The economic impact of earthquakes: some evidence from Italian provinces

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Joint work with

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Resilienza ai Disastri e Sviluppo Sostenibile
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Introduction I

- On 6^{th} April 2009, a severe earthquake hit L'Aquila, causing 309 deaths, more than 1500 wounded, and almost 70000 people displaced.
- The total estimated cost of the earthquake was more than 10 billion euros (DPC, 2011).
- In May 2012, another earthquake sequence struck the North of Italy, causing 26 deaths and a total loss of up to 13 billion euros.
- Most of the effort of the country was devoted to the process of private reconstruction, and only a small amount of money was allocated to the future local development, especially in the case of the event in 2009 (Modica et al., 2019).

Introduction II

- The direct economic cost, that is, the value of what has been damaged or destroyed by the disaster, is not a sufficient indicator of the seriousness of the disaster, and estimating indirect losses is crucial to assess the consequences on the economy.
- This paper aims to provide some evidence on the indirect cost of natural disasters.
- Assessing indirect economic losses and ripple effects of natural disasters is difficult, and the results of previous studies are quite ambiguous from both a theoretical and an empirical point of view.

Theoretical literature

- According to neoclassical models, disasters negatively affect economic development in the short run, but the overall effect is neutral in the long run.
- The endogenous growth models predict negative effects on gross production and on economic growth.
- "Creative destruction" models indicate positive economic growth because of the replacement and upgrading of damaged physical capital with new capital stock.

Empirical literature

- Early cross-country studies found positive effects on GDP (Albala-Bertrand, 1993; Skidmore and Toya, 2002).
- Loayza et al. (2009) and Noy (2009) argue that heterogeneous effects, either positive or negative, are observable depending on the type of disaster and the level of socio-economic development of the country.
- Cavallo et al. (2013) find that only extremely large disasters have a negative effect on output in both the short and the long run.
- Barone and Mocetti (2014) compare the earthquakes in Friuli-Venzia Giulia and Irpinia, showing that the short-term effects are negligible in both regions. In the long-run, the effect on GDP is negative in areas with lower pre-quake institutional quality.

The aim of the paper

- This paper aims to analyze the heterogeneous economic effects of earthquakes across Italian provinces.
- We quantify the impact of earthquakes on the gross value added, considering the seismic events in 2009 and 2012.
- We also verify whether the effect differs across events and sectors.
- We investigate the factors that may explain these differences.

Methodology

- To evaluate the effects of the two earthquakes, we use the Synthetic Difference-in-Differences (SDID).
- SDID builds on insight behind the difference-in-differences and synthetic control methods (Arkhangelesky et al., 2021).
- Like synthetic control methods (SMC), SDID reweights and matches pre-exposure trends to weaken the reliance on parallel trend type assumptions.
- Like DID, it calculates a treatment effect as the pre versus post difference-in-difference between treated units and (synthetic) control units, and allows for valid large-panel inference.

SDID I

- Like SCM, SDID allows to find weights $\hat{w}^{sdid}$ that align pre-exposure trends in the outcome of unexposed units with those for the exposed units:

$$\sum_{i=1}^{Nco} \hat{w}^{sdid} Y_{it} \approx N_{tr}^{-1} \sum_{i=Nco+1}^{N} Y_{it}$$

- In addition, SDID includes time weights $\hat{u}^{sdid}$ that balance pre-exposure time periods with postexposure ones.

SDID II

- These weights are used in a basic two-way fixed effects regression to estimate the average causal effect of exposure:

$$(\tau^{sdid}, \mu, \alpha, \beta) = \\ argmin_{\tau,\mu,\alpha,\beta}\{\sum_{i=1}^{N}\sum_{t=1}^{T}(Y_{it} - \mu - \alpha_i - \beta t - W_{it}\tau)^2 \hat{w}_i^{sdid}\hat{u}^{sdid}\}.$$

- SDID can be implemented in the case of staggered adoption with multiple dates at which the event of interest occurred.

- With staggered adoption, it is possible to apply the SDID estimator repeatedly, once for every adoption date.

- SDID also allows for the inclusion of covariates in the calculation of the synthetic counterfactual.

Data I

- We use a balanced panel of Italian provinces from 1980 to 2019.
- We consider as treated all the provinces included in the earthquake zones by the legislative decrees:
  - in the 2009 event, L'Aquila, Teramo and Pescara;
  - in the 2012 event, Bologna, Modena, Reggio nell'Emilia, Ferrara, Piacenza, Mantova, and Rovigo.
- We drop from the control group all the provinces hit by the earthquake in 2016: Rieti, Macerata, Ancona, Ascoli Piceno, Fermo, Perugia, Terni.
- We use data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO).

Data II

We consider:

- gross value added (GVA) at the provincial level and constant prices;
- gross value added (GVA) at the provincial level and constant prices in the construction sector;
- gross value added (GVA) at the provincial level and constant prices in industry, excluding construction.

- For inference, we implement bootstrap with 100 repetitions.

Results: Average Treatment effect on the Treated (ATT)

	Global	2009	2012
Total	255.12**	179.09**	299.93*
Construction	90.99***	149.59***	56.46*
Industry (excluding construction)	164.38*	-6.58	265.13*

*** p<0.01, ** p<0.05, * p<0.1

The role of institutions

- We use the IQI Dataset on Italian provinces to evaluate these dimensions:
  - corruption;
  - government effectiveness;
  - regulatory quality;
  - rule of law;
  - voice and accountability.
- We find that the negative effect vanishes when we consider all the institutional quality indexes but the corruption one.

Conclusions

- Our results show that earthquakes may have heterogeneous effects across provinces and sectors.
- The earthquake in 2009 led to a significant increase of 32% in the GVA of the construction sector, while the increase was only 5.5% for the earthquake in 2012.
- On the GVA in the industry sector (excluding construction), we find a small negative impact in 2009, and a positive impact in 2012.
- The quality of local institutions may play a role in explaining these differences.
- Our results provide insights into the sector-specific effects that should be considered in post-disaster recovery planning.

Thank you!

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