L’influenza di fattori legati al contesto urbano sui valori delle unità residenziali: stime riferite all’area urbana di Cagliari

Michele Argiolas, Sabrina Lai, Corrado Zoppi
Università di Cagliari - Dipartimento di Ingegneria Civile, Ambientale e Architettura
michele.argiolas@unica.it; sabrinalai@unica.it; zoppi@unica.it
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

- Housing market: municipality of Cagliari, Italy.

- We analyze the estimated market values of a representative sample of **304 apartments** spread over **18 market areas (OMI)**.

- To estimate each property’s market value can involve a significant margin of error:
  - size of the sample
  - real estate market stagnation
  - general lack of transactional data.

- Hence, we use different appraisal approaches and market price references.

https://wwwt.agenziaentrate.gov.it/geopoi_omi/index.php
1. ALTERNATIVE MEASURES OF THE VALUE OF HOUSES

- **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

- **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**
  - marketability risk (potential risk when re-converting the property investment into cash)
  - legislative risks

(leading quality characteristics affecting property prices, after Orefice, 2007)
1. ALTERNATIVE MEASURES OF THE VALUE OF HOUSES

- Estimated through a linear regression for each market area (dependent variable: market price; explanatory variable: quality of the features):
  - Dataset from a 2013 survey concerning residential property sales.
  - Resulting regression line next used to define the market value for each of the 304 apartments in our sample.

- Cadastral value appraised for each single apartment by means of the on-line evaluation service provided by the Italian Cadastre.

- List price estimated 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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>St.dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>EST_VAL</td>
<td>Market value (€/m²) estimated through regression analysis (source: 2013 direct survey)</td>
<td>2,279.77</td>
<td>404.02</td>
</tr>
<tr>
<td>CAD_VAL</td>
<td>Cadastral Assessed Value (€/m²) (source: 2013 cadastral register of the city of Cagliari)</td>
<td>714.64</td>
<td>294.76</td>
</tr>
<tr>
<td>OMI_VAL</td>
<td>Market value (€/m²) estimated through average market values range (source: OMI)</td>
<td>2,325.56</td>
<td>220.75</td>
</tr>
<tr>
<td>RENT_VAL</td>
<td>Rent value (€/m² per month) estimated through average rent values range (source: OMI)</td>
<td>7.84</td>
<td>0.62</td>
</tr>
<tr>
<td>SUPP_VAL</td>
<td>Average list price (€/m²) recorded from other apartments for sale (source: 2013 direct survey)</td>
<td>2,515.00</td>
<td>308.59</td>
</tr>
</tbody>
</table>
2. FACTORS THAT INFLUENCE THE VALUE OF HOUSES

We regard the value of houses as dependent upon:

1. **structural characteristics** of the residential unit
2. **neighborhood** demographic characteristics
3. **plan-related** characteristics
4. **land cover** types.
2. FACTORS THAT INFLUENCE THE VALUE OF HOUSES

1. Structural (intrinsic) characteristics

- Collected through interviews (real estate agencies, landlords, renters, homeowners) and through direct observation.

- We expect the value of houses to be negatively correlated to finished interior area, since we express it as the value per unit of finished interior area: “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”. (Palmquist, 1984, p. 397)

- **Typological quality** concerns physical characteristics and 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 be worth the related cost.

- Conversely, **position quality** cannot be improved by property owners and affects significantly price formation, especially for residential units located in multistory buildings.
  - Features like “panoramic views” or “daylighting quality” can differ significantly depending on the apartment level.
  - The **distance from the seashore** is important in our context: if a proximity-to-coast effect occurs, the value of houses increases as the distance from the coast goes down.
2. FACTORS THAT INFLUENCE THE VALUE OF HOUSES

2. Neighborhood demographic characteristics

- 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 developing 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

3. Plan-related characteristics

- We assume the value of a house to be dependent on the zoning rules of the city Masterplan in place in that house’s neighborhood.

- The zoning scheme is as follows:
  - 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

4. Land-cover types

- We use the 2008 land cover maps of Sardinia, whose taxonomy 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: 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.

5. Autocorrelation

- Finally, we consider a spatially-lagged dependent variable as a covariate related to the spatial autocorrelation of the dependent variable.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>St.dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristics of housing units (vector HUNIT)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AREA</td>
<td>Finished interior area ($m^2$)</td>
<td>109.43</td>
<td>34.89</td>
</tr>
<tr>
<td>Q_POS</td>
<td>Position quality (presence and quality of panoramic views, distance from other buildings and structures / daylighting quality, apartment level).</td>
<td>4.52</td>
<td>1.84</td>
</tr>
<tr>
<td>Q_TYP</td>
<td>Typological quality (building and apartment maintenance level, quality of construction, equipment and mechanical system conditions, building age).</td>
<td>4.19</td>
<td>1.41</td>
</tr>
<tr>
<td>DISCOAST</td>
<td>Distance from the coastline (m)</td>
<td>1788.15</td>
<td>877.80</td>
</tr>
<tr>
<td><strong>Demographic characteristics of the neighborhood where a house is located (vector DEMOG)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DENSITY</td>
<td>Population density in the Census tract (residents/km$^2$)</td>
<td>21,704.12</td>
<td>10,632.79</td>
</tr>
<tr>
<td>FOR_2012</td>
<td>Foreign residents in the neighborhood (foreign residents)</td>
<td>354.17</td>
<td>203.23</td>
</tr>
<tr>
<td>RES_2012</td>
<td>Residents in the neighborhood (residents)</td>
<td>7645.28</td>
<td>2,978.05</td>
</tr>
<tr>
<td><strong>Plan-related characteristics of the neighborhood where a house is located (vector PLANREL)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL_ZONE</td>
<td>Dummy, location in a residential completion area</td>
<td>0.12</td>
<td>0.33</td>
</tr>
<tr>
<td>A_ZONE</td>
<td>Area of the “A” zone in a buffer of 150 m around the location of a house ($m^2$)</td>
<td>4,753.14</td>
<td>11,935.82</td>
</tr>
<tr>
<td>B_ZONE</td>
<td>Area of the “B” zone in a buffer of 150 m around the location of a house ($m^2$)</td>
<td>33,033.85</td>
<td>14,514.09</td>
</tr>
<tr>
<td>C_ZONE</td>
<td>Area of the “C” zone in a buffer of 150 m around the location of a house ($m^2$)</td>
<td>400.78</td>
<td>2262.48</td>
</tr>
<tr>
<td>EZ_ZONE</td>
<td>Area of the “EZ” zone in a buffer of 150 m around the location of a house ($m^2$)</td>
<td>678.98</td>
<td>3287.24</td>
</tr>
<tr>
<td>MIXUSE</td>
<td>Percent area of the “IS” zone in a buffer of 150 m around the location of a house (%)</td>
<td>12.66</td>
<td>11.78</td>
</tr>
<tr>
<td>PARKS</td>
<td>Area of the “S3” and recreational “G” zones in a buffer of 800 m around the location of a house ($m^2$)</td>
<td>24.17</td>
<td>13.68</td>
</tr>
<tr>
<td><strong>Artificial land cover of the neighborhood where a house is located (variable LANDCOV)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC_URB</td>
<td>Artificial surfaces, urban fabric in 2008 ($m^2$)</td>
<td>64,577.89</td>
<td>9,560.18</td>
</tr>
<tr>
<td><strong>Spatially-lagged dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUTOCORR</td>
<td>Spatially-lagged dependent variable, spatial lags of variables</td>
<td>-0.01</td>
<td>0.41</td>
</tr>
</tbody>
</table>
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 this approach, a house is a parcel of goods. Hence, who buys a house, buys a basket of amenities (Thaler and Rosen 1976; Dickens 1984; Gegax et al., 1991).
  - Demand side: the price is the arithmetic sum of what the buyer is willing to pay for the amenities or is willing to accept as a refund for the bads contained in the basket (King, 1976).
  - Supply side: the vendor sells a bundle of goods and is willing to accept a price that equals the arithmetic sum of the values of each contained amenities or bads.

- Each determinant can be sold 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.

- This quasi-market price is termed **hedonic price** and the function expressing the housing price as dependent on the quantities of the amenities or bads contained in the basket containing the housing unit is termed **hedonic function** (Ridker and Henning, 1967; Brown and Rosen, 1982; Cropper and Oates, 1992).
3. THE HEDONIC APPROACH

The hedonic function takes the following form:

\[
\text{PRICE} = \beta_0 + \beta_1 \text{HUNIT} + \beta_2 \text{DEMOG} + \beta_3 \text{PLANREL} + \beta_4 \text{LANDCOV} + \beta_5 \text{AUTOCORR} + \epsilon
\]

where

- **PRICE**, the dependent variable, is one of the five alternative measures of the value of houses here considered
  
  \( (\text{EST\_VAL, CAD\_VAL, OMI\_VAL, RENT\_VAL, SUPPL\_VAL}) \)

- **HUNIT** is the vector of characteristics of a house

- **DEMOG**, **PLANREL** and **LANDCOV** are the vectors of characteristics of a house’s neighborhood
  
  \( (\text{DEMOG, PLANREL, LANDCOV}) \)

- **AUTOCORR** is the spatially-lagged dependent variable.

We estimate **five linear multiple regressions**, each using one of the five alternative dependent variables.
4. RESULTS

1. When using cadastral value as dependent variable...
   - results are almost completely non-significant.
   - the goodness of fit of the regression is lower than in the other cases (adjusted $R^2 < 10\%$).
   - Cadastral values, on which the property taxes are based, do not represent effectively the value of houses, as expected.
   - A comprehensive and equity-oriented reform of cadastral values and related property taxes is needed, and effective analysis of the factors influencing the value of houses cannot be related to the actual cadaster’s.

2. Structural characteristics of houses
   - The coefficients of the variables related to the structural characteristics are almost always significant (p-values < 5\%) and show the expected sign.
   - The only case in which 3 out of 4 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 proximity to the seashore is one of the most important factors which influences the value of houses in the municipality of Cagliari.
4. RESULTS

3. Structural characteristics of houses: density

- **Density** is significant only 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, occurs only when the model uses rental value (RENT_VAL) as dependent variable, but the estimate of the coefficient is not significant (p-value > 10%).

4. Neighborhood characteristics

- The coefficients of the variables related to the presence of **foreign residents** (FOR_2012) and to **population size** (RES_2012) are almost always significant.

  ➔ FOR_2012’s sign is consistent with expectation, while RES_2012’s sign is negative: 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.
5. Plan-related variables

Significant estimates only in three cases: PL_ZONE, EZ_ZONE and PARKS.

- Houses in the completion areas (PL_ZONE) have lower values than those located in the historic center.

- The presence of enterprise zone areas in the neighborhood implies a negative marginal effect on the value of the house.
  - The future of residential and public services and infrastructure layout of these not-yet-urbanized areas is characterized by uncertainty.

- As expected, the variable related to presence of public parks in the neighborhood (PARKS) is always positively correlated to the value of houses, and significant in 3 out of 4 cases.

- The location of a house in the historic center (A_ZONE) has a negative and significant effect on the market value of houses (EST_VAL), while in the other three cases the effect is negative, but not significant.
  - Houses closer to the historic center are comparatively less valuable.
  - This may possibly be due to the fact 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

6. Land-cover related variable
   - LC_URB is never significant

7. Spatially-lagged dependent variable
   - Always positively and significantly correlated to the four dependent variables, as expected.

We have also estimated the log-linear specifications of the five regression models, which gave results quite similar to those here presented, even though with a slight lower goodness of fit.
In terms of planning policies:

- 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, since 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 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.
  - Even within a single multistory building overlooking the sea or having 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.
In terms of planning policies:

- 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.
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:

- 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 representations provide decision makers with clear indications on which are the “best” possible areas that policies should target in order to affect market prices.
5. DISCUSSION AND CONCLUSION

The greatest change in market price is produced by implementing policies that increase the variable PARKS; the market price would increase unevenly across the city, as both the lowest and the highest variations are strongly clustered.
5. DISCUSSION AND CONCLUSION

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.
5. DISCUSSION AND CONCLUSION

- The results obtained with reference to Cagliari’s urban area allow for generalization.

  - **No similar empirical studies** have been carried out in other Italian contexts (because of data scarcity?). The housing market in 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.

  - 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 planning consent (Auerhahn, 1988). This is a controversial policy, since it can slow development or raise development costs.
Rigid separation between right to build and property right allows **Italian cities** to determine how much developers must pay to compensate their local communities for the increased pressure on the existing public infrastructure and services.

- in the **United States** the issue is addressed on a case-by-case basis.
- in **France**, cities establish the contribution developers must pay to obtain their building permits, 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 a research methodology 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 offers powerful tools to define city fiscal policies which could successfully deal with value generated by urban residential expansion. 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 needed 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.