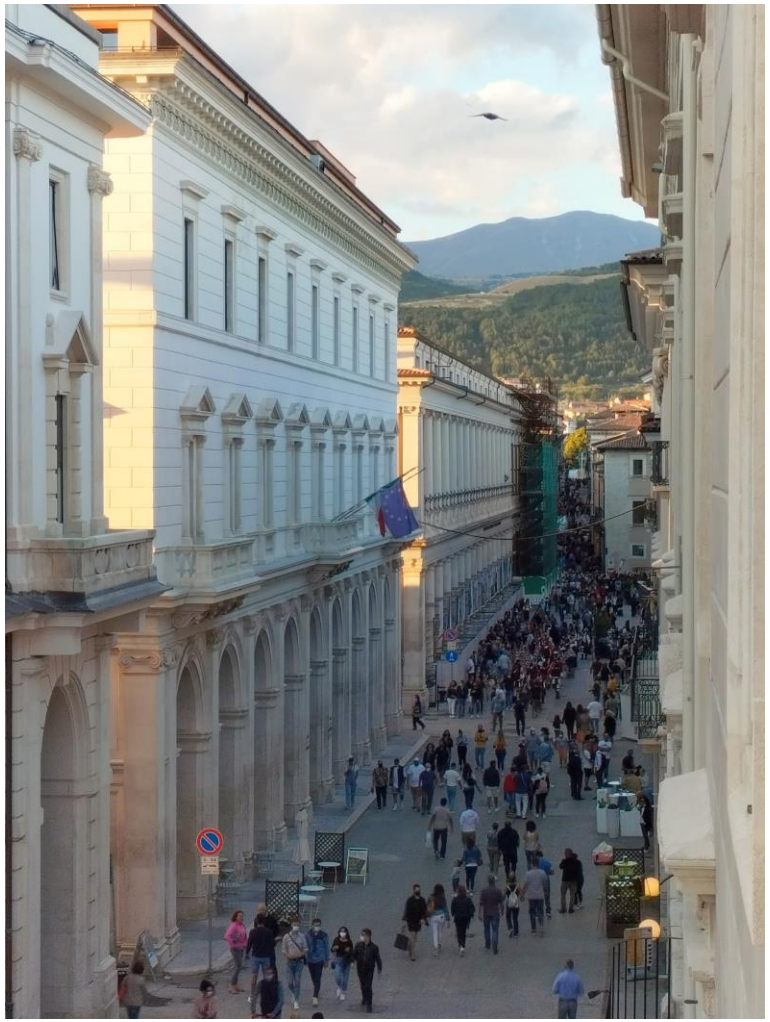
The impact of natural disasters: how the 2009 earthquake transformed the economy of L'Aquila's labour market area

Giovanni Baiocchetti, Università degli Studi di Milano
Francesco Scotti, Politecnico di Milano
Pasquale Lelio Iapadre, Università degli studi dell'Aquila

«**Resilienza ai disastri e sviluppo sostenibile**»

Conferenza nazionale Territori Aperti

Napoli, 1-2 febbraio 2024



Overview

- Reasons for the analysis
- Research objectives
- Introducing the case study
- Data & Methods
- Results
- Conclusion

Reasons for the analysis

- Growing interest in **regional economies' resilience** (Martin 2012).
- Reconstruction still an **ongoing process**: more than 320 million € already allocated for local development; more to come (e.g. 1,78 billion € PNRR) → **inform policymaking**.
- **Marginality** compared to large urban areas (Glaeser 2011): 20/29 municipalities classified as inner areas (SNAI).
- **No consensus in literature** on the impact of natural disasters (Cavallo and Noy 2010).

Other analyses' caveats

- Data at **provincial** (NUTS 2) or **regional** (NUTS 3) level (Di Pietro and Mora 2015; Mendoza, Breglia and Jara 2020) include areas that were not hit by the earthquake.
- **LMAs 2011 revision** by ISTAT complicates long-term comparative analysis (Banca d'Italia 2019).
- **Different focuses**: local fiscal multipliers (Trezzi and Porcelli 2014), employment likelihood (Di Pietro and Mora 2015), working hours and salaries (Mendoza, Breglia and Jara 2020) employment rate and employment by economic sector (Basile et al. 2023).

Research Objectives

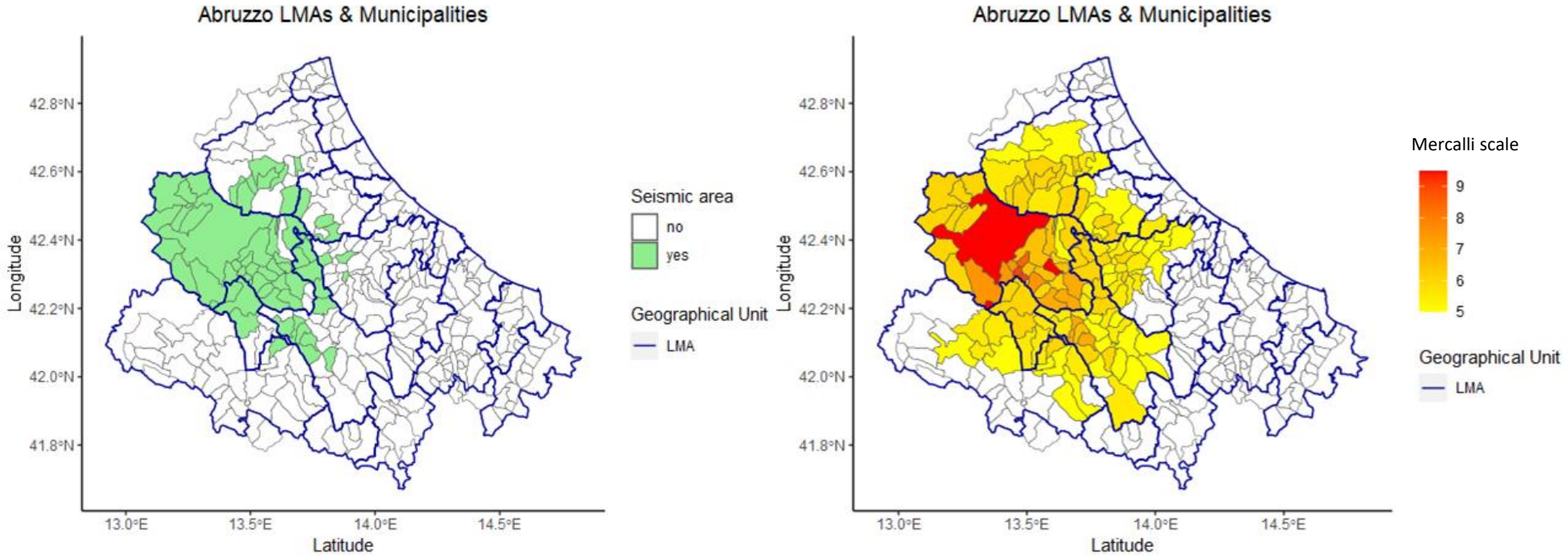
Counterfactual analysis of the earthquake impact on:

- **Number of firms;**
- **Number of employees;**
- **Per-capita income level;**
- **Sector diversification.**

Results' interpretation according to **post-earthquake policy guidelines** by Formez PA (2011), Italian Ministry for Territorial Cohesion (2012, known as "Rapporto Calafati") and the OECD (2013).

Introducing the case study

- The concept of adaptive resilience (Martin 2012) is at the core on geo-economic analyses on how territories react and adapt to new scenarios, trying to «bounce forward» rather than back (Manyena et al. 2011, Gemmiti 2014).
- L'Aquila's LMA best identifies the area hit by the 2009 earthquake. The other 19 LMAs of Abruzzo represent our counterfactual.



Data

Outcome variables $\boldsymbol{Y_{i,t}}$:

- **Employment ($\boldsymbol{Index\ number_{2006} = 1}$)**
- **Firms ($\boldsymbol{Index\ number_{2006} = 1}$)**
- **Income per capita (€, current prices)**
- **Sector diversification (Finger−Kreinin, $\boldsymbol{Index\ number_{2006} = 1}$)**

$$FK_{it} = 0.5 * \sum_{k} \left| \frac{Employees_{ikt}}{Employees_{it}} - \left[\frac{Employees_{A,k,t} - Employees_{ikt}}{Employees_{A,t} - Employees_{i,t}} \right] \right| \quad (1)$$

- $Employees_{ikt}$ is the number of employees in LMA *i* in sector *k* in year *t* .
- $Employees_{i,t}$ is the total number of employees in LMA *i* in year *t*.
- $Employees_{A,k,t}$ is the number of employees in Abruzzo in sector *k* in year *t*.
- $Employees_{A,t}$ is the total number of employees in Abruzzo in year *t*.

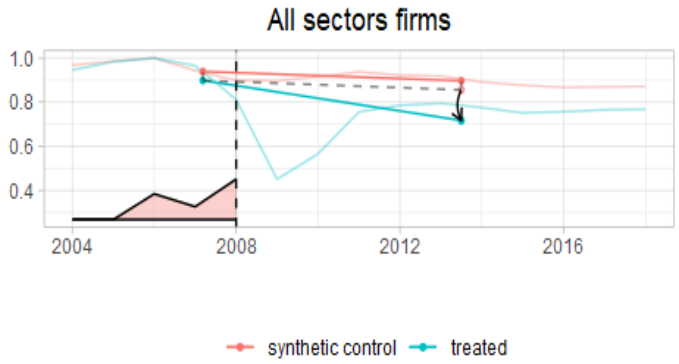
Methods

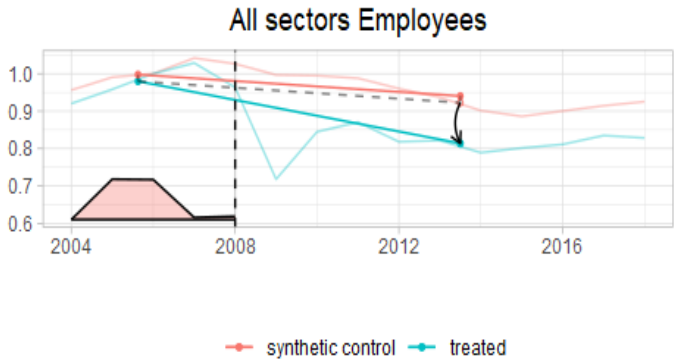
Synthetic Difference in Differences (SDID) estimator (Arkhangelsky et al. 2021). It estimates the ATT ($\hat{\tau}^{sdid}$) through the following two-ways fixed effects regression:

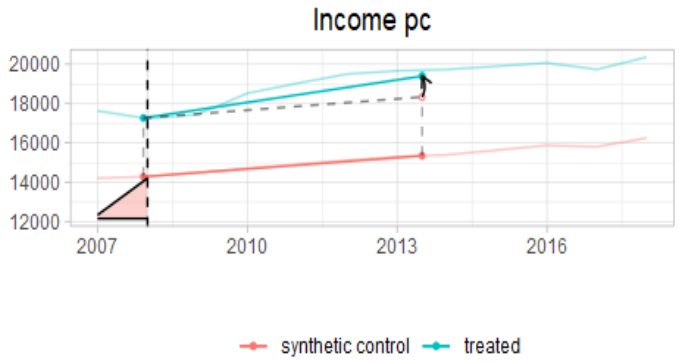
$$(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \underset{\tau, \mu, \alpha, \beta}{argmin} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{i,t} - \mu - \alpha_i - \beta_t - W_{i,t}\tau)^2 \hat{w}_i^{sdid} \hat{\lambda}_t^{sdid} \right\}$$

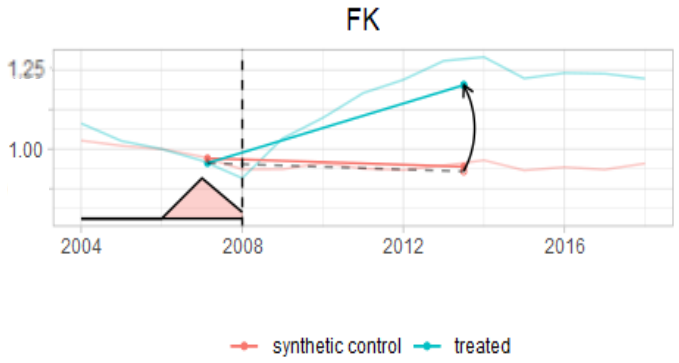
- $Y_{i,t}$ is the dependent variable
- μ is a constant term
- α_i and β_t are units and time fixed effects
- $W_{i,t} \in \{0; 1\}$ is the binary exposure treatment variable.
- $\hat{\boldsymbol{w}}_{\boldsymbol{i}}^{\boldsymbol{sdid}}$ and $\hat{\boldsymbol{\lambda}}_{\boldsymbol{t}}^{\boldsymbol{sdid}}$ are units and time coefficients weighting more units that on average are more similar in terms of their past to the treated units, and on periods that are on average more similar to the time frame when the treatment is performed.

Aggregate results (all sectors)





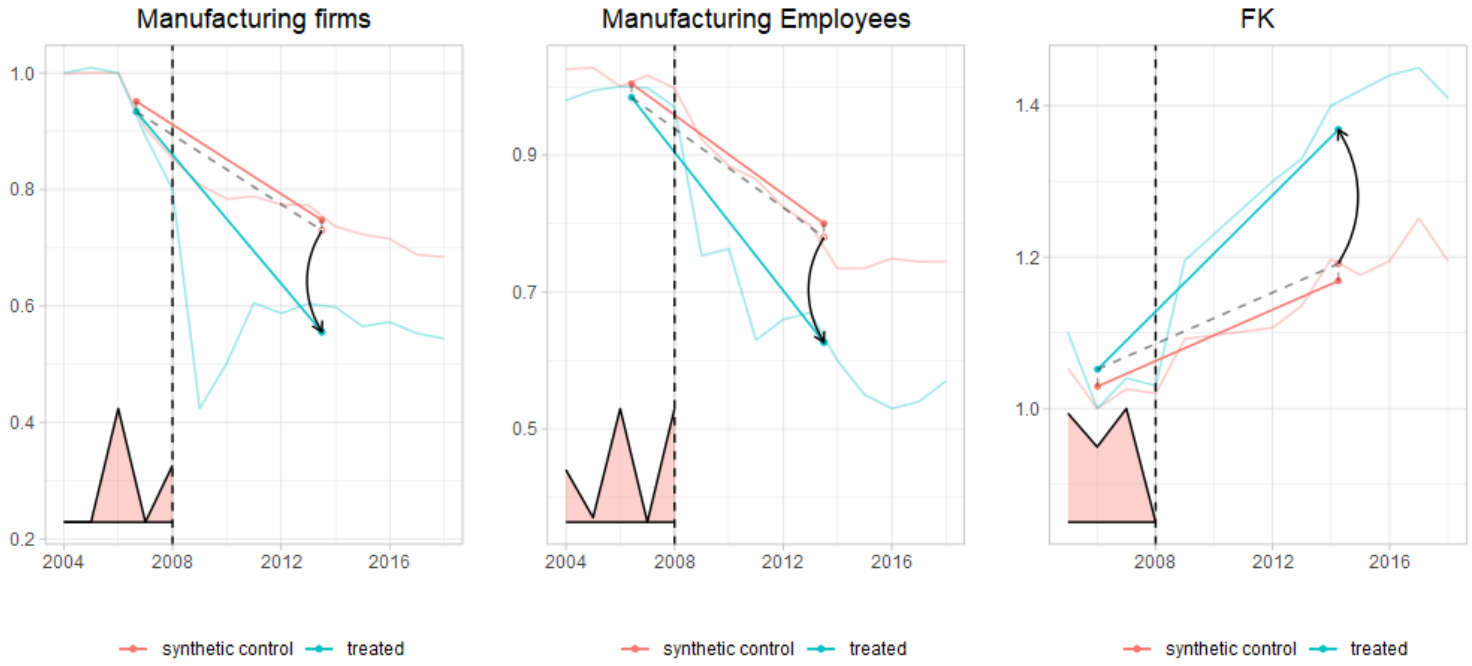




Variable	5 years	10 years
Firms	-0.213***	-0.139***
	(0.028)	(0.028)
Employees	-0.144***	-0.109**
	(0.043)	(0.058)
Income pc	902.459***	1060.586***
	(213.105)	(269.234)
FK	0.223***	0.236***
	(0.078)	(0.081)

- Five years after the earthquake, employment experienced a significant reduction compared to the synthetic control **(-14.4%).**
- Similarly, the number of firms was 21.3% lower than that observed in the counterfactual.
- Effects are **persistent** and not transient (as Basile et al. 2023 find).
- Contrarily, we find a significant growth of **income per capita** [**+1060€** ~ 6% of pre-earthquake per-capita income].
- We also observe a significant growth of **sector diversification** of "L'Aquila" with respect to other Abruzzo LMAs.

Results: manufacturing sector



Variable	5 years	10 years
Firms	-0.217*** (0.032)	-0.174*** (0.037)
Employees	-0.136* (0.075)	-0.153* (0.084)
FK	0.138*** (0.053)	0.177*** (0.064)

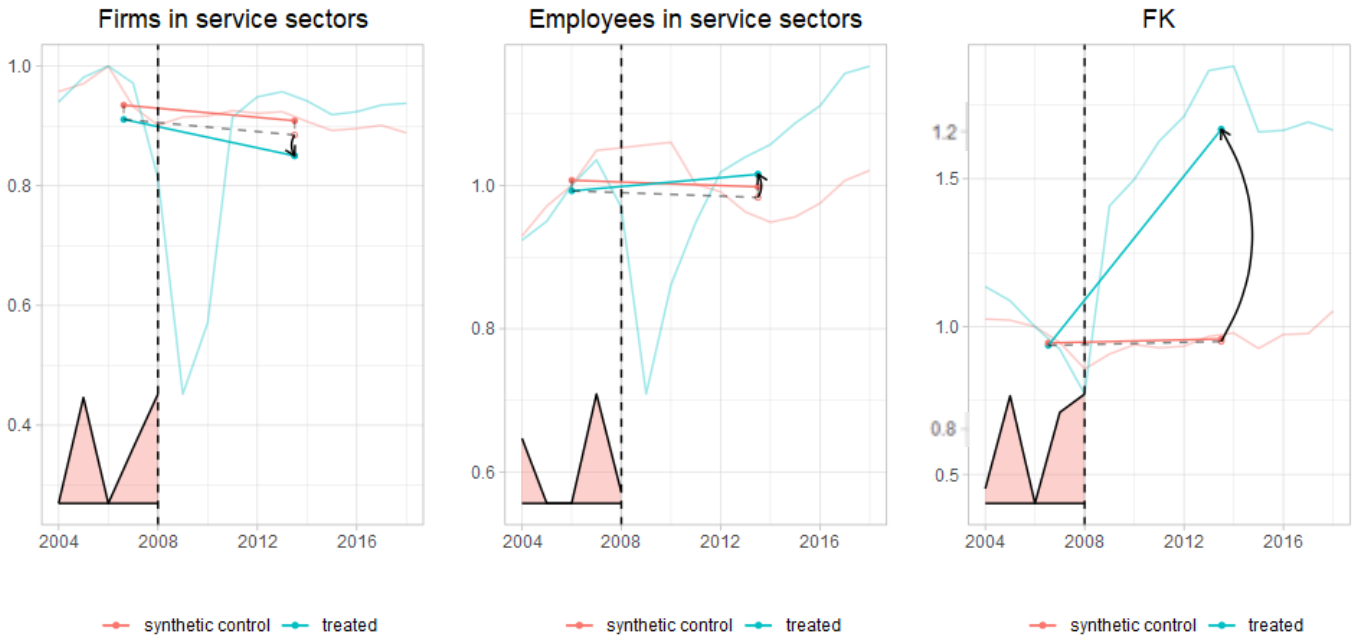
- L'Aquila's LMA experienced a reduction in the **number of local firms** 5 years after the event that is **21.7%** larger than that observed in the synthetic control.
- A similar evidence holds in terms of number of **employees** (**-13.6%**).
- The earthquake favored a dynamic of higher **sector diversification** of L'Aquila with respect to other LMAs, meaning that few specific sectors increased their relevance within the local economic structure and within the whole Abruzzo region.

Results: Employees by manufacturing subsectors (2-ATECO digits)

Sub-sector	5 years	10 years
Chemicals	-0.109* (0.058)	-0.254*** (0.084)
Electrical components	-0.021 (0.057)	-0.141* (0.082)
Electronics	-0.157** (0.080)	-0.327*** (0.128)
Food	-0.225*** (0.075)	-0.282*** (0.118)
Machineries	-0.063 (0.058)	-0.165** (0.082)
Metallurgy	-0.118* (0.062)	-0.122 (0.092)
Other manufacturing	-0.089* (0.049)	-0.123 (0.089)
Pharmaceuticals	0.080* (0.046)	0.071 (0.063)
Rubber and other plastics	-0.134** (0.064)	-0.099 (0.072)
Textile	-0.001 (0.045)	0.001 (0.059)
Transport	-0.001 (0.051)	-0.024 (0.075)
Wood-paper	-0.105* (0.058)	-0.120* (0.068

- The majority of **manufacturing sub-sectors** experienced a **significant downturn** on employment level, with effects that tend to be persistent over time.
- The most hardly hit sub-sector in the medium-short term is the "**Food**" industry with a reduction of number of employees compared to the synthetic control equal to -22.5%.
- The only sector showing a positive medium-short ATT is the "**Pharmaceutical**", with an 8% growth in employment compared to the counterfactual. This sub-sector also significantly raised its weight within L'Aquila's LMA shifting from 16.2% to 24.9% between the periods 2004-2008 and 2009-2018.

Results: services sector



Variable	5 years	10 years
Firms	-0.115***	-0.035
	(0.018)	(0.027)
Employees	-0.064*	0.001
	(0.037)	(0.058)
FK	0.266***	0.277***
	(0.147)	(0.144)

- We observe a **negative impact** of the earthquake in terms of both employees and number of firms five years after from the event.
- The effects are **not significant** when considering a **10 years horizon**.
- This means that the **services sector** experienced a **relevant rebound after the earthquake** allowing to achieve a level of activities that is similar to the pre-treatment period.
- Also in this case, we find that the service sectors tend to diversify in L'Aquila with respect to other LMAs.

Results: Employees by services subsectors (1-ATECO digit)

Sub-sector	5 years	10 years
Construction	0.489***	0.599***
	(0.107)	(0.125)
Professional activities	0.063	0.159**
	(0.084)	(0.073)
Restaurants and accommodation	-0.057	0.069
	(0.062)	(0.068)
Real estate	0.122*	0.413**
	(0.067)	(0.179)

- "**Construction**" and "**Real Estate**" sectors experience a **positive and significant** medium-short term ATT.
- This pattern coincides with the beginning of the **reconstruction activities**, that boosted such businesses.
- A significant growth in employees is observed also in the "**Professional Activities**" sector compared to the counterfactual.
- We do not spot significant results for the "**Restaurants and Accommodation**" sector.

Conclusions: general data

- The event disrupted the local economy both in terms of **employment** and **number of firms**, with effects equal to **-21.3%** and **-14.4%** 5 years after the earthquake.
- **Manufacturing** appears to suffer from **persistent effects** (10-years ATT equal to -15.3% and -17.4%), whereas **services sector** showed a **strong recovery** leading to not significant 10-years ATT coefficients.
- We found a strong pattern of **sector diversification** of "L'Aquila" compared to other Abruzzo LMAs, characterizing both Manufacturing and Service activities.

Conclusions: policy-related issues

- The **OECD** (2013) already highlighted that an observed **employment decrease in the manufacturing sector** was representing a **threat** for the economy of Abruzzo, suggesting that a regional innovation strategy was urgently needed. The warning is still valid.
- Employment in "**Construction**", "**Real Estate**" and "**Professional Activities**" will probably **decrease** once reconstruction activities are over (Ministero per la Coesione Territoriale 2012), therefore a relevant number of employees are at risk of **becoming redundant** unless firms specialize in tradeable goods and services and export know-how (Formez PA 2011).

The impact of natural disasters: how the 2009 earthquake transformed the economy of L'Aquila's labour market area

Thank you
for your attention!

giovanni.baiocchetti@unimi.it

francesco.scotti@polimi.it

pasqualelelio.iapadre@univaq.it