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SCUOLA DI INGEGNERIA INDUSTRIALE
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EXECUTIVE SUMMARY OF THE THESIS

Railway Accessibility and Property Values around Stations in Italy: HPM–SUR Evidence on Residential and Commercial Prices and Rents

TESI MAGISTRALE IN MOBILITY ENGINEERING – INGEGNERIA DI MOBILITÀ

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ACADEMIC YEAR: 2026-2027

1. Introduction

Transport infrastructure can generate benefits beyond direct user time savings. When accessibility improves, part of the benefit can be transmitted to external systems—especially the labour market and the real-estate market—through mechanisms commonly discussed under Wider Economic Impacts (WEIs) [9] and land value capture. In station areas, these mechanisms matter for policy because they connect mobility interventions to measurable economic outcomes such as property prices and rents, which in turn inform investment prioritization and funding strategies.

While international evidence on rail accessibility and property values is extensive, nationwide evidence for Italy remains limited due to fragmented data and inconsistent coverage, often forcing decision-makers to rely on local case studies that are difficult to generalize. This thesis addresses this gap by developing a station-level econometric and decision-support framework to quantify how railway accessibility, multimodal integration, and urban context are associated with real-estate outcomes across Italy.

2. Research objectives and contributions

The This thesis pursues three interrelated objectives:

1. Quantify and interpret how station-area attributes (rail services, accessibility, multimodal services, land-use intensity, and socioeconomic context) [4] relate to real-estate outcomes in four segments:

- residential purchase prices
- residential rents
- commercial purchase prices
- commercial rents

2. Compare purchase vs rental markets within each sector using hybrid log–level Seemingly Unrelated Regression (SUR) and Wald tests to determine whether the same determinants are valued differently by buyers vs tenants (capital values vs willingness-to-pay).

3. Translate estimates into policy outputs via a scenario engine that applies standardized intervention "levers" and reports impacts in units used by practitioners (€/m² and €/m²/year, and scalable to a reference floor area such as 100 m²).

Original contribution. Beyond estimating hedonic relationships, the thesis provides a structured bridge from econometric evidence to implementation-oriented scenario metrics suitable for station-area planning and asset strategies, while showing that purchase prices and rents often respond systematically but differently to the same attributes.

3. Data and indicators

3.1 Dataset and unit of analysis

The empirical analysis is based on a 2023 cross-sectional dataset of 985 Italian railway stations, corresponding to about 43% of the stations managed by Rete Ferroviaria Italiana (RFI). Station surroundings are operationalized using a 1 km radius buffer as a consistent approximation of the pedestrian catchment around each station. Real-estate outcomes are extracted from OMI for station surroundings, modelling both stock values (purchase prices) and flows (rents) for residential and commercial markets.

Station Class	Sample Dataset	Sample Dataset [%]	RFI Network (Population)	RFI Network (Population) [%]
Main Hub	0	0%	25	1%
Hub	32	3.25%	53	3%
Major	60	6.09%	114	6%
Plus	120	12.18 %	242	12%
Local Plus	259	26.29 %	518	25%
Local	514	52.18 %	1104	54%

Table 1: Comparison between the sample dataset (985 observations) and the full RFI network across station classes.

Table 1 demonstrates that the sample closely mirrors the RFI network across station classes (excluding Main Hubs, which are too few for a representative subsample), supporting national station-level inference.

The dataset integrates three information blocks:

1. Railway services and multimodal accessibility (e.g., daily trains by service type; train catchment area

within 1 hour; presence of sharing services and facilities)

2. Socioeconomic context at municipal level (notably GDP per capita; tourist orientation classes)
3. Land-use and local environment (catchment areas by mode, distances to attraction poles, counts of services/commerce/schools, residents and jobs, etc.)

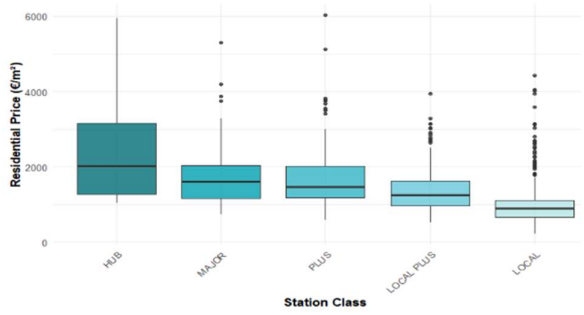

Figure 1: Distribution of Residential Property Prices (€ / sqm) by Station Class

Figure 1 shows a clear gradient: higher-tier stations (Hub/Major) are associated with higher residential purchase prices than Local/Local Plus contexts.

3.2 Composite and latent constructs

A key modelling choice is to represent multidimensional station characteristics through latent constructs, recognizing that concepts such as perceived accessibility, residential attractiveness, and multimodal integration are not captured by single observed indicators. Confirmatory Factor Analysis (CFA) is used as a dimensionality-reduction tool to build composite constructs (e.g., Residential Attractiveness; Rail Centrality & Connectivity; Long-distance Supply; Sharing Services; Distance to Attraction Poles).

Table 2: Confirmatory Factor Analysis (CFA) results – Unstandarized and standardized loadings

Latent construct	Observed indicator	Loading (unstandardized)	Loading (standardized)
Residential Attractiveness	res	1.000	0.041
	school	0.551	0.844
	commerce	19.082	0.968
	services	1.955	0.959
Railway Centrality & Connectivity	train_reg	1.000	1.001
	catchment_train	0.282	0.727
Long-distance Railway Supply	train_longhaul[4]	1.000	0.686
	train_regv	1.020	0.549
Sharing Services	taxi_parking	1.000	0.555
	sharing_car	1.201	0.644
	parking_bike	0.800	0.541
	sharing_bike	0.441	0.434
	bike_lanes	7.323	0.618
Distance to Attraction Poles	dist_to_hospital	1.000	0.548
	dist_to_edu	1.922	0.680

These constructs are used both to reduce multicollinearity and to preserve interpretability in the regression models.

4. Methodological framework

4.1 Hedonic modelling strategy (MLR)

The thesis adopts a hedonic price modelling [1] logic, where real-estate outcomes are explained as a function of accessibility, land-use intensity, and socioeconomic context—operationalized at station level.

The baseline regression structure can be expressed as:

$$Pi = \alpha + k\sum\beta kZik + l\sum\gamma lLVil + \varepsilon i$$

where $P_i$is the real-estate outcome (€/m² or €/m²/year), $Z$are observed variables, and $LV$are latent variables from CFA.

Four separate Multiple Linear Regression (MLR) models are estimated: residential purchase, residential rent, commercial purchase, commercial rent. Variable inclusion follows a combined approach: theory-driven selection supported by diagnostic screening, multicollinearity checks (VIF), and algorithmic selection procedures (forward/backward/stepwise/best subset) to improve robustness while maintaining interpretability.

4.2 Joint estimation and cross-market comparison (hybrid log–level SUR)

To compare purchase and rental markets within each sector, the thesis estimates Seemingly Unrelated Regression (SUR) systems, allowing correlated error terms across the price and rent equations. A hybrid log–level specification is adopted: strictly positive continuous variables are log-transformed (elasticities), while dummy/level variables remain in levels (semi-elasticities). Cross-equation Wald tests assess whether coefficients are statistically different between price and rent equations for the same variable.

This design is central to the thesis as it treats purchase prices and rents not as interchangeable proxies, but as outcomes linked to different behavioural horizons—capital valuation vs short-run willingness-to-pay.

5. Key empirical findings

Across the four hedonic models, results show consistent roles for (i) demand fundamentals, (ii) rail and multimodal accessibility, (iii) urban centrality and amenities, and (iv) tourism context—with systematic differences between asset values (purchase) and flows (rents).

5.1 Residential purchase prices

Purchase prices are most strongly associated with GDP per capita and with rail accessibility constructs (centrality/connectivity and long-distance service supply). Amenities and urban quality matter (parks positive; distance to key attraction poles negative). Tourism pressure (hotels/BnB and interactions) is associated with additional price premiums in touristic contexts. Car-oriented catchments are negatively associated with prices, while multimodal/sharing signals correlate positively. Parking shows heterogeneity: private parking is generally negative but becomes positive in local contexts (scarcity/quality signal).

5.2 Residential rents

Rents reflect the same broad mechanisms but place greater emphasis on day-to-day usability: frequency/service intensity and practical accessibility features show strong positive associations, while car-oriented catchments remain negative. Tourism pressure is strongly linked to higher rents, consistent with competition between long-term rental markets and short-term accommodation.

5.3 Commercial purchase prices

Commercial values reflect demand fundamentals (GDP per capita), activity intensity (commerce), tourism pressure (hotels/BnB), operational access (frequency), and shared mobility availability. Urban centrality raises values and distance from centres reduces them. Rail service effects differ by category (e.g., InterCity positive; RegV negative), consistent with service types correlating with distinct station/urban

archetypes rather than a uniform "more rail is always better" mechanism.

5.4 Commercial rents

Commercial rents emphasize short-run performance: frequency, commerce intensity, and tourism pressure are positive; distance from centres is negative; parks show a small positive association. Long-distance supply appears slightly negative, consistent with some long-distance nodes not necessarily maximizing short-run retail footfall. Parking remains context-dependent.

6. Purchase vs rent comparison: SUR evidence

6.1 Residential markets (Log–SUR)

The SUR results confirm that several shared determinants affect both purchase prices and rents but with statistically different magnitudes, consistent with distinct valuation horizons.

Figure 2: Comparison of Residential Purchase Price vs Rent Coefficients (mutual Significant Variables)

Figure 2 supports a two-channel interpretation: purchase prices place relatively more weight on structural/economic factors, while rents are relatively more sensitive to usability-related factors (e.g., last-mile convenience and proximity to essential poles). Wald tests reject equality for several shared variables, confirming structural differences between the two residential tenure markets.

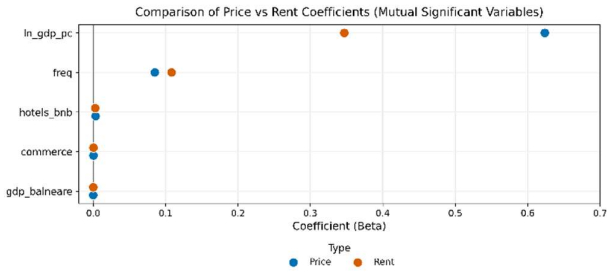

Figure3: Comparison of Commercial Purchase price vs Rent Coefficients (mutual Significant Variables)

In commercial markets, local economic context is disproportionately capitalized into asset values, while operational accessibility (notably service intensity) is more strongly reflected in rents, consistent with the cash-flow nature of commercial leasing.

7. Policy translation: scenario engine and decision-support outputs

A distinctive element of the thesis is the translation of SUR estimates into a policy scenario engine for station-area decision-making. Standardized intervention "levers" (e.g., adding shared mobility services, expanding bike lanes/bike parking, improving service supply, and reducing effective access impedance to key poles) are applied to station archetypes to produce baseline predictions and lever-induced changes in €/m² (purchase) and €/m²/year (rent). These unit impacts can be rescaled to any reference floor area (e.g., 100 m²) by multiplying the €/m² and €/m²/year deltas by the selected surface.

Consistent patterns emerge for Local station contexts: last-mile and shared-mobility levers tend to generate the largest combined uplifts in both residential purchase values and rents, highlighting their practical relevance for station-area stakeholders. Place-based measures (shared mobility agreements, cycling facilities, station-area public realm improvements) are typically more directly implementable by station-area actors, while service

supply/frequency levers can yield benefits but often require broader coordination. The thesis also highlights an implementation constraint: interventions that strongly increase rents may intensify affordability pressures in high-demand or tourism-oriented contexts, motivating complementary safeguards where appropriate.

8. Conclusions, limitations, and research agenda

This thesis develops a scalable station-level econometric and decision-support framework to assess how railway accessibility, multimodal integration, and urban context are associated with real-estate outcomes in Italy. Using a 2023 dataset of 985 stations, it estimates four hedonic models and applies hybrid log–level SUR to compare purchase and rental capitalization within residential and commercial sectors.

Three robust conclusions emerge. First, demand fundamentals dominate: GDP per capita and tourism context are strongly associated with higher values and rents. Second, accessibility is consistently valued but through different channels: purchase prices respond more to structural/economic components, while rents respond more to day-to-day usability and operational accessibility. Third, car-oriented station contexts are penalized, while multimodal and last-mile provisions show measurable positive associations, especially in Local contexts where marginal improvements reduce binding accessibility frictions.

The analysis is cross-sectional and identifies capitalization patterns rather than causal treatment effects. Future work should incorporate panel designs around upgrades and timetable changes, explicitly model spatial dependence, and integrate distributional indicators (affordability/displacement risk) to support more equity-sensitive implementation.

Refrences

[3] Coppola, P.; De Fabiis, F.; Silvestri, F. Urban Air Mobility (UAM): Airport Shuttles or City-Taxis? Transp. Policy (Oxf). 2024, 150, 24–34, doi:10.1016/j.tranpol.2024.03.003.

[4] Coppola, P., & Nuzzolo, A. (2011). Changing Accessibility, Dwelling Price and the Spatial Distribution of Socio-Economic Activities

[9] Transport, D. for TAG Unit A2-1 Wider Economic Impacts Appraisal; GOV.UK, 2018;