Rent and Buy Market Interactions: a Focus on Energy Performance and Building Technological Systems

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Abstract. This study investigates the relationship between the rental and sales segments of the housing market in the city of Rome (Italy), with a specific focus on the role of building energy efficiency and technological systems features. Although renting and buying are driven by distinct market drivers, both segments increasingly respond to sustainability-oriented and comfort-enhancing attributes. Understanding how these characteristics are appreciated across markets is fundamental for interpreting household choices, investor behaviour and policy effectiveness. The proposed methodological approach develops two separate econometric evaluation models, i.e. one for the sales market (BUY model) and one for the rental market (RENT model), to identify the most influential energy-related variables and building technological systems factors to quantify their marginal contribution to housing prices and rents. The two comparable datasets are constructed for properties sold and rented within the same urban context, specifically focusing on the following variables: energy performance label, central heating systems, photovoltaic installations, air conditioning systems and building automation technologies. Energy efficiency and technological factors have notable impacts on each housing segment, though with different intensities and directions. Overall, the findings highlight differentiated market appreciation of sustainable housing features and demonstrate the effectiveness of the flexible data-driven approach in capturing the cross-market dynamics.

Keywords: rental market · sale market · real estate · energy performance · EPC label · building automation · photovoltaic panels · influencing factors · econometric analysis

1 Introduction

The residential real estate sector is commonly articulated into two main components, namely the selling market and the renting market. While these segments operate according to distinct transactional logics, they are structurally interconnected and respond to a

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shared set of drivers. Changes in demand conditions, price levels and investment expectations in one segment often translate into adjustments in the other, contributing to cyclical dynamics that characterise urban housing markets. Factors such as credit availability, interest rate trends, fiscal frameworks and broader macroeconomic conditions influence households' and investors' choices between purchasing and renting, thereby shaping the relative balance between the two markets.

Alongside these general factors, the buildings attributes play an important role in the formation of prices and rents. In recent years, particular attention has been directed towards aspects related to energy performance, driven by regulatory requirements, rising energy costs and growing awareness of environmental sustainability [1, 2]. Energy efficiency is no longer perceived solely as a technical attribute, but rather as a component of overall housing quality that may affect operating expenses, comfort levels and long-term asset value. Consequently, energy-related variables are progressively incorporated into the decision-making processes of both buyers and tenants.

Within this context, features such as the energy label, the presence of central heating systems, photovoltaic installations, air conditioning and building automation technologies have the potential to influence residential market outcomes. However, the extent to which these characteristics are reflected in selling prices and rental levels may differ between the two segments, depending on the objectives, time horizons and financial constraints of market participants. While purchasers may place greater emphasis on long-term performance and capital value, tenants may prioritise immediate usability and cost efficiency, leading to differentiated market appreciations and preferences mechanisms.

Despite the growing relevance of energy performance in the real estate market, empirical evidence comparing its impact across sales and rental markets remains limited, particularly in cities characterised by heterogeneous building stocks and complex demand structures. Addressing this gap is especially relevant for urban contexts where territorial policies objectives related to energy transition intersect with housing affordability and investment dynamics.

In this background, the present paper focuses on the analysis of the relationships between residential sales and rental markets, with specific attention on the role played by energy performance variables and technological systems factors. The empirical investigation is carried out with reference to the city of Rome (Italy), providing a structured framework for examining similarities and divergences in the way these building characteristics influence prices and rents.

The structure of the paper is described below: Sect. 2 presents a review of the existing literature on the relationship between building energy performance and residential property values; Sect. 3 outlines the proposed methodological approach aimed at evaluating the impact of building energy performance and related techno-logical systems on housing prices; Sect. 4 illustrates the application of the method-ology to the case study related to the city of Rome (Italy); Sect. 5 discusses the conclusions and the further insights of the analysis.

2 Literature Background

During the last two decades, the academic literature has increasingly attested that building energy performance and associated technological systems are significant determinants of residential property values [3, 4], both in terms of selling prices and rental fees. Early studies by Brounen and Kok (2011) [5] and Hyland, Lyons and Lyons (2013) [6] have shown that homes with higher energy ratings (Energy Performance Certificates, EPCs) enjoy a green premium generally ranging from 2% to 10%, with positive effects also observed in the rental market, albeit often smaller than in sales. Comparable evidence has been reported in the context of Germany [7, 8], Sweden [9, 10], Wales [11] and Denmark [12], confirming that the real estate market tends to partially capitalize expected energy savings and improvements in housing comfort.

A comprehensive review of the European literature developed by Ou et al. (2025) [13] has highlighted high heterogeneity in the magnitude of premiums, attributable to i) government differences, ii) varying quality of EPC information, iii) input data included in econometric analysis and iv) stage of real estate market evolution. Similarly, Aydin, Brounen and Kok (2020) [14] have used large-scale disaggregated transaction data to show that the contribution of energy performance tends to be stronger in markets with higher buyer awareness and more transparent energy disclosure regimes.

From a methodological perspective, almost all contributions have adopted hedonic pricing approaches [15], where energy performance - measured either as EPC label or a continuous energy consumption index - is included among the structural characteristics of the property. However, research such as Fuerst, McAllister and Nanda (2015) [16] and Kahn and Kok (2014) [17] explicitly addressed potential endogeneity and omitted variable bias by applying matching techniques, fixed or spatial effects and instrumental strategies, in order to isolate the causal effect of energy performance on property prices and rental rates, separating it from other potentially correlated physical or locational characteristics.

In the Italian context, recent studies by Loberto, Mistretta and Spuri (2023) [18] and Giarda and Panarello (2025) [19] pointed out statistically significant price premiums associated with higher energy labels, with impacts that vary across regions, property types and segments of the price distribution. These findings are consistent with Chareyron (2026) [20], who have recognised similar price increments in the French housing market, and with de Ayala, Galarraga and Spadaro (2016) [21] in Spain, indicating that energy rating consistently affects property values across a wide range of European housing markets.

Beyond overall energy certification, the emerging literature has increasingly examined the role played by the presence of specific building technologies and systems in the selling and rental prices formation processes. For the U.S. market, Hoen et al. (2013) [22] have observed that homes equipped with photovoltaic systems tend to sell at significantly higher prices (on average above 3–4%), while Dastrup et al. (2012) [23] have demonstrated how these effects are moderated by tax incentives and expectations regarding future energy costs. Additional research by Wee (2016) [24] have estimated how much a solar PV system affects the price of a home on the island of O'ahu (Hawaii, U.S.), pointing out that a PV home is worth 5.4% more on average than a non-PV one, which translates to an increase of 35,000$.

Studies examining Heating, Ventilation and Air Conditioning (HVAC) systems, insulation upgrades and smart controls - such as Eichholtz, Kok and Quigley (2013) [25] - have indicated that certified green homes not only achieve higher prices but may also experience lower price volatility during market downturns, suggesting an additional risk-mitigating benefit of energy and performance-oriented investments. Newell and Siikamäki (2014) [26] concluded that disclosure of expected operating costs can strongly affect potential buyer willingness to pay, implying that information transparency - not just property physical performance and characteristics - assumes a key function in value realization.

Moreover, a growing body of relevant research has extended the analysis of the relationship between the property energy component and real estate values in both sales and rental segments to additional markets and contexts. For example, Deng, Li and Quigley (2012) [27] and Chegut, Eichholtz and Holtermans (2016) [28] have confirmed positive price effects of energy efficiency in multiple European countries, while Jiang et al. (2021) [29] and Zhang et al. (2023) [30] have provided evidence from Asia, showing that both sales prices and rental fees benefit from higher energy performance. Other studies, such as Ullah and Sepasgozar (2020) [31], Kahn and Kok (2014) [17] and Allameh, et al. (2012) [32], have emphasized the role of specific building features, including insulation, HVAC systems and smart controls, in shaping contributions for both ownership and rental sectors. Specifically focused on rental markets Reichardt et al. (2012) [33] in the U.S., Fuerst and Warren-Myers (2018) [34] in Australia and Eichholtz, Kok and Quigley (2010) [35] have recognized that energy-efficient properties tend to attract higher rents as well as increase in selling prices.

Overall, the literature on the energy topic associated to the real estate field suggests that property markets increasingly incorporate information related to energy performance and building technologies into property values. However, the magnitude of the weight in the selling and rental values is not uniform, but depends on buyer awareness, energy costs dynamics, regulatory frameworks and the quality of energy information transparency policies. The importance of robust empirical investigations based on effective evaluation methodological approaches is crucial to carry out cross-market comparisons for identifying causal effects and informing both investors and policymakers about the value implications of energy efficiency and technological upgrades.

3 Methodological Approach

According to the scope of the present research, a methodological approach aimed at evaluating the impact of building energy performance and related technological systems on residential property values, both for sales and rentals, is proposed and tested. Specifically, the objectives of the methodological approach are i) to identify the key energy-related and technological systems characteristics affecting selling prices and rental rates, and ii) to compare how these determinants operate across the two market segments. In this sense, while sales and rental markets share the same urban context, the role of energy efficiency, HVAC systems, photovoltaic installations and smart automation technologies may differ, reflecting distinct preferences, financial constraints and decision-making patterns of buyers versus tenants.

The approach relies on the definition of two tailored models - the BUY model and the RENT model - calibrated on datasets comprising properties sold or leased in a specific time horizon. By isolating the marginal contribution of each energy-related and structural variable, the methodological approach allows a systematic evaluation of whether the same factors determine comparable, contrasting or negligible effects on market prices and rents. This comparative perspective provides insight into how households incorporate energy considerations into their choices, and supports more informed property appraisals, investment strategies and government policies aimed at promoting energy-efficient housing.

The methodological approach follows six sequential steps:

Phase 1 – Variable definition: key dependent variables (selling price or rental fee depending on the analyzed market segment) and explanatory factors are selected, with a focus on energy efficiency elements (energy labels, heating systems, insulation, renewable energy installations, automation technologies included in the property) alongside ordinary physical/structural and locational attributes (i.e. intrinsic and extrinsic characteristics that are mostly taken into account in the negotiation phases by potential buyers). Stakeholder and local market operators' consultation ensures that the variables to be selected reflect the most relevant drivers in each market.

Phase 2 – Data collection: comprehensive datasets are built from multiple sources to capture both the technical and market characteristics of the housing stock. Special attention is given to obtaining accurate energy performance data. In this sense, for each database (constituted by rented or sold residential unit) the values of the selected variables are recorded.

Phase 3 – Data cleaning and standardization: data are filtered to remove inconsistencies, while variables values are normalized to enable comparison and accurate model estimation.

Phase 4 – Evaluation models definition: econometric techniques are applied separately to the sales and rental datasets to quantify the effect of energy performance and related features on prices and rents, and to identify the functional relationships between dependent and explanatory variables.

Phase 5 – Assessment of marginal contribution: the influence of each energy-related and intrinsic characteristic is analyzed, considering statistical significance and relative importance. This phase highlights which energy features most strongly influence housing market dynamics, including their effect on both selling prices and rental fees. Moreover, it allows for the identification of synergies between different technological systems (e.g., insulation, HVAC, photovoltaic installations and smart automation) and provides insights into how these features are valued by different market participants, helping to explain variations in price formation and tenant or buyer preferences.

Phase 6 – Comparative Analysis: results from the BUY and RENT models are systematically compared to assess whether energy efficiency and technological features have similar, divergent, or limited effects across the two market segments. This analysis provides evidence of how household decision-making and market mechanisms differ and informs targeted strategies for promoting energy-efficient housing, optimizing investment returns and guiding urban policy interventions.

In Fig. 1 the main steps of the proposed methodological approach are summarized.

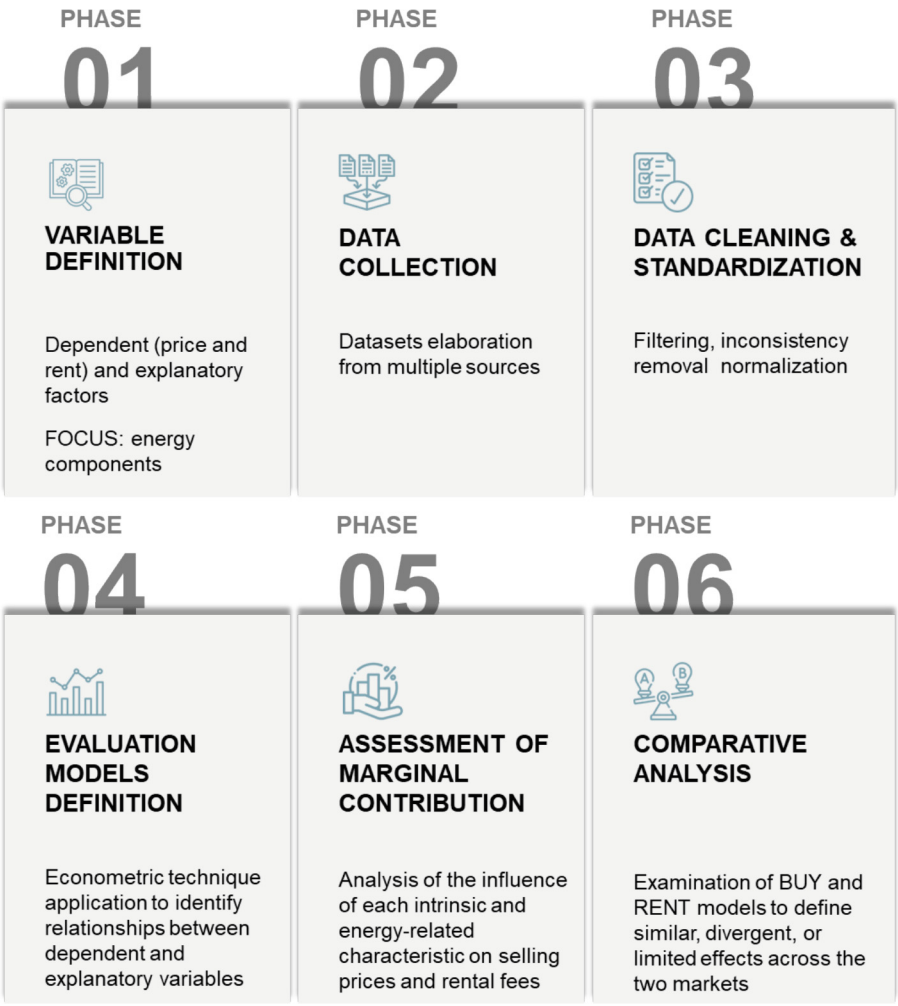

Fig. 1. Main steps of the proposed methodological approach

4 Case Study

The proposed methodological approach is applied to the city of Rome (Italy) using two datasets of residential properties on rental (1,800 units) and on sale (11,359 units) in the first half of 2025.

The presence of two distinct databases allows for a coherent comparison between the factors influencing asking rents and those affecting asking selling prices, since both samples refer to properties located within the same geographic context. The shared geographical context allows for a consistent comparison of the determinants of rental and selling prices, isolating segment-specific dynamics from locational effects.

The six-step methodology is implemented to estimate the BUY and RENT models, illustrating their ability to capture the key factors driving price formation in both market segments.

Phase 1 involves the definition of the dependent variables, represented by natural logarithm of the asking unitary selling price, expressed in €/m2 for the sales dataset - BUY model - ($Y = \ln(Y_S)$), and by the unitary rental price, denoted as Y_R and expressed in €/m2/month for the rental dataset - RENT model.

For both samples, the selection of intrinsic property characteristics, with particular emphasis on energy performance variables are selected. These include:

- energy label,
- central heating systems,
- photovoltaic installations,
- air conditioning systems,
- building automation technologies,

alongside conventional physical and functional attributes.

It should be pointed out that the set of independent variables considered in this analysis involves exclusively intrinsic variables, while extrinsic factors - such as location and broader market conditions - are not taken into account. This choice is justified by the aim of isolating the specific contribution of building-level factors, particularly energy efficiency features, to price formation, thereby reducing potential confounding effects arising from spatial heterogeneity and local market dynamics.

A summary of the independent variables chosen based on recommendations from key local real estate market operators and reflect the primary attributes considered during negotiation by sellers, buyers, and tenants is reported in Table 1. The acronym, full descriptive name, and corresponding unit of measurement for each variable are specified.

Table 1. Summary of the independent variables considered in the analysis

Variable	Acronym	Unit of measurement
Property type (apartment)	[A]	dummy variable [0 = absence; 1 = presence]
Floor Area	[F]	m^2
Number of Bathrooms	[B]	n.
Number of Rooms	[R]	n.
Number of Bedrooms	[Be]	n.
Floor Level	[Mf]	n.
Last Floor	[Lf]	dummy variable [0 = absence; 1 = presence]
Energy Label	[E]	Score [from 1 = label G to 10 = label A4]

(*continued*)

Table 1. (*continued*)

Variable	Acronym	Unit of measurement
Property Maintenance State	[S]	Score [1 = to be refurbished, 2 = poor conditions, 3 = good conditions, 4 = excellent/fully renovated]
has_Furniture	[Fu]	Score [0 = unfurnished, 1 = partially furnished (essential furnishings only), 2 = largely furnished (almost fully furnished), 3 = fully furnished]
Lift (i.e. presence of the lift in the building in which the property is located)	[L]	dummy variable [0 = absence; 1 = presence]
Private Garden	[Pg]	dummy variable [0 = absence; 1 = presence]
Shared Garden	[Sg]	dummy variable [0 = absence; 1 = presence]
Private Garage	[G]	dummy variable [0 = absence; 1 = presence]
Parking Space	[Ps]	dummy variable [0 = absence; 1 = presence]
Cellar	[C]	dummy variable [0 = absence; 1 = presence]
Terrace	[T]	dummy variable [0 = absence; 1 = presence]
Building Automation technologies	[Ba]	dummy variable [0 = absence; 1 = presence]
Central Heating	[Ch]	dummy variable [0 = absence; 1 = presence]
Photovoltaic installations	[Ph]	dummy variable [0 = absence; 1 = presence]
Air Conditioning systems	[Ac]	dummy variable [0 = absence; 1 = presence]
Optical Fiber	[Of]	dummy variable [0 = absence; 1 = presence]
Fireplace	[Fi]	dummy variable [0 = absence; 1 = presence]
Alarm	[Al]	dummy variable [0 = absence; 1 = presence]

(*continued*)

Table 1. (*continued*)

Variable	Acronym	Unit of measurement
has_Concierge	[Co]	score [0 = never available, 1 = limited availability (only for a few hours), 2 = daytime availability only, 3 = always available (24/7)]

Phase 2 focuses on the systematic collection and verification of data for all selected variables. In particular, the two datasets are derived from property listings gathered across the leading Italian real estate websites as well as local market operators, providing a uniform and comparable information base for both sales and rental markets.

Phase 3 is dedicated to data filtering and normalization, aimed at removing inconsistencies and outliers and harmonising the scale of the explanatory variables to ensure comparability across observations.

In Phase 4, an econometric technique called Evolutionary Polynomial Regression (EPR) is applied separately to the sales and rental datasets. This method, which integrates hedonic pricing logic with genetic algorithms, allows for the identification of (i) nonlinear relationships between the dependent variable and the explanatory ones and (ii) interaction effects among property characteristics. Adopting this dual approach facilitates a systematic comparison between the determinants shaping rental levels and those influencing selling prices, while maintaining constant the territorial and contextual conditions that characterize both samples. In particular, by estimating two valuation models - one for the purchase market (BUY - Eq. 1) and one for the rental market (RENT - Eq. 2) - within the same geographical context but under different market mechanisms, the distinct contributions of intrinsic property characteristics to the formation of values across the two markets are investigated.

For each of the two examined market segments, the EPR has generated a wide set of candidate polynomial functions, in which the dependent variable corresponds either to the unitary selling price or to the unitary rental fee of the property, whereas the explanatory variables are automatically selected from the group of intrinsic attributes included in Table 1. Each functional specification assumes the form of a sum of additive components, where every term is composed of combinations of independent variables raised to predetermined numerical exponents. Within the modelling phase, the set of admissible exponents is constrained to the values (0; 0.5; 1; 2), and the maximum number of additive components allowed in each equation is fixed at ten. This restriction is introduced to maintain a suitable compromise between the descriptive capacity of the model and the interpretability of the resulting mathematical formulation.

Among the numerous equations determined by the EPR technique for the residential market of Rome, the final models (i.e. the optimal BUY and RENT econometric evaluation models) have been selected by jointly evaluating several criteria, including model statistical goodness, algebraic parsimony and the empirical reliability of the estimated equation terms' coefficients.

$Y_S = \text{Exp}\ (0.74864 \bullet S^{0.5} + 0.082215 \bullet R \bullet G^{0.5} \bullet C * Ph^2 + 0.0013128 \bullet B^2 \bullet Be^2 \bullet A^{0.5} - 0.050351 \bullet F^{0.5} \bullet S^{0.5} + 0.017866 \bullet A^{0.5} \bullet MF \bullet T^2 + 0.00033002 \bullet A^{0.5} \bullet F \bullet R \bullet G^{0.5} - 0.20416 \bullet A + 0.066377 \bullet A \bullet B \bullet E^{0.5} \bullet L^2 + 7.5165)$.

$Y_R = 1.8557 \bullet Ac^{0.5} + 8.4831 \bullet S^2 \bullet Fu^2 \bullet Pg \bullet Ps^{0.5} \bullet T^2 \bullet A \bullet Co^2 + 0.82985 \bullet E^2 \bullet Fu^2 \bullet Of \bullet Co^{0.5} + 2.5035 \bullet Ba \bullet Lf^{0.5} \bullet S \bullet Fu^2 \bullet L^2 \bullet Ac^{0.5} - 116.1861 \bullet F^{0.5} + 94.8019 \bullet F + 120.8465 \bullet F^2 \bullet Fu^2 \bullet Ph^2 \bullet A^2 - 3.4591 \bullet A^{0.5} \bullet Ps + 2.987 \bullet A^{0.5} \bullet Ba^{0.5} \bullet S - 2.0621 \bullet A \bullet F^{0.5} \bullet E^{0.5} \bullet S \bullet T + 43.9611$.

Phase 5 concerns the interpretation of the results. For both models (BUY and RENT) the analysis of the functional relationships between the dependent variable (selling prices and rental fees) is developed. Specifically, the marginal contribution of each selected factor is assessed through a simulation procedure. In particular, the i-th explanatory variable is varied across the range of values observed in the sample, while all other variables are fixed at their respective mean levels.

In line with the objectives of this study, the following results discussion focuses specifically on the functional relationships associated with variables describing building energy performance and technological systems. All the relationships identified by both econometric models are consistent with expectations, reflecting the market mechanisms that are empirically observed and commonly recognised within the residential real estate sector of the city of Rome.

4.1 BUY Model

In the BUY model, variables related to building energy performance and technological systems emerge as significant determinants of residential selling prices.

The energy label exhibits a clear positive and progressive relationship with unitary prices, detecting that higher levels of energy efficiency are systematically capitalised into market values. The strongest variation emerges in the transition from the least efficient labels to intermediate classes, signalling that the market strongly penalises properties with poor energy performance. This pattern suggests that buyers explicitly account for expected reductions in energy consumption, operating costs and improvements in indoor comfort when forming their willingness to pay.

Similarly, photovoltaic installations are associated with a distinct price premium, confirming that on-site renewable energy generation is recognised as a value-enhancing feature with long-term economic and environmental benefits. In fact, when the variable shifts from the absence to the presence of the system, the unitary selling price increases significantly, indicating that the market systematically attribute a premium for dwellings equipped with renewable energy technologies. This outcome reflects the growing relevance assigned by buyers to solutions capable of reducing energy expenditure and improving environmental sustainability and contributing directly to property appreciation.

It should also be pointed out that air conditioning systems, building automation technologies and central heating systems have not been included in the final evaluation model, as the EPR selection procedure has not identified them as statistically significant contributors to price formation within the analysed dataset.

Overall, the BUY model reveals a coherent monetisation of energy-related attributes into residential selling prices, underscoring the central role of energy performance in contemporary housing market valuations. The graphical representations of the functional relationships between the selling prices and the factors associated with the building energy performance and technological systems are reported in Fig. 2.

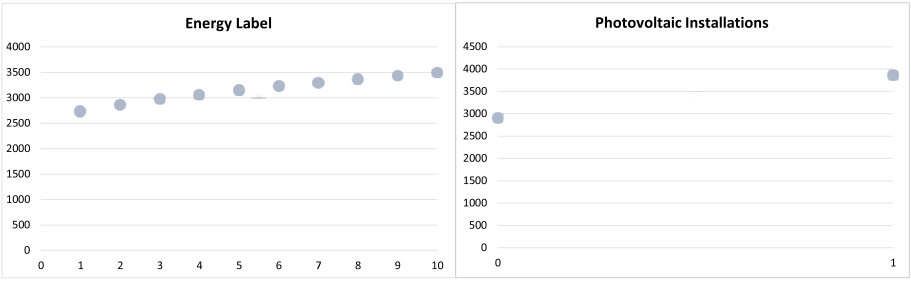

Fig. 2. Functional relationships between the energy-related variables selected by the EPR technique and the unitary selling prices in the BUY model

4.2 RENT Model

In the RENT model, energy-related variables and technological systems factors exhibit differentiated effects on rental price formation, reflecting tenants' priorities and short-term decision horizons.

The energy label shows a positive but limited influence on unitary rents, indicating that energy efficiency is recognised by tenants but plays a secondary role compared to immediate comfort-oriented attributes. In fact, the model suggests that improvements in the energy rating are associated with marginally higher rental levels, although the effect remains relatively limited in magnitude. This may suggest that the expected savings on operating costs are only partially capitalised into rents within the Roman rental market.

Photovoltaic installations are associated with a rental premium, showing tenants' appreciation for potential energy savings and environmentally sustainable features, albeit with a weaker effect than in the sales market. In this sense, rental units equipped with solar energy systems tend to achieve slightly higher rents, reflecting tenants' appreciation for the potential reduction in electricity costs and the environmental benefits connected to renewable energy production. Moreover, photovoltaic installations may signal the presence of recently renovated or technologically upgraded buildings, indirectly contributing to the overall attractiveness of the dwelling.

The availability of air conditioning systems emerges as one of the most relevant energy-related determinants of rents, reflecting strong demand for indoor comfort under Rome's Mediterranean climate characterised by hot summer periods. The installation of air conditioning therefore increases the perceived quality of the dwelling and reduces potential discomfort related to indoor temperatures, leading to a higher willingness to pay among tenants. The detected relationship confirms that climate-control technologies represent a relevant attribute in shaping rental values.

The presence of building automation technologies shows a positive relationship with rental values. Smart systems capable of managing lighting, climate control or security

features contribute to improving the usability and technological quality of the dwelling. The model therefore attests that tenants attribute additional value to properties integrating modern digital management systems, as these solutions enhance both convenience and perceived housing modernity.

Among the characteristics related to technological and energy components, it should be noted that central heating systems have not been included in the optimized predictive model, as the EPR selection did not identify them as statistically significant contributors to rental price formation. This outcome may be explained by the widespread presence and standardisation of central heating across the properties of the collected sample, which reduces its variability and, consequently, its marginal impact on rental values.

In Fig. 3, the graphs illustrating the detected trends for each selected variable are reported.

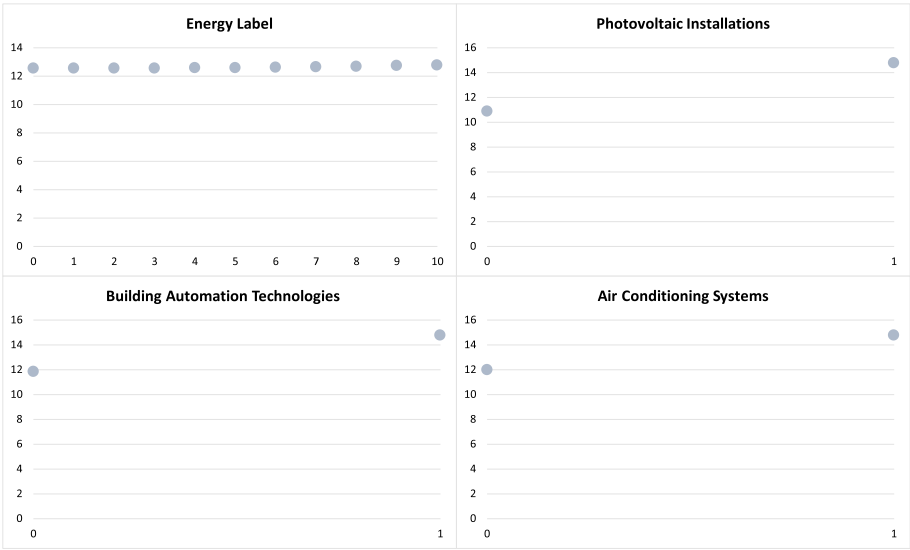

Fig. 3. Functional relationships between the energy-related variables and the technological systems factors selected by the EPR technique and the unitary rental prices in the RENT model

4.3 Comparing the Two Econometric Models

Phase 6 of the methodological approach applied to the selected case study involves the comparative assessment of the extent to which energy-related variables and technological systems factors are capitalised into selling prices and rental values. The results of the two EPR models highlight fundamental differences in the way energy characteristics of residential buildings influence prices in Rome's housing market. In the sales segment, the BUY model shows that energy performance plays a key role in determining property values. The positive and progressive relationship between the energy label and selling prices indicates that residential buildings with higher energy classes tend to achieve higher market prices. This suggests that buyers consider the economic and qualitative advantages associated with energy-efficient buildings, such as lower energy

consumption, reduced operating costs and improved indoor comfort. In this context, a higher energy label reflects a higher buyers' willingness to pay that is, consequently, reflected in captured in real estate dynamics. On the other hand, the RENT model attests that, while energy-related variables still show a positive influence on rental levels, their overall impact is more limited. The energy label shows a positive but relatively modest effect on rents. This behaviour could demonstrate that tenants recognize the importance of energy efficiency but do not capitalise its long-term benefits when determining their willing to pay for a dwelling on rent, due to the typically shorter time horizon associated with rental rather than buying.

A different result is obtained for the factor "photovoltaic installations", which is associated with a price premium in both the sales and rental market, as the presence of on-site renewable energy production represents an additional value component that can lead to lower electricity expenditures and greater environmental sustainability. The found marginal contribution of photovoltaic installations to property prices is quantitatively analogous in both the sales and rental segments, suggesting that this feature adds comparable value to dwellings whether they are sold or rented,

This similarity may be explained by the increasing importance of energy cost savings and sustainability in household decision-making, which appear to influence both long-term investment choices in the sales market and willingness to pay in the rental market.

By contrast, the availability of air conditioning systems and the presence of building automation technologies emerge among the most influential technological factors only in the RENT model. This result reflects the importance of immediate indoor comfort for occupants, particularly in a city such as Rome where summer temperatures can be high. While energy-efficient features like photovoltaic installations provide value across both sales and rental markets, technologies that enhance short-term comfort, such as air conditioning and smart building systems, are particularly rewarded in the rental segment, where tenants prioritize daily usability and comfort over long-term energy savings. This distinction underscores how different types of building characteristics can influence willingness to pay depending on the time horizon and priorities of buyers versus renters. In particular, the result appears consistent with the underlying dynamics of the two market segments considered. In the rental market, high attention is generally paid to elements such as air conditioning systems and building automation, as these features directly enhance immediate living comfort and represent a relevant factor in tenants' decision-making process: i.e. renters tend to prefer properties that are ready to use and equipped with modern services. Moreover, these technologies can mitigate the perceived discomfort and uncertainty related to short- and medium-term occupancy, thereby further influencing tenants' preferences.

On the other hand, in the sales market, buyers typically adopt a longer-term perspective and assign greater importance to structural characteristics rather than specific technological features. The latter are generally characterized by rapid technological obsolescence and relatively low installation costs, making their presence less decisive at the time of purchase, as they can be easily upgraded or installed at a later stage. In this context, the observed market appreciation of such attributes is different in the sale

sector compared to the rental ones, highlighting that their market appreciation depends on the transaction type and user needs.

Furthermore, the econometric analysis shows that central heating is not identified as a significant factor in any of the two evaluation models, attesting that this feature neither substantially influences property prices nor rental values. This may indicate that central heating is considered a standard provision in the housing stock of the city of Rome and therefore does not serve as a differentiating factor compared to other technological or energy-efficient features.

5 Conclusions

From a comparative perspective, the analysis of the obtained BUY and RENT models has highlighted both convergences and divergences in the capitalisation of energy-related variables and technological systems factors within the residential market of the city of Rome. The findings indicate that energy efficiency measures and on-site renewable technologies, such as photovoltaic installations, consistently contribute to price premiums across both market segments. In addition, building technological systems that enhance immediate comfort and control, including air conditioning and building automation, exert a stronger influence on rental price formation, reflecting the shorter planning horizon and day-to-day usability priorities of renters.

These insights point out the differentiated ways in which market participants value sustainability and comfort, and they provide useful indications for policymakers, developers and investors aiming to promote energy-efficient housing strategies that are consistent with the distinct logics of sales and rental segments.

The structured approach implemented in the present work – based on the twofold application of the econometric EPR technique - offers a robust analytical framework for evaluating the role of building energy performance and technological systems in shaping residential market outcomes and for identifying similarities and contrasts between the different market sectors under identical spatial conditions.

Integrating previous works results [36–39], future developments of this research may include the extension of the analysis to different international and national geographical contexts and comparing the results obtained using alternative assessment methodologies. These further insights would allow for a broader evaluation of how energy-related variables and technological systems influence residential property values across diverse markets and would verify the robustness and generalisability of the current findings.

Note: The current study has been developed within the current research “Evaluation models for the preservation and the revitalization of the small towns”, Call for Research Projects 2024, Sapienza University of Rome.

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