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Determinants of the value of houses: a case study concerning the city of Cagliari, Italy



DICAAR

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Layout

1. Alternative measures of the value of houses
2. Factors that influence the value of houses
3. A methodology to analyze the determinants of the value of houses: the hedonic approach
4. Results
5. Discussion and conclusion



1. Alternative measures of the value of houses

- ▶ We study the housing market of the municipality of Cagliari, Italy, performing an analysis of the estimated market values of a representative sample consisting of 304 apartments spread over 18 market areas.
- ▶ Having regard to the current real estate market stagnation and to the consequent general lack of specific transactional data, to estimate each property's market value, given also the size of the sample, can involve a significant margin of error.
- ▶ For this reason, we use different appraisal approaches and market price references.
- ▶ For each property, we collect the relative overall gross living area **[AREA]** and evaluate, in qualitative terms, the potential incidence of the leading quality characteristics in the formation of property prices.



<https://maps.google.com>



1. Alternative measures of the value of houses

As theorized by one of the main national reference on the subject (Orefice, 2007), these characteristics can be grouped in four categories:

- ▶ **Localization quality** (distance from the city center, efficiency of public transportation service, quality of local services, reputation of the area, proximity to open spaces or other natural features, availability of private or public parking lots for tenants and guests).
- ▶ **Position quality** (presence and quality of panoramic views, distance from other buildings, daylighting quality, apartment level).
- ▶ **Typological quality** (building and apartment maintenance level, equipment and mechanical system conditions, building age).
- ▶ **Economic productivity**: potential risk to re-convert the property investment into cash (marketability risk) and legislative risks. Given the impossibility to access information concerning the property owners, we assess marketability risk as related to the overall gross living area and consider legislative risk almost uniform in a given market area.



1. Alternative measures of the value of houses

- ▶ In addition, we consider another market value definition **[EST_VAL]** by estimating a linear regression for each market area.
 - For this estimate, we consider a dataset based on a survey concerning residential property sales carried out in 2013.
 - Considering the market price as the dependent variable and the quality of the features as the explanatory variable, we assess the relationship between prices and quality for each market area.
 - Subsequently, we make use of the resulting regression line to define the market value for each of the 304 apartments.
- ▶ Moreover, we appraise the cadastral value **[CAD_VALUE]** for each single apartment, by means of the on-line evaluation service provided by the Italian Cadastre.
- ▶ Finally, we estimate the list price **[SUPP_VAL]** by considering a sample of list prices observed during the first semester of 2013 and comparing each property with the nearest detected apartment for sale.



1. Alternative measures of the value of houses

Quality characteristic category	Incidence in central market areas	Incidence in intermediate market areas	Incidence in suburban market areas
<i>Localization quality</i>	from 5% to 10%	from 10% to 30%	from 15% to 35%
<i>Position quality</i>	from 15% to 25%	from 10% to 20%	from 10% to 25%
<i>Typological quality</i>	from 15% to 30%	from 20% to 25%	from 5% to 20%
<i>Economic productivity</i>	from 25% to 35%	from 10% to 25%	from 10% to 20%
Overall incidence	from 60% to 100%	from 50% to 100%	from 40% to 100%

Variable	Definition	Mean	St.dev
<i>EST_VAL</i>	Market value (€/m ²) estimated through regression analysis (source: 2013 direct survey)	2,279.77	404.02
<i>CAD_VAL</i>	Cadastral Assessed Value (€/m ²) (source: 2013 cadastral register of the city of Cagliari)	714.64	294.76
<i>OMI_VAL</i>	Market value (€/m ²) estimated through average market values range (source: OMI)	2,325.56	220.75
<i>RENT_VAL</i>	Rent value (€/m ² per month) estimated through average rent values range (source: OMI)	7.84	0.62
<i>SUPP_VAL</i>	Average list price (€/m ²) recorded from other apartments for sale (source: 2013 direct survey)	2,515.00	308.59



2. Factors that influence the value of houses

- ▶ Characteristics of housing units and of the neighborhoods where houses are located could possibly be either positive, in which case they are considered goods, or negative, in which case they are considered bads. Since the characteristics of neighborhoods where houses are located are locally intrinsically non-excludable and non-rivalrous they can be considered public goods or public bads.
- ▶ The more the quantity of a public bad, the less the value of houses in the neighborhood, and vice-versa.
- ▶ Under this perspective, Zoppi (2000) analyzes the quantitative negative impact of widespread illegal building activity on the value of houses in the metropolitan area of Cagliari (Italy) by considering illegal buildings as a public bad, that is, a negative characteristic of the neighborhood where a house is located.



2. Factors that influence the value of houses

- ▶ In the light of the essays quoted above and of many others which deal with the issue of the determinants of the value of houses, in this paper we use the following taxonomy of the characteristics of houses:
 - structural characteristics of the residential unit
 - neighborhood demographic characteristics
 - plan-related characteristics
 - land cover types.
- ▶ Structural characteristics of houses are collected through interviews to real estate agencies, landlords, renters and homeowners, and through direct observation.
- ▶ Surely, more reliable estimates could have been obtained, had more precise and standardized databases, such as the American Housing Survey, been available, which is not the case for Italy.



2. Factors that influence the value of houses

- ▶ A question that is widely recognized in the literature, with reference to finished interior floor area, concerns the functional behavior of the value of houses with respect to finished interior area.
- ▶ Palmquist (1984, 397) observes that:

“one characteristic requires special attention. It would be anticipated that the number of square feet of living space would not simply have a linear effect on price. As the number of square feet increases, construction costs do not increase proportionally since such items as wall area do not typically increase proportionally. Appraisers have long known that price per square foot varies with the size of the house.”

- ▶ As a consequence, in our discussion it could be expected that the value of houses is negatively correlated to finished interior area, since we express it as the value per unit of finished interior area.



2. Factors that influence the value of houses

- ▶ Two quality factors related to typology and position represent two intrinsic features of the property.
- ▶ **Typological quality** regards the physical characteristics of the house and, in most aspects (i.e. maintenance level and quality of construction), it can be improved by property owners.
 - Depending on the buyer's willingness to pay, the value added or lost by carrying or not carrying out these improvements may not worth the related cost.
 - For example, to renovate an apartment by providing high-end quality finishes can be a cost-rewarding operation in a prestigious district. In a less qualified market area, where potential buyers usually are not interested in supporting the marginal cost of this improvement, the same process has a more limited influence on the value of the apartment. Considering the state of the regional housing market and the multifaceted Italian taste in design and materials, sellers are used to sell the property "as it is" avoiding the risk of supporting additional costs without meeting the expectations of potential buyers.



2. Factors that influence the value of houses

- ▶ Conversely, **position quality** cannot be improved by property owners and has a significant influence in price formation, especially for residential units located in multistory buildings.
 - In these cases, features like “presence and quality of panoramic views” or “daylighting quality” can differ significantly according to the apartment level.
 - We include the **distance from the seashore** as well.
 - If a proximity-to coast effect does occur, the value of houses will increase as distance from the coast diminishes.



2. Factors that influence the value of houses

- ▶ **Neighborhood demographic characteristics** are drawn from the most recent demographic survey.
 - We consider **population density**, whose correlation with demand for new houses, which could possibly put in evidence a positive agglomeration effect, is underlined in several studies (Sklenicka, 2013; Guiling et al., 2009; Forster, 2006).
 - **Population size** and the presence of **foreign residents**, mostly coming from underdeveloped countries, are the other factors we include as determinants of the value of houses.
 - The value of houses is expected to be positively correlated to the presence of foreign residents, whose presence, everything else being equal, is expected to increase the demand for houses.
 - There is no prior expectation related to the effect of population size, since concentration could cause a negative effect in terms of possible shortage of public services and infrastructure due to overcrowding, but also positive impact, since excess demand for houses could raise their market value.



2. Factors that influence the value of houses

- ▶ **Plan-related characteristics** are the features of the neighborhood where a house is located which are related to the zoning rules of the city Masterplan. We class them into the following categories, identified in the zoning rules through acronyms in parentheses:
 - historic center zone ("A" zone)
 - residential completion zone ("B" zone)
 - residential expansion zone ("C" zone)
 - enterprise zone ("EZ" zone)
 - parks (open-space leisure areas, "S3" and recreational "G" zone)
 - mixed use zone (industrial and service areas, "IS" zone).



2. Factors that influence the value of houses

- ▶ The last characteristic is related to **land cover**. The land cover map of Cagliari was drawn from the 2008 land cover maps of Sardinia made available in 2008 by the Sardinian regional administration, whose nomenclature is based on that of the inventory of land cover carried out in the frame of the European programme *COoRdination de l'INformation sur l'Environnement* (CORINE).
 - We consider artificial (urban fabric) surfaces of the neighborhood where a house is located.
 - There is no prior expectation on the effect of this characteristic on the value of houses, since a higher level of urbanization can, to some extent, raise environmental and social quality of urban contexts, but it could be related to the negative impact of services' and infrastructure's overcrowding as well.
- ▶ Finally, we consider a **spatially-lagged dependent variable** as a covariate related to the spatial autocorrelation of the dependent variable.



Variable	Definition	Mean	St.dev.
Characteristics of housing units, vector HUNIT			
AREA	Finished interior area (m ²)	109.43	34.89
Q_POS	Position quality (presence and quality of panoramic views, distance from other buildings and structures / daylighting quality, apartment level).	4.52	1.84
Q_TYP	Typological quality (building and apartment maintenance level, quality of construction, equipment and mechanical system conditions, building age).	4.19	1.41
DISCOAST	Distance from the coastline (m)	1788.15	877.80
Demographic characteristics of the neighborhood where a house is located, vector DEMOG			
DENSITY	Population density in the Census tract (residents/km ²)	21,704.12	10,632.79
FOR_2012	Foreign residents in the neighborhood (foreign residents)	354.17	203.23
RES_2012	Residents in the neighborhood (residents)	7645.28	2,978.05
Plan-related characteristics of the neighborhood where a house is located, vector PLANREL			
PL_ZONE	Dummy, location in a residential completion area	0.12	0.33
A_ZONE	Area of the "A" zone in a buffer of 150 m around the location of a house (m ²)	4,753.14	11,935.82
B_ZONE	Area of the "B" zone in a buffer of 150 m around the location of a house (m ²)	33,033.85	14,514.09
C_ZONE	Area of the "C" zone in a buffer of 150 m around the location of a house (m ²)	400.78	2262.48
EZ_ZONE	Area of the "EZ" zone in a buffer of 150 m around the location of a house (m ²)	678.98	3287.24
MIXUSE	Percent area of the "IS" zone in a buffer of 150 m around the location of a house (%)	12.66	11.78
PARKS	Area of the "S3"and recreational "G" zones in a buffer of 800 m around the location of a house (m ²)	24.17	13.68
Artificial land cover of the neighborhood where a house is located, variable LANDCOV			
LC_URB	Artificial surfaces, urban fabric in 2008 (m ²)	64,577.89	9,560.18
Spatially-lagged dependent variable			
AUTOCORR	Spatially-lagged dependent variable, spatial lags of variables	-0.01	0.41

3. The hedonic approach

- ▶ The hedonic methodology considers quality of urban life as a phenomenon embedded into the value of houses through their characteristics.
- ▶ According to the hedonic approach, a house is a parcel of goods. This means that a person who buys a house, buys a basket of amenities (Thaler and Rosen 1976; Dickens 1984; Gegax et al., 1991).
- ▶ What is paid is the arithmetic sum of what the buyer is willing to pay for each of the amenities or is willing to accept as a refund for each of the bads contained in the basket (King, 1976).
- ▶ If we consider this methodology on the supply side, the vendor sells a bundle of goods and is willing to accept a price that is equal to the arithmetic sum of the values of each contained amenities or bads (a negative price in case of a bad).
- ▶ Each determinant can be sold just as a component of the bundle of goods contained in the housing unit and its price cannot be observed directly from the housing market; however, it can be estimated as a component of the housing price through direct observation of the housing market.



3. The hedonic approach

- ▶ This quasi-market price is called a hedonic price and the function which expresses the housing price as dependent on the quantities of the amenities or bads contained in the basket containing the housing unit is called a hedonic function (Ridker and Henning, 1967; Brown and Rosen, 1982; Cropper and Oates, 1992).
- ▶ The hedonic function takes the following form:

PRICE =

$$\beta_0 + \beta_1 \text{HUNIT} + \beta_2 \text{DEMOG} + \beta_3 \text{PLANREL} + \beta_4 \text{LANDCOV} + \beta_5 \text{AUTOCORR} + \varepsilon$$

where

- the dependent variable, **PRICE**, is one of the five alternative measures of the value of houses defined above,
- **HUNIT** is the vector of characteristics of a house
- **DEMOG**, **PLANREL** and **LANDCOV** are the vectors of characteristics and of a house's neighborhood (demographic, DEMOG; plan-related, PLANREL; artificial land cover, LANDCOV)
- **AUTOCORR** is the spatially-lagged dependent variables defined through the procedure described in paragraph 4.1.1 of the paper.



4. Results

- ▶ We estimate the **five linear multiple regressions**, using the five alternative dependent variables indicated above.
- ▶ Results concerning the **cadastral value** of houses are almost completely non-significant. Moreover, the goodness of fit of the regression is quite lower than in the other four cases, since adjusted $R^2 < 10\%$.
 - So, we can conclude that cadastral values, which are the values property taxes are based upon, do not represent effectively the value of houses, as it was expected.
 - This outcome indicates that a comprehensive and equity-oriented reform of cadastral values and related property taxes is needed, and that an effective analysis of the factors influencing the value of houses cannot be related to the actual cadaster's.



4. Results

- ▶ The coefficients of the variables related to the **structural characteristics of houses** are almost always significant (p-values < 5%) and show the expected sign.
 - The only case three out of four of them are not significant (p-values > 10%) is the model where the dependent variable is the average list price recorded from other apartments for sale (SUPP_VAL).
- ▶ **Distance from the coast** is always significant and presents the expected sign, so we can conclude that proximity to the seashore is one of the most important factors which influences the value of houses in the municipality of Cagliari.



4. Results

- ▶ Among the variables related to the demographic characteristics of the neighborhood where a house is located, **density** is significant just in one case (EST_VAL), and it shows the negative sign, which implies no agglomeration effect.
 - A positive sign, which could possibly be related to an agglomeration effect, does occur only in the case of the model which uses rental value (RENT_VAL) as dependent variable, but the estimate of the coefficient is not significant (p-value > 10%).
- ▶ The coefficients of the variables related to the presence of **foreign residents** (FOR_2012) and to **population size** (RES_2012) are almost always significant.
 - The sign of FOR_2012 is consistent with expectation, while the RES_2012's sign is negative, which indicates that the higher the concentration of residents in the neighborhood where a house is located the less the quality of the urban environment, possibly due to shortage of public services and infrastructure.



4. Results

- ▶ **Plan-related variables** show significant estimates only in three cases: PL_ZONE, EZ_ZONE and PARKS.
 - The value of houses located in the historic center is higher than the houses located in the **completion areas** (dummy variable PL_ZONE), and the presence of **enterprise zone areas** in the neighborhood of a house implies a negative marginal effect on the value of the house, which could be explained by the uncertainty that characterizes the future residential and public services and infrastructure layout of these not-yet-urbanized areas.
 - As expected, the variable related to presence of **public parks** in the neighborhood of a house (PARKS) is always positively correlated to the value of houses, and significant in three out of four cases.
 - Nothing can be stated with reference to the other plan-related variables, except for **A_ZONE**, which has a negative and significant effect on the variable related to the market value of houses (EST_VAL), while in the other three cases the effect is negative, but not significant, which indicates that houses closer to the historic center are comparative less valuable, which may possibly be explained by observing that historic areas of the city of Cagliari are often characterized by old urban fabric with lots of obsolescent buildings, roads and public areas, which could make the location of houses less attractive, everything else being equal.



4. Results

- ▶ Finally, the **land cover-related variable** (LC_URB) is never significant, while the spatially-lagged dependent variable is always positively and significantly correlated to the four dependent variables, as it was expected.
- ▶ We have also estimated the log-linear specifications of the five regression models discussed in this paper, which gave results quite similar to those proposed in this section, even though with a slight lower goodness of fit.



5. Discussion and conclusion

In terms of policy planning:

- ▶ A reduction in **size** of large apartments (area > 120 m²) resulting from their being split in two or more residential units could increase the value of houses, because smaller houses are cost-rewarding and allow for effective functional recovery of apartments, whose living area otherwise would be not appropriate for current needs.
- ▶ The variable **Q_POS (position quality)** has a significant relationship with the dependent variable EST_VAL, but it should not be effectively targeted for housing policies for various several reasons:
 - Some aspects of Q_POS (e.g. presence of panoramic views) are related to other independent variables such as DISCOAST or PARKS.
 - This variable varies greatly across the study area. Moreover, even within a given multistory building overlooking the sea or having an excellent sun exposure, Q_POS varies greatly depending on the apartment level and exposition.
 - Position quality is usually influential in price formation in high-quality districts, where it works as a specific market segment determinant.



5. Discussion and conclusion

Again, in terms of policy planning:

- ▶ The variable **Q_TYP (typological quality)** shows a significant correlation with EST_VAL, and produces an increase in the value of residential properties.
 - Some features of typological quality of houses can be improved by landlords and homeowners depending on their cost-effectiveness or needs related to the use value.
 - In order to increase cost-effectiveness margin, policies that focus on improving the quality level of neighboring urban spaces can lead landlords and homeowners to renovate private and common parts of their building.
 - Such kind of public investment can possibly have a direct impact on the local community by both encouraging private development and improving citizens' quality of life.



5. Discussion and conclusion

- ▶ GIS was used to discuss some policy implications of our results through spatial representations. Such GIS-based representations are easily reproducible in other urban areas, provided that the value of the characteristics here analyzed are available, and they allow for a pretty straightforward spatial interpretation of the results.
- ▶ A “what-if” scenario was simulated: for each apartment, we estimated the magnitude of the impact on the variable `EST_VAL`, that is the percent change that would occur if a single explanatory variable had increased by a given quantity – that is, ten percentiles in that variable’s distribution.
- ▶ The explanatory variables used are those that are generally significant and that can be driven in some way by means of appropriate policies, that is,
 - the size of the residential unit (`AREA`)
 - the distance from the shoreline (`DISCOAST`)
 - the endowment of recreational areas (`PARKS`).



5. Discussion and conclusion

- Such spatial indications of impact should target

Policies affecting either AREA or DISCOAST would produce a consistent decrease in market prices, but not as significant (in quantitative terms) and not as spatially clustered as that produced by varying the value of PARKS.



Impact on EST_VAL produced by policies affecting AREA

- -4.72 -- -2.87 %
- -2.88 -- -1.96%
- -1.97 -- -1.60 %
- -1.61 -- -1.33 %
- -1.34 -- -0.83 %

Impact on EST_VAL produced by policies affecting PARKS

- 0.76 - 1.32 %
- 1.33 - 1.68 %
- 1.69 - 2.73 %
- 2.74 - 4.02 %
- 4.03 - 6.61 %

Impact on EST_VAL produced by policies affecting DISCOAST

- -6.06 - -2.22 %
- -2.23 - -1.67 %
- -1.68 - -1.46 %
- -1.47 - -1.21 %
- -1.22 - -0.56 %



5. Discussion and conclusion

- ▶ The results obtained with reference to Cagliari's urban area allow generalization for two reasons.
 - **No similar empirical studies** have been carried out in other Italian contexts (probably because of scarce availability of data). The housing market in the urban area of Cagliari should not be compared to other situations in which more flexible, inclusive, bottom-up planning processes were implemented, as these would have probably encouraged people to lobby in favor of effective planning policies concerning the housing market (such situations are very rare in Italy, however).
 - Empirical results suggest that there would be **benefits for the public providing utilities concurrent with development**. This finding is relevant in Florida, which has enacted concurrency rules that require this as a condition of development approval (Auerhahn, 1988). This is a controversial policy, since it can slow development or raise development costs.



5. Discussion and conclusion

- ▶ Rigid separation between right to build and property right allows the **Italian cities** to determine how much developers must pay to compensate the local communities for the increased pressure on the existing public infrastructure and services.
- ▶ This is different from the approach in the **United States**, where the question is addressed on a case-by-case basis.
- ▶ In **France**, cities establish the contribution developers must pay to obtain their building permits, adopting an approach that lies between the Italian and the United States ones, with plenty of room for free negotiation.
- ▶ It would be interesting to explore if, and to what degree, planning policies aimed at qualitative improvements of houses would develop in a United States or French context had local developers been discouraged due to very high development costs.



5. Discussion and conclusion

- ▶ This empirical work defines and implements a research methodology and design to evaluate the monetary value of the extrinsic and intrinsic characteristics of houses as determinants of the formation of market price of houses.
- ▶ This research methodology and design offers powerful tools to define city fiscal policies which could successfully deal with value generated by urban residential expansion. This is implemented through an analysis of the housing market, through direct observation of human behavior. The more reliable the information, the more effective policy decisions can be in order to convey part of the generated value to the financial resources of the cities.
- ▶ A sound institutional framework is necessary to allow the cities to implement zoning regulations and fiscal policies to deal with the determinants of the value of houses. This would be based on negotiation with developers, landlords, homeowners, and local communities, along with detailed and standardized territorial information systems and databases regarding the housing market.

