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Energy Retrofitting for the Modern Heritage Enhancement in Weak Real Estate Markets: The Olivetti Housing Stock in Ivrea

Alice Barreca, Rocco Curto, Giorgia Malavasi * and Diana Rolando

Architecture and Design Department, Politecnico di Torino, 10125 Turin, Italy; alice.barreca@polito.it (A.B.); rocco.curto@formerfaculty.polito.it (R.C.); diana.rolando@polito.it (D.R.)
* Correspondence: giorgia.malavasi@polito.it

Abstract: The enhancement of Modern Heritage buildings is nowadays a challenging issue as they are often degraded or abandoned and their historical value is not well acknowledged by potential buyers and their owners. Moreover, they are usually energy inefficient and obsolete, but investments for energy retrofit interventions are not always convenient, especially in socio-economic contexts characterized by weak real-estate market dynamics. This paper aims to study the influence of intrinsic and extrinsic characteristics on housing prices and, in particular, to understand whether elements of building cultural connotations or some housing green features are monetized by the real estate market. The UNESCO site "Ivrea, industrial city of the 20th century", located in the weak real-estate context of the Eporediese territorial area, was selected as an emblematic case study and two data samples of property listings were built to perform spatial regression analyses. The results showed that the green features of housing, such as the heating type and the EPC level, have a greater influence on property prices than those characteristics related to the cultural connotations of a building, such as the Olivettian context. Therefore, the current incentive-based policies for energy efficiency can represent great opportunities that can be exploited both to preserve and to improve the condition of this valuable Modern Heritage.

Keywords: Olivetti Modern Heritage; Ivrea UNESCO site; real estate market; housing prices; energy retrofit; spatial error model

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1. Introduction

The enhancement of Modern Heritage constitutes a key issue for restoration, technology, and economic evaluation disciplines, all of which can help to develop sustainable projects. This implies that the broad concept of sustainability includes different project requirements, such as historical compatibility, energy efficiency and economic feasibility.

Buildings belonging to the Modern Movement and its legacy generally have a high historical and cultural value, but they are often physically degraded, underused, or abandoned. Therefore, for their enhancement, new uses must be thought of, even temporary ones, new users should be introduced, and an adaptation to today's standards and comfort levels should be implemented, while also considering the economic sustainability of the whole project. Another element of complexity for the enhancement of Modern Heritage lies in the fact that buildings of the twentieth century are almost always obsolete and energy inefficient, both due to the high thermal transmittance of the materials, for the experimental technologies used (also in the plants) and for the compositional characteristics of the projects (large-glazed surfaces, non-insulated *pilotis* floors, complex geometric shapes, etc.) [1,2].

In Italy, the improvement of the energy performance of buildings makes them more sustainable from a green and economic point of view, defined in the Italian Decree "Minimum Requirement" and its subsequent integration and modification (Ministerial Decree 26 June 2015 as modified Ministerial Decree 6 August 2020). It is, today a mandatory practice also in the restoration of Modern Heritage, in line with the provisions of the European standard of 2017 implemented by UNI EN 16883: 2017. In particular, the recent Ministerial Decree 6 August 2020 (called "DL Rilancio") introduced a series of technical requirements outlining a higher tax deduction (110%) for the energy requalification of buildings, representing a great opportunity that many are taking advantage of in order to renovate and improve the energy efficiency of their properties. Moreover, in 2021, the National Recovery and Resilience Plan (PNRR) [3] offered new important opportunities in terms of substantial tax incentives to increase the energy efficiency of private and public buildings. In particular, Mission 2 "Green revolution and ecological transition" aims to improve the sustainability and resilience of the economic system and ensure a fair and inclusive environmental transition. The green growth pillar derives directly from the European Green Deal [4,5] and the EU's dual goal of achieving climate neutrality by 2050 and reducing greenhouse gas emissions by 55 percent compared to the 1990 scenario by 2030. In particular, as part of Mission 2, the item "Energy efficiency and building renovation" takes on particular importance with its 15.36 billion euros of planned investments.

Although these incentive policies represent great opportunities that are able to foster energy retrofit interventions both for recent and historical buildings, the enhancement and energy retrofitting of Modern Heritage presents elements of complexity that must be faced [6]. It is first of all important to distinguish the assets that can be maintained with their original use—such as residential buildings—from those that could change their uses. In the first case, it is necessary to improve their physical–technical aspects, to make them compliant with current regulations and improve their energy efficiency to make them suitable for contemporary ways of living. In the second case, in addition to all the interventions already mentioned, new, compatible and economically sustainable functions must be identified [7]. The owners of residential assets usually consider retrofit projects as convenient investments, only if the economic value of the redeveloped property covers at least the intervention costs. Moreover, it must be considered that property values depend not only on their physical characteristics, but also on the real estate market trends, which cyclically change in the analyzed context [8].

Since 2008, Italy has experienced the effects of the international financial crisis that triggered a crisis in the real estate market. Currently, in several fragile socio-economic contexts property price trends are still decreasing, so that investments in energy retrofit interventions are not always convenient for the properties' private owners [7].

The aim of the present research is to study the influence of intrinsic and extrinsic housing features on housing prices in a context characterized by the presence of Modern Heritage buildings and by a weak real estate market. The UNESCO site "Ivrea, industrial city of the 20th century", located in the weak real-estate context of the Eporediese area, was selected as an emblematic case study because it represents the legacy of the great company and community developed during the twentieth century by Adriano Olivetti, who commissioned the development of numerous residential buildings by prominent architects of the Modern Movement, which emerged for the cultural and historical connotation. Therefore, this research focuses on the relationship between the property-price-determination process and two main characteristics, namely housing green features (such as air conditioning, heating type, energy class and winter or summer energy behaviour) that contribute to improving energy efficiency and the cultural connotations of buildings linked to the UNESCO site, such as the buildings with an Olivettian connotation. All the studies analyzed in the literature review highlighted that the impact of energy efficiency on property prices remains rather underexplored in weak suburban real estate markets; moreover, at least to our knowledge, there is no evidence of studies on building cultural connotations related to UNESCO sites and their influence on housing prices.

In Ivrea, the enhancement of the Olivetti Modern Heritage deals with the weakness of the socio-economic context, due to the progressive contraction and aging of the population, which started with the closure of the Olivetti company in 1990. Furthermore, the low dynamism and values of the real estate market in that area do not foster energy retrofit interventions, whose high investment costs are hardly balanced by a significant increase in the renovated property price [8]. The necessity to preserve and enhance Modern Heritage is not well acknowledged by most of the inhabitants and neighboring population who do not recognise its historical and cultural value. Therefore, the case of Ivrea is an example of how the reuse and restoration of Modern Heritage cannot be separated from the energy requalification of buildings and how economic evaluation plays an important role in supporting the identification of new functions and the technological/design scenarios necessary to improve both the energy performance and the property value of the asset. In particular, economic evaluation helps to identify the optimal technological intervention from alternative scenarios, considering the entire life cycle of the building [9–11].

This paper starts with a literature review and the research framework; this section is followed by the presentation of the applied methods; the fourth section illustrates the study areas and the data sampling. The results are presented in the fifth section while the last section provides discussion and conclusions.

2. Background

2.1. Energy Retrofit Intervention on Built Heritage and UNESCO Site: The Case of the Company Towns

This paper analyses the Ivrea municipality and its surroundings, that is, a former company town developed in the twentieth century under the leadership of the innovative vision of Adriano Olivetti.

There are company towns designed in a unitary way throughout Europe that were built during the twentieth century; this Modern Heritage, as in many former industrial European cities, consists of unitary designed areas including the production area, housing for workers and, sometimes, other services such as the company canteen and the library [12–14]. Currently, the redevelopment, reuse and energy retrofitting of the abandoned or underused industrial areas is a necessary step to guarantee the well-being of current users, but also to safeguard the building conservation and maintenance. Understanding the motivations and the socio-economic contexts that guided the construction of the assets is the only correct way by which to define intervention guidelines aimed at preserving their historical and cultural value.

Energy retrofitting the former industrial buildings and the related housing districts, particularly of those belonging to the Modern Movement [12,13], is a crucial objective of the 21st century, especially when considering the enormous size of this heritage and its inadequacy due to the deterioration and aging of the original buildings technologies. Given that many houses are still inhabited, the enhancement and energy efficiency of this heritage are fundamental means for the regeneration of entire territories, with positive impacts from a political, social and economic point of view. The preservation of the industrial assets of the company towns is even more complex due to the lack of recognition of their values: however, there are some enhancement initiatives promoted in various sites, which are not under protection even if they all represent emblematic examples of the industrialization period [12,14–18].

Table 1 shows some examples of international company towns, only partially under protection. It is worth mentioning that energy retrofit interventions were performed in only 2% of the analyzed cases (partial or complete).

Firstly, evidence could be found in the New Lanark mills and village in the UK, in which historic buildings were restored and redeveloped for tourist and commercial uses, by considering energy retrofitting interventions [19,20]. In fact, the New Lanark Trust, the organization that has coordinated its UNESCO candidacy, supported the site's transformation as an example of green energy and efficiency by using renewable sources during their operations, including hydro-electricity production. A similar approach was followed in Rjukan Hydro Town in Norway, where a sort of passive energy retrofit was installed in 2013 with the setting of large mirrors reflecting sunlight and illuminating the site which would otherwise be in the dark [21].

Table 1. Company towns overview (Source: Authors' re-elaboration on Santi and Laiola's table [2]).

Company Town	Dates	Country	Protection	Energy Retrofit
New Lanark	1795	United Kingdom	Yes and UNESCO Site	Elements-ongoing
Saltaire	1850	United Kingdom	Yes	-
Leumann	1875	Italy	-	-
Crespi d'Adda	1878	Italy	Yes and UNESCO Site	Yes-elements
Rjukan Hydro Town	1905–1916	Norway	-	Yes-2013
Cave del Pedril	1910	Italy	-	-
Van Nelle Factory	1930	Netherlands	Yes and UNESCO Site	Yes-ongoing
Torviscosa	1930	Italy	Yes	-
Svit	1934	Czech Republic	-	-
Sunila	1936–1937	Finland	Yes	-
Carbonia	1937	Italy	-	Yes-elements
Wolfsburg	1938	Germany	-	-
Bat'ovany-Partizánske	1939–1949	Czech Republic	Yes	-
Ivrea, industrial city of the 20th century	**1900–1960**	**Italy**	**Yes and UNESCO Site**	**Yes (few cases)**
Buffer Zone, Unesco Site Ivrea	**1940–1970**	**Italy**	**-**	**Yes (few cases)**

A different approach of conservation was carried out during the adaptive reuse of the Van Nelle Factory in Rotterdam, whereby the Technological Committee performed "chrono-mapping" to create a referenced recording; the loss of interior space due to the installation of a climate wall was compensated for by smart interior planning, i.e., establishing a museum in the former industrial building [22,23].

Focusing on the Italian cases, it is possible to find a wide range of examples of company villages such as Leumann in Turin, Crespi d'Adda in Bergamo, Carbonia in Sardinia region, Panzano, Cave del Predil and Torviscosa [24] in Friuli Venezia Giulia region. In Carbonia village, the purpose of conservation was to overcome the Italian reality of management difficulties in the work of redevelopment and enhancement. Considering the urban planning, dissemination actions and the sharing of objectives with the inhabitants, the renovation intervention could be evaluated as successful [24]. Some "best practices" for improving the energy efficiency of the workers' houses are expressed in the restoration handbook that describes guidelines for both Carbonia and Crespi d'Adda sites [25,26].

During the administration of Ivrea, aiming to overcome the problems deriving from the refurbishment of assets belonging to private owners, a Color Plan with guidelines for recovery interventions on some buildings in the Canton Vesco district was drawn up. This document provided standards for maintenance and redevelopment interventions, based on a catalogue of technical standard solutions, and thus provided the possibility to define Olivetti's modern district features by analysing the exposure, open spaces and applied technology. Another important intervention in the same area pertained to the ICO Factories, and confirmed their original function by adapting the building to the standard of recent laws and by installing a double façade with a conservative renovation of the existing window frames. During these interventions, the original colours were restored together with a structural consolidation [1,27].

2.2. How Energy Retrofit Intervention Influence the Real Estate Market

Following the first Energy Performance of Buildings European Directive (EPBD I, 2002) [28], in the last two decades, countries in Europe have sought to improve the energy efficiency of buildings and recently, (EPBD III, 2018) more attention has been paid to existing buildings.

In 2020, European Commission issued some enhancements to improve the Energy Performance Certificate (EPC) of existing buildings by underlining benefits arising from energy retrofit and promoting legal certainty so as to reduce the time and provided incentives to support public and private owners in investing in such interventions [29].

An EPC (Energy Performance Certificate) rating is a classification of the housing stock energy efficiency (Directive 2002 91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (EPBD I) and subsequent integration EPBD II, EPBD III). It depends on the amount of energy used per area and on the level of carbon dioxide emissions: the ranking used in Italy ranges from G as the worst label to A4 as the best label (Inter-ministerial Decree 26 June 2015). In Italy, it has been possible to obtain the housing EPC label by reviewing real estate ads since 2012, when it became mandatory (Legislative Decree 63/2013 amending the European Directive 2010/31/UE).

The EPC has always been a key document in the "measurement" of building energy efficiency. Additionally, from January 2018, all new public buildings were required to be Nearly Zero Energy Buildings (NZeb) and, from 1 January 2021, newly built private buildings were also brought under the same requirements. In 2020, for the first time, buildings under protection were also cited in the regulatory document for energy efficiency [30]. Moreover, the Italian government is currently fostering the implementation of two important measures aimed at improving the energy efficiency of buildings. The first is the Ministerial Decree 6 August 2020 (called "DL Rilancio"), and the second is the National Recovery and Resilience Plan (PNRR-Mission 2 item "Energy efficiency and building renovation"). The high level of potential funding represents not only a real opportunity for private and public entities, but also a challenge in addressing design proposals. For these reasons, the green-housing features and energy-efficiency characteristics of buildings have increased in relevance during the last ten years, which is partially reflected in the real estate market. In this regard, a great number of studies produced both at a national and international level, have highlighted a variety of relevant information [31–39].

Considering the European context, the impact of the energy performance level on the housing prices was investigated in a recent study conducted by Chen and Marmolejo-Duarte [31], who carried out a spatial regression analysis (Spatial Error Model). Their research demonstrated that the EPC level does not influence the price of multi-family housing in Barcelona compared with the building location, which is highly relevant in terms of marginal prices.

Dell'Anna et al. [32] compared the real estate markets of Barcelona and Turin by considering the listing prices of residential buildings to understand where the energy performance level was most appreciated and by using a hedonic pricing model with spatial specifications. The results highlight that EPC is more significant in Italy than in Spain, which could be a sign of the growth of the green culture; on the contrary, in Barcelona, housing features (such as location) have a great influence on marginal prices.

In Northern Ireland, an analysis of Belfast-transacted housing prices was performed by McCord et al. [40] by means of both OLS and Spatial Lag Model; with a data sample of over 1400 residential sales, the authors did not find a constant effect of EPC on housing values, but they found that EPC scores affect the market. A previous study of the authors in the same area [34] highlighted a relationship between property type, energy efficiency and transacted prices, underlining the necessity of carefully evaluating the EPC impact on prices.

The hedonic price model was also applied by Taltavull et al. [36] in Bucharest on more than sixteen-thousand apartments, determining that a price premium was associated with energy efficiency only in some areas of the city; for this study, OLS was integrated with a spatio-temporal auto-regressive approach (STAR GLS model).

Focusing on the Turin real estate market, an OLS method was applied by Fregonara et al. [35] on a sample of about 500 cases to understand whether an EPC label was able to influence housing prices variation, for which their results highlighted a partial influence of the EPC labels on housing prices. The same authors [41] also analyzed a dataset of over 800 old apartments sold in Turin in 2011–2014 period and demonstrated that EPC labels have generally no impact on dwellings prices, but also that low EPC labels (E, F and G) are able to explain 6–8 percent of the price variation.

Then, another recent study in Turin performed Exploratory Spatial Data Analyses (ESDA), hedonic price models (OLS) and Spatial Error Models (SEM) on housing properties [37] to understand the influence of energy performance and other features (architectural, typological, and physical-technical) of the dwellings on the listing prices was performed. In contrast with the previous studies in the same areas, EPC labels gained power in the price-formation process; this research showed spatial effects on different sub-markets, thereby confirming the importance of including a spatial analysis during real-estate market investigations. The increasing impact of EPC labels on selling prices is highlighted in Morano et al. [40], who analyzed a data sample of 200 residential properties collected in 2016–2017 in Bari (Italy) with evolutionary polynomial regression. Their results showed, on the one hand, the positive effects on prices for buildings with label A, and on the other, negative impacts for buildings with label G.

Another interesting study which analyses how factors influence housing prices is presented by Li et al. [42], who selected a total of 11,365 observations in Hong Kong and investigated if the time series variables follow the ANN (Artificial Neural Network). In addition to housing intrinsic characteristics, this study also considers the macroeconomic environment and heat island effect by performing two different models. Their conclusions highlight that walled buildings have a negative influence on the housing prices of private properties, as well as that the heat island effect negatively impacts housing prices in some residential areas.

By considering that the above mentioned studies analyzed big metropolitan cities, it emerged that the energy efficiency in suburban real estate markets and weak suburbs contexts fairly unexplored; moreover, at least at our knowledge, there is no evidence of studies on the influence of UNESCO sites and their tangible and intangible values on housing prices.

3. Methods

In order to study the impact of a series of building and housing characteristics on property prices, spatial regression models can be applied for both descriptive and predictive purposes.

First, Exploratory Data Analyses should be applied to detect the presence of both spatial autocorrelation and linear correlation between the considered variables and to analyse the presence of outliers and the sample distribution curve. Exploratory data analyses should also be focused on the presence of green features in housing that are analyzed in the regression models, such as information related to the EPC level, which should be present in all real estate ads (by law), although they are often missing [43].

Then, a standard OLS model must be performed, following which, in case of the presence of spatial autocorrelation, spatial regression models must be performed.

3.1. Ordinary Least Squares (OLS)

The OLS model formally has the following form (1):

$$Y = \alpha_k + \sum_{i=1}^{n} \alpha i X_{ik} + \ldots + \sum_{i=1}^{n} \beta i \, Z_{im} + \varepsilon \quad (1)$$

where: Y stands for the dependent variable (logarithm of property Total Listing Price-logTLP), α_k stands for the model intercept, X_{ik}, with k = 1, . . . , K, and Z_{im}, with m = 1, . . . , M stand for the variables introduced for each of the n observable characteristics, αi and βi represent the hedonic weights assigned to each variable, i.e., the contribution of each single characteristic level to the price value, and ε represents the error term. In performing OLS models, the presence of spatial effects (or spatial heterogeneity) as measures of the similarity between value associations (covariance, correlation, or difference) and associations in space (contiguity) [43,44] is tested by means of Moran's test and the Lagrange Multiplier tests (LM-lag and LM-error) [45], which also indicated the possibility of a spatial model to be used (SLM or SEM). A spatial autocorrelation statistic is considered significant when it assumes an extreme value, compared to what would be expected for a null hypothesis (absence of spatial autocorrelation) [45,46]. Therefore, a spatial regression model, namely, Spatial Error Model (SEM), can be performed to correctly manage the error correlation due to spatial effects [45].

3.2. Spatial Error Model (SEM)

The Spatial Error Model can be specified as follows (2):

$$y_i = X_i\beta + \lambda w_i \varepsilon_i + u_i \quad (2)$$

where u_i is the random error (independent identically distributed—i.i.d.), and the spatially structured error is composed of the added spatial error coefficient (λ) and the original error term (ε) weighted by a weight matrix w_i (W). If there is no spatial correlation between errors, then λ = 0. If $\lambda \neq 0$, OLS is unbiased and consistent, but the standard errors will be wrong and the β will be inefficient. Notice that a positive and significant value of λ means that the model fit is good. Some tests were applied to verify the robustness of the model. The Jarque–Bera test for the normality of errors and Breush–Pagan and Koenker–Bassett tests to verify the absence of heteroskedasticity were implemented [47].

4. Study Areas and Data Sampling

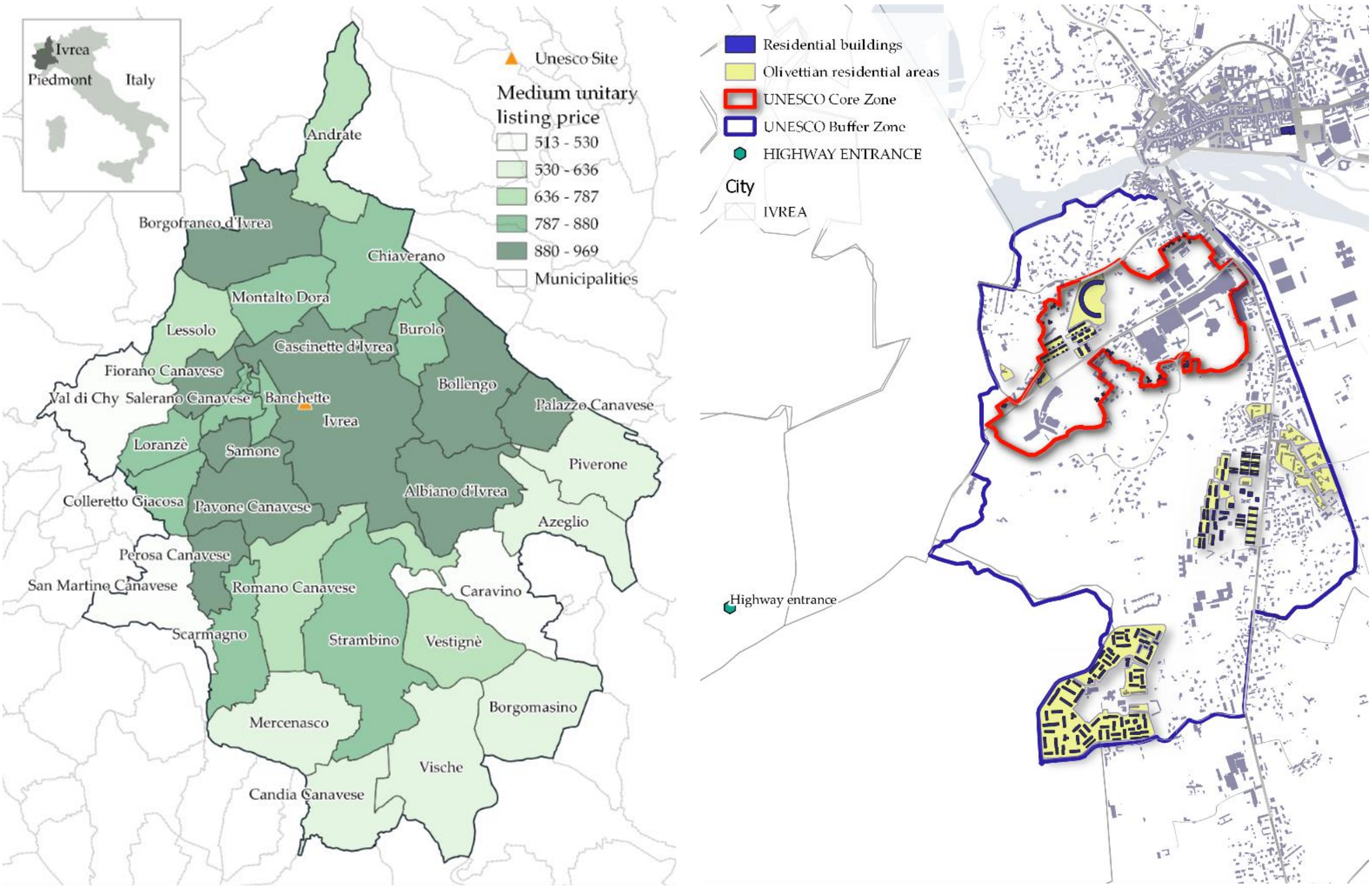
4.1. Study Areas

The focus area of this research is a territorial sub-area of Eporediese in the Piedmont region (Italy). Eporediese is a bounded area, defined by Piedmont Regional Landscape Plan (PPR), that includes 64 municipalities; its historical settlement system gravitates toward Ivrea, which is the main urban centre [48]. The sub-area studied in this work comprises 31 municipalities, including Ivrea and its surrounding (Figure 1).

The city of Ivrea, whose historic centre dates back to 100 BC, was drastically transformed at the beginning of the twentieth century when the Olivetti company, one of the most important Italian typewriter manufacturers, was installed there. This fact assumed an even greater importance considering the new idea of community promoted by Adriano Olivetti, son of Camillo Olivetti, who was its founder. With his visionary entrepreneurship he created an "urban laboratory" that promoted modern architecture as an expression of the new community and the new way of life of the factory's employees [15,49,50]. The leadership of Adriano Olivetti allowed for the development of Ivrea and its urban settlement, including lots of residential districts, villas, schools, social services and green areas that were built to ensure a high quality of life and well-being for workers and their families.

The first residential area created for Olivetti workers is the Borgo Olivetti Social Building (1939–1941) a balcony-style property near the nursery of the industrial city; L. Figini and G. Pollini's project was located on the ground floor with a service area and included 24 apartments for families of employees [51,52]. The same architects began the realization of the Castellamonte district (1940–1960) on the west side of via Jervis, the main axis of the Olivetti productive area. The Castellamonte district became an excellent example for housing studies in Ivrea, first with the rationalists "Houses for large families", that are the result of a huge typological study on typical workers houses, and then with the addiction of the "Houses for Executives" and the "Building with 4 Homes" by M. Nizzoli and G. M. Oliveri. In addition to this district, in the seventies, from an idea of R. Gabetti and A. Isola, the "Western Residential Unit" was added; with a semi-circular plan, this property includes 81 apartments both simplex and duplex (originally 72) to accommodate Olivetti employees temporarily in Ivrea. Thanks to the Ina-Casa Plan and the Istituto Case Popolari (IACP, Public Housing Association), Adriano Olivetti could build some council housing districts for workers and promoted some loan programs to facilitate home ownership [53]. This provided an opportunity for the establishment of the residential districts of Canton

Vigna, Canton Vesco and Bellavista [54]. Canton Vigna was built between 1950–1953 and was comprised of three tenement blocks organized on three or four floors with an open courtyard. Near Canton Vigna alongside via Torino, E. Devoti, L. Figini and L. Piccinato designed the Canton Vesco district as part of Ivrea Town Plan (1938–1942). This project provided different types of residences, a kindergarten [55] and a primary school; later, this district was expanded with a further appendix called "La Sacca". Then, in 1957, L. Piccinato designed Bellavista, which is the last popular residential district. The complex consists of low-density buildings and services for the neighborhood (church and schools) [50,56]. The situation of the city has changed over time, and the transition from a Company town to a contemporary city is today and ongoing process, beginning in 1990 with the closure of the factory [53].



(a) (b)

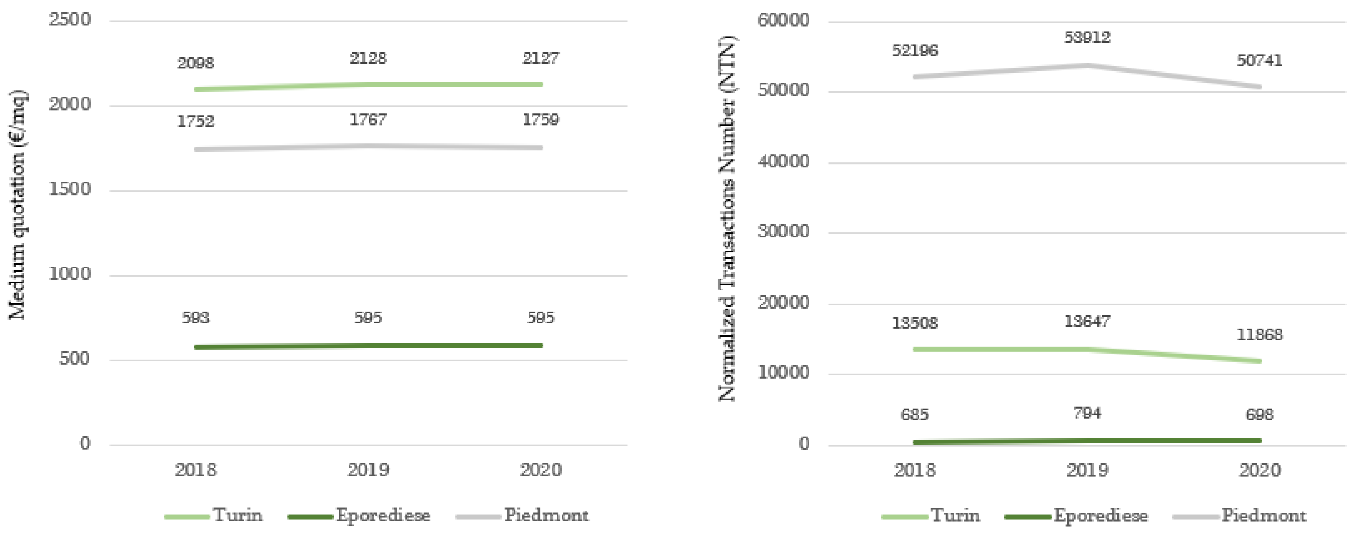
Figure 1. (**a**) Ivrea and the 31 surrounding municipalities. (**b**) Ivrea and the Olivettian residential heritage (Source: Authors elaboration on Immobiliare.it (accessed on 15 January 2022) data, 2020).

In 2018, the urban site defined as "Ivrea, industrial city of the 20th century" was included as 54th Italian Site in the UNESCO World Heritage List. Most of the architecture sited in the UNESCO site represent valuable examples of the Modern Movement and a great architectural and urban experimentation carried out by the most important Italian architects of those years. The historical and cultural value of these modern architectures was not highly appreciated and recognized, but in the last twenty years, attention and appreciation of them have increased, thanks to many studies that were carried out internationally by organizations such as DOCOMOMO [57].

The buildings belonging to the different Olivettian neighborhoods were originally unitarily designed and thus were mapped in the "Quality map of the city of Ivrea" in 2004 (Municipal town plan-PRGC, 2000), defined as "Buildings and complexes of the modern historical city, with the classification of "buildings and complexes of architectural and monumental importance", "buildings and author complexes with formal and historical-documentary value" or "buildings and complexes of testimonial value". On these buildings, starting from 22/01/2020 the safeguard regulatory provisions and the cartographic indications of the PRGC relating to the UNESCO site (Core zone and Buffer zone) were applied.

Currently, the UNESCO site is formed by 98% of private assets and for the most part it needs to be restored and enhanced. Residential buildings represent 83% of the Olivetti's heritage in Ivrea; 59% of them are inhabited and less than half are currently under protection [8].

Despite the fact that attention and the acknowledgment for these Modern Heritage examples have increased since the beginning of the UNESCO candidacy process in 2008, the real estate market has yet to monetize their architectonic and cultural value, probably due to the economic-financial crisis, which at the same time also impacted the Eporediese area. Currently, the real estate market in this area is characterized by low property prices and dynamism. The mean quotations (Figure 2a) are considerably low in comparison with those in Turin and in the Piedmont region, moreover the Normalized Transactions Number (NTN) representing real estate market dynamism is considerably low in comparison with the other territories (Figure 2b). It is likely that the UNESCO designation and the high visibility given to Ivrea by the Canoe World Championships in 2018 probably influenced the real estate market. In 2019, the NTN slightly increased, even if the medium quotation in the Eporediese area remained constant.



(**a**) (**b**)

Figure 2. Property price mean quotation (**a**,**b**) Normalized Transactions Number (NTN) in the metropolitan city of Turin, Eporediese area and Piedmont region. (Source: Authors' elaboration on Agenzia delle Entrate-OMI Residential Reports).

The analysis of the housing prices trend in the city of Ivrea in Figure 3 highlights the general decrease from 2018 to 2020, confirming that the real estate market is rather weak. A slight increase in the price values per square meter was observed in 2018 after the UNESCO nomination in July, potentially denoting a sort of "UNESCO effect" on the real estate market, but then, in 2019, the trend continued to decline. In 2021, the general trend seems to have changed in the first part of the year, with a medium price per square meter of 1013 EUR/m^2 in July, while in the final part of 2021, the property prices decreased even further (966 EUR/m^2 in December).

Figure 3. Listing prices trend (Euro per square meter) in Ivrea for residential properties. (Source: Authors' elaboration of Immobiliare.it (accessed on 15 January 2022) data).

4.2. Data Sampling

In order to analyse the real estate market at urban and territorial level, it was necessary to use different data samples. All the analyses were carried out by using Listing Prices (LP). It is worth mentioning that in Italy, researchers are used to analysing listing prices since transaction prices (TP) are not public information. Nevertheless, previous research demonstrated that LP can be used as a proxy for TP [58] because they can influence the property-price determination process.

Therefore, the sample consisted of point/morphological-based data, also referred to as Points of Interests (POIs). In this work, real estate listings published on Immobiliare.it, that is, one of the most important Italian real estate advertisement websites, were considered and georeferenced for the whole territory of analysis. In particular, the listed housing units were collected in a relational database, including the property price and other characteristics of the building and the residential unit. Data sampling was based on a simple geographically stratified sampling method, on the basis of the systematic sampling supplied by Immobiliare.it (accessed on 15 January 2022). In fact, from the whole Data Warehouse of Immobiliare.it (accessed on 15 January 2022), data referring the housing market of the study area were extracted, from which those that were no longer on the site were deleted.

The overall data sample (DS) includes the city of Ivrea and the 31 surrounding municipalities of the Eporediese area by considering a set of POIs data related to 1154 existing property advertisements listed during 2019 and 2020, with a rather low mean LP (830 EUR/m^2). Starting from DS, a subsample limited to the city Ivrea (SS) and consisting of 248 data was extracted, whose mean LP rose to 970 EUR/m^2, highlighting a 17% difference in relation to the mean value of Eporediese (Table 2).

Table 2. Data samples (Source: Authors' elaboration).

	Description	Variables Number	Observations Number	Mean LP (Euro per Square Metre)
DS (Data Sample)	Ivrea and the 31 surrounding municipalities (POIs data)	16	1154	830
SS (Sub-Sample)	Ivrea (POIs data)	10	248	970

Figure 4 shows the unitary LP of the listing properties of the DS sample: it is possible to notice that listings are concentrated in the city of Ivrea and the residential units with the highest prices are located in the centre of Ivrea, while in the surrounding municipalities, the property listings are more dispersed. The lowest property prices are generally concentrated in the second municipality ring around Ivrea, even if some municipalities such as Strambino, Montalto Dora e Pavone Canavese also present high property prices.

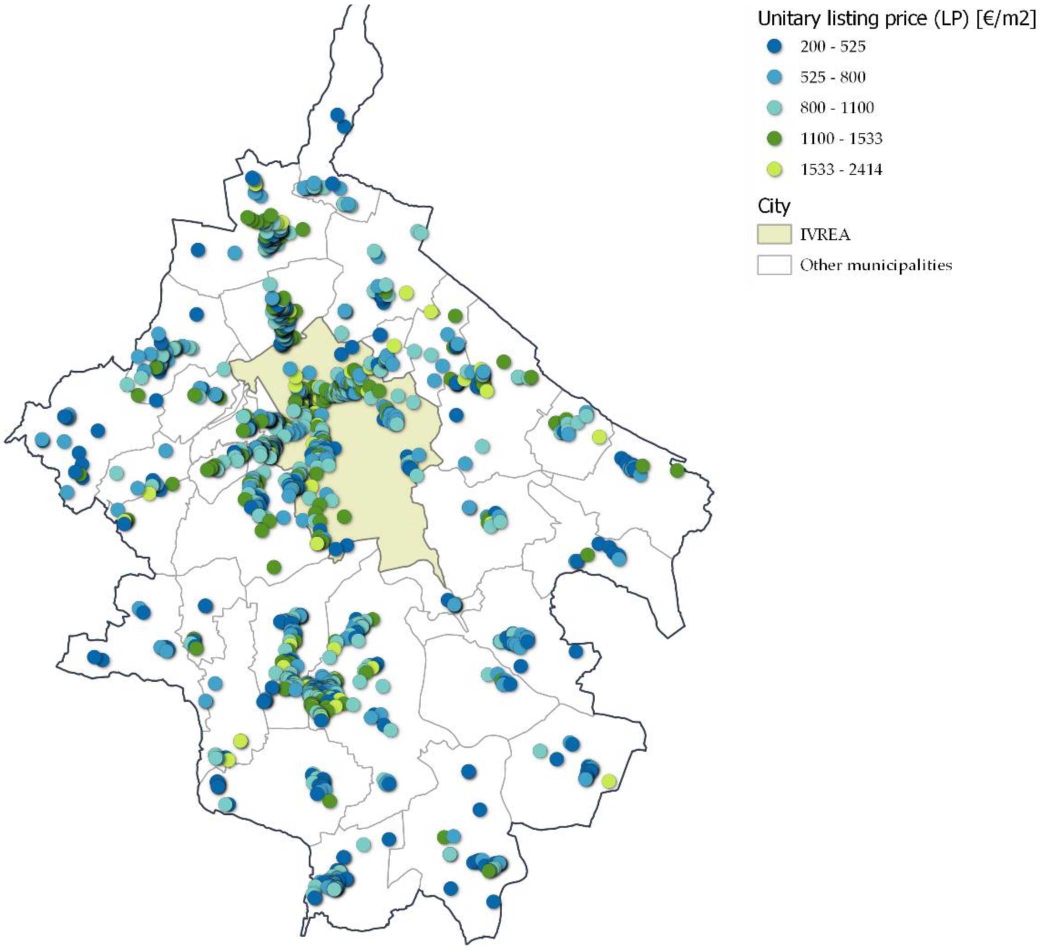


Figure 4. Unitary LP in Ivrea and in the surrounding municipalities. (Source: Authors' elaboration on Immobiliare.it (accessed on 15 January 2022) data).

Focusing on the Energy Performance Certificates (EPC) in the Eporediese area (Figure 5), it is important to notice the extensive lack of information. The data used in this research are based on the advertisements shown on the Immobiliare.it (accessed on 15 January 2022) web-portal and are therefore strictly influenced by the accuracy of the compilation of the advertisements module.

Figure 5 shows that in most of the ads, the lowest EPC levels are reported, which could be evidence of both the need of energy retrofit in the area, and also a "wake-up call" to data accuracy. In fact, it is important to remember that advertisers often state the lowest levels when they do not know the actual EPC level of their properties. On the contrary, there are only a few housing units with an EPC level higher than B, meaning that this could be a real representation of this area, especially when considering the age of the buildings.

In both the DS and SS samples, for each housing unit listed on the market, in addition to LP, a series of intrinsic and extrinsic features were considered for the analyses (as shown in Table 3). In this paper, intrinsic characteristics are related housing features (such as building typology, number of rooms, surface area, status, etc.), while extrinsic characteristics are related to the context where the houses are located (such as location quality, presence of urban services, proximity to the highway exit, etc.).

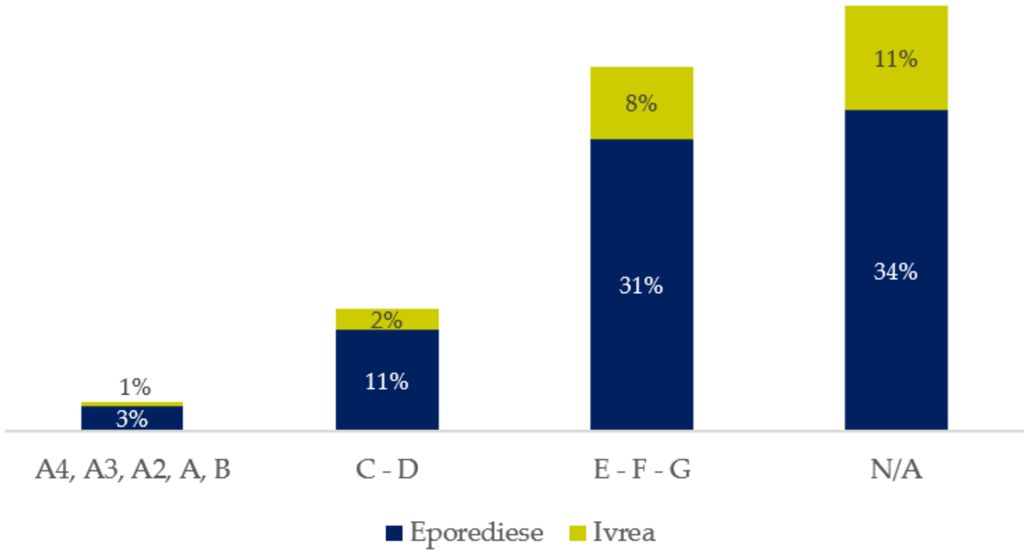


Figure 5. Energy performance certificate distribution in the data sample. (Source: Authors' elaboration on Immobiliare.it (accessed on 15 January 2022) data).

Table 3. DS and SS summary statistics. (Source: Authors' elaboration).

				DS (1154 Data)		SS (248 Data)	
Variable	**Sample**	**Description**	**Type**	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**
		Dependent Variables					
logTLP	DS, SS	Log total listing price	Log e	11.72	10.39	11.42	0.54
TLP	DS, SS	Total listing price	Euro	123,754	32,848	107,177	68,486
ULP	DS, SS	Unitary listing price	Euro/m^2	830	373	970	368
		Independent variables					
FA	DS, SS	Floor area	numeric	139	84	112	60
PT	DS, SS	Property type (0 = NA, 1 = condominium, 2 = detached house, 3 = villa)	dummy	1.81	0.65	2.59	1.51
BC	DS, SS	Building category (0 = NA, 1 = economic, 2 = medium, 3 = noble)	dummy	1.45	0.90	1.56	0.80
US	DS, SS	Unit status (0 = NA, 1 = not renovated, 2 = partially renovated 3 = totally renovated)	dummy	2.16	0.62	2.13	0.55
TR	DS, SS	Terrace (0 = no, 1 = yes)	dummy	0.32	0.46	0.27	0.44
EPC	SS	Energy performance certification (EPC) level (0 = NA, 1 = F–G, 2 = C–D–E, 3 = B and over)	dummy	0.74	0.80	0.63	0.76
BN	DS, SS	Bathrooms number	numeric	1.47	0.73	1.40	0.58
HT	DS, SS	Heating type (0 = NA, 1 = central, 2 = independent)	dummy	1.56	0.63	1.43	0.52
E	DS, SS	Elevator (0 = no, 1 = yes)	dummy	0.22	0.42	0.46	0.49
PG	DS, SS	Private garden (0 = no, 1 = yes)	numeric	-	-	0.57	0.27
OL	SS	Building Olivettian connotation (0 = no, 1 = yes)	dummy	-	-	0.25	0.43
UD	SS	Distance from UNESCO Site	numeric	-	-	1520	830
HD	SS	Distance from the nearest highway exit	numeric	6151	3620	3507	1068
RE	DS	Retail services	numeric	0.21	0.20	0.48	0

It is worth mentioning that property type (PT) and building category (BC) can be used as a proxy of the economic level of the owner. Moreover, considering that the samples consist of properties located in existing buildings, the EPC level (EPC) represents a very interesting variable to define the energy condition of the whole building, that often differs from the unit status. In fact, in council buildings there are usually only a few single residential units that have been totally refurbished and energy efficient, but in buildings in a poor or bad state of conservation.

The presence of a private garden (PG) in Ivrea characterizes a huge part of detached housing and represents a fundamental element of a buyer's choice, especially after the COVID-19 pandemic [59].

The distance from the nearest highway exit (HD) represents another key variable for the properties in these data samples: vehicular mobility is very relevant in this territorial area since public services (bus and train) are lacking, and citizens are used to moving from one municipality to another to access different services.

In the SS sample, since 2018, the Olivettian connotation of the buildings (OL) and the distance from the centre of the UNESCO site (UD) "Ivrea, industrial city of the 20th century" could also be interesting aspects to be explored, since the UNESCO site represents a distinctive point of interest for Ivrea. For this reason, they are included in the regression model as factors that describe cultural and historical values of the buildings. It is worth mentioning that the OL dichotomous variable was created to specifically identify those buildings built during the 20th century and commissioned by Adriano Olivetti to create the "industrial city" around his company headquarter and to in the SS sample, so as to distinguish this valuable cultural and historical heritage from the common residential stock of Ivrea.

5. Regressions Results

Both the main data sample (DS) and the Ivrea sub-sample (SS) were processed and tested by means of the GeoDa software [60], and by the "R" software [61]; spatial analyses and maps were produced using the ArcGIS Desktop software package. The results are illustrated and elaborated on in the following subsections.

5.1. DS-Ivrea and the 31 Eporediese Municipalities

To study the real estate market in the Eporediese area, regression analyses were performed using the 1154 POIs data of DS and by focusing attention on the relation between a series of intrinsic and extrinsic features of a property.

The logTLP was assumed as a dependent variable and a "foreward" stepwise regression was applied to select the independent variables so as to build the most suitable regression model. In addition, Spearman's correlation test was performed. The results showed the absence of a significant correlation among the considered variables; finally, the spatial autocorrelation tests confirmed the presence of spatial dependence between variables, so the Spatial Error Model (SEM) was identified as the best model for these analyses, since AIC and Log likelihood values were, respectively, lower and higher than in the Spatial Lag (SLM) model. The Breusch-Pagan test of the spatial effects, calculated for testing the homoscedasticity hypothesis, showed that the null hypothesis was confirmed (Table 4).

The SEM regression results (Table 4) showed that the model is able to explain 66% of the price variation (R squared = 0.664) and the regression residuals are not clustered.

The results also showed that the number of bathrooms (BN), property type (PT = villa), a high building category (BC = noble) and a good level of conservation of the residential unit (US = partially or totally renovated) are the most significant variables with the highest positive marginal coefficients. The other two variables positively influencing the price variation, even in the case of lower coefficients were the presence of a terrace (TR), the presence of an elevator (E).

Table 4. DS SEM regression results. (Source: Authors' elaboration).

Regression Model: Spatial Error Model (SEM)				
Dependent Variable: Listing Prices Logarithm (logTLP)				
Independent Variables	**Coefficient**	**Std.Error**	**z-Value**	**Probability**
LAMBDA	0.321	0.0456	7.043	0
CONSTANT	10.23	0.076	134.079	0
PT (Villa)	0.381	0.038	9.903	0
BC (Building Class-Economic)	−0.114	0.035	−3.281	0.001
BC (Building Class-Medium)	−0.065	0.031	−2.079	0.037
BC (Building Class-Noble)	0.135	0.047	2.862	0.004
FA (Floor area)	0.004	0.001	22.816	0
TR (Terrace)	0.105	0.025	4.126	0
US (Unit Status-Partially renovated)	0.271	0.038	7.105	0
US (Unit Status-Renovated)	0.466	0.042	10.962	0
EPC (Energy Performance Certification -B and over)	0.162	0.066	2.45	0.014
HT (Heating Type-independent)	0.106	0.021	5.013	0
E (Elevator)	0.101	0.033	3.054	0.002
BN (Bathrooms number)	0.958	0.017	5.728	0
HD (Distance from the nearest highway exit)	-1.42×10^{-005}	5.628×10^{-005}	−2.517	0.011
RE (Retail services)	0.248	0.083	2.980	0.002
Number of observations	1154			
R squared	0.664			
Log likelihood ratio test	−521.72			0
Breush-Pagan test	103.897			0
AIC	1073.44			
DIAGNOSTICS FOR SPATIAL DEPENDENCE FOR WEIGHT MATRIX				
	MI/DF	Value	Probability	
Moran's I	0.116	7.723	0	
Lagrange Multiplier	1	43.885	0	
Robust LM	1	5.746	0.016	
Lagrange Multiplier	1	53.518	0	
Robust LM	1	15.379	0.001	
Lagrange Multiplier	2	59.264	0	

The analysis of the impact of the housing green features highlighted that high EPC levels (EPC = B and over) and the heating type (HT = independent) significantly affect LP, confirming that, as demonstrated in other studies [32,37,62], the energy efficiency is a noteworthy feature with an increasing influence in the real estate market.

Finally, it is worth mentioning the influence of the extrinsic characteristics, such as the presence of retail services (RE) and the distance from the nearest high-way exit (HD).

5.2. SS-Ivrea

Focusing on the city of Ivrea, the real estate market dynamics were analyzed in relation to both some property features (including the "green" ones) and to the presence of the site "Ivrea, industrial city of 20th century". Therefore, the two variables "distance from the UNESCO site (UD) and the "building Olivettian connotation" (OL) were considered in the model since the UNESCO site will become a relevant point of interest for tourists and citizens, even if the weak socioeconomic context may not foster this process.

Additionally, in this case, the logarithm of total listing price (logTLP) was used as a dependent variable and a set of intrinsic and extrinsic features, selected by means of a "foreword" stepwise method, were assumed as independent variables. Additionally, in this case, the spatial autocorrelation tests indicated the Spatial Error Model (SEM) regression as the most suitable model.

The regression results (Table 5) showed that this model is able to explain 62% of the price variation (R squared = 0.620).

Table 5. SS SEM regression results. (Source: Authors' elaboration).

Regression Model: Spatial Error Model (SEM)				
Dependent Variable: Listing Prices Logarithm (logTLP)				
Indipendent Variables	**Coefficient**	**Std.Error**	**z-Value**	**Probability**
Lambda (TLP)	0.246	0.1	2.451	0.014
CONSTANT	10.528	0.107	98.02	0
BC (Building Class-Noble)	0.35	0.078	4.454	0
FA	0.005	0.001	12.813	0
US1 (Unit Status-Partially renovated)	0.237	0.073	3.248	0.001
US2 (Unit Status-Renovated)	0.398	0.085	4.68	0
HT (Heating Type-independent)	0.135	0.046	2.933	0.003
PG (Private Garden)	0.152	0.065	2.343	0.019
OL (Building Olivettian Connotation)	−0.174	0.066	−2.658	0.008
UD (Distance from the UNESCO site)	-9.921×10^{-005}	-3.49×10^{-005}	−2.845	0.004
EPC (Energy Performance Certification-B and over)	0.311	0.14	2.219	0.027
Number of observations	248			
R squared	0.62			
Log likelihood ratio test	−80.169			0
Breush-Pagan test	104.524			0
AIC	180.338			
Diagnostics For Spatial Dependence For Weight Matrix				
	MI/DF	Value	Probability	
Moran's I	0.0831	2.7892	0.005	
Lagrange Multiplier	1	6.206	0.013	
Robust LM	1	1.432	0.231	
Lagrange Multiplier	1	5.471	0.019	
Robust LM	1	0.697	0.403	
Lagrange Multiplier	2	6.903	0.031	

In line with the results obtained by the previous model, the building category (BC = noble), the unit status (US = renovated), the heating type (HT = independent) and high EPC levels (EPC = B and over) are characteristics that can considerably influence TLP.

Unlike the previous result, this regression analysis also highlighted that the presence of a private garden (PG) positively affects TLP; in this regard, it is worth mentioning that in Ivrea there are several villas and detached houses that include their own garden.

Focusing on the influence of the UNESCO site, it is interesting to notice that the distance from the UNESCO site (UD) has a negative coefficient: thus, the greater the distance from the site, the lower the property TLP. This is an important result which confirms that this important and strategic point of interest could progressively increase its positive influence on the Ivrea real estate market.

On the other hand, the variable "Olivettian connotation" (OL) of buildings presents a negative coefficient, which means that the Olivettian connotation is not positively recognized by the real estate market. This result is in agreement with recent studies that demonstrated that the architectural quality is not easily acknowledged by buyers and sellers [8,63]. In Ivrea, in fact, even if the Olivettian housings often represent valuable examples of Modern Heritage, they are classified as "economic" buildings and thus devalued. These buildings represent the legacy of the Olivetti company, but even if their tangible and intangible value is relevant for architectural, social and political reasons, it does not positively influence the property price variation. On the contrary, the building category (BC), the unit status (UT) and some green features have a stronger influence on property prices.

Therefore, it is possible to affirm that the green features (of which the EPC is a proxy) are even more recognised by the real estate market than the architectural or historical values.

5.3. Prediction of Property Values after Energy Class Upgrade

In order to simulate a potential increase in the property price after a hypothetical energy class upgrade deriving from possible energy retrofit intervention, the results of the last regression were used to estimate new real estate market values of the asset collected in the SS. This operation aimed not only to understand the potentiality of an energetic optimization on the Modern Heritage, but also to evaluate if the costs of intervention could be covered by the sale of the properties.

Firstly, only the listing price of the assets with the lowest EPC levels (E-F-G, 446 observations) were estimated; this operation was performed to compare the model predicted values to the observed listing prices. The results highlighted an acceptable discrepancy in the prediction of the listing price, which represents the error rate of the model.

The estimated property prices were calculated on the basis of the predicted values of the SEM model calculated by GeoDa, assuming the simplified following formula [45,60,64]:

$$ELP\ (CEL) = (\lambda_{TLP} + 10.528)^{-1}\ (0.35\ BC + 0.005\ FA + 0.237\ US1 + 0.398\ US2 + 0.152\ PG - 0.174\ OL - 9.921^{-005}\ UD).$$

where: *ELP* (*CEL*) is the predicted value of the Total Listing Price with the current *EPC* level of the SEM model (Table 5) expressed by its logarithm, λ stands for added spatial error coefficient; *BC*, *FA*, *US1*, *US2*, *PG*, *OL*, *UD* are the variables introduced for each of the analyzed characteristics.

Subsequently, a second estimation was performed to understand whether an energy retrofit intervention, which would change the lowest EPC levels ("E-F-G") to the highest ones ("B and over"), could lead to an increase in the listing prices. The energy upgraded property price was estimated by changing the marginal coefficient related to the lowest EPC levels with the one related to the highest EPC levels, according to the following formula:

$$ELP\ (ELU) = (\lambda_{TLP} + 10.528)^{-1}\ (0.35\ BC + 0.005\ FA + 0.237\ US1 + 0.398\ US2 + 0.152\ PG - 0.174\ OL - 9.921^{-005}\ UD + 0.311\ EPC)$$

where: *ELP* (*ELU*) is the predicted value of the Total Listing Price with the *EPC* level upgraded of the SEM model (Table 5) expressed by its logarithm, λ stands for added spatial error coefficient; *BC*, *FA*, *US1*, *US2*, *PG*, *OL*, *UD* are the variables introduced for each of the analyzed characteristics, with the addition of the calculated marginal coefficient of upgraded EPC level ("B and over").

Therefore, the results deriving from the two estimations were compared. Figure 6 shows the comparison between the first estimation with Total Listing Prices at the current energy level and the same cases but with a hypothetical upgrade in energy class maybe due to a general intervention such as walls and roof insulation and the replacement of windows. The difference between those two estimated prices is positive for 93% of the observations, thereby providing evidence of the cost-effectiveness of retrofitting houses, and it can be considered as a starting point for the conservation of these residential buildings, especially those located in the Olivetti's residential districts (Figure 6).

Initial evidence can be found in Canton Vesco; by looking at the maps, it is possible to see the retrofit intervention effects on the listing prices. In Figure 6a, values of this district fall into the lowest Jenks range, while in the map in Figure 6b the estimated listing prices fall into the highest price range. In the Historical Centre of the city and in the UNESCO Site, prices rise from a mean of 110,000 Euro/sqm to 118,000 Euro/sqm and by observing the map it is possible to see that prices increase not so much to the higher range but to the intermediate one. In particular, the number of apartments with the lowest observed listing prices is 191, while the number of those with an ECP level from B is 176. Furthermore, there is also a considerable increase in the dwellings with the highest values, i.e., in the first image only one case is observed, but in the second there are 34.

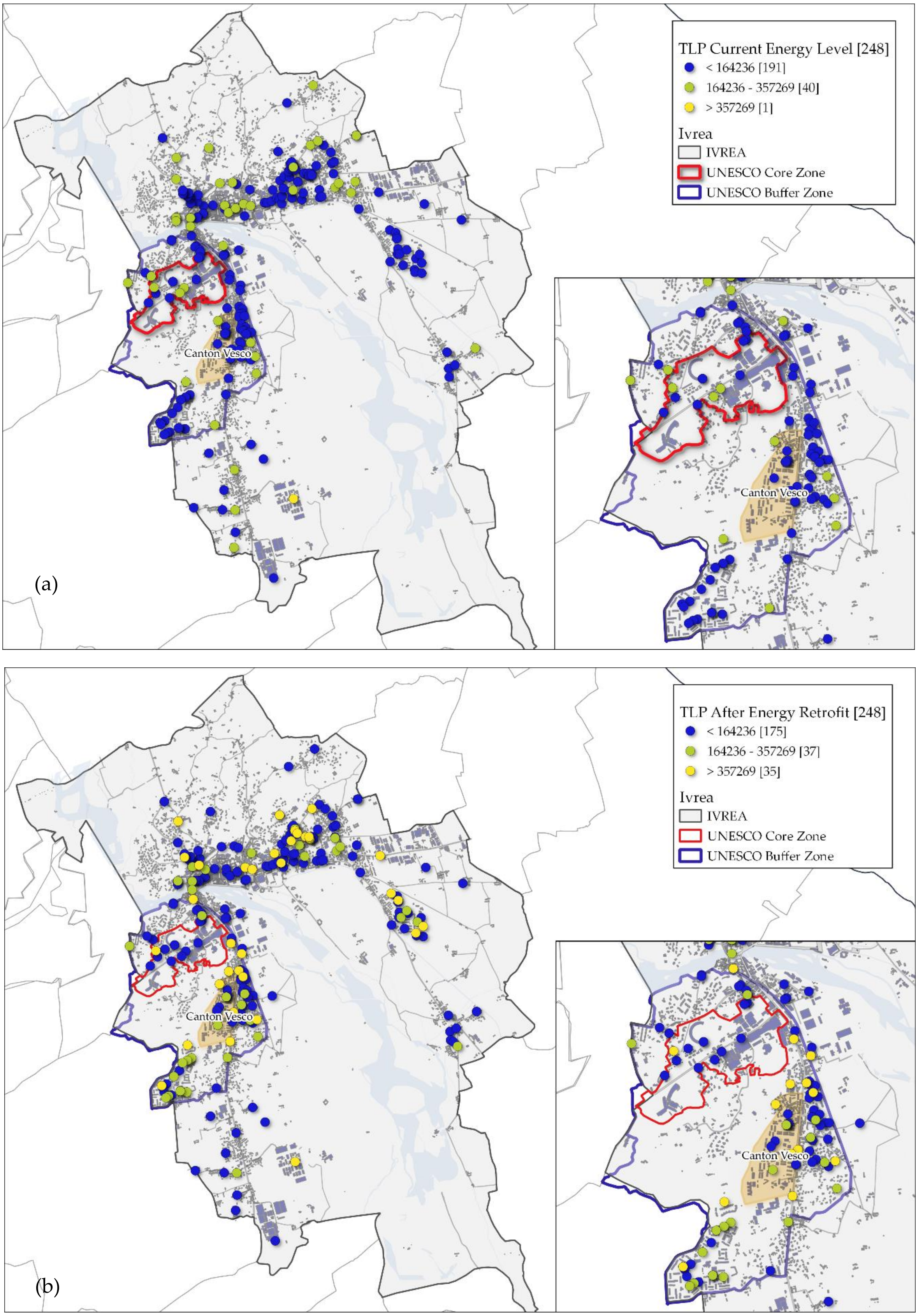


Figure 6. (**a**) Total Listing Price at current EPC level (above) and (**b**) Total Listing Price after possible energy retrofit interventions (EPC level = A4-B). (Source: Authors' elaboration on Immobiliare.it (accessed on 15 January 2022) data).

Finally, the mean predicted value of the TLP with the EPC level upgraded was calculated (EUR 152,173.14) and compared to the mean TLP of the SS sample (EUR 106,407.26). This result highlights that energy retrofit interventions on housing properties in Ivrea could increase value by 43%. Nevertheless, it is worth noticing that this increase, if related to the property dimension, is not sufficient to cover the necessary investment costs required to improve the energy condition of the housing unit. In fact, by calculating the mean property floor area of the SS sample (111 m^2), it is evident that the mean cost per square meter necessary for an EPC level upgrade (412.31 EUR/m^2), is able to cover only a limited part of the investment for energy retrofitting. For example, the replacement of windows and the installation of the thermal coat, according to [7], can amount up to 448.7 EUR/m^2. Therefore, the great importance and necessity of specific measures and incentives is apparent, so as to entice property owners to invest in energy retrofit interventions. In particular, these economic supports represent great opportunities to preserve the Modern Heritage of the housing.

6. Discussion

The relation between housing prices and the related characteristics was analyzed by means of spatial regression models in order to particularly clarify the Olivettian connotation of buildings and the green features influence on prices. Thus, this article addressed, on the one hand, the theme of the acknowledgment and monetization of some historical-architectural values and, on the other, the issue of the economic affordability of the redevelopment interventions of Olivetti's buildings.

Economic feasibility represents a key aspect since it is the main influence on the protection of this valuable housing heritage and it is currently supported by policies and incentives.

Two models were performed in this study, The first analyzed a data sample related to the 32 Municipalities of the Eporediese area (DS), while the second analyzed a sub-sample focused on the city of Ivrea (SS).

The results of the first SEM regression model showed that in the Eporediese area (DS), the property-price formation process mainly depends on intrinsic characteristics, but also social and cultural factors of the context are strictly related to the real estate market. Additionally, two variables that can be considered proxy of the territory accessibility emerged, namely the presence of retail services (RE) and the proximity to high-way exits (HD), which are monetized by the real estate market, reflecting the current mobility habits of the Ivrea population which are somewhat in contrast with the trend of the town "downscaling" to favour slow mobility and walking.

Focusing only on the second model applied on the Ivrea SS, the regression results underlined that intrinsic characteristic (building classification and apartment unit status) mainly influence housing prices. Moreover, the creation of the OL indicator (building Olivettian Connotation), helped us to distinguish the buildings with a recognized cultural and historical value from the whole residential stock of Ivrea and to compare its marginal coefficient with those related to other intrinsic features, such as the energy efficiency, expressed by the EPC level.

The results showed that, even in this town, as confirmed in other studies relating to larger urban contexts [32,37,65], the green characteristics (heating type and ECP level) are more monetized with respect to architectural and historical characteristics, such as authorship and building Olivettian connotation (OL). In fact, the main result of this regression model is that the OL variable presents a significant negative marginal coefficient, despite the fact that Olivetti's architecture was recognized by UNESCO as a World Heritage Site. This result is even more relevant if compared to the positive marginal coefficient of EPC. Thus, it can be assumed that consumers do not buy properties with the building cultural and historical value as their main consideration, but are more attuned to the energy performance, which is often considered as a proxy of the building quality. Moreover, it is also worth mentioning that other variables probably have a greater influence on property prices than the building Olivettian connotation, such as the building category (the Olivettian neighborhoods were originally built as council housing), the asset physical degradation, the social connotation of the inhabitants and the quality of the surrounding public spaces and green areas [66].

Therefore, the regression results of the Ivrea SS demonstrated that several intrinsic and extrinsic characteristics, which are related to the property "use value" and to "comfort" aspects, have a higher influence on consumers' preferences than the cultural features of the building.

The regression models were also applied with predictive purposes to verify whether the Ivrea real estate market is potentially able to guarantee a sufficient increase in the property values after a hypothetical energy class upgrade deriving from possible energy retrofit intervention, so as to cover the investment costs for energy retrofitting. The regression models showed that the average predicted value with an upgraded EPC level ("B and over") is 43% higher than the average price value of the properties at the current condition. Nevertheless, this difference in values, if analyzed in relation to the mean property dimension, corresponds to 412.31 EUR/m^2, demonstrating that at the current condition of the real estate market, the investment costs for energy retrofitting can be only partially covered.

This key issue emerged not only from the regression results, but also from the descriptive statistics of the Ivrea SS. The mean LP, reduced by 15% to be approximately assimilated to transaction costs, is around 800 EUR/m^2, therefore, it is lower than the depreciated reconstruction values calculated without considering the land value. Such low prices highlight that the energy retrofit costs are surely significantly higher than the "intrinsic value" of the properties and thus, highlight the weakness of the Ivrea socio-economic context. Therefore, it is evident that economic factors play a predominant role, due to low-income or limited willingness to pay both property owners and potential buyers.

Moreover, the Ivrea real estate market is also characterized by a low level of dynamism (demonstrated by the ratio between the property transactions and the housing stock). This condition does not foster the economic enhancement and energy retrofitting of the assets located in the UNESCO site and, in particular, the housing heritage of the Olivettian neighborhoods.

7. Conclusions

The UNESCO site of Ivrea and the modern architecture of high documentary and authorship value represent an important aspect of heritage for the city of Ivrea and the surrounding municipalities of the Eporediese area. Currently, the main criticalities consist of the fact that those valuable buildings are very numerous, almost totally privately owned and some of them are in a bad state of conservation after being abandoned and unattended to for many years. Moreover, as in other similar contexts, such small municipalities have inadequate tools and less opportunity to preserve and enhance a heritage of such a magnitude. Thus, the convenience of intervening for the private owners is strictly related to the economic feasibility of the project and to the real estate market dynamics, which in Ivrea are unfortunately rather weak.

This article outlined which of the intrinsic and extrinsic housing features are most appreciated in the real estate market of Ivrea and the Eporediese area, and indirectly investigated the theme of the future of the UNESCO site, with particular reference to the Olivettian housing neighborhoods.

The results suggested that interventions aimed at improving energy efficiency may represent a possible future direction to facilitate private owners in preserving and enhancing this heritage. Some studies that focus on the conservation of Modern Heritage addressed the issue of energy requalification with respect to the protection of the original characteristics that characterize them. In this regard, previous researches of the Ivrea UNESCO site highlighted that modern buildings could be effectively improved by means of energy redevelopment interventions and that energy retrofit projects could play an important role in consolidating the protection of architecture with their energy performance and, therefore, in optimizing the quality of the whole building [67,68]. Previous studies also showed that the most critical issues in the enhancement of the Ivrea UNESCO site depend, above all, on the fragility of the socio-economic context [8] and the inefficiency of the administration [69]. It has also been found that functional and energy degradation is often higher than material and structural decay, so that both restoration methodologies based on specialized technical and specialized economic skills are necessary to identify new redevelopment and reuse strategies.

The real estate market, intended as an expression of society, reflects its transformations by changing its own paradigms and dynamics.

Thus, the importance of some social preferences and trends cannot be underestimated in analysing the real estate market, especially when the analyzed housing heritage is historical and protected by law. The regulatory documents for the buildings energy efficiency specify, for the heritage under protection, the necessity to balance conservation and environmental issues. However, as of yet, there are no specific rules which explicitly guide the development of high-quality interventions at the building and the micro-surrounding level for implementing these regulations. For example, it is fundamental to understand how Modern Heritage buildings can be enhanced by improving their energy efficiency in terms of plant equipment, facade materials, finishes and common areas without losing their unique characteristics.

To understand if and how the market recognizes and monetizes the new environmental and social values emerging in the peri-urban contexts of the post-pandemic world is a challenge that will continue to be grappled with in the coming years.

Therefore, future research should seek to understand specific rules and operational specifications concerning energy efficiency interventions that can favour renovation and also guarantee the conservation of buildings with high architectural and historical value. The following key questions could guide future insights: Can Modern Heritage buildings be preserved by energy retrofit interventions? Can energy retrofit interventions be economically sustainable for private owners?

Our results highlight that the energy retrofitting of Modern Heritage must become an absolute priority, due to the recent requirements of restoration and protection of this heritage, which represents a great part of the existing housing stock and above all by taking into consideration that most of the European housing stock (75%) is more than 50 years old and only 1% is restructured every year [29]. Moreover, by also considering the theory of contemporary restoration, it is evident that the current urgency/necessity to improve the Modern Heritage energy efficiency has to be addressed in order to develop sustainable projects that can merge restoration requirements and economic feasibility and profitability.

Currently, in Italy, in line with all of the measures that each nation has been trying to manage in order to make existing buildings more energy efficient, the campaign of fiscal incentives for energy retrofit interventions of various types of building represents a key strategy that has achieved considerable success. In particular, the incentives of the Super Eco Bonus, (extended until 2023) and funding from PNRR (in line with the Next Generation EU plan) represent excellent opportunities by which to foster restoration and enhancement interventions for this particular type of buildings, specifically in socio-economic contexts characterized by weak real estate market dynamics.

In conclusion, it is important to reconsider the Italian government measure which in 2019/2020 favoured the redevelopment of existing heritage by supporting, with public funding, property owners with up to 110% of the cost of the interventions (Super Ecobonus). The Super Ecobonus, of Keynesian origin, had the economic objective of fostering the recovery of the construction sector and, at the same time, reducing the CO_2 emissions of the existing building stock. Despite the magnitude of allocated public resources, this measure has had no significant impact on the redevelopment of low-value properties and of those with an historical value, since it did not establish any income limit of the beneficiaries nor did it provide any incentives aimed at redeveloping the most degraded buildings or those with a particular cultural and architectural interest. Therefore, the requirements for Super

Ecobonus application and for PNRR funding allocation should be partially revised to better support the redevelopment of existing heritage and urban regeneration projects. In this way, the lower-economic and council housing of the Olivettian neighborhoods in Ivrea could also be properly enhanced and preserved for future generations.

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References

1. Galbiati, G.; Medici, F.; Graf, F.; Marino, G. Methodology for energy retrofitting of Modern Architecture. The case study of the Olivetti office building in the UNESCO site of Ivrea. *J. Build. Eng.* **2021**, *44*, 103378. [CrossRef]
2. Graf, F.; Marino, G. Modern and Green: Heritage, Energy, Economy. *Mod. Sustain.* **2011**, 32–39. [CrossRef]
3. Governo Italiano. Presidenza del Consiglio dei Ministri Piano Nazionale di Ripresa e Resilienza. 2021; p. 269. Available online: https://www.governo.it/sites/governo.it/files/PNRR.pdf (accessed on 15 January 2022).
4. Samper, J.A.; Schockling, A.; Islar, M. Climate politics in green deals: Exposing the political frontiers of the european green deal. *Polit. Gov.* **2021**, *9*, 8–16. [CrossRef]
5. Mastini, R.; Kallis, G.; Hickel, J. A Green New Deal without growth? *Ecol. Econ.* **2021**, *179*, 106832. [CrossRef]
6. Villari, A.; Danaro, P. The addition of architectural quality to the built environment in structural retrofitting strategies. *ArcHistoR* **2019**, *12*, 796–807. [CrossRef]
7. Anna, F.D.; Vergerio, G.; Corgnati, S.; Mondini, G. Un nuovo prezzario per la valutazione di interventi di retrofit su archetipi di edifici. *Valori e Valutazioni* **2019**, *22*, 3–17.
8. Malavasi, G. Housing values of the Olivetti villasin the Ivrea real estate market. *Territ. Ital.* **2020**. [CrossRef]
9. Fregonara, E.; Lo Verso, V.R.M.; Lisa, M.; Callegari, G. Retrofit Scenarios and Economic Sustainability. A Case-study in the Italian Context. *Energy Procedia* **2017**, *111*, 245–255. [CrossRef]
10. Fregonara, E.; Giordano, R.; Rolando, D.; Tulliani, J.M. Integrating Environmental and Economic Sustainability in New Building Construction and Retrofits. *J. Urban Technol.* **2016**, *23*, 3–28. [CrossRef]
11. European Parliament. Directive 2012/27/EU. *Off. J. Eur. Union* **2012**, L315/1. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32012L0027 (accessed on 15 January 2022).
12. Ascione, P. Conoscere e riqualificare il patrimonio architettonico del Novecento: Esperienze e metodologie/Cognitive study and upgrading of the 20th century architectonic heritage: Experiences and methodologies. *Techne* **2012**, *3*, 250.
13. Ascione, P. Tecnologie, sperimentazione e uso delle risorse tra progetto Moderno ed esigenze di riqualificazione. *Techne* **2017**, *13*, 212–221. [CrossRef]
14. Tronti, L. L'idea di cultura in Adriano Olivetti. Valore e attualità di un'esperienza intellettuale e imprenditoriale. *Econ. Lav. Riv. Quadrimestrale di Polit. Econ. Sociol. e Relaz. Ind.* **2014**, *48*, 171–190.
15. Galuzzi, P. Storicità dell'architettura moderna: Tutela e rigenerazione delle architetture olivettiane a Ivrea. *Techne* **2016**. Available online: https://www.researchgate.net/publication/311068346_Historical_authenticity_of_modern_architecture_Preservation_and_regeneration_of_Olivetti_architecture_in_Ivrea/fulltext/5a20a12a4585158865c505a4/Historical-authenticity-of-modern-architecture-Preservation-and-regeneration-of-Olivetti-architecture-in-Ivrea.pdf (accessed on 15 January 2022). [CrossRef]

16. Héberlé, E.; Borderon, J.; Burgholzer, J. Guidance for Finding a Sustainable Balance between Energy Savings and Heritage Preservation When Retrofitting Heritage Buildings. *Restor. Build. Monum.* **2019**. Available online: https://www.degruyter.com/document/doi/10.1515/rbm-2017-0007/html?lang=en (accessed on 15 January 2022). [CrossRef]
17. Cerquetti, M. Value creation in industrial heritage management. Evidence from the City of Paper (Fabriano, Italy). *Bud. Archit.* **2018**, *16*, 035–047. [CrossRef]
18. Preite, M. Recovered factories: Industrial heritage reuse in Italy. *Ural. Istor. Vestn.* **2021**, *71*, 55–64. [CrossRef]
19. Rodwell, D. The world heritage convention and the exemplary management of complex heritage Sites. *J. Arch. Conserv.* **2002**, *8*, 40–60. [CrossRef]
20. Smith, M.J. New Lanark Walls: Examples of sustainable design for a World Heritage Site. In Proceedings of the Geotechnical Engineering for the Preservation of Monuments and Historic Sites-Proceedings of the 2nd International Symposium on Geotechnical Engineering for the Preservation of Monuments and Historic Sites, Naples, Italy, 30–31 May 2013.
21. Johnson, H. Language revitalisation, sonic activism and cultural sustainability: Voicing linguistic heritage on Jersey. In *Theory and Practice in Heritage and Sustainability: Between Past and Future*; Routledge: Oxon, UK, 2015.
22. Kee, T.; Chau, K.W. Adaptive reuse of heritage architecture and its external effects on sustainable built environment—Hedonic pricing model and case studies in Hong Kong. *Sustain. Dev.* **2020**, *28*, 1597–1608. [CrossRef]
23. Pottgiesser, U.; Ayón, A. Van Nelle Factory. In *Reglazing Modernism*; 2019. Available online: https://www.degruyter.com/document/doi/10.1515/9783035619348-014/html (accessed on 15 January 2022).
24. Santi, M.V.; Laiola, G.S. Retrofitting of Company Towns' Residential Buildings: From International Best Practices to Local Implementations in Friuli Venezia Giulia Region (NE Italy). *Vitr. Int. J. Archit. Technol. Sustain.* **2019**, *4*, 13. Available online: https://polipapers.upv.es/index.php/vitruvio/article/view/11158 (accessed on 15 January 2022). [CrossRef]
25. Borgarino, M.P.; Gasparoli, P.; Ronchi, A.T.; Scaltritti, M. Governare l'Evoluzione di un Sistema Urbano. Il Sito UNESCO di Crespi d'Adda. *Techne* **2016**. Available online: https://oaj.fupress.net/index.php/techne/article/download/4577/4577/ (accessed on 15 January 2022). [CrossRef]
26. Carbotti, D.; Morandini, G. Restoration and strengthening of historical heritage with composite materials: The chimney of crespi d'adda village. In Proceedings of the 38th International Conference on Cement Microscopy, Lyon, France, 17–21 April 2016. Available online: http://toc.proceedings.com/35479webtoc.pdf (accessed on 15 January 2022).
27. Giacopelli, E. *Recupero e Conservazione Magazine*; 2021; pp. 88–97. Available online: http://www.g-studio.biz/wp-content/uploads/2021/12/recmagazine168_Olivetti_Giacopelli.pdf (accessed on 15 January 2022).
28. European Parliament. European Council Directive 2002/91/EC of 16 December 2002 on the Energy Performance of Buildings. *Off. J. Eur. Union* **2002**. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32002L0091 (accessed on 15 January 2022).
29. European Comission. *A Renovation Wave for Europe-Greening Our Buildings, Creating Jobs, Improving Lives*; 2020. Available online: https://c2e2.unepdtu.org/kms_object/a-renovation-wave-for-europe-greening-our-buildings-creating-jobs-improving-lives/ (accessed on 15 January 2022).
30. European Commission. *Next Steps towards 'Vision Zero'*; 2020; ISBN 9789276132158. Available online: https://op.europa.eu/en/publication-detail/-/publication/d7ee4b58-4bc5-11ea-8aa5-01aa75ed71a1 (accessed on 15 January 2022).
31. Chen, A.; Marmolejo-Duarte, C. How Different Are Dwellings Whose Energy Efficiency Impacts Price Formation? *IOP Conf. Ser.* **2019**. Available online: https://www.researchgate.net/publication/335884090_How_different_are_dwellings_whose_energy_efficiency_impacts_on_price_formation (accessed on 15 January 2022). [CrossRef]
32. Dell'Anna, F.; Bravi, M.; Marmolejo-Duarte, C.; Bottero, M.C.; Chen, A. EPC Green Premium in Two Different European Climate Zones: A Comparative Study between Barcelona and Turin. *Sustainability* **2019**, *11*, 5605. Available online: https://www.mdpi.com/2071-1050/11/20/5605 (accessed on 15 January 2022). [CrossRef]
33. McCord, M.; Davis, P.; McCord, J.; Haran, M.; Davison, K. An exploratory investigation into the relationship between energy performance certificates and sales price: A polytomous universal model approach. *J. Financ. Manag. Prop. Constr.* **2020**, *25*, 247–271. [CrossRef]
34. McCord, J.; McCord, M.; McCluskey, W.; Davis, P.T.; McIlhatton, D.; Haran, M. Effect of public green space on residential property values in Belfast metropolitan area. *J. Financ. Manag. Prop. Constr.* **2014**, *19*, 117–137. [CrossRef]
35. Fregonara, E.; Rolando, D.; Semeraro, P.; Vella, M. The impact of Energy Performance Certificate level on house listing prices. First evidence from Italian real estate. *Aestimum* **2014**, *5*, 65. [CrossRef]
36. Taltavull, P.; Anghel, I.; Ciora, C. Impact of energy performance on transaction prices: Evidence from the apartment market in Bucharest. *J. Eur. Real Estate Res.* **2017**, *10*, 57–72. [CrossRef]
37. Barreca, A.; Fregonara, E.; Rolando, D. Epc labels and building features: Spatial implications over housing prices. *Sustain.* **2021**, *13*, 2838. [CrossRef]
38. Di Liddo, F.; Morano, P.; Tajani, F.; Maria Torre, C. An innovative methodological approach for the analysis of the effects of urban interventions on property prices. *Valori E Valutazioni* **2020**, *26*, 25–49. [CrossRef]
39. Morano, P.; Rosato, P.; Tajani, F.; Di Liddo, F. An Analysis of the Energy Efficiency Impacts on the Residential Property Prices in the City of Bari (Italy). In *Green Energy and Technology*; 2020. Available online: https://www.researchgate.net/publication/335023777_An_Analysis_of_the_Energy_Efficiency_Impacts_on_the_Residential_Property_Prices_in_the_City_of_Bari_Italy (accessed on 15 January 2022).

40. McCord, M.; Lo, D.; Davis, P.T.; Hemphill, L.; McCord, J.; Haran, M. A spatial analysis of EPCs in The Belfast Metropolitan Area housing market. *J. Prop. Res.* **2020**, *37*, 25–61. [CrossRef]
41. Fregonara, E.; Rolando, D.; Semeraro, P. Energy performance certificates in the Turin real estate market. *J. Eur. Real Estate Res.* **2017**, *10*, 149–169. [CrossRef]
42. Li, R.Y.M.; Cheung, K.Y.; Shoaib, M. Walled buildings, sustainability, and housing prices: An artificial neural network approach. *Sustainability* **2018**, *10*, 1298. [CrossRef]
43. Haining, R.; Wise, S.; Ma, J. Exploratory spatial data analysis in a geographic information system environment. *J. R. Stat. Soc. Ser. D Stat.* **1998**, *47*, 457–469. [CrossRef]
44. Anselin, L.; Griffith, D.A. Do spatial effecfs really matter in regression analysis? *Pap. Reg. Sci.* **1988**, *65*, 1–34. [CrossRef]
45. Anselin, L.; Rey, S. Properties of Tests for Spatial Dependence in Linear Regression Models. *Geogr. Anal.* **1991**, *23*, 112–131. [CrossRef]
46. Baltagi, B.H.; Heun Song, S.; Cheol Jung, B.; Koh, W. Testing for serial correlation, spatial autocorrelation and random effects using panel data. *J. Econom.* **2007**, *140*, 5–51. [CrossRef]
47. Cajias, M.; Ertl, S. Spatial effects and non-linearity in hedonic modeling. *J. Prop. Investig. Financ.* **2018**, *32*, 36–49. [CrossRef]
48. Urbanistica, A.A. *Piano Paesaggistico Regionale Piemonte. Programmazione Territoriale e Paesaggistica, Sviluppo Della Montagna, Foreste, Parchi e Civile*; 2017. Available online: https://www.regione.piemonte.it/web/temi/ambiente-territorio/paesaggio/piano-paesaggistico-regionale-ppr (accessed on 15 January 2022).
49. Pacella, S.; Vianzone, G. Valorizzare, Fruire, Trasmettere: Il sito UNESCO "Ivrea Città Industriale del XX Secolo". 2019. Available online: https://webthesis.biblio.polito.it/12722/ (accessed on 15 January 2022).
50. Bonifazio, P.; Giacopelli, E. Il paesaggio Futuro. Letture e Norme per il Patrimonio Dell'architettura Moderna a Ivrea. Allemandi, 2007; Available online: https://www.amazon.com/paesaggio-patrimonio-dellarchitettura-Edizione-italiana/dp/8842215376 (accessed on 15 January 2022).
51. Figini and Pollini. *Encyclopedia of Contemporary Italian Culture*; 2020. Available online: https://www.routledge.com/Encyclopedia-of-Contemporary-Italian-Culture/Moliterno/p/book/9780415145848 (accessed on 15 January 2022).
52. Collins, M. The Formation of a Heterotopia: An Inquiry into the Intermingling of Utopic Thoughts and Concrete Activities in Olivetti's Ivrea. *Calif. Ital. Stud.* **2017**, 7. Available online: https://escholarship.org/uc/item/75t413bz (accessed on 15 January 2022). [CrossRef]
53. Carlo, O.; Patrizia, B.; Lazzarini, L. *Le case Olivetti a Ivrea. L'Ufficio Consulenza Case Dipendenti ed Emilio A. Tarpino*; 2018. Available online: https://www.amazon.com/Olivetti-LUfficio-Consulenza-Dipendenti-Tarpino/dp/8815274626 (accessed on 15 January 2022).
54. Di Biagi, P. Quartieri e città nell'Italia degli anni Cinquanta. Il piano Ina Casa 1949–1963. *Mélanges L'école Française Rome. Ital. Méditerranée* **2003**, *115*, 511–524. [CrossRef]
55. Ridolfi, M.; Frankl, W. Olivetti Kindergarten Ivrea, Canton Vesco, Viale Della Liberazione 4, 1954–1968. *Italomodern* **2012**, 64–67. [CrossRef]
56. Olmo, C. *Costruire la Città Dell'uomo: Adriano Olivetti e L'urbanistica/a Cura di Carlo Olmo*; Edizioni di Comunità: Torino, Italy, 2001.
57. Palomares Figueres, M.T. DOCOMOMO. Modern architecture and heritage. *Loggia Arquit. Restaur.* **2018**, *31*, 8–21. [CrossRef]
58. Curto, R.; Fregonara, E.; Semeraro, P. Asking prices vs Market Prices: An Empirical Analysis. *Territ. Ital.* **2012**, *12*, 53–72.
59. Banca D'Italia Sondaggio Congiunturale sul Mercato Delle Abitazioni in Italia-2° Trimestre 2020. 2020. Available online: https://www.bancaditalia.it/pubblicazioni/sondaggio-abitazioni/2020-sondaggio-abitazioni/02/statistiche_SAB_20201020.pdf (accessed on 20 October 2021).
60. Anselin, L.; Syabri, I.; Kho, Y. GeoDa: An introduction to spatial data analysis. *Geogr. Anal.* **2006**, *38*, 5–22. [CrossRef]
61. German, D.M.; Adams, B.; Hassan, A.E. The evolution of the R software ecosystem. In Proceedings of the European Conference on Software Maintenance and Reengineering, Genova, Italy, 5–8 March 2013.
62. Barreca, A.; Curto, R.; Rolando, D. Urban vibrancy: An emerging factor that spatially influences the real estate market. *Sustainability* **2020**, *12*, 346. [CrossRef]
63. Barreca, A. *20th Century 'Invisible' Heritage: Qualities and Values in the Real Estate Market*; Politecnico di Torino: Torino, Italy, 2021. Available online: https://www.mdpi.com/2071-1050/14/5/2565/pdf (accessed on 20 October 2021).
64. Darmofal, D. Spatial Lag and Spatial Error Models. In *Spatial Analysis for the Social Sciences*; Cambridge University Press: Cambridge, UK, 2015; pp. 96–118.
65. Aroul, R.R.; Rodriguez, M. The Increasing Value of Green for Residential Real Estate. *J. Sustain. Real Estate* **2017**, *9*, 112–130. [CrossRef]
66. Barreca, A.; Curto, R.; Rolando, D. An Innovative Methodological and Operational Approach to Developing Management Plans for UNESCO World Heritage Sites: A Geographic Information System for "Ivrea, Industrial City of the 20th Century". *Aestimum* **2017**, *71*. Available online: https://oaj.fupress.net/index.php/ceset/article/view/5651 (accessed on 20 October 2021). [CrossRef]
67. Curto, R.; Barreca, A.; Rolando, D. Restoration, Reuse and Energy retrofit for the enhancement of 20th Century Heritage: A learning experience on the Ivrea Site Inscribed on the UNESCO World Heritage List. *Valori e Valutazioni.* **2018**, *21*, 41–57.

68. Curto, R.; Barreca, A.; Rolando, D. Interventi di Retrofit Energetico sul Patrimonio Moderno in Mercati Immobiliari Deboli: Problematiche e Convenienze Economiche per la Valorizzazione dell'Edilizia Residenziale Olivettiana. In *"RE-Inventare il Nuovo Sull'Esistente"*; 2019; pp. 55–72. Available online: https://iris.polito.it/handle/11583/2756672 (accessed on 20 October 2021).
69. Curto, R.; Norese, M.F.; Rolando, D. A Multi-Criteria Decision Aid Perspective that Guides an Incremental Development of Knowledge and Fosters Relationships and Decisions. *Submitt. Publ. EURO J. Decis. Process.* **2022**. Available online: http://www.cs.put.poznan.pl/ewgmcda/newsletter/Spr21.pdf (accessed on 20 October 2021).