"Natural" Disasters and regional governance: Evidence from European NUTS-3 Regions

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TERRITORI APERTI

Introduction

- The frequency of "natural" disasters* in both Europe and worldwide is **on the rise** (Swiss Re, 2022).
- We investigate the effects of "natural" disasters on the GDP of 1,028 European NUTS-3 regions between 2003 and 2017.
- We selected GDP as the measure because it summarizes the overall economic effect of natural hazards on the regional economy.
- We also delve into the role played by the **severity** of disasters and the important moderating activity of the **quality of regional institutions** in influencing the effects on the GDP.

*The term "natural" is in brackets when it is associated with the term 'disaster' because the concept of "natural' is inaccurate. Disasters intersect two forces: processes that generate vulnerabilities, and natural hazards (Wisner et al., 2003). The first force cannot be described as 'natural' as human beings are responsible for creating vulnerabilities (Quarantelli, 2005). "Earthquakes don't kill people, collapsing infrastructure does" (Kelman, 2023).

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Literature Review

- The existing literature has not produced clear-cut results (Cavallo and Noy, 2011).
- The majority of costs and negative impacts tend to occur in **the year of the event** (Raddatz, 2007).
- The occurrence of a natural hazard tends to be a **negative** determinant of GDP growth (Klomp and Valckx, 2014; Noy, 2009; Hochrainer, 2009).
- Albala-Bertrand (1993) argues that disasters can **neutral or positively** affects the economy.
- Deryugina (2022) shows that impacts on certain economic variables are significant at the **local level** but may not be significant at the national level.

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Gaps

1. **Geographic disaggregation of the analyses**: The literature mainly focuses on the country level. However, "natural" disasters can have a significant effect at the local level while being negligible at the country level (Barone and Mocetti, 2014);
2. **Severity of disasters**: Most of the literature simply divides events into two distinct groups, i.e., large and small (Onuma et al., 2021), without considering a graded severity. In addition, datasets with information regarding the severity of hazards is quite limited;
3. **Moderating role of regional governance**: Literature has primarily examined the countries' institutions. However, the quality of regional government institutions plays an important role in shaping all crises within the EU (Rios and Gianmoena, 2020; Ezcurra and Rios, 2019).

Research Questions

1. How does the occurrence of a "natural" disaster at the **local level** impact the GDP, regardless of its effect on the country as a whole?
2. How is the impact of the occurrence of a natural hazard on GDP explained by the **magnitude** of the "natural" disaster?
3. Does the presence of **high-quality local institutions** enable regions to recover more quickly and effectively compared with low-quality regions?

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Data: GDP

- Source: **Eurostat**
- Matching with the disaster data at NUTS-3 level.
- Adjustment of GDP of NUTS-2 regions and countries.

- Dropped from the database:
  - France, Norway, Albania, Serbia, Montenegro for lack of economic data.
  - United Kingdom because of data not available at Eurostat.
  - Malta, Cyprus and some other NUTS-3 regions for the perfect overlap between regions and provinces.

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Data: Disasters

- Source: **EM-DAT**
- Have to fulfil at least one of the following criteria (EM-DAT conditions):
  - 10 or more people reported killed
  - 100 or more people reported affected
  - Declaration of a state of emergency
  - Call for international assistance
- In addition we eliminate all the events without a clear identification at the NUTS-3 level.
- A limited number of information on the severity and magnitude of the natural hazards.

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Data: Disasters - A unique dataset

- Sources:
  - Floods: **Global Active Archive of Large Flood Events (GAALFS)**;
  - Earthquakes: **Earthquake Hazards Program (EHP, United States Geological Survey)**;
  - Extreme temperature events: **Eurostat**.
- "Natural" disaster if:
  - Floods: List of floods;
  - Earthquakes: All the events with a Richter scale **higher than 5**;
  - Extreme Temperature events (and droughts): when the HDD of the NUTS-3 region is at least **20% higher than the average of the other years**.
- Data on the severity of natural hazards:
  - GAALFS's severity index (floods);
  - Richter Scale (earthquakes);
  - Heating Degrees DAYS (HDD, extreme temperature events).

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Data: Quality of regional institutions

- Source: **QoG Institute**
- EQI (European Quality of Government) index based on perception and experiences of 129,000 respondents in EU regions.
- Values for the EQI index from -2.5 (for the NUTS-2 regions with the worst governance) to 2.5 (for the NUTS-2 regions with the best governance).

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Methodology: Variables (1)

- **Independent Variable**:
  - VarGdpNuts3:The **growth rate of the GDP** of the NUTS-3 region *i* in the year *t*.
- **Dependent Variables**:
  - *eventnuts3*: Dummy of the **occurrence of a "natural" disaster** in the NUTS-3 region *i* (Source: EM-DAT);
  - *disasterseverity*: Index considering the occurrence of a natural hazard and the **size** of the disaster. (Sources: EHP, Eurostat, GAALFS);

Value	heating_severity	flood_severity	earthquake_severity
0	no event	no event	no event
0.25	20-22.5% higher	Severity index = 1	5-5.29 Richter Scale
0.5	22.5-25% higher	Severity index = 1.5	5.3-5.59 Richter Scale
0.75	25-27.5% higher		5.6-5.89 Richter Scale
1	>27.5% higher	Severity index = 2	>5.9 Richter Scale

$$\text{disasterseverity} = \text{heating\_severity} + \text{flood\_severity} + \text{earthquake\_severity} \quad (1)$$

If *disasterseverity* > 1, we fixed *disasterseverity* $= 1$.

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Methodology: Variables (2)

- *top10*: Dummy of the occurrence of a disaster in **the top 10%** of the distribution in the NUTS-3 region *i* (Sources: EHP, Eurostat, GAALFS);
- *top5*: Dummy of the occurrence of a disaster in **the top 5%** of the distribution in the NUTS-3 region *i* (Sources: EHP, Eurostat, GAALFS).
- *regionalgovernance*: Index of the **quality of regional institutions** at NUTS-2 level. Standardization of the EQI index between 0 and 1 (Source: QoG);
- *eventgovernance*: **Interaction** between the dummy eventnuts3 and the index regionalgovernance (Sources: EMDAT and QoG);
- *severitygovernance*: **Interaction** between the index disasterseverity and the index regionalgovernance (Sources: EMDAT and QoG);

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Methodology: Variables (3)

- *vargdpcountryadj*: The **growth rate of the GDP** of the respective country with the adjustment described above by the GDP of the NUTS-3 region (Source: Eurostat)
- *regionalcorrection*: **Regional correction** obtained with a regression between the GDP growth rate of NUTS-2 region and the respective country (Source: Eurostat);
- *crisis09* and *Crisis10*: Dummies of the Sub-prime Crisis.

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Methodology: Model

- Model 1 (for research questions 1 and 2):

$$\begin{aligned} VarGdpNuts3 = &\beta_0 + \beta_1 event_{i,t} + \beta_2 regionalgovernance_k + \\ &\beta_3 VarGdpCountryAdj_{i,t} + \beta_4 regionalcorrection_{i,t} + \\ &\beta_5 crisis09_t + \beta_6 Crisis10_t + \epsilon_{i,t} \end{aligned} \tag{2}$$

- Model 2 (for research question 3):

$$\begin{aligned} VarGdpNuts3 = &\beta_0 + \beta_1 event_{i,t} + \beta_2 regionalgovernance_k + \\ &\beta_3 \textbf{event*regionalgovernance}_{i,t} + \\ &\beta_4 VarGdpCountryAdj_{i,t} + \beta_5 regionalcorrection_{i,t} + \\ &\beta_6 crisis09_t + \beta_7 Crisis10_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

Results: Model 1 (1)

VARIABLES	Vargdpnuts3
eventnuts3	−0.00283**
	(0.00138)
regionalgovernance	0.00538***
	(0.00139)
vargdpcountryadj	0.971***
	(0.0136)
regionalcorrection	−0.272***
	(0.0531)
crisis09	−0.00663***
	(0.00163)
Crisis10	0.00300**
	(0.00144)
Constant	−0.00310***
	(0.000964)
Observations	15,420
R-squared	0.649
Number of id	1,028

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Results: Model 1 (2)

VARIABLES	(1) Vargdpnuts3	(2) Vargdpnuts3	(3) Vargdpnuts3	(4) Vargdpnuts3
eventnuts3	−0.00283**			
	(0.00138)			
disasterseverity2		−0.00545*		
		(0.00328)		
top10			−0.00698*	
			(0.00367)	
top5				−0.00859*
				(0.00445)
regionalgovernance	0.00538***	0.00604***	0.00609***	0.00611***
	(0.00139)	(0.00136)	(0.00135)	(0.00135)
Controls	Yes	Yes	Yes	Yes
Observations	15,420	15,420	15,420	15,420
R-squared	0.649	0.648	0.648	0.648
Number of id	1,028	1,028	1,028	1,028

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Results: Model 2 (1)

VARIABLES	(1) VarGdpNuts3	(2) VarGdpNuts3	(3) VarGdpNuts3	(4) VarGdpNuts3
eventnuts3	-0.00361			
	(0.00291)			
eventnuts3 = L		0.00465		
		(0.00336)		
eventnuts3 = L2			-0.00699**	
			(0.00347)	
eventnuts3 = L3				0.00598**
				(0.00282)
eventgovernance	0.00219			
	(0.00601)			
eventgovernance = L		-0.0119		
		(0.00743)		
eventgovernance = L2			0.0121*	
			(0.00686)	
eventgovernance = L3				-0.0119**
				(0.00591)
regionalgovernance	0.00522***	0.00777***	0.00534***	0.00855***
	(0.00146)	(0.00143)	(0.00149)	(0.00156)
Controls	Yes	Yes	Yes	Yes
Observations	15,420	14,392	13,364	12,336
R-squared	0.649	0.651	0.658	0.646
Number of id	1,028	1,028	1,028	1,028

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Results: Model 2 (2)

VARIABLES	(1) VarGdpNuts3	(2) VarGdpNuts3	(3) VarGdpNuts3	(4) VarGdpNuts3
disasterseverity	0.000431			
	(0.00650)			
disasterseverity = L		-0.0157**		
		(0.00701)		
disasterseverity = L2			0.00619	
			(0.00767)	
disasterseverity = L3				0.00513
				(0.00891)
severitygovernance	-0.0154			
	(0.0156)			
severitygovernance = L		0.0244*		
		(0.0141)		
severitygovernance = L2			-0.0105	
			(0.0155)	
severitygovernance = L3				-0.00859
				(0.0168)
regionalgovernance	0.00625***	0.00623***	0.00739***	0.00710***
	(0.00137)	(0.00138)	(0.00147)	(0.00137)
Control	Yes	Yes	Yes	Yes
Observations	15,420	14,392	13,364	12,336
R-squared	0.649	0.651	0.658	0.646
Number of id	1,028	1,028	1,028	1,028

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Robustness

VARIABLES	(1)	(2)
disaster	−0.00347**	
	(0.00171)	
Eventnuts3part		−0.00417***
		(0.00160)
regionalgovernance	0.00604***	0.00503***
	(0.00135)	(0.00141)
vargdpcountryadj	0.968***	0.971***
	(0.0136)	(0.0137)
regionalcorrection	−0.272***	−0.272***
	(0.0530)	(0.0530)
crisis09	−0.00690***	−0.00661***
	(0.00162)	(0.00163)
crisis10	0.00397**	0.00308**
	(0.00155)	(0.00144)
Constant	−0.00351***	−0.00291***
	(0.000946)	(0.000972)
Observations	15,420	15,420
R-squared	0.649	0.649
Number of id	1,028	1,028

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Conclusion (1)

- The GDP growth rate of NUTS-3 regions affected by a "natural" disaster experiences a **negative** effect of approximately **0.28 percentage points**.
- The magnitude of the disaster explains part of the negative economic effect of the "natural" disaster. A NUTS-3 region affected by a top-5 disaster shows a decline of about **0.86 percentage points** in its GDP.
- Two years after the event, the GDP growth rate of a NUTS-3 region **becomes positive** if the index of *regionalgovernance* is above 0.41.
- Regions with good governance tend to experience a **faster recovery** after a disaster, typically a year earlier, compared to regions with poor institutional quality.

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Conclusion (2)

- In the case of a major disaster, the effect of the quality of regional governance is evident just **1 year later** (maybe because the bigger events attract a **faster and bigger help** by government and international institution).
- In the case of a major disaster, the threshold for the quality of regional governance to ensure a return to growth one year after the event **must be higher** (0.52) compared to the previous analysis (0.41).
- This is an important signal that policymakers need to take into account, rather than continuing to emphasize only the natural dimension of disasters in order to "find an **alibi** and try to escape responsibility" (Gaillard et al., 2007).
- The recovery quality is mainly in the hands of the institutions.

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End

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Appendix

VARIABLES	VarGdpNuts3	VarGdpNuts3	VarGdpNuts3
eventnuts3	-0.00296**	-0.00292**	-0.00282**
	(0.00147)	(0.00146)	(0.00139)
regionalgovernance		0.00528***	
		(0.00140)	
Fixed Effects	Yes	No	Yes
Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	No
Observations	15,420	15,420	15,420
R-squared	0.649	0.627	0.649
R-squared	0.627	0.648	0.649
Number of id	1,028	1,028	1,028

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