4th INTERNATIONAL WORKSHOP ON HIGH-SPEED RAIL SOCIOECONOMIC IMPACTS

Relationship between real estate prices and High-Speed railway services in Italy

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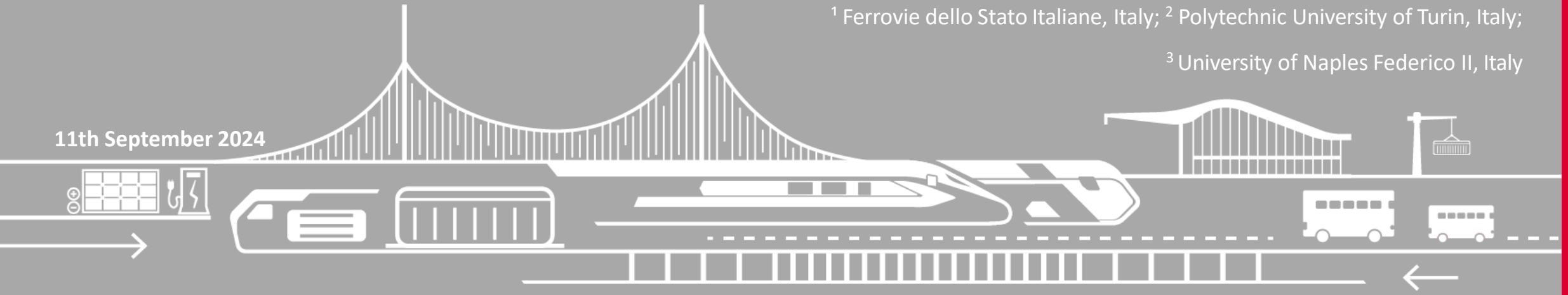

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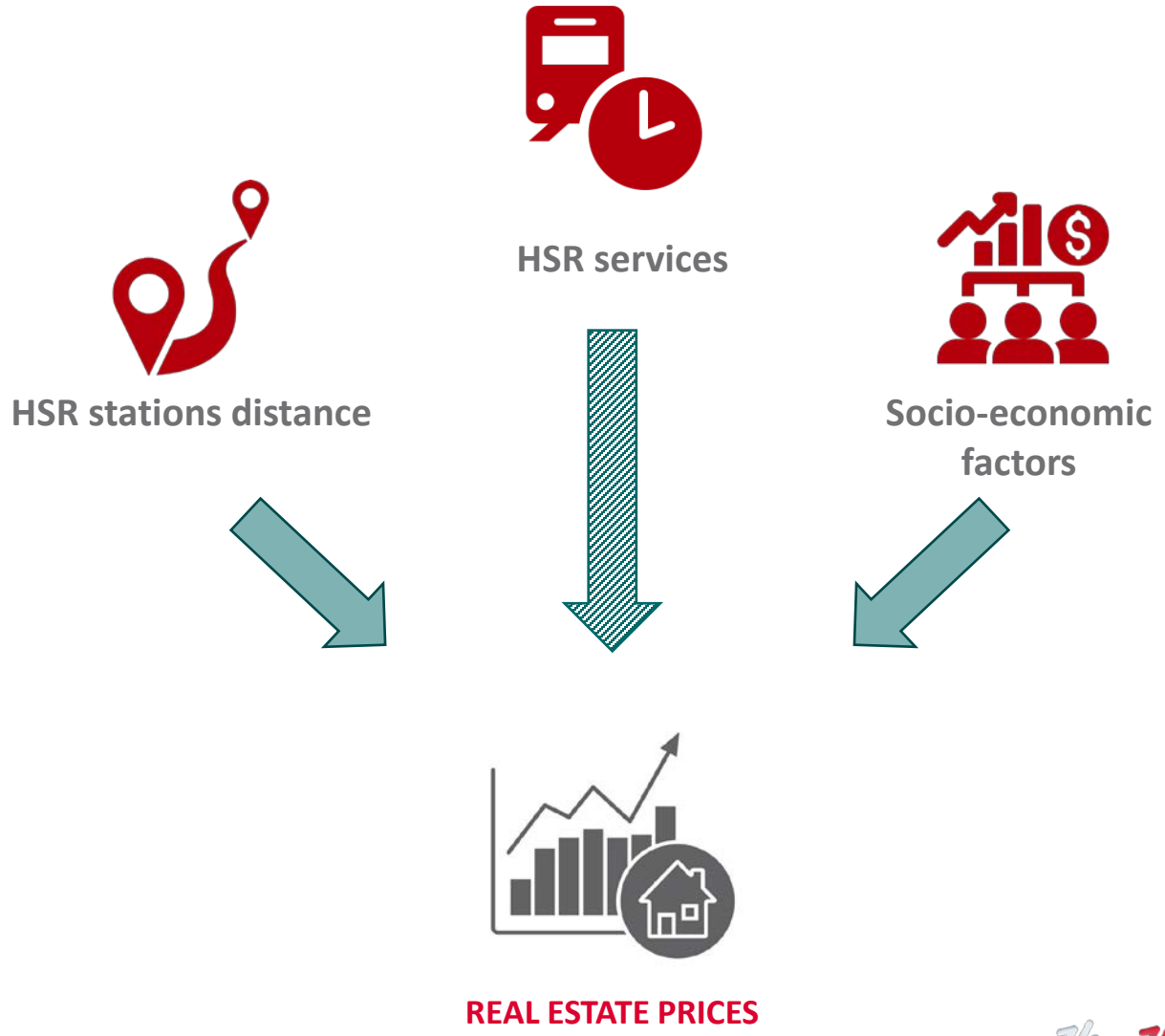
Study object

Investigating the relationship between **real estate prices** and Italy's **HSR services**.

- Based on HSR service **frequency, journeys** and **time**.
- Considering the effects of the **distance** to HSR stations.
- Assessing the **socio-economic factors** influencing real estate prices.



Literature review

High-Speed Rail impact overview

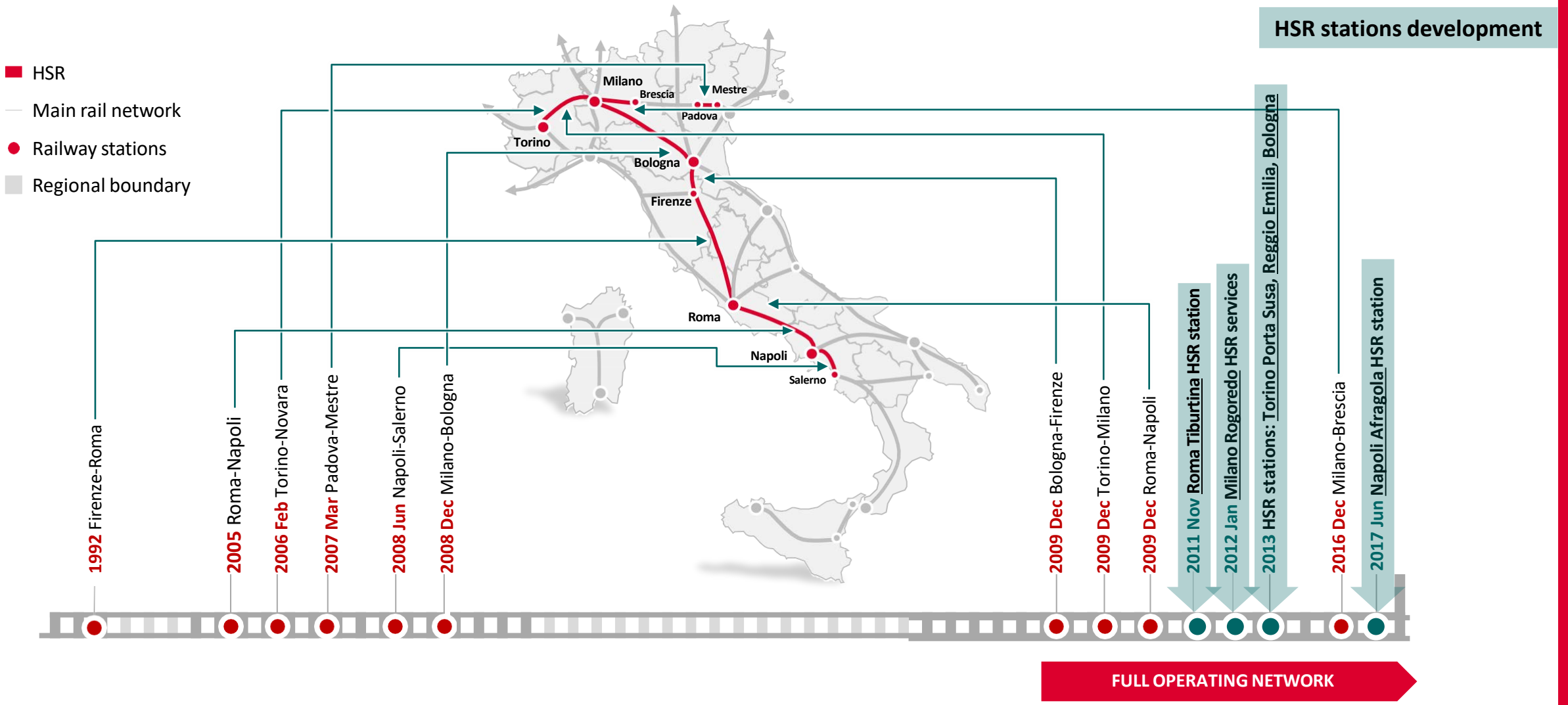
- Reports show that the impact of transport, neighbourhood and property characteristics affect **housing prices**.
- *Compared to conventional rail systems (Huang and Du, 2021), HSR operating over medium to long distances, reducing journey times and providing services, can also affect the **real estate market**.*
- The urban form of the city has changed due to the presence of HSR that has boosted the **real estate market** to reallocate resources near stations according to new travel demand needs. (Di Ruocco I., Mauriello F., Pagliara F., 2022).
- The literature has estimated **positive gains** in property values **near** stations for most rail systems.
- *HSR has a minor effect when the **distance** of the property from the HSR increases. (Di Ruocco I., Mauriello F., Pagliara F., 2022).*
- A small number of studies have found that at locations very close to stations or railway lines, property and land values have **reduced**. (Diaz, 1999)
- Although on average rail schemes tend to have economic benefit on land and property values, there is a **large variation** in estimates across case studies.
- *The house prices change between two cities linked by HSR services is influenced also by some **socio-economic variables**, like growth rate, population density, GDP, unemployment rate. (Pagliara F., 2019).*

Literature review

Variables in studies on HSR vs Property values

- '*High Speed Rail, megalopolis and house prices: what is the link?*'. (Pagliara F., 2019):
  - Dependent variable:
    - **House price change** between two cities under analysis
  - Independent variables:
    - **Transportation system variables**: **HSR travel time**, HSR travel cost, **HSR frequency**, HSR comfort
    - **Socio-economic variables**: Population growth rate, **Residential density**, Migration rate, GDP, Unemployment rate
- *'Impacts of High Speed Rail on residential property prices in Italy: a panel-data set analysis*'. (Di Ruocco I., Mauriello F., Pagliara F., 2022):
  - Dependent variable:
    - **Residential property value**
  - Independent variables:
    - **Transportation system variables**: **HSR opening year**, Metropolitan city, HSR distance to main road
    - **Attractiveness variables**: School, Shopping centre
    - **Socio-economic variables**: Population, **Population's density**, **Income per capita**, GDP, Unemployment

The case study: Italy's High Speed Rail System



Methodology and data

Based on previous literature, the study will employ a **Hedonic Pricing Model** implemented through a **Generalized Linear Model**.

The study has been conducted on the **2007 - 2019** period.

DEPENDENT VARIABLE:

Data	Unit	Source
Average price of **residential** buildings	€/m^2	Estimate and Observatory on Real Estate *The Revenue Agency*
Average price of **commercial** buildings	€/m^2	
Average price of **office** buildings	€/m^2	

INDEPENDENT VARIABLES:

Data	Unit	Level	Source
Service frequency	stops/day	Station	Train Timetable
Travel time to Roma Termini	minutes	Station	Train Timetable
Population density	inhabitants/km^2	Municipality	ISTAT
Average income	€	Municipality	ISTAT
Distance to HSR station	m	Station	*Authors' processing*

HSR data

Sources

Data has been gathered for 9 stations served by HSR services on the main HSR corridor:

- The study focused on a subset of **6** out of 9 original stations to analyse residential prices.
  This selection was made because the 6 stations are located in neighbourhoods predominantly featuring **residential properties**.

- This focus allows for a more detailed analysis of how HSR services impact residential prices in areas where residential properties are the primary land use. For this reason, stations situated in neighbourhoods with a high prevalence of **commercial properties** were not included in the study.

HSR data

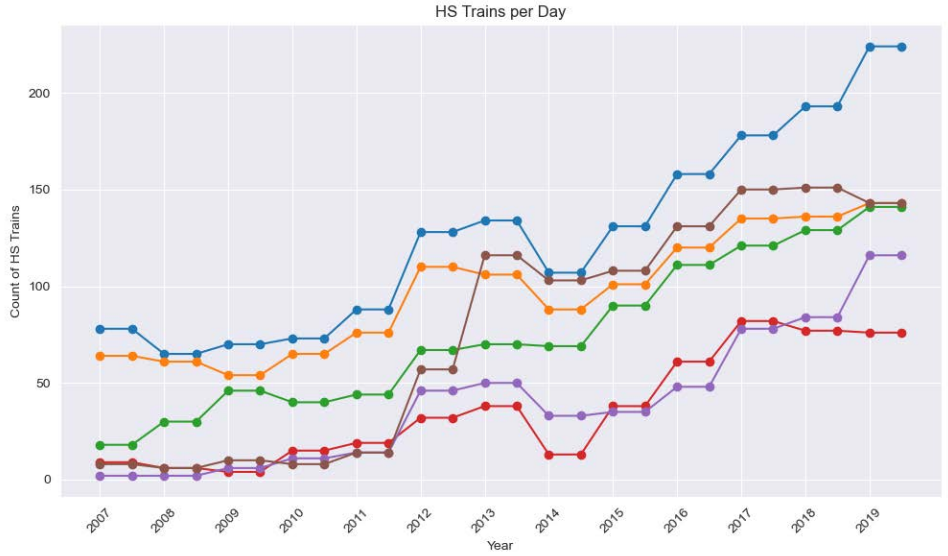
Sources

The data on the HSR services are the following:

- **Service frequency**
- **Travel times**

The type of HSR services considered are the following (through the years):

- **Eurostar Italia**
- **Frecciarossa**
- **Frecciargento**
- **Italo Treno**

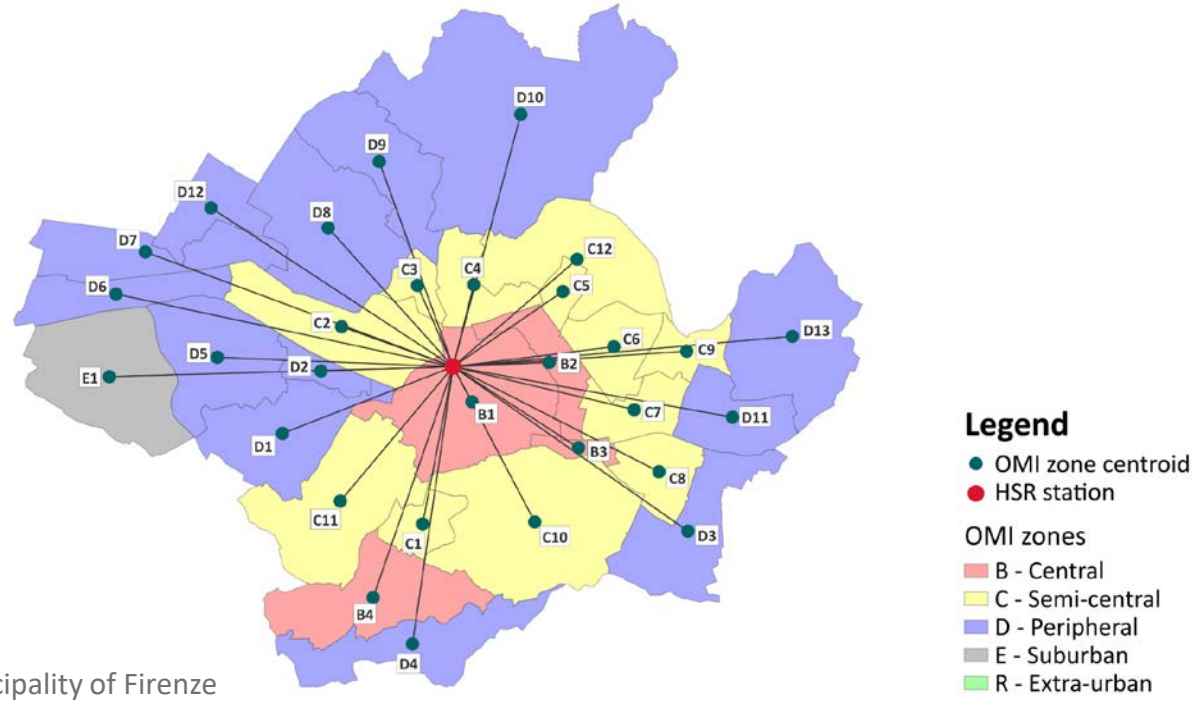


Real estate data

Sources

Real estate data has been gathered from the **Estimate and Observatory on Real Estate** – *The Revenue Agency* (**OMI** – Osservatorio del Mercato Immobiliare – Agenzia delle Entrate).

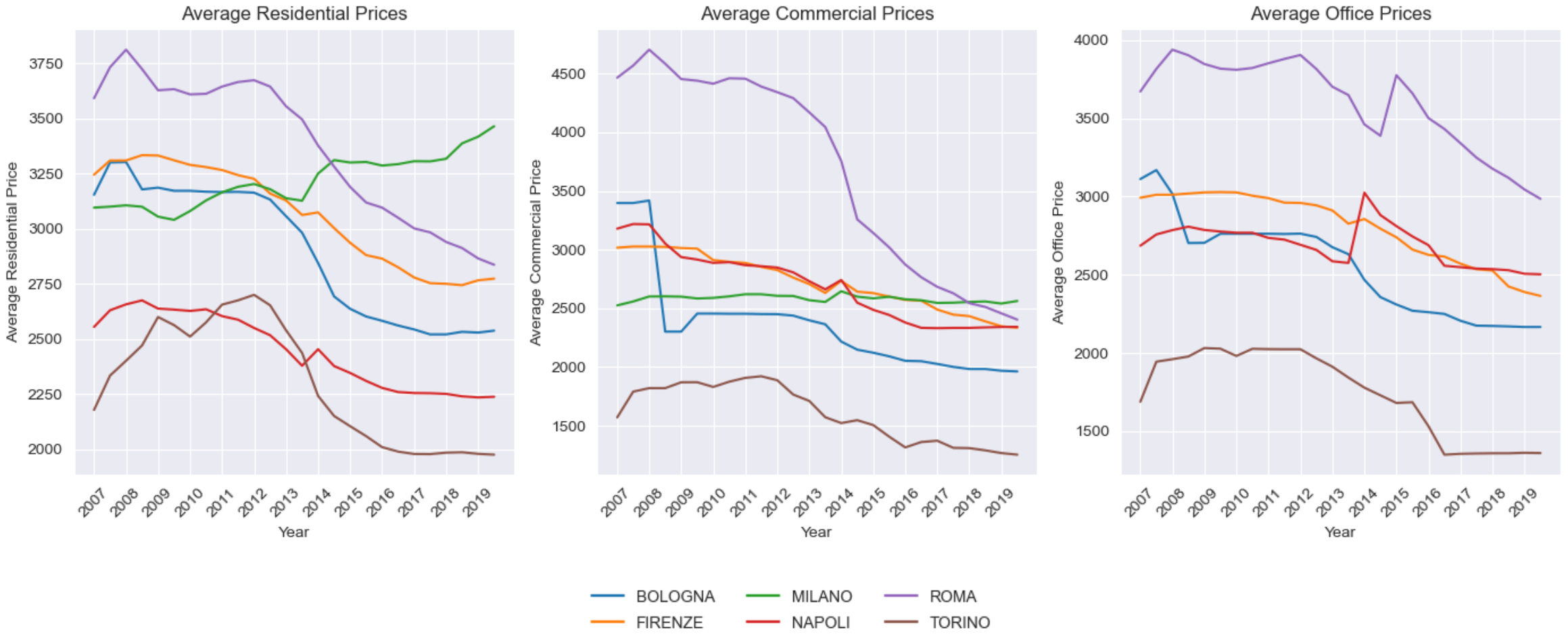
- The national OMI database divides each municipality in different **homogeneous zones**.
- For each zone, minimum and maximum average market values expressed in €/m^2 are provided for **residential**, **commercial** and **office** buildings.



OMI Zones from the municipality of Firenze

Real estate data

Trends from OMI Observatory



Analysis

Research design

The following fixed effects panel data regression model is estimated:

$$ln(price\_residential) = \beta_1 \cdot distance\_HS\_station + \beta_2 \cdot pop\_density + \beta_3 \cdot avg\_income + \beta_4 \cdot num\_HS\_trains + \beta_5 \cdot time\_Roma\_Termini + \beta_5 \cdot years\_HSR + \alpha_i + \varepsilon_{i,t}$$

where:

- *ln(price_residential)* is the natural logarithm of the **average prices** of residential buildings;
- *distance_HS_station* is the **distance** from the OMI zone's centroid to the HSR station;
- *pop_density* is the **population density** for the station's municipality;
- *avg_income* is the value for the **average income** in the station's municipality;
- *num_HS_trains* is the **number of trains** that stops in a working day in the station;
- *time_Roma_Termini* is the **average travel time** from the station to Roma Termini and vice-versa;
- *years_HSR* is the difference in **years from the activation** of HSR services in a station;
- α_i and $\varepsilon_{i,t}$ are the individual fixed effect term and the error term for individual *i* at time *t*.

Results and discussion

	Dependent variable:
	log(price_residential)
distance_HS_station	-0.00004***
	(3.669e-06)
pop_density	0.0002***
	(9.183e-06)
avg_income	0.00004***
	(2.195e-06)
num_HS_trains	0.0002***
	(3.726e-05)
time_Roma_Termini	-0.001***
	(3.901e-05)
years_HSR	-0.031***
	(7.098e-04)
Observations	11,937
R^2	0.548
Adjusted R^2	0.521
F Statistic	2,278.201*** (df = 6; 11266)
Note:	*p<0.1; **p<0.05; ***p<0.01

The **distance** between OMI zone and HSR station has a negative effect, indicating that prices drop as the distance increases.

Population density has a positive effect on housing prices.

Average income also has a positive effect on housing prices.

Housing prices show a positive correlation with **train frequency**.

Housing prices show a negative correlation with **travel times** to Roma Termini station.

This result shows that the positive effect of HSR services on housing prices seems to **decrease over time**.

Conclusions and further developments

Main findings:

Opening a HSR station served by HSR services with a *high frequency*, *reducing connection time* between cities, leads to **increasing property values**. The positive effect of the HSR services, decrease with the distance from the HSR station.

Further developments:

After having reached these preliminary results, it would be possible to:

- Analyse the relationship between **commercial prices** and HSR services, in HSR stations located in mainly commercial areas, like Torino Porta Nuova and Milano Centrale.
- Compare the effects of the HSR services in main metropolitan cities, with singular real estate dynamics, with the effects in **smaller cities** (i.e. Bari, Verona, etc.) outside the 'T corridor'.
- In relation with the previous point, compare the effects of the HSR stations analysed in this study with other stations not too far from those HSR stations, as a sort of **control areas**.
- Extend the **time series**, considering also the years after Covid-19, but having almost 2-3 years out of pandemic effects.

Thanks