

## Historic Centers and Urban Quality: a Study Concerning Perceived Needs and Expectations

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### 1 ABSTRACT<sup>1</sup>

This paper proposes an econometric approach based on Discrete Choice Models to identify and analyze the residents' needs and expectations concerning the spatial organization of the historic neighborhoods where they live, which provides inferences on residential satisfaction's determinants.

In this framework, determinants are grouped into three distinct categories as follows: i. level of satisfaction related to house; ii. neighborhood characteristics; iii. respondents' social and demographic characteristics. The information coming from the implementation of the DCM-based analysis can be used as an important reference point for the definition of planning policies for historic centers' preservation.

In order to test and discuss its effectiveness, we use the model to analyze needs and expectations of the residents of the historic center of Cagliari, a medium-sized urban context of the Italian insular region of Sardinia.

### 2 INTRODUCTION

Planning and historic centers' preservation can be considered synergetic concepts (Frank and Petersen, 2002) and activities. Indeed, effectiveness of preservation is founded on analytic and detailed planning which should implement policies aimed at preserving the characteristics of historic urban tissues and at boosting their capability of being attractive for the most important contemporary urban functions, such as housing, retail shops, and financial, insurance and real estate firms (Mueller et al., 2005). Moreover, it could be important to maintain the sense of identity of the people who live there. Hence, it is necessary to implement participatory processes involving resident families, entrepreneurs, employees and shoppers (Comune di Reggio Emilia, 2005; 2011).

One of the main components of sustainable planning approaches to the preservation of historic centers implies the availability of detailed and, as much as possible, complete information on residents' perceived needs and expectations.

We propose an econometric approach based on Discrete Choice Models (DCMs) (Ben-Akiva and Lerman, 1985; Greene, 1993; Greene and Hensher, 2010) to identify and analyze residents' needs and expectations concerning the spatial organization of the historic neighborhoods where they live, which provides inferences on residential satisfaction's determinants (Lu, 1999). In this framework, determinants are grouped into three distinct categories as follows: i. level of satisfaction related to house; ii. neighborhood characteristics; iii. respondents' social and demographic characteristics. The information coming from the implementation of the DCM-based analysis can be used as an important reference point for the definition of planning policies for historic centers' preservation (Fantin, 2013).

In order to test and discuss its effectiveness, we use the model to analyze needs and expectations of the residents of the historic center of Cagliari, a medium-sized urban context of the Italian insular region of Sardinia. In figure 1, the historic centre of Cagliari with its four historic neighborhoods (Castello, Villanova, Marina, Stampace) is presented, whereas a typical alley in the neighborhood of Castello is captured in figure 2.

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<sup>1</sup> This essay comes from the joint research work of the authors. Sections 1, 5 and 6 have been jointly written by the authors. Anania Mereu has taken care of sections 3 and 4.



Fig. 1: Historic centre of Cagliari (Comune di Cagliari, 2011).



Fig. 2: View of a typical alley in the historic centre of Cagliari.

The DCM-based analysis is implemented through a questionnaire delivered to the residents of the Cagliari's historic center's neighborhoods (Comune di Cagliari, 2011). Through their participation in the experiment, resident families' representatives should increase their awareness of the most important issues related to the spatial organization of their urban living areas, and provide information on correlations between perceived urban quality and the three types of determinants mentioned above.

Qualitative and quantitative inferences on the correlations between residents' level of satisfaction related to the neighborhood and its determinants, generated by the DCM-based analysis, imply important arguments

and indications on planning policies related to the spatial organization of the historic centers, which will be discussed in the final part of the paper, starting from the results of the DCM-based case study concerning the historic center of Cagliari.

This paper is organized as follows. The institutional and normative framework of historic centers' planning of the Sardinia region is described in the second section. In the third section, we discuss the DCM-based analysis we use to analyze the residents' perceived needs and expectations. The fourth section shows the implementation and results of the estimates of the DCM-based analysis applied to the historic center of Cagliari which uses the level of the respondents' residential satisfaction and its covariates in order to address arguments and indications on issues related to planning policies concerning the spatial organization of the historic centers. The results coming from the implementation of different discrete-choice models are presented and compared.

In the concluding section, we discuss the influence of the determinants found relevant on the level of residential satisfaction with the neighborhood, through the results of the DCM-based analysis. This influence could be taken into account to define future planning policies to increase the quality of urban life. Exportability to other urban contexts and further developments of the research work are discussed as well.

### 3 INSTITUTIONAL AND NORMATIVE FRAMEWORK

Cagliari is the main Sardinian conurbation, with a population of about 150,000 residents in 2012, and a regional capital city. Here, all the main offices of the regional administration are located. Furthermore, Cagliari is the main site of the Cagliari province, which includes the whole territory of Southern Sardinia. The main Sardinian University, with a student population of about 29,000 students in 2013, and the most important Sardinian Law Court are located in Cagliari. Cagliari has been identified as one of the nine main Italian metropolitan areas by the Italian Law No. 1990/142 and confirmed as one of the twelve Italian metropolitan areas by the Italian Law No. 2014/56. Therefore, it is a site where a new metropolitan province can be established if the regional administration wishes, which indicates that the importance of Cagliari as a key Italian conurbation has been officially recognized at the national level.

Moreover, the Sardinian regional administration has primary jurisdiction for land-use and urban planning, according to its special constitution. In other words, the Sardinian regional government may define Sardinian public planning policies. In fact, the Sardinian region is to some extent autonomous with respect to planning policies established at the national level.

For all these reasons, the metropolitan area of Cagliari can be considered a significant and well-defined urban environment to analyze the historiccenter-related planning policies, one which is sufficiently internally developed and integrated, and isolated from external influences as well.

In the framework of regional and urban planning processes of Sardinia, in the context of the Regional Landscape Plan (RLP), established by the Decision of the Sardinian Regional Government (DSRG) no. 36/7 of 5 September 2006, the Implementation plans of the historic centers (IPHCs) are planning tools which implement the Planning implementation code (PIC) of the RLP into the "Areas characterized by historic settlements". For these areas, the PIC defines a set of prescriptive rules and planning criteria (articles nn. 51-53 of the part of the PIC related to "Cultural and historic spatial framework", which is defined by articles nn. 47-59). More precisely, article no. 52 identifies the IPHC as a plan which has to be necessarily approved through the cooperation of the Sardinian regional administration and a municipality as a necessary precondition for a municipality to exert its ruling power over the local transformation processes related to the municipal spatial jurisdiction, which implies a considerable pressure on the local administrators in order to implement valuable and effective planning processes concerning the municipal historic centers.

Under this perspective, it is not surprising that the RLP, the first statutory landscape plan with regional dimensions produced in Italy under the new legislation, focused on the coastal zone because of the complexity of development conflicts arising from tourism (on which a large part of the economy of the island relies) and other development-related pressures, and owing to the fact that thirteen out of the fourteen previous landscape plans covering coastal areas, which contained some restrictions on coastal development, had been quashed between 1998 and 2003.

Following approval of the plan in 2006, restrictions and prohibitions (on development of land and on certain changes in land uses) stemming from the plan are currently in force, in order to protect a part of the island

considered economically strategic and environmentally sensitive. Restrictions and prohibitions are set out by the plan by means of a system of rules.

The planning activity of the regional administration of Sardinia has undergone a deep change after the approval of the RLP, which establishes the directions for nearly any future planning activity in Sardinia, and requires that actual sectoral and local plans, as well as plans for protected areas, be changed to comply with its directions.

#### 4 METHODOLOGY, SAMPLING METHOD AND QUESTIONNAIRE

This section is organized as follows. In the first paragraph, the DCM approach is presented in the context of the case study discussed in this paper. In this paragraph, we explain why we choose the DCM approach to implement our estimates and which part of the methodology is already used in other papers. Secondly, we explain the sampling method and the delivered questionnaire.

We use a discrete-choice approach since the dependent variable, that is the level of residential satisfaction perceived by the residents of the historic center is ordinal. In this case, discrete-choice models are the most appropriate, while regression models would be preferred were the dependent variable is continuous. On the side of the explanatory variables, there is no loss of information since all the values of the variables used in the model are not subject to any transformation.

In this paper, we use a DCM approach to implement the analysis of perceived level of residential satisfaction, in order to assess the influence of a set of characteristics on this variable, which are grouped into three categories: i. level of satisfaction related to the house; ii. neighborhood characteristics; and, iii. respondents' social and demographic characteristics. This is a step further in the use of DCMs, since we implement effectively a methodology, used to study discrete-choice problems in other disciplinary contexts, in the field of policy analysis concerning regional and city planning.

##### 4.1 Methodology

DCMs model choices among a discrete set of mutually exclusive alternatives that could be travel modes, products or, as in the case we discuss in this paper, options proposed in a questionnaire related to residential satisfaction. For a synthetic comprehensive discussion on the DCM approach we address the reader to Zoppi and Lai (2013) which largely draws on Cherchi (2009).

As Zoppi and Lai (2013) put in evidence “Consistent with this framework is McFadden’s theoretical and practical research<sup>2</sup>, which was awarded the Nobel prize in 2000 (McFadden won the prize with Heckman). McFadden studies the issue of discrete choice under different points of view. Among these are the demand for urban transport services (1974), the choice between different transport modes (McFadden and Train, 1978), the demand for local phone services (McFadden et al., 1987), the decision-making processes of the public administration (1976). Other important applications of the DCM approach are referred to the analysis of wage mobility in Europe (Pavlopoulos et al., 2010), and to the assessment of the incidence of specific external factors on the ineffectiveness of particular clinical treatments (Ambrogi et al., 2009).” (p. 297)

Different kinds of DCMs exist, such as the binary-choice models, the multinomial logit/probit models, the event counts and the ordered-choice models (Greene, 1993; Greene and Hensher, 2010).

In particular, the ordered-choice models are suitable to analyze the determinants of a dependent variable which represents a scale of preferences. Analysis of ordered responses started in 1957, with an extension to Finney’s work by Aitchison and Silvey. Aitchison’s and Silvey’s (1957) work was based on a sample of observations related to a species of insect, with the goal to determine the probability of observing a particular stage of the insect’s life cycle at time  $x$ . Snell’s work (1964), that used regression methods and variance techniques, represents the first application of ordered-choice models for the analysis of a set of scores.

The ordered-choice model-based methodology is used to study phenomena characterized by observations represented by categories of naturally-ordered outcomes. Every category is associated to a natural number which represents an ordinal ranking, with no quantitative meaning.

<sup>2</sup> See McFadden 1978; 1980; 2000.

There are different kinds of ordered-choice models, depending on the prior on the error distribution, such as the Logit models, characterized by a logistic distribution, and the Probit models, whose errors are assumed to be normally-distributed.

In this paper, an Ordered Logit Model (OLM) is used to analyze the relation between a discrete variable, which represents the residential satisfaction with the neighborhood where a family lives, and covariates, that are correlated to the dependent variable, which include: i. level of satisfaction related to the house; ii. neighborhood characteristics; and, iii. respondents' social and demographic characteristics.

The model operationalizes by assuming that a latent continuous dependent variable  $y^*$  is linearly dependent on a vector of explanatory variables,  $x = (x_1, \dots, x_k)$ , through the following relation:

$$y^* = \beta'x + \varepsilon, \quad (1)$$

where  $\beta = (\beta_1, \dots, \beta_k)$  is a vector of coefficients and  $\varepsilon$  is the error term.

Vector  $x$  is a set of  $k$  covariates that are assumed to be strictly independent of  $\varepsilon$ . Moreover, the components of a vector which represents a set of  $J+1$  discrete outcomes,  $y = (1, \dots, J)$  are assumed to be related to the latent variable  $y^*$  as follows.

The values of  $y$  are obtained through a censoring mechanism from  $y^*$  as follows:

$$y = 1 \text{ if } 0 < y^* \leq \mu_1, \quad (2)$$

this notation indicates that we label the first of the  $J$  events as equal to 1, and that the lowest range of values of the latent variable  $y^*$  corresponds to values higher or equal to zero;

$$y = 2 \text{ if } \mu_1 < y^* \leq \mu_2;$$

$$y = 3 \text{ if } \mu_2 < y^* \leq \mu_3;$$

....

$$J+1. y = J \text{ if } \mu_{J-1} \leq y^*;$$

where  $\mu_1, \dots, \mu_{J-1}$  are unknown threshold parameters. The model assumes that the error term  $\varepsilon$  has the following properties: i.  $E(\varepsilon|x) = 0$  (i.e., the error term has a 0 conditional mean), ii.  $\text{Var}(\varepsilon) = \sigma^2$  (i.e.: the error term has the same variance at each observation), and, iii.  $E[\varepsilon_i \varepsilon_j | X] = 0$  (i.e.: the error term is uncorrelated between observations) (Greene and Hensher, 2010). The logistic form and the standard normal form for the error distribution, that lead to a OLM or to a Ordered Probit Model (OPM) respectively, are expressed by:

$$f(\varepsilon_i) = \frac{\exp(\varepsilon_i)}{[1 + \exp(\varepsilon_i)]^2} \quad (3)$$

$$f(\varepsilon_i) = \frac{\exp\left(-\frac{\varepsilon_i^2}{2}\right)}{\sqrt{2\pi}} \quad (4)$$

where  $\varepsilon$  has mean equal to 0 and variance equal to  $\pi^2/3$  in (3) and mean equal to 0 and variance equal to 1 in (4).

The estimates of the components of the vector of coefficients  $\beta$ , indicated as the components of a vector  $b$  in the formula reported below, are derived from the solution of the maximization problem of the following log-likelihood function,  $\ln L$ :

$$\ln L = \log L = \sum_{i=1}^n \sum_{j=1}^J m_{ij} \log [F(\mu_j - b'x_i) - F(\mu_{j-1} - b'x_i)] \quad (5)$$

where  $m_{ij} = 1$  if  $i = j$ , and  $m_{ij} = 0$  otherwise.

The expression in parentheses is the probability of having a particular value of  $y$  given  $x_i$ , which is represented by:

$$\text{Prob}[y = j | x_i] = [F(\mu_j - b'x_i) - F(\mu_{j-1} - b'x_i)] > 0, j = 0, 1, \dots, J \quad (6)$$

The derivatives of (5) with respect to the components of vector  $b$  have the following form, taking account of notation (6):

$$\frac{\partial \ln L}{\partial \beta_j} = \sum_{i=1}^n [m_{ij} - \text{Prob}(y = j | x_i)] x_i \quad (7)$$

The values of the components of vector  $\mathbf{b}$  which maximize (5) are the solution of the system which comes from equalizing to zero the J derivatives expressed by (7).

The odds ratio, that is the ratio of the probability of higher level of residential satisfaction with the neighborhood where a house is located in case of the event related to the value “1” of a dummy variable to the probability of the event related to the value “0”,  $\delta_j(x_i)$  can be computed as follows:

$$\delta_j(x_i) = \frac{\text{Prob}(y=j|x_i=1)}{\text{Prob}(y=j|x_i=0)} = \frac{[F(\mu_j - b') - F(\mu_{j-1} - b')]}{[F(\mu_j) - F(\mu_{j-1})]} \quad (8)$$

Standard errors of the estimates of the components of vector  $\beta$  and of the odds ratios can be calculated, that are the most important parameters to assess the impact of the explanatory variables on the ordered variable  $y$ , and hypothesis tests based on p-values can be implemented.

## 4.2 Sampling method and questionnaire

A random sample of people living in the historic center of the city of Cagliari was extracted by associating a random number to each name listed in the phone directory. About 1000 people were randomly selected. The extracted people were contacted by telephone and asked if they were willing to participate in the survey. Out of these 1000 people, just 167 people agreed to participate, implying a 16,7 percent rate of participation. 353 people explicitly refused to cooperate and another 480 did not answer the phone. The phone calls, which asked if the resident would be willing to participate in the survey and, in the case of positive answer, administered the questionnaire, were made at different times of the day. One third were made between 10.30 a.m. and 12.30, two thirds between 4 p.m. and 7.30 p.m. The rate of participation was higher in the second period (about 25 percent).

If the randomly selected person answered to the phone call, and he was willing to participate in the survey, a questionnaire of about 30 questions was administered to the respondent. The questionnaire includes questions related to: i. level of satisfaction related to the house; ii. neighborhood characteristics; and, iii. respondents' social and demographic characteristics. The questionnaire was administered through a call, instead of being sent by e-mail, because data were immediately needed and because a higher rate of participation was expected had the questionnaire been directly delivered.

Although the respondents showed interest in the topics, the majority refused to answer the question concerning their income level. This implies the exclusion of a variable related to this aspect from the set of covariates of the OLM and OPM.

## 5 MODEL IMPLEMENTATION AND RESULTS

This section presents the implementation of the DCM-related analysis and its results.

In the first subsection we define the dependent and explanatory variables whose values are derived from the delivered questionnaires, their specifications and their behavior across the survey. As we stated above, they can be grouped into three categories: i. levels of satisfaction; ii. neighborhood characteristics; iii. respondents' social and demographic characteristics.

In the second subsection we present the inferences concerning the influence of the covariates on the level of residential satisfaction perceived by the respondents estimated through the implementation of an OLM.<sup>3</sup>

### 5.1 Discussion on factors

The model's implementation implies a definition of residential satisfaction and residential environment. According to Galster (1987), residential satisfaction entails an assessment of the qualitative difference between the present and the perceived best conditions of a house's and of a neighborhood's characteristics. The quality of a residential environment depends on the house's and neighborhood's characteristics. Social aspects, that account for relations with neighbors are particularly relevant (Amerigo and Aragones, 1999).

In the literature (among many, Palmquist, 1984, Cheshire and Sheppard, 1995, Kiel and Zabel, 1999, Zoppi, 2000), a widely accepted classification of factors influencing residential satisfaction distinguishes those intrinsically belonging to a particular house and those belonging to the house's neighborhood. Palmquist

<sup>3</sup> We estimated the OPM as well. The results are very close to the OLM's, so we do not believe it is worth discussing them.

(1984) uses thirty-two variables to define the value of houses in seven United States metropolitan contexts. Twenty-three factors are related to a housing unit, while nine determinants concern the neighborhood where a house is located. Characteristics related to the house's neighborhood are drawn from the census data with reference to the census tract where the house is located, e.g., median age of residents, percentage of workers that has a blue/white collar job, population classified as non-white, and so on. Cheshire and Sheppard (1995) use a similar approach to the definition of the set of factors, but they add characteristics related to the zoning rules established by municipal Masterplans and urban land uses, such as industrial land, land for new residential developments, open space for leisure.

Characteristics 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 residential satisfaction with 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.

In the light of the essays quoted above and of many others which deal with the issue of the determinants of residential satisfaction, in this paper we focus on residential satisfaction with the neighborhoods where houses are located.

As we stated in the introduction to this section, we implement a OLM-based analysis of residential satisfaction, founded on information derived from the questionnaire delivered to people extracted from a set of residents of the historic center of Cagliari through the sampling method described above.

Information concerning the level of residential satisfaction, that is the values of variable  $y_i$  of model (2)-(8), is expressed through the following five levels of residential satisfaction, related to the neighborhood characteristics, the respondents have to choose among:

- (1) low level,  $y=1$ ;
- (2) medium-low level,  $y=2$ ;
- (3) medium level,  $y=3$ ;
- (4) medium-high level,  $y=4$ ;
- (5) high level,  $y=5$ .

Neighborhood characteristics we use in order to analyze their influence on residential satisfaction, that is the values of the components of vector  $x$  of (1), which are labelled  $x_i$  in model (2)-(8), are derived from the answers to the questionnaire as well. In the following paragraphs, we indicate in parentheses the labels of the implemented OLM. These labels are used to make reference to the corresponding variables in Tables 1-2 and in the rest of the paper.

We consider positive aspects such as the perceived tranquillity (D-QUIET) of the location and the presence of services, such as schools (D\_SCHOOL), public gardens (D\_GARD), markets (D\_MARKET), pharmacies (D\_PHARM), bus stops (D\_BUSST) and post offices (D\_POST). Indeed, lack of services is likely to determine lower satisfaction which may cause mobility intentions and moving behaviors (Lu, 1998). Hence, a positive correlation is expected between these variables and the residential satisfaction expressed by the respondents as well as in the case of the location's tranquillity (Bonaiuto, Fornara, & Bonnes, 2003).

Negative aspects are related to the presence of problems such as (Branton & Jones, 2005; Atkinson & Kintrea, 2002) insufficient street lighting (D\_STRLIGHT), deficient garbage collection (D\_REFUS), lack of car parks (D\_PARK), presence of water losses (D\_WATLOS), bad street paving (D\_PAV), noise (D\_NOISE), crime (D\_CRIME) and traffic (D\_TRAFF). For instance, in figure 3, an area in the neighborhood of Marina with a number of car parks not sufficient to people's needs is presented.



Fig. 3: Lack of car parks in the neighborhood Marina.

The issues, which enter as explanatory variables in the model we estimate in our analysis, should be addressed and managed through the urban planning policies defined by the political and administrative authorities of the local municipalities.

Finally, we include in our model variables which control for characteristics related to the respondents, as follows.

(1) Presence of relatives of the respondent in the historic center (D\_RELAT). This variable should be positively correlated to residential satisfaction (among many, Perez, Fernandez\_Mayoralas Fernandez, Rivera, and Rojo Abuin, 2001, Mohit, Ibrahim, and Rashid, 2010, Smith, 2010, Dekker and Bolt, 2005).

(2) Age (D\_AGE), gender (D\_GEN), education level (EDUC\_LEV), employment (JOB). The age of a person reflects the stage of her/his life cycle. It is likely that the older the respondent, the higher her/his residential satisfaction, since, on the average, older, more mature people are likely to be more settled down than younger ones, who are likely to have higher expectations (Amerigo and Aragones, 1990, Dahmann, 1985, Lu, 1999). The gender variable (dummy: female) is expected to be positively correlated to residential satisfaction because women are likely to have deeper affective relations with their neighborhood and house than men (Lu, 1999). The education level represents the school degree of the respondent. It is likely that the higher the education level the lower the residential satisfaction, since a higher level of education should be related to a higher awareness of suitable residential alternatives (Van Ham, Manley, Bailey, Simpson, and Maclennan, 2012). It is likely that the higher the income related to the respondent's job the lower the residential satisfaction (Lu, 1999), since a higher income should generate a higher awareness of suitable residential alternatives. On the other hand, retirees, students, unemployed people or housewives are expected comparatively to be more satisfied with their residential neighborhood.

(3) Duration of residence (DUR\_RES) and relationships with her/his neighbors (D\_RELATION). It is likely that the duration of residence and good relationships with neighbors be positively correlated to residential satisfaction, since they signal a strong emotional bond between the respondent and the neighborhood where she/he lives (Amerigo and Aragones, 1997, Anderson, 2010, Dekker and Bolt, 2005, Parkes, Kearns, and Atkinson, 2002).

(4) Level of satisfaction related to the house (D\_HOU\_SAT). It is pretty straightforward that a positive attitude towards the house where she/he lives exerts a positive influence on residential satisfaction with the neighborhood, so we include a variable related to this issue in the set of covariates (Parkes et al., 2002, Galster and Hesser, 1981).

Variable	Definition	Mean	St.dev.
<b>Residential satisfaction</b>			
<i>NEIG_SAT</i>	Ordered categorical variable of residential satisfaction related to neighborhood that can take five values, as follows: 1-Low level of satisfaction; 2-low-medium; 3-medium; 4-medium-high; 5-high	3.77	1.06
<b>Neighborhood-related variables</b>			
<i>D_SCHOOL</i>	Dummy variable related to the presence of schools or university facilities near the respondent's house	0.65	0.48
<i>D_MARKET</i>	Dummy variable related to the presence of a market near the respondent's house	0.65	0.48
<i>D_POST</i>	Dummy variable related to the presence of a post office near the respondent's house	0.71	0.46
<i>D_PHARM</i>	Dummy variable related to the presence of a pharmacy near the respondent's house	0.80	0.40
<i>D_GARD</i>	Dummy variable related to the presence of a garden near the respondent's house	0.45	0.50
<i>D_BUSST</i>	Dummy variable related to the presence of bus stops near the respondent's house	0.79	0.41
<i>D_QUIET</i>	Dummy variable related to the perceived tranquility of the location where the respondent lives (1 if it is a calm place, 0 otherwise)	0.71	0.46
<i>D_RELAT</i>	Dummy variable related to the presence of respondent's resident relatives in the historic center (1 if there are relatives, 0 otherwise)	0.35	0.48
<i>D_PARK</i>	Dummy variable related to the absence of parking spaces in the neighborhood of the respondent's house	0.83	0.38
<i>D_STRLIGHT</i>	Dummy variable related to the presence of a deficient street lighting in the neighborhood of the respondent's house	0.14	0.35
<i>D_CRIME</i>	Dummy variable related to the presence of criminal activity in the neighborhood of the respondent's house	0.16	0.36
<i>D_REFUS</i>	Dummy variable related to the presence of problems of refuse collection in the neighborhood of the respondent's house	0.44	0.50
<i>D_TRAFF</i>	Dummy variable related to the presence of traffic in the neighborhood of the respondent's house	0.36	0.48
<i>D_WATLOS</i>	Dummy variable related to the presence of water losses in the neighborhood of the respondent's house	0.10	0.30
<i>D_NOISE</i>	Dummy variable related to the presence of noise in the neighborhood of the respondent's house	0.42	0.49
<i>D_PAV</i>	Dummy variable related to the presence of incoherent paving in the neighborhood of the respondent's house	0.07	0.26
<b>Respondent-related control variables</b>			
<i>D_AGE</i>	Dummy variable that represents the age of the respondent (1 if the age is less than 40, 0 otherwise)	0.13	0.33
<i>D_GEN</i>	Dummy variable related to the gender of the respondent (1 for female and 0 for male)	0.63	0.48
<i>EDUC_LEV</i>	Dummy variable related to the respondent's education level (1 if the respondent has a university degree or a diploma, 0 otherwise)	0.14	0.35
<i>JOB</i>	Set of dummy variables related to the respondent's job (JOB2 is 1 if the respondent is a practitioner, 0 if the respondent is a public employee; JOB3 is 1 if the respondent is a student or an unemployed person, a retiree or a housewife, 0 if the respondent is a public employee)	0.13	0.34
		0.56	0.50
<i>D_RELATION</i>	Dummy variable related to the goodness level of the relationships between the respondent and his neighbors (1 if good or excellent, 0 otherwise)	0.77	0.42
<i>D_HOU_SAT</i>	Dummy variable related to the respondent's satisfaction concerning the house where he/she lives (1 if the satisfaction degree is medium-high or high, 0 otherwise)	0.84	0.36
<i>DUR_RES</i>	Ratio between the number of years the respondent has been living in the house and his/her age (percentage of lifetime the respondent has spent in the house)	0.57	0.33

Table 1: Variables and descriptive statistics

## 5.2 Results

The results of the implementation of the OLM are described in the sub-subsections that follow. We present the estimates concerning the control variables in the first place, and afterwards we report the outcomes related to the influence of neighborhood characteristics on residential satisfaction. The detail of the estimates is reported in Table 2. The table shows the OLM's estimated odds ratios. As we stated in (8), the odds ratio is the ratio of the probability of higher level of residential satisfaction with the neighborhood where a house is located (variable "NEIG\_SAT" in Tables 1-2) in case of the event related to the value "1" of a dummy variable to the probability of the event related to the value "0". A change of the level of residential satisfaction can occur as follows:

- (1) from low ( $y = 1$ ) to a higher level ( $y = 2, 3, 4$  or  $5$ );
- (2) either from low or from medium-low ( $y = 1$  or  $2$ ) to a higher level ( $y = 3, 4$  or  $5$ );
- (3) either from low or from medium-low or from medium ( $y = 1, 2$  or  $3$ ) to a higher level ( $y = 4$  or  $5$ );
- (4) either from low or from medium-low or from medium or from medium-high ( $y = 1, 2, 3$  or  $4$ ) to high ( $y = 5$ ).

Ordered Logit model (Dependent variable NEIG_SAT)				
Variable	Odds ratio	Stand.error	t-statistic	Hypothesis test: coefficient=0
<b>Respondent-related control variables</b>				
<i>D_AGE</i>	1.8558	1.0110	1.14	0.256
<i>D_GEN</i>	1.2165	0.4175	0.57	0.568
<i>D_RELATION</i>	4.8451	2.0846	3.67	0.000
<i>EDUC_LEV</i>	0.8550	0.5763	-0.27	0.788
<i>JOB2</i>	0.6431	0.3648	-0.78	0.436
<i>JOB3</i>	0.6324	0.2512	-1.15	0.249
<i>D_HOU_SAT</i>	2.5904	1.1824	2.09	0.037
<i>DUR_RES</i>	1.2638	0.4083	0.55	0.581
<b>Neighborhood-related variables</b>				
<i>D_QUIET</i>	2.0624	0.9069	1.65	0.100
<i>D_RELAT</i>	1.3349	0.4767	0.81	0.419
<i>D_SCHOOL</i>	1.4088	0.6374	0.76	0.449
<i>D_MARKET</i>	0.5028	0.2679	-1.29	0.197
<i>D_POST</i>	1.4236	0.7920	0.63	0.526
<i>D_PHARM</i>	1.7580	1.5070	0.66	0.510
<i>D_GARD</i>	0.9126	0.3610	-0.23	0.817
<i>D_BUSST</i>	2.8139	1.9434	1.50	0.134
<i>D_PARK</i>	1.0284	0.4884	0.06	0.953
<i>D_STRLIGHT</i>	1.0469	0.5103	0.09	0.925
<i>D_CRIME</i>	0.4026	0.2437	-1.50	0.133
<i>D_REFUS</i>	0.4098	0.1542	-2.37	0.018
<i>D_TRAFF</i>	0.5714	0.2078	-1.54	0.124
<i>D_WATLOS</i>	0.6978	1.2838	-1.50	0.135
<i>D_NOISE</i>	0.2973	0.1128	-3.20	0.001
<i>D_PAV</i>	0.9406	0.6336	-0.09	0.928
Pseudo R-squared= 0,1886				

Table 2: OLM's estimated odds ratios, dependent variable NEIG\_SAT. The odds ratio is the ratio of the probability of higher level of residential satisfaction with the neighbourhood where a house is located in case of the event related to the value "1" of a dummy variable to the probability of the event related to the value "0": the model includes the covariates of Table 1.

### 5.2.1 Respondent-related control variables

The signs of the estimated odds ratios of the respondent-related control variables are always consistent with expectations discussed in the previous subsection.

The variable related to the quality of relationships with neighbors, *D\_RELATION*, shows a positive odds ratio, 4.86, as expected.

The model's results show that respondents older than 40 express a higher satisfaction degree than younger people, which can be related to expectations' and needs' change during lifetime. The results concerning variable *D\_AGE*'s odds ratio indicate that if the respondent is older than 40, the probability of having a higher satisfaction degree increases by a 0.86 factor. With reference to the gender-related variable *D\_GEN*, women express a level of satisfaction higher than men's, which can be explained through comparatively higher emotional connection with the residential location-related relationships. The model's results show that in case of a female respondent the probability of having a higher level of satisfaction increases by a 0.22 factor, with a low significance level.

As expected, the presence of relatives in the neighborhood has a positive influence.

The variable related to the quality of relationships with neighbors, *D\_RELATION*, shows a positive odds ratio, 4.85, as expected.

Respondents with a low education level reveal a higher satisfaction degree than graduate's (variable *EDUC\_LEV*, odds ratio equal to 0.86), as expected.

Practitioners show a residential satisfaction level lower than employees, as well as students, unemployed and retiree people (variables *JOB2* and *JOB3*, odds ratio equal to 0.64 and 0.63 respectively).

Finally, the variables related to the number of years the respondent has been living in the house (*DUR\_RES*) and to the level of satisfaction related to the house (*D\_HOU\_SAT*) exhibit positive odds ratios (1.26 and 2.59).

### 5.2.2 Neighborhood-related control variables

The signs of the estimated odds ratios of the neighborhood-related variables are mostly consistent with expectations discussed in the previous subsection.

The variable related to the tranquillity of the respondent's house location, D\_QUIET, shows a positive odds ratio, 2.06, as expected.

Variables related to the presence of schools (D\_SCHOOL), post offices (D\_POST) and bus stops (D\_BUSST) have a positive influence on the satisfaction related to the neighborhood of the respondent's house, as expected. Odd ratios are 1.41, 1.42 and 2.81. The availability of public bus services nearby the house's location is perceived as comparatively more important in terms of residential satisfaction.

Variables related to the presence of markets (D\_MARKET) and gardens (D\_GARD) have negative effects, which is not consistent with expectations. A possible reason could be that the supply of these services is higher than the demand expressed by the residents of the historic center, so the marginal value of these services is negative, in terms of the cost-opportunity of losing the availability of other services perceived as underendowed.

The presence of pharmacies (D\_PHARM) has a positive effect on the level of satisfaction. Odds ratio is 1.76.

The absence of parking spaces (D\_PARK) and the lack of sufficient street lighting (D\_STRLIGHT) show no evidence of any impact on residential satisfaction since the corresponding p-values are more than 90 percent.

The presence of crime in the neighborhood and problems connected to refuse collection, that is variables D\_CRIME and D\_REFUS, exhibit less-than-one odds ratios (0.40 and 0.41), as expected.

The traffic-related variable D\_TRAFF has a negative influence as expected, and it shows an odds ratio nearly equal to 0.57.

The variable related to water losses, D\_WATLOS, has a negative effect, and it exhibits a 0.69 odds ratio.

Finally, noise-related and paving-related variables, that is D\_NOISE and D\_PAV, show negative effects as well (0.30 and 0.94).

## 6 DISCUSSION AND CONCLUSION

The outcomes of the DCM-based model entail important implications for future planning policies. The restricted availability of public services and infrastructure is a very influencing factor in determining low satisfaction. As a consequence, it could very possibly be effective to provide the historic center with important services such as schools, public gardens, parking lots, bus stops, groceries and retail shops and pharmacies.

Moreover, crime control, effective refuse collection, thoughtful noise mitigation strategy, improved street lighting and paving, and traffic control are other factors which could increase the perceived satisfaction by the residents.

These outcomes provide local decision makers and public officials with important information on the historic center's residents' expectations related to urban planning policies.

For instance, a very effective policy to enhance residential satisfaction with the neighborhood could be to improve the public transportation network in order to make it easier for the residents to commute from the historic center to other urban destinations.

Another proposal could be the implementation of a demand-responsive transport service, characterized by flexible routing and scheduling of small vehicles operating in shared-ride mode, according to passengers' needs. This would be useful and a sustainable, since it would reduce the overall cost of the public transport system.

With reference to traffic problems, which is another negative factor, it seems that policies that entail an increase and a more effective management of parking space very close to the historic center boundary could generate a positive effect on residential satisfaction related to neighborhood, which may possibly imply the pedestrianization of the most part of Cagliari's inner-city as well. Moreover, a more effective refuse collection system could be based on the project of locating dustbins underground, which could possibly improve the urban cleanliness perception.

Considering relationships with neighbors, the outcomes of the model's implementation show that good relationships have a positive effect on residential satisfaction. So, it is reasonable to propose a policy that contributes to improve relationships between neighbors, such as, for instance, making available public facilities where residents can implement social activities and build a sense of community. These facilities could also improve participation related to planning decisions, since residents and city users could feel at ease with a familiar environment for public discussion.

Finally, since, as we put in evidence in the previous section, residential satisfaction is positively related to residents' satisfaction concerning the house where they live, a decisive role to improve perceived quality of the neighborhood is played by public planning policies for residential reuse and renewal, which is the core of the implementation plans of the historic centers (IPHCs) defined by the Regional Landscape Plan of Sardinia (RLP). Following the RLP's approval, the Sardinian regional administration provided municipalities and practitioners with a wide range of technical guidelines and documentation that are significantly influencing the implementation of the planning processes of IPHCs. As a consequence, in the planning processes of the IPHCs, heavily influenced by the control of the technical staff of the regional offices, a strong consistency and implied uniformity do show up as: i. a strong attention to historical, typological and morphological characteristics in terms of the territorial analysis of historic urban settlement systems, which are identified by the RLP as "Centers of antique and primary development"; ii. A strong prescriptive ruling framework characterized by a markedly-conservative attitude (Leone and Zoppi, 2014). In this context, it would be reasonable a urban-renewal policy that entails the transformation of private buildings into public housing, in order to revitalize the historic center through the integration of public and private financial efforts.

Since more liveable houses and neighborhoods endowed with high-quality public services and infrastructure make peripheral and outbound locations more attractive than the historic centers', a key element to rebalance the historic centers' displacement is to increase the quality of inner cities' houses and neighborhoods. As an example, in the case of Cagliari, the model's implementation shows that attractiveness of the historic center could improve substantially if the availability of post offices, bus stops and retail shops is increased. Moreover, the model's outcomes indicate that a comprehensive planning approach to public transportation, parking, and pedestrian paths would help making the historic center comparatively more attractive, since these issues are much more important for the historic center than for other urban neighborhoods. Furthermore, the establishment of one or more restricted-traffic areas could increase the tranquillity of the historic center's neighborhoods, and, by doing so, determine a rise in the level of satisfaction of the residents.

This paper has employed an OLM-based approach to analyze questionnaires delivered to the residents of the historic center of Cagliari in order to investigate the determinants of their satisfaction with the neighborhood where they are living. Moreover, the application of this method allows for an integration of the results of the questionnaire analysis and DCM-based approaches, which can be used by city planners in the development of policy-making processes concerning city residential areas. In this respect, the paper makes an important methodological contribution.

The optimal choice of the attributes to be included in the OLMs includes as many variables as necessary to describe the residential satisfaction with the neighborhoods where people are living. Of course, this choice is heavily influenced by available information. The analysis here implemented is based on a set of variables representing the best choice given the information available, rather than the optimal choice. These variables should be considered as a subset of the optimal variable choice. Nevertheless, they give us an interesting picture of the phenomenon.

Regarding this point, it must be stated that there are a number of variables that should have been included in the OLM model and were not included since no information is available. One is the household income, which could be very important in determining the income effect on the investment. Moreover, data on capacity of the system of public infrastructure and services would be very helpful.

The method developed in this paper could be easily exported to assess residential satisfaction related to the neighborhood on behalf of residents living in other urban contexts, in particular of people living in residential peripheries, by adapting the questionnaire to the different situations at stake.

The results obtained with reference to Cagliari's historic center allow generalization for two reasons. On the one hand, no similar empirical studies have been implemented to analyze the determinants of residential

satisfaction related to neighborhood in other Italian conurbations by means of a DCM-based approach. On the other hand, it is not possible to compare the situation of the urban area of Cagliari to a situation in which a more flexible, participatory, faster and bottom-up planning process was implemented. This kind of situation would have probably encouraged people to lobby in favor of effective planning policies concerning the historic center, since the established planning process has been developed quite homogeneously in all of Italy, and counter-examples are very rare.

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