LOCAL ECONOMIC IMPACT OF HIGH-ENERGY PHYSICS (HEP) PROCUREMENT

Riccardo Crescenzi and Gabriele Piazza

London School of Economics and Political Science

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Outline

- **Motivation and aims**
- Case study
- The conceptual framework
- Counterfactual approach: Trajectory Balancing Method
- Preliminary Results
- Next steps

Motivation & Aims (1/2)

What we already know:

- Benefits for Large Research Infrastructures (RIs) suppliers– industrial spillovers study.

What we would like to discover:

- What are local socio-economic benefits that a particle-collider based RI set up as a worldwide distributed project can generate **beyond the boundaries of the supplying firms**? What is the spatial spread of these wider economic effects?

Our approach:

- Using cutting-edge methods, we devise a new framework to estimate the additional territorial impact of procurement **over and above what would have happened in its absence;**

- We test this approach by evaluating the impact of a large HEP procurement contract (XFEL) on the municipality of Schio in Italy, where E. Zanon, one of the two suppliers, is located.

Motivation & Aims (2/2)

Why we should care:

- SRF cavities are a key technology for the Future Circular Collider (FCC)
- Governments are interested in understanding the socio-economic returns from investing in Ris
- Lack of evidence on territorial impacts of RIs in general and HEP in particular supported by a suitable counterfactual;
- Greater demand for evidence when making public investment decisions;
- A growing interest in public procurement as a policy tool.

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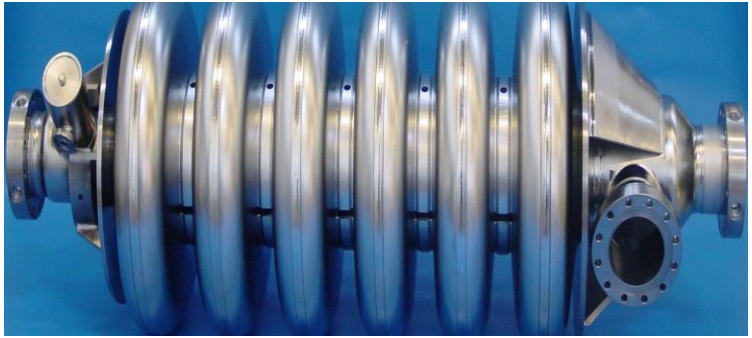
Scoping study: Why SRF cavities

We focus on specific types of procurement activities that have the following characteristics

- **Relevant for FCC-ee** ✔
- **Technology mainly developed for HEP** ✔
- **Production requires close collaboration between RIs and industry** ✔
- **Potential use outside HEP** ?



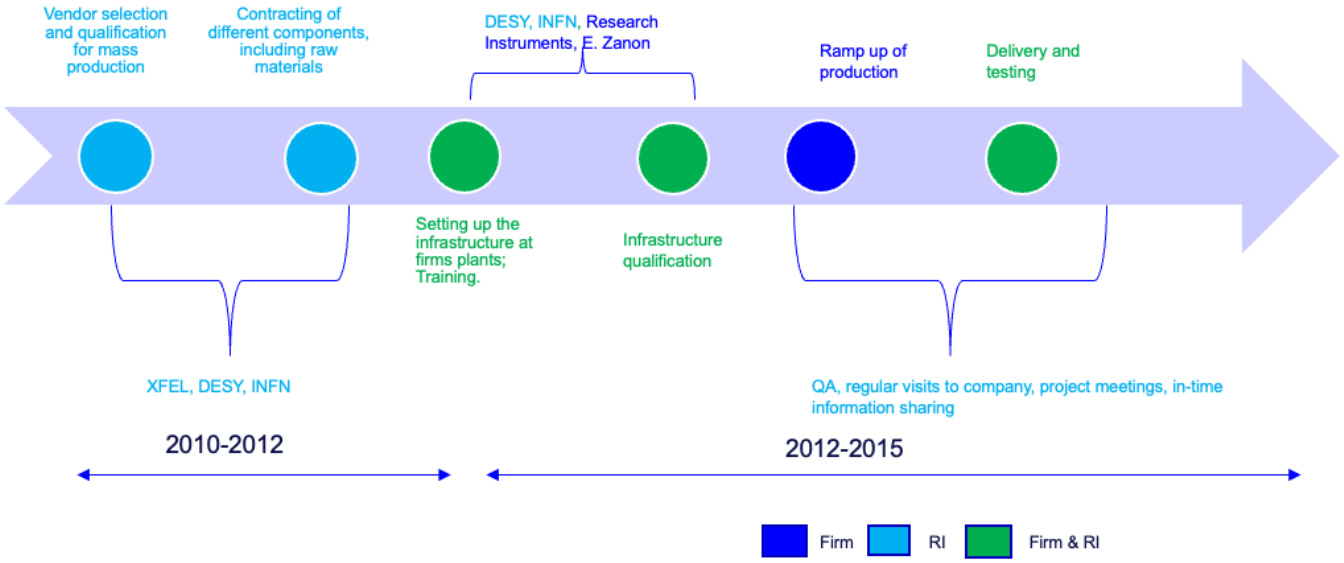
Scoping study: Why XFEL?

About EXFEL

- The largest production of SRF cavities in industry to date.
- **Number of cavities**: 840 cavities produced whose overall design was developed in the frame of TESLA R&D*
- **Manufacturers:** Production equally split between Research Instruments (HQ in Bergisch, Germany) and E. Zanon's physics branch (Schio, Italy) – first time, the surface treatment of the cavities was entirely done by firms.
- **Production period:** 2012-2015; the two companies were supervised by INFN (Italy) and DESY (Germany) – contracts were assigned in 2010.

Scoping study: SRF procurement

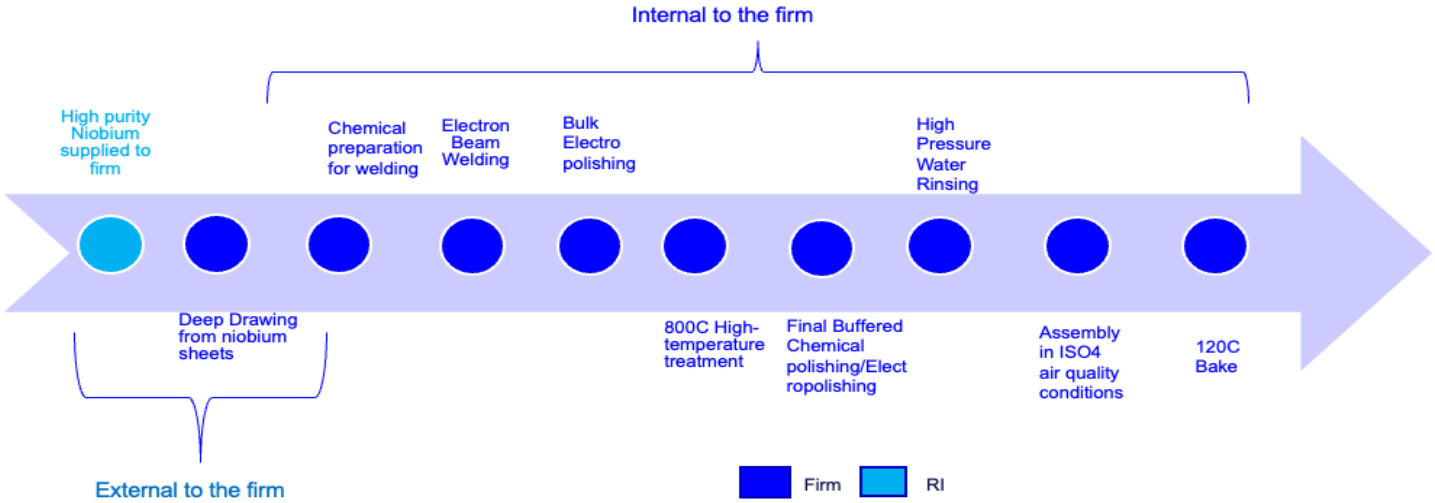
Figure 1: Overview of SRF procurement and production process for XFEL. Infrastructure upgrade and "build-to-print" contract led to **close collaboration between suppliers and research institutes**



Source: Based on information from Pagani (2012); Singer et al. (2013) and input with INFN and DESY staff

Scoping study: SRF manufacturing process

Figure 2: SRF cavities manufacturing steps - **Limited role for subcontractors**.



Source: Based on information from Pagani (2012); Singer et al. (2013) and input from DESY and INFN staff

Why E. Zanon?

We interviewed managers at both companies. We found out that:

- **E. Zanon Physics branch** (part of E.Zanon) has only **one site** in Schio (Vicenza), Italy. It had up to **60 employees (30 additional employees were recruited to fulfil the contract)** during the production for XFEL. Almost **all employees were involved in the XFEL project. ***
- **Research Instruments GmbH** has **two sites**: Bergisch Gladbach and Dortmund. It has 280 employees. **Only a third** of the employees were involved in the XFEL project.
- **E. Zanon is a more self-contained case and more suitable to test our approach for the territorial impact.**

**E. Zanon produced other cryomodule components for the EXFEL, but this were of low technological intensity*

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The conceptual framework: Local multiplier

Popularized by Moretti (2010), it conceptualized the local effects within **the general equilibrium framework:**

- **Tradable sector: Exposed to competition from outside the region.**
  Manufacturing, Agriculture, Information & Communication, Financial & Insurance Activities;

- **Non-tradable sector: Prices are set locally.**
  Construction, Hospitality, Real Estate activities, Transport, Wholesale & Retail;

Procurement contract as a positive economic '*shock*' (something that is exogenous and unpredictable) that can have:

- **Direct effects:**
  Procurement contracts can increase labour demand → higher employment and wages in the supplier's industry (+).

- **Indirect effects:**
  Rest of tradable:
  Increase in labour demand → higher labour costs (+) → lower employment (-)
  Increase in intermediate goods and services → higher employment (+)
  More agglomeration→ higher employment (+)

  Non-tradable:
  Positive effect on tradable→ higher demand for local services (+)→ higher employment and wages in non-tradable (+)

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Trajectory Balancing Method in a nutshell

To estimate the **additional impact**, we would like to compare the effect of this large HEP procurement contract on Schio municipality with a **counterfactual;**

Ideally, you would compare the change in the variables of interest in Schio with other municipalities with similar characteristics (**control group**)**.** But:

- Location choice can be endogenous;
- Only two companies in the world can produce SRF cavities in large quantities.

The **Trajectory Balancing Method (TBM)** is the best way to compare the effect on Schio with a 'counterfactual'.

TBM creates a synthetic Schio by making a weighted average of other local authorities that resembles Schio as closely as possible *before* the EXFEL procurement contract.

- **Main advantages**:
  - It identifies the **causal effect** of the procurement contract. This is the first time this approach has been used to estimate the local impact of HEP procurement and procurement more generally.
  - It can be replicated for other case studies (different technologies, firms, and regions) subject to data availability and identification of the effect.

- **Limitation**: Assumption of no other shock in the post-treatment period in the treated unit or similar shock in the donor pool units; **External validity**

How widespread is the impact?

To understand the spatial spread of the potential benefits, we intend to look at two geographical units:

- Municipality
- **Labour market Areas (LMAs)**: larger geographical area that accounts for commuting patterns:
  - Schio LMA includes 18 municipalities
- But it is essential to be aware of the trade-off:
  - Municipality: easier to attribute the impact but not capture the effects in neighbouring areas
  - LMAs: the product is more diluted and more confounding factors

Figure 3: ISTAT 2011 definition of Schio TTWA – 18 municipalities

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Initial Preliminary Results: Manufacturing

Figure 4: Trends in manufacturing employees

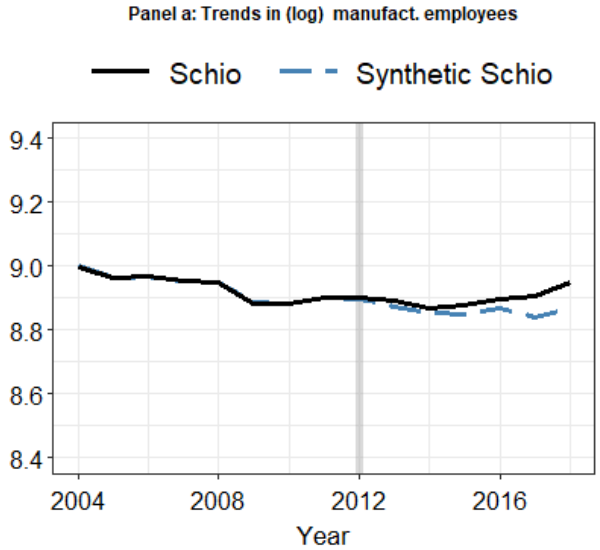
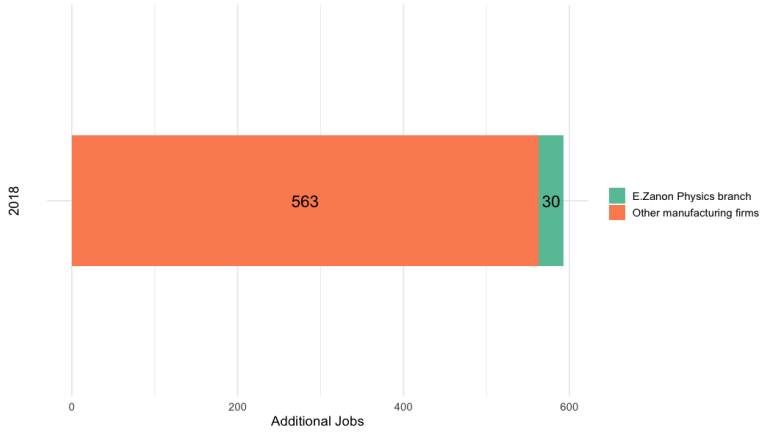


Figure 5: Additional manufacturing employees in Schio, 2018



Note: Estimates based on counterfactual analysis and insights from interviews

Next steps

Counterfactual analysis:

- Estimating the effects for other sectors and geographical units;
- Conducting robustness checks;
- Understanding how these results compare to other local “shocks.”

Context knowledge

- Gaining more context knowledge – what has happened in the economy of Schio and neighbouring areas in the post-treatment period?
- How many of these jobs can we attribute to the procurement contract?

External validity

- Depending on interest, data availability, assessing whether these findings can be generalized to other settings

Any questions or suggestions

E-mail: G.piazza@lse.ac.uk

Appendix Schio and E. Zanon Location

Figure 6: **Schio** is a 39,000 municipality, located in the province of **Vicenza**, in Northeastern Italian region of **Veneto**

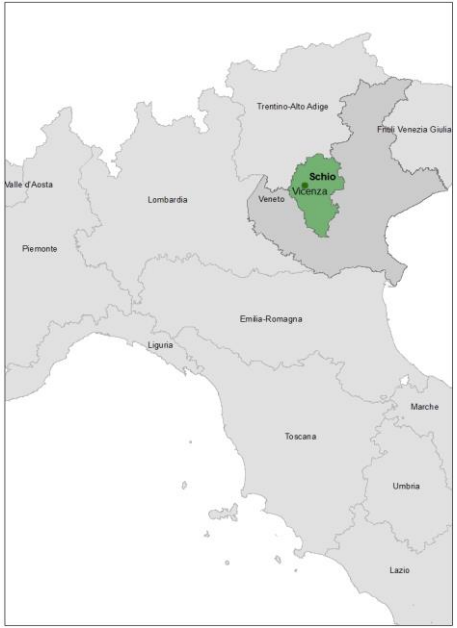
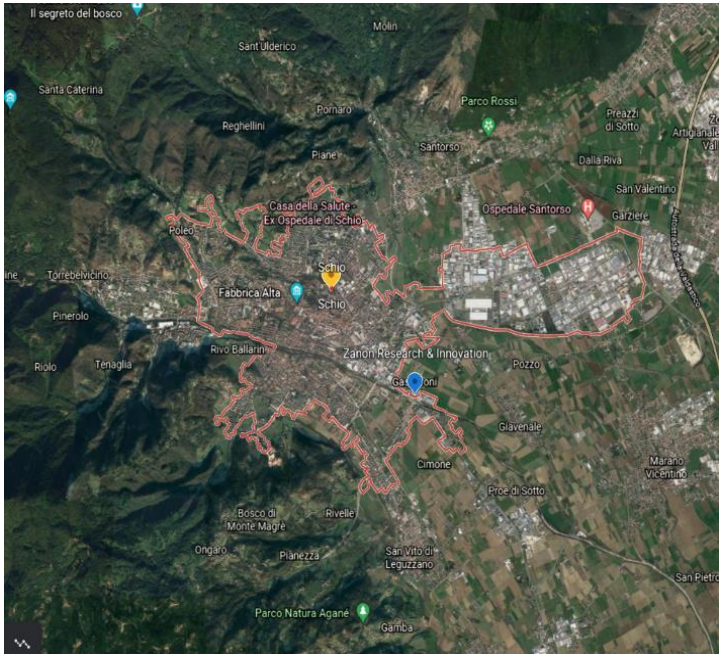


Figure 7: **E. Zanon** (now Zanon Research & innovation) is located close to the administrative boundary – **blue pin** in the map below



Appendix: E. Zanon

- Zanon was set up in 1919 by Ettore Zanon and started by manufacturing tanks for the local textile industry.
- It started its activity with Research Institutes in the 1970s.
- In the 1990s, it started producing the first niobium cavities.
- In 2010, with the award of the EXFEL contract, a new facility was installed.
- After EXFEL, E. Zanon won other scientific research contracts, including ITER.
- The pressure equipment division was acquired in 2019 by Brembane & Rolle S.p.A.
- In 2020, the “Physics” business branch was acquired by Simic Spa, another Italian company, and a new company, Zanon Research & Innovation was set up.

Appendix: Data

- **ASIA: Italian Business Register for Local Units – employees data:**
  - 2004-2018 panel, aggregated at the municipality level, by selected ATECO sections. We follow the OECD (2018) definition and we create:
    Tradable sector: Business activities, Manufacturing, Mining & Quarrying, Electricity, Finance;
    Non-tradable sector: Construction, Wholesale & Retail, Transport, Education, Health & Social, Hospitality.

- **Italian CENSUS 2011:**
  - Selected variables to use as covariates: population density, employment rate, population change (2001-2011), share of young population with a degree, share of workers in high-skilled occupations.

- **IRPEF Data**
  - Data on taxable income from subordinate employment provided by the Italian Ministry of Economy and Finance, 2004-2018 as a proxy for wages;

- **OMI (Italian Properties Observatory) valuations:**
  - data on house prices (*Work in progress*);

Appendix: Data restrictions

- **When implementing the TBM, we follow Abadie (2021) and we impose the following restrictions:**

1. To ensure that the control units in the donor pool resemble Schio as much as possible, we follow Cerqua (2022) and include only the municipalities in Northern Italy with a population size close to Schio (% 50 more or less than Schio's population);

2. To minimize the possibility that other units in the donor pool have a received a similar treatment, we use CERN procurement data to exclude all the municipalities that have received large procurement contracts in the post-treatment period (sum of all the CERN procurement contracts assigned to local firms exceeded 1 million CHF);

3. To enforce the non-interference assumption, we exclude the neighbouring municipalities part of the same Local Labour Market System - a geographical unit created by ISTAT that takes into account for commuting and living patterns.

→ *After imposing these restrictions, our sample includes 142 municipalities*

Appendix: Balance table and donor pool

Table 1: Balance table for manufacturing

	Schio	Average Northern municipalities	Synthetic Schio (TBM)
(Log) Employees in non-tradable (2004-2012)	8.4	8.3	8.5
(Log) Average employee income (2004-2012)	9.9	9.9	9.9
Population (2011)	39131.0	30619.2	38963.9
Population density (2011)	591.1	1366.6	605.9
Share of high-skilled population (2011)	35.2	33.3	31.3
Share of young people with a degree (2011)	23.1	24.7	23.1
Population change (2001-2011)	0.4	0.6	0.4
Employment Rate (2011)	48.3	49.9	48.3

Table 2: Control group weights – manufacturing (top 10)

	TBM weights
CORNAREDO	0.22
BELLUNO	0.17
TREVIGLIO	0.14
MARIANO COMENSE	0.09
MARTELLAGO	0.07
SEREGNO	0.06
SENAGO	0.06
SEGRATE	0.05
CESENATICO	0.04
SAN BONIFACIO	0.03

External validity

- A potential limitation is: to what extent can the insights from this study be generalized to other settings?

- A number of factors could be playing a mediating role:
  - Type of contract (Czarnitzki et al., 2018);
  - Technology (Castelnovo et al., 2018)
  - Firm characteristics (evidence from MNEs literature on knowledge spillovers, see Crescenzi et al., 2022);
  - Regional characteristics (Backman, 2014; Ganau & Rodrigez-Pose, 2019);

- The case study of this project should be considered **a pilot to test this novel approach** that can be potentially adapted for other settings, depending on**:**
  - Demand
  - Data availability
  - Additional resources