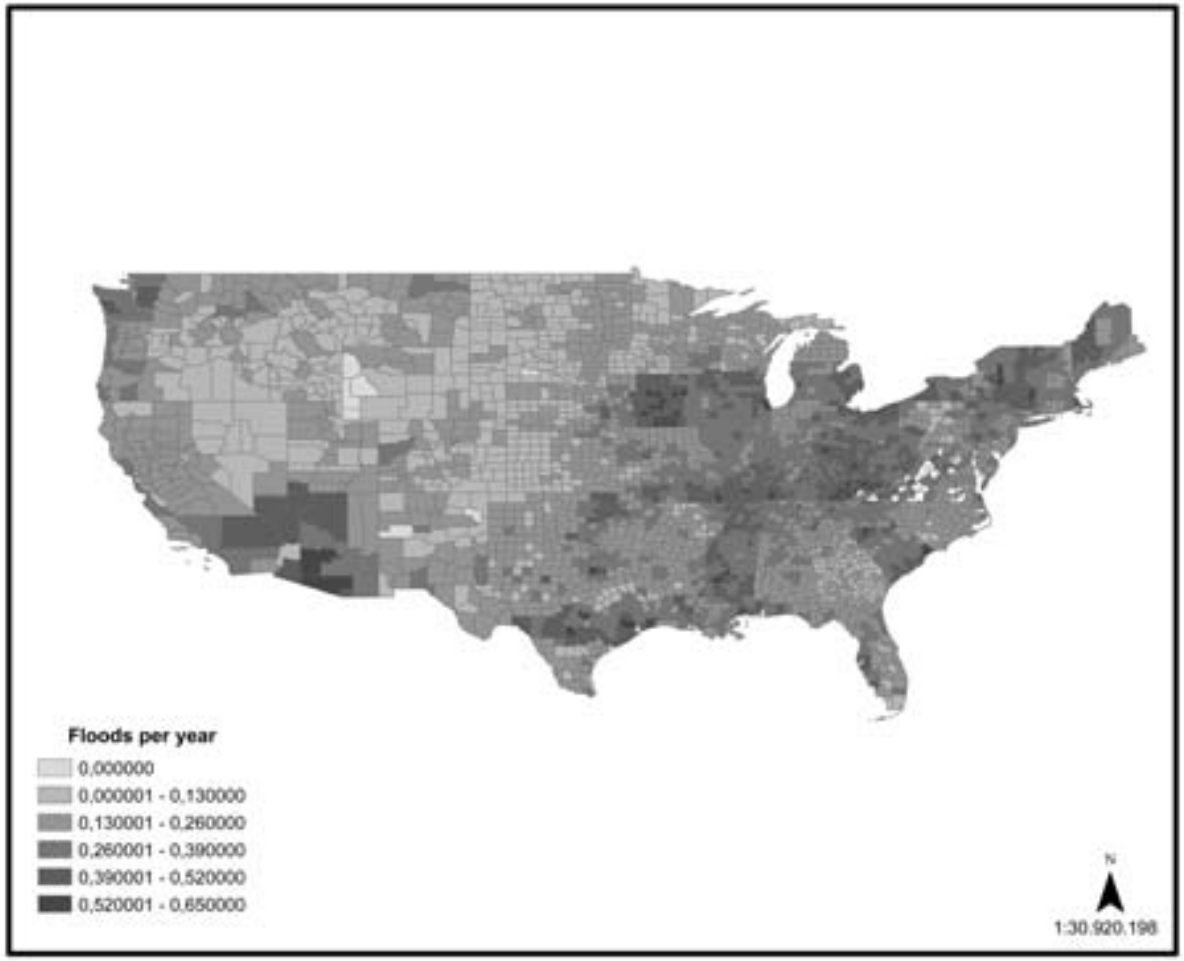
1. Historical flood events:

1. Europe:
   - Major flood events
   - EM-DAT, CRED Brussels
2. U.S.A:
   - Flood events on county level (Damage: >$ 50.000)
   - Sheldus database, University of South Carolina

No. of floods per annum European sample



No. of floods per annum U.S. sample



Empirical strategy

Flood dummy:

1. "Economic damages" inaccurate, inconsistent collection methods
2. Disaster damages are endogenous
3. Exogenous variables on magnitude !?
4. Effects of an *average* flood

Hazard data

2. Flood hazard distribution :

- GIS-data on flood areas
- Spatial data on historical flood events (geo-referenced)
- Calculation of regional (NUTSII or county) mean
- Cross section data!
- Worldbank and Columbia University (Dilley et. al. 2005)

Social Risk-Transfer

Variable	Exp. sign ex-ante	ex-post	Variation
Europe:			
Mandatory insurance	+	+	Countries
Federal Election years	-[1]	+/- [2]	Countries & Years
U.S.A:			
National Flood Insurance Program (NFIP)	+	+	Counties & Years
Federal Election years	-[1]	+/-[3]	Years
Presidential Election years	-[1]	+/-[3]	Years

[1] *charity hazard*, (Raschky & Weck-Hannemann (2006)
[2] *rubber-boots-policies*, (Schwarze & Wagner 2004)
[3] Garrett & Sobel (2003)

Empirical strategy

- Presence of lagged (endogenous) dependent variable ($\ln y_{i,t-1}$)
- Large number of N (counties, regions) vs. small number of T
- $\Rightarrow$ Dynamic panel models
- Lags of $Flood_{it}$, $Flood * Insurance_{it}$ as additional instruments for ($\ln y_{i,t-1}$)
- Judson & Owen 1999
  1. Sample Europe: One-step GMM-Diff estimator (Arellano & Bond 1991)
  2. Sample U.S.: Anderson & Hsiao (1981)

Effects of flood events regional GDP in Europe, GMM-DIFF-estimator, 1980-2004

Dependent Variable $\ln y_{it}$	1.1	1.2	1.3	1.4
$\ln y_{i,t-1}$	0.438***	0.438***	0.442***	0.437***
	(9.14)	(9.20)	(9.44)	(9.11)
$\ln s_{it}$	0.182***	0.180***	0.181***	0.188***
	(6.42)	(6.37)	(6.33)	(6.57)
$Agriculture_{it}$	−0.097***	−0.096***	−0.096***	−0.098***
	(−5.71)	(−5.71)	(−5.44)	(−5.55)
$Service_{it}$	0.136**	0.137**	0.160**	0.154**
	(2.14)	(2.12)	(2.27)	(2.34)
$Flood_{it}$	−0.004*			−0.006**
	(−1.78)			(−2.36)
$Flood_{i,t-1}$		−0.000		
		(−0.08)		
$(Flood * Exposure)_{it}$			−0.001***	
			(−3.09)	
$(Flood * Insurance)_{it}$				0.007*
				(1.75)
Number of obs.	4,277	4,277	4,277	4,277
Number of Instruments	194	194	184	205
Prob $>$Chi^2	0.000	0.000	0.000	0.000
Sargan	0.208	0.147	0.191	0.264
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.244	0.246	0.246	0.242

Effects of flood events personal income, U.S. county, Anderson-Hsiao, 1970-2003

Dependent Variable $\ln y_{it}$	2.1	2.2	2.3	2.4
$\ln y_{i,t-1}$	0.356***	0.361***	0.933***	0.361***
	(4.99)	(5.02)	(5.72)	(5.08)
$Agriculture_{it}$	0.044***	0.044***	0.065***	0.044***
	(36.36)	(36.15)	(20.42)	(36.51)
$\ln(Population\ density)_{it}$	−0.351***	−0.353***	−0.446***	−0.353***
	(−15.51)	(−15.48)	(−9.27)	(−15.60)
$Flood_{it}$	−0.003***			−0.004***
	(−7.02)			(−3.27)
$Flood_{i,t-1}$		0.003***		
		(5.88)		
$(Flood * Exposure)_{it}$			−0.001***	
			(−6.61)	
$(Flood * Insurance)_{it}$				0.001*
				(1.76)
$(NFIP)_{it}$				0.001
				(−0.50)
Number of obs.	75,525	75,525	50,709	75,525
Number of Instruments	27	27	27	29
Prob $>Chi^2$	0.000	0.000	0.000	0.000
Sargan	0.678	0.647	0.196	0.532

Marginal effects of floodings and election years

- **Europe**
  1. Effect of flood larger in election years
  2. Positive effect in following year eliminated
- **USA**
  1. No difference between election and non-election years
  2. Negative effect in following year

Conclusion

1. "Institutions matter"
2. Significant negative impact of floods on economic growth
   - European NUTSII-regions: 0.4-0.6 %-points
   - U.S. counties: 0.3-0.4 %-points
3. Mitigating effects of mandatory insurance systems
   - Europe, Mandatory Insurance regimes: 100%
   - USA, NFIP: 50%
4. Election years (and assumed increased governmental support) even increase negative effects of floodings

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http://www.uibk.ac.at/volkswirtschaft_und_statistik/forschung/wopec