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2 **Exploring residential satisfaction in shrinking cities: A** 3 **decision-tree approach**

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7 **Abstract** The number of cities experiencing population decline has been increasing
8 worldwide. Despite the existence of theoretical propositions of shrinkage as an
9 opportunity to increase levels of residential satisfaction, the issue has not been addressed
10 empirically. This paper contributes to fill this gap by assessing through survey the
11 residential satisfaction of inhabitants of four shrinking Portuguese cities.

12 Data were analysed by means of a tree-decision approach: the Chi-squared Automatic
13 Interaction Detection analysis (CHAID). The sense of safety is the feature that mostly
14 discriminates inhabitants' residential satisfaction. The results show that only shrinkage
15 due to deindustrialisation processes is detrimental to residential satisfaction.

16 **Keywords:** Residential satisfaction, population decline, shrinking cities, cities' features,
17 tree-based approach.

1. Introduction

The theme of population decline has been viewed by politicians as a sign of ineffective governance and by planners as a conceptual failure, and thus the word “shrinkage” has been avoided. Only after 1980, in the German-based literature, did the word began to enter the lexicon of publications and reports (Hoekveld 2014). Between the end of World War II and the 1980s, expressions such as population decline, urban decay, urban crisis, and demographic change became commonly used (Haase et al. 2014). Given the negative perception generally associated with shrinkage, many countries continue to implement policies oriented towards regaining inhabitants (e.g., Popper and Popper 2002, for the USA; Panagopoulos and Barreira 2012, for Portugal; Rink et al. 2014, for Poland, Check Republic and Romania). However, empirical studies have shown that growth is not a requirement for inhabitants to experience satisfaction from living in cities with declining populations (Delken, 2008; Hollander, 2011).

Planners in the twenty-first century are increasingly focused on sustainability issues, because enduring urban growth has been associated with a reduction in the perceived quality of life (Baldassare and Wilson 1995). As such, places losing inhabitants can be regarded as an opportunity to obtain better life-styles for those who stay (Pallagst et al. 2009), as such loss can decrease the cities’ stressors, like traffic congestion and rush-hour problems (van Dalen and Henkens 2011; Hollander and Németh 2011). Because urban planners have to struggle to maintain the provision of public goods and services under increasingly scarce resources, urban decline is often regarded as a condition leading to disorder, decay, and consequently unhappiness or low quality of life. However, recent empirical evidence has shown that this is not always the case (Delken 2008; Hollander 2011). An understanding of the factors that ensure inhabitants of shrinking cities a sense of belonging, happiness, and residential satisfaction is a central requirement if the effects of urban decline are to be mitigated (Dassopoulos et al. 2012).

Despite the theoretical proposition that cities by losing population gain quality of life because they are less crowded, less polluted, and have more open spaces (Baldassare and Wilson 1995; Pallagst et al. 2009), thereby contributing to residential satisfaction and a lower propensity of citizens to move out, assessments of residential satisfaction in those environments are scarce. The studies of Hollander (2011) and Dassopoulos et al. (2012) are the two exceptions. Most empirical studies of urban transformation have focused on deteriorated or decayed spaces (Andersen 2002; Abbott and Sapsfort 2005; Friedrichs and Blasius 2009), which are distinct from shrinking environments as population decline does

not necessarily imply the degradation of place. In contrast, shrinkage provides an opportunity for environmental improvement (Dodman 2009; Ryan 2012) and housing rehabilitation (Carmon 1999; Kauko 2011).

The study of population decline in Portugal is at an early stage, but is becoming a popular research topic, with recent examples including the investigations of Balsas (2000), Sousa (2010), Panagopoulos and Barreira (2012), Guimarães et al. (2014), Sousa and Pinho (2014), and Panagopoulos et al. (2015). By looking at the residential satisfaction of those citizens living in cities that are declining in inhabitants, this paper addresses a topic that remains scarcely explored in the literature. This exploratory study aims to sound the main features that discriminate the level of residential satisfaction in four shrinking Portuguese cities, by using a tree-decision approach based on the Chi-squared Automatic Interaction Detection (CHAID) algorithm.

2. Aspects influencing the assessment of residential satisfaction

Residential satisfaction is a multi-dimensional concept (Francescato 2002) that refers to the experience of pleasure, gratification, or contentment derived from living in a specific place (Galster and Hesser 1981; Bonaiuto et al. 2003). Residential satisfaction can be assessed at the levels of the home (Perez et al. 2001; McCrea et al. 2005), the neighbourhood (Galster and Hesser 1981; Sirgy and Cornwell 2002), or the community (Türksever and Atalik 2001; Sirgy and Cornwell 2002), depending on the scale of interest. For the purpose of this paper, residential satisfaction was assessed at the community level because the city is the geographic unit of study and because inhabitants' satisfaction with their city appears as an integrative approach "as social life and social interactions are no longer confined to neighbourhoods, while social opportunities may not be neighbourhood-related" (Musterd and Ostendorf 2008; pg.90).

According to Rosenberg and Hovland (1960), residential satisfaction is a three-component psychological construct: cognitive, affective, and behavioural. The cognitive component is perceived through indicators of environmental quality (Craig and Zube 1976; Carp and Carp 1982). The affective and behavioural components refer to the bonds that people develop over time with their social and physical environments (Brown and Perkins 1992), often referred to as place attachment.

The level of residential satisfaction commonly influences inhabitants' decisions to leave or stay in an area (Galster and Hesser 1981; Oh 2003), which is an important issue

1 in refraining the shrinking process and thus relevant for policy-makers. Residential
2 satisfaction has to be reconciled with residential preferences in the sense that only when
3 residents' needs are fulfilled do inhabitants report satisfaction with living in a certain area
4 (Kim et al. 2005; McCrea et al. 2014) and therefore feel encouraged to stay. This aspect
5 is of paramount importance in a context of population decline. However, low levels of
6 residential satisfaction may not necessarily imply a move-out by inhabitants, because of
7 the lack of better alternatives, implying that those dissatisfied inhabitants feel trapped in
8 their locations (Fang, 2006).

9 According to Amérigo (2002), three main evaluative aspects should be considered
10 when assessing residential satisfaction: spatial (architectural and town-planning features),
11 human (social-relational features), and functional (services and facilities). Spatial aspects
12 relate to residents' perceptions of the environmental quality of the place of residence,
13 with features such as pedestrian walks, roads, and the quality of open-air facilities being
14 of particular relevance (Perez et al. 2001; Grzeskowiak et al. 2003), as well as the city's
15 design/layout, crime rate, and housing quality (Taylor et al. 1984; Brown et al. 2003).
16 Human factors include social connection to the place and civic engagement (Puddifoot
17 1994; Amérigo and Aragonés 1997). The building of social connections plays a crucial
18 role in assuring residential satisfaction, because it promotes in inhabitants a sense of trust,
19 mutual aid, and psychological comfort that conveys into high levels of place attachment
20 and residential satisfaction (Grzeskowiak et al. 2003; Oh 2003). The connection to a place
21 is relevant because such bonds reduce inhabitants' will to leave and increase their wish
22 to return (Bilig 2005). Functional factors refer to the availability of education, police
23 services, public transport, parks, and green areas, as well as leisure opportunities, space
24 for sports practice, and time spent on daily commutes to and from work (Türksever and
25 Atalik 2001; Sirgy and Cornwell 2002).

26 In addition to the aforementioned aspects, personal characteristics such as gender, age,
27 length of residence, economic status, education, and homeownership have also been
28 reported to influence residential satisfaction. However, for each of these characteristics,
29 the literature describes differing and sometimes opposite effects, as outlined below.

30 Women typically develop higher residential satisfaction compared with men (Lu 1999;
31 Aiello et al. 2010), although Galster and Hesser (1981) found that women were less
32 satisfied than men. According to Preza and Constantini (1998), this difference appears to
33 be relevant only in bigger cities, whereas Oh (2003) found no evidence for gender
34 differences in explaining residential satisfaction and Bonaiuto et al. (1999) found that

gender did not affect perceptions of urban quality. Regarding the effect of age, as individuals become older, their level of satisfaction with residence increases (Newman and Duncan 1979; Parkes et al. 2002; Kamlipour et al. 2012). However, Aiello et al. (2010) found that the greater the age of residents, the worse is their perception of a variety of urban quality indicators, thus rendering lower residential satisfaction.

Another important predictor of residential satisfaction is the length of residence in a place (Bonaiuto et al. 1999; Kamlipour et al. 2012). Although the majority of the literature describes a positive relationship between length of residence and residential satisfaction, Lu (1999) found a negative relationship probably because the author failed to find a difference in the residential satisfaction assessment between new movers and residents with higher duration of residence. Further, Aiello et al. (2010) established that the longer residents live in a place and the more time they spend in it, the higher is their perception of the negative aspects. A longer experience in the urban environment may lead people to focus their attention on the negative aspects of urban places (Perez et al. 2002; Bonaiuto et al. 2004).

The socioeconomic status of inhabitants associated with higher levels of income is positively related with residential satisfaction (Carp and Carp 1982; Christensen and Carp 1987; Christensen et al. 1992). However, some authors have found that economic aspects have a higher likelihood of affecting residents' satisfaction with their homes than with their place of residence (Sirgy and Cornwell 2002), whereas others have not identified any relationship between income level and residential satisfaction (Mohan and Twigg 2007). In the particular context of urban decline, Dassopoulos et al. (2012) discovered that income is not a relevant variable in explaining residential satisfaction.

Education has been found by some studies to influence residential satisfaction, with the more highly educated being the more satisfied (Lee 2008). However, other studies report the more educated inhabitants as being the less satisfied, probably on account of the discrepancy between their higher expectations and their reality (Filkins et al. 2000; Hur and Morrow-Jones 2008). Still other authors report that education has no effect on residential satisfaction (Lu 1999; Oh 2003).

High levels of homeownership reflect high levels of residential satisfaction (Newman and Duncan 1979; Grinstein-Weiss et al. 2011). Owners invest in their own residence, establishing a strong connection with a place (Brown et al. 2003; Hipp, 2009), and therefore show a lower propensity compared with tenants to move to another locality

(Vardy 1983; South and Crowder 1997). However, Ringel and Finkelstein (1991) found that homeownership is related to place attachment but not to residential satisfaction.

In this context, interconnecting the spatial, human, and functional factors and individuals' demographic characteristics as explanations for residential satisfaction, the literature reports the existence of some relationships, but once again contradictory conclusions are found.

With regard to spatial aspects, gender differences emerge concerning perceived insecurity, with the residential environment being rated as more insecure for women than for men (Smith et al. 2001; Carro et al. 2010). Moreover, residents with a greater fear of crime also feel less attached to a place, which decreases their desire to remain there (Kamlipour et al. 2012) and lowers the level of residential satisfaction (Sirgy and Cornwell 2002; Oh 2003). McCrea et al (2005) ascertained that crime is more important for single people and for younger people in their assessment of residential satisfaction, whereas Abbott and Sapsford (2005) found that concerns about crime are more relevant to older inhabitants than to younger citizens. However, in some studies, concerns about crime have been shown to not play a significant role in generating feelings of dissatisfaction with the environment (Marans and Rodgers 1975; Newman and Duncan 1979). In fact, Taylor (1996) found high levels of place attachment in areas with more police-reported crime and higher observed rates of incivilities. The reason may be because those inhabitants reporting high levels of residential satisfaction are less sensitive to crime (Bolan 1997; Sirgy and Cornwell 2002). Despite the literature mainly indicating residents as being less attached to places perceived as physically in disorder (McGuire 1997; Hipp 2009) or deteriorated (LaGrange et al. 1992), some authors have found that the incidence of incivilities and decay is unrelated to place attachment (Taylor et al. 1985).

Concerning human aspects, women show to feel more attached to their home and surroundings compared with men (Perez et al. 2001; Kamlipour et al. 2012). Older individuals (Woolever 1992; Lu 1999; Hidalgo and Hernandez 2001) and those with longer durations of residence (Kasarda and Janowitz 1974; Brown et al. 2003) become highly attached citizens. Education and homeownership also have positive effects on place attachment (Woolever 1992; Hidalgo and Hernandez 2001; Kamlipour et al. 2012).

Combining functional aspects with individuals' characteristics shows that the residential satisfaction of older inhabitants is less influenced by the existence of facilities and spaces for playing sports or for engaging in leisure/entertainment activities compared with younger inhabitants (Aiello et al. 2010). However, citizens' participation in

recreational activities such as sports and physical activity reinforces the sense of belonging and reduces crime (Harrison et al. 2007). The composition of households also biases preferences towards certain types of service or facility depending on whether the family has to take care of parents or children (Strömberg 2006); for instance, access to schools or kindergartens is assessed differently by older inhabitants depending on the proximity to the family and whether they have to take care of grandchildren (Gradstein and Kaganovich 2004).

3. Methodology

3.1. The case—study cities and research goals

The literature identifies several causes of reductions in the number of urban inhabitants (Oswalt and Rieniets, 2006; Reckien and Martinez-Fernandez 2011; Haase et al. 2013), including the natural evolution of birth rates and the phenomena of suburbanisation and of economic transformation. Climatic drivers and the satellite effect have also been reported as reasons for urban decline in Portugal (Guimarães et al. 2015). Using the work of Guimarães et al. (2015) as a basis, four case-study cities were selected as representative of different causes of urban shrinkage: Oporto (suburbanization), Barreiro (deindustrialization), Moura (severe climatic conditions), and Peso da Régua (satellite effect).

Oporto is the second-largest city in Portugal and lost 21.5% (from 302,500 to 237,600 inhabitants; based on census data; Portuguese Statistics) of its inhabitants from 1991 to 2011. Suburbanisation was the main cause of this decline, a process described in Fernandes (2011), even though the city's historical core is classified as being of World Heritage status by UNESCO. The crime rate of 69.5 per thousand inhabitants in 2013 (Pordata, 2013) compared with the national average of 38.5 might explain the reports of urban insecurity by residents in previous surveys (Santos and Martins, 2007). Barreiro experienced the second-highest relative loss of population in the country from 1991 to 2011, with a decline of 21.2% (from 47,900 to 37,700 inhabitants; census data; Portuguese Statistics). The reason behind this population decline was an abrupt phase of deindustrialisation, when this city had been the most important Portuguese pole of the production of the chemical industry. The city also shows some signs of social deprivation, as revealed by crime and unemployment rates that lie above the respective national averages. Moura is a small city that in 2011 had a population of 8,400 inhabitants and faced a population decline of 9% during the previous ten years. The city is located in the

hinterland of the country and is heavily affected by desertification and heat waves. Peso da Régua shows a slow but persistent decline in its population, presenting a population loss of 3% between 1991 and 2011 (from 10,300 to 10,000; census data; Portuguese Statistics). The city is located in a hilly area near the Douro River, and thus benefits by being surrounded by a beautiful landscape. Its proximity to another city, Vila Real, which offers higher-education provision and more appealing economic conditions, relegates Peso da Régua to a satellite role.

By considering shrinking cities affected by different reasons for shrinkage, the goal of the present study was to identify the main features that contribute to discriminate the level of residential satisfaction reported by their inhabitants. In accordance with the stated objective, this study poses three research questions:

1. How is residents' satisfaction (inhabitants' residential satisfaction) related to their intention to abandon a shrinking city?
2. In a context of shrinkage, what are the spatial, human and functional aspects of cities that significantly discriminate the assessment of inhabitants' residential satisfaction?
3. What socio-demographic and contextual variables affect the residential satisfaction of inhabitants of shrinking cities?

3.2. The instrument and data

The use of questionnaires to assess residential satisfaction is a common practice (e.g., Bonaiuto et al. 2006; Mellander et al. 2011); however, the available instruments were not conceived to address shrinking environments. Reckien and Martinez-Fernandez (2011) proposed an instrument to identify the attractive features of shrinking cities, but did not evaluate residential satisfaction. Dassopoulos et al. (2012) assessed the residential satisfaction of a city that was losing population, but they used part of the survey developed and implemented by the Las Vegas Metropolitan Area, which includes growing areas and as such is not considered to specifically address the phenomenon of shrinkage. Therefore, an instrument dedicated to surveying inhabitants of shrinking Portuguese cities was constructed, based on the literature that considers features contributing to residential satisfaction and on the specific characteristics of the case-study cities.

The survey was applied face to face by a company selected through an open call, between 7 and 23 July 2014, to 701 inhabitants of the four case-study cities: Oporto (180 respondents), Barreiro (179), Moura (171), and Peso da Régua (171). The sample was

defined using the random stratified method, ensuring a maximum margin of error of 7.45% for the 95% confidence interval. The stratification considered first the number of inhabitants in each city and their distribution by the parishes that comprehend the city: Oporto (15 parishes), Barreiro (3), Moura (3) and Peso da Régua (2), and afterwards the stratification considered the typology of households characterizing each city¹, according to Portuguese statistics data from the 2011 census. The survey was applied on the following typologies of households: : 1) One person (15–64 years old) with or without other(s) (< 15 years old); 2) One person (> 64 years old); 3) Two persons (both 15–64 years old) with or without other(s) (< 15 years old); 4) Two persons in which at least one is > 64 years old; 5) Three persons (> 15 years old) with or without other(s) (< 15 years old).

The questionnaire included 24 features to be evaluated by respondents as constituting attractive features of the city. The process of rating the features was based on a 5-point Likert scale, ranging from 1 (strongly unimportant) to 5 (strongly important). Residential satisfaction (i.e., residents' satisfaction with their city as a place to live) was assessed by a 5-point Likert scale, ranging from 1 (strongly dissatisfied) to 5 (strongly satisfied). The questionnaire also contained questions regarding the demographic and socio-economic characteristics of individuals (i.e., gender, age, household income, education level, homeownership, and the number of years of residence in the city). Further, the questionnaire included two additional questions: respondents' intention to abandon the city within one year (answered with no/yes, with a "no" answer being interpreted as a willingness to remain in the city), and respondents' desires for population trend regarding the evolution of the number of inhabitants in their city of residence: increasing, stable, or decreasing.

Table 1 provides a summary of the main socio-demographic and contextual variables and also the descriptive statistics of the collected data. Data are shown by city and for comparison purposes the last column of Table 1 presents the Portuguese national average values for the socio- demographic variables.

(Insert Table 1 here)

Respondents as a whole are predominantly female, representing, on average, 61.2%, with up to 9th grade of school, and have an average age of 54 years. The majority of the respondents are homeowners (59.1%) and belong to a household with a monthly income

¹ Details in Panagopoulos et al. (2015).

of up to 1000 euros, both values below national average. Most of the residents wished that the number of people living in their city would increase (78.3%), did not anticipate leaving their city in the coming year (94%), and have lived in the same city for more than 20 years (60.3%).

3.3. Data analysis

Data analysis was initiated with the assessment of the importance ascribed by residents to the city's features that contributed to their decision to live there. This was achieved by using the dependency analysis technique CHAID, an exploratory statistical method first developed by Kass (1980) for database segmentation. This technique is particularly adequate to the analysis of categorical data, as is the case in this study, and it is used in various disciplines that focus on segmenting individuals' perceptions (Hsu & Kang, 2007). Since the literature review shows mixed results regarding the evaluative aspects that promote residential satisfaction as well as the results relating personal characteristics of the residents with residential satisfaction, this exploratory technique offers the advantage of let the data speak for themselves, thus avoiding preconditions. This technique produces a tree diagram in which the root node (node 0) contains the whole sample and each terminal node represents a segment of the sample. During this procedure, the associations between a dependent variable and a set of independent variables are examined. This process results in depicting segments that are mutually exclusive and exhaustive in a hierarchical order (starting with the independent variable that best discriminates the dependent variable), by performing Chi-square tests of independence (Legohérel and Wong 2006; McCarty and Hastak 2007). By using SPSS (Statistical Package for the Social Sciences) software, CHAID computes a Bonferroni adjusted p -value for each of the significant independent variable (Kass 1980; Magidson 1993).

In the present study, the dependent variable "residents' satisfaction" measures residential satisfaction, being the potential independent variables a set of 24 features identified in the literature as being of importance to residents in the decision-making process of choosing a particular city in which to live and according to the specificities of each of the four cities considered as case studies. The CHAID tree allows identification of the variables that significantly discriminate the segments in terms of "residents' satisfaction", and to rank the variables according to their importance in the segmentation process (McCarty and Hastak 2007). The overall percentage of correctly classified statistical units resulting from CHAID is used for validation purposes. The method also

1 indicates the “risk estimate”, which for a categorical dependent variable is the proportion
2 of statistical units incorrectly classified. The “cross-validation” method is also used here
3 to assess how well the estimated tree is able to be applied to other data or to the overall
4 population. The data are split into k distinct groups ($k = 10$, by default, in SPSS) and k
5 separate trees are produced, each one using all data except one group. This method used
6 for validation indicates a risk estimate for each tree and the average of the k risks
7 estimated (Magidson 1993; Valle et al. 2012).

8 Criterion-based techniques, such as CHAID, have several advantages compared with
9 non-criteria methods, such as cluster analysis, which consider all of the variables
10 interdependently (Chen 2003). In the CHAID method, a set of variables able to
11 significantly discriminate among segments are identified, whereas in a non-criterion
12 method, post-hoc tests are required to detect which variables are able to significantly
13 describe the segments. Furthermore, the criterion-based techniques allow researchers to
14 discover the segment that has the strongest relationship with a particular criterion and to
15 identify opposing trends among the segments, which allows the development of specific
16 policies to approach each segment (Chen 2003; Agapito et al. 2011; Valle et al. 2012).
17 Other advantages of criterion-based techniques like CHAID include the facility to
18 interpret the results presented via a tree diagram, the possibility of exploring the most
19 important independent variable explaining the dependent variable, the ability for the
20 technique to be used before a parametric technique, and to improve the credibility of the
21 results (Sargeant and McKenzie 1999; Levin and Zahavi 2001).

22 Before discriminating between segments, a chi-square test was performed to discern
23 whether or not the variables “residents’ satisfaction” and “intention to abandon the city
24 within one year” were independent. Based on the tree diagram, the chi-square test and
25 cross-tabulation tables were implemented to define the profiles of the segments, which in
26 the CHAID analysis showed opposing trends.

27 To conduct the CHAID analysis, it was decided to merge the five original response
28 categories (from 1 = ‘Strongly dissatisfied / Strongly unimportant’ to 5 = ‘Strongly
29 satisfied / Strongly important’) into two groups that aggregated categories 1 to 3 on the
30 one hand and categories 4 and 5 on the other, representing dissatisfied and satisfied,
31 respectively, for the dependent variable and not important and important, respectively,
32 for the independent variables. This procedure was followed because some of the
33 categories contained only a small number of responses (Magidson, 1993; Valle et al.,
34 2012). Criteria were also defined for tree growth: a minimum of 50 cases for parent nodes

and 25 cases for child nodes. All of the analyses were implemented using SPSS 20.0 software.

4. Results

4.1. Research question 1: Residents' satisfaction and intention to abandon the city

Table 2 presents the results of the importance attributed by the surveyed residents to the listed 24 features with respect to their decision to live in a particular city. The items present a Cronbach's alpha of 0.89, indicating that the measure is reliable.

(Insert Table 2 here)

To assess the relationship between residents' satisfaction and their intention to abandon the city, the chi-square test was performed to discern whether or not the variables were independent. The test resulting from the cross of the variables "residents' satisfaction" and "intention to abandon the city within one year" revealed a significant dependent relationship between these variables (chi-square = 18.999; p -value = 0.000). When crossing the variables using a cross-tabulation table, it is observed that whereas 96% of satisfied or strongly satisfied residents are not planning to leave the city within a period of one year, this percentage falls to 86.5% for residents who claim to be dissatisfied or neutral.

4.2. Research question 2: Features of cities linked with differences in inhabitants' residential satisfaction

The analysis shows that of the 701 respondents, 22% were dissatisfied (which includes the original categories of strongly dissatisfied, dissatisfied, or neutral) with respect to the city where they live, whereas 78% claim to be satisfied or very satisfied (Figure 1). The CHAID tree depicts five terminal nodes (nodes 4 to 8), suggesting that there are five distinct segments of residents considering the dependent and independent variables in analysis. Four independent variables out of the original set of 24 provided a significant explanation of the dependent variable with the power to discriminate segments, which led to the tree being divided into three levels: 1) "safe city" (chi-square = 46.104; p -value = 0.000); 2) "close to schools" (chi-square = 3.916; p -value = 0.048) and "trust and cooperation in the neighbourhood" (chi-square = 7.637; p -value = 0.006); and 3) "areas for outdoor sports" (chi-square = 6.871; p -value = 0.009) (Figure 1). Accordingly, the safety of the city is the best discriminator of residents' satisfaction, followed by social cooperation and trust, the existence of areas for sports, and the proximity to schools.

The final tree has an estimated risk of 0.21, with a standard error of 0.15, which means that the overall percentage of correct classification is 79%, considered to be a good result (Escobar 1998). As the number of cases was less than 1000, a cross-validation method was performed, which involved dividing the initial data into 10 different sub-samples, validating them, and estimating the errors of incorrect classifications. In the present study, the model presents a risk ratio for the overall sample that is close to the average of the estimated errors for each of the sub-samples (0.22). This result does not preclude the application of the model to other samples from the same population (Magidson 1993).

(Insert Figure 1 here)

Fig. 1 CHAID (Chi-Squared Automatic Interaction Detector) tree with the independent variables that significantly discriminate the segments in terms of residents' satisfaction, and a ranking of those variables according to their importance in the segmentation process.

4.3. Research question 3: Socio-demographic and contextual profiles affecting the residential satisfaction

Table 3 presents the profiles of the two segments that in the CHAID analysis show opposing trends (nodes 6 and 8) with respect to the importance attributed to the respective cities' features by residents concerning their level of satisfaction. These nodes were the ones analysed since they distinguish the profiles of the inhabitants that are more satisfied (node 8) and less satisfied (node 6), considering their evaluation of the city's features. This distinction provides the most relevant insights for policy making. Node 6 represents 4% of the total sample and comprises the individuals who rate the independent variables that are responsible for producing this terminal node, namely "safe city" and "close to schools" (Figure 1), as unimportant in their decision to live in their respective cities. In contrast, node 8 represents 51% of the total sample and includes the citizens who consider that the independent variables with the greatest capacity to discriminate residents' satisfaction, namely "safe city", "cooperation and trust in the neighbourhood", and "outdoor sports areas", are important features with respect to living in their respective cities.

(Insert Table 3 here)

The use of the chi-square test for independence (Table 3) allowed differences between the profiles of terminal nodes 6 and 8 to be identified, based on the city where residents live (chi-square = 119.26; p -value = 0.00), residents' age (chi-square = 10.97; p -value = 0.00), residents' wishes for the evolution of inhabitants (chi-square = 16.71; p -value =

0.00), and years of residence in the city (chi-square = 6.64; p -value = 0.04). Conversely, the variables of gender (chi-square = 0.10; p -value = 0.92), education level (chi-square = 0.01; p -value = 0.93), intention to abandon the city (chi-square = 0.09; p -value = 0.77), homeownership (chi-square = 0.37; p -value = 0.54), and income (chi-square = 0.96; p -value = 0.33) do not show significant differences between the two nodes.

5. Discussion

The residents claiming to be mainly satisfied with their city are more willing to remain in the city and less likely to abandon it in one year's time compared with those showing lower levels of satisfaction. This result reinforces the need for politicians to look carefully to the city's features that ensures high residential satisfaction to contain the population decline in cities already facing shrinkage. The result confirms that high levels of residential satisfaction help dissuade inhabitants from moving out (Oh 2003; McCrea et al. 2014), although it should be noted that inhabitants who are dissatisfied do not necessarily move out, because of the lack of better alternatives (Fang, 2006).

For the four studied shrinking cities, the perception of safety is the main aspect that allowed inhabitants who were predominantly satisfied to be segmented from those who were dissatisfied with their place of residence. Moreover, 78% of the inhabitants of the shrinking cities reported residential satisfaction (Figure 1), thus supporting the claim that shrinking cities are not necessary detrimental for the inhabitants who remain (Pallagst et al. 2009; Hollander 2011). There is a significant difference between assessing residential satisfaction in shrinking cities and assessing it in deprived or decayed localities. In shrinking cities, the sense of safety is not compromised by the fact that the city is reducing in population, and reports of high residential satisfaction may be found (Delken, 2008; Hollander, 2011). Under urban degradation, high levels of insecurity and low levels of residential satisfaction are identified. As predicted by previous studies, the concern with crime plays an important role in how inhabitants assess their living conditions (Brown et al. 2003; Oh 2003), with citizens who value the sense of safety (a spatial aspect) being mainly satisfied when living in safe places. If it is different to assess residential satisfaction in shrinking and decaying cities, also will be the assessment of residential satisfaction in growing and shrinking cities, since the attributes that may explain residential satisfaction in these two types of cities will be distinct.

In addition to safety, 71% of the surveyed inhabitants reported that the development of feelings of social cooperation, mutual aid, and trust (a human aspect) is important to

1 their remaining in the city, which results in residential satisfaction (84% of respondents
2 in node 3). In the CHAID analysis, this variable is the second most important in
3 contributing to the evaluation of residential satisfaction. This result supports previous
4 findings that sentiments of trust promote place attachment, which in turn increases
5 residential satisfaction (Grzeskowiak et al. 2003; Oh 2003).

6 Functional aspects such as the accessibility of outdoor sport areas emerge as a third
7 variable significantly explaining residential satisfaction. Contrary to some previous
8 studies, which have considered other services or facilities (including proximity to schools
9 or to work) to be more relevant for residential satisfaction (Turksever and Atalik 2001;
10 Sirgy and Cornwell 2002), here the possibility of practicing outdoor sports enhances
11 residential satisfaction as it promotes social interaction (Oh 2003; Dassopoulos et al.
12 2012), which in turn increases the level of trust in social relationships and decreases
13 feelings of insecurity (Harrison et al. 2007).

14 Those inhabitants placing importance on city safety, neighbourly cooperation, and the
15 availability of areas for outdoor sports (node 8) with regard to residing in the respective
16 cities report themselves to be satisfied (81%), and are predominantly young and middle-
17 aged residents, reinforcing their sense of belonging and safety (Harrison et al. 2007;
18 Aiello et al. 2010). This result is in line with Santos et al. (2007) finding for the Oporto
19 case that young people tend to value aspects related to leisure and tend to have a more
20 favorable assessment of the city. This result also shows that the investments made in
21 recent years by Portuguese municipalities in recovering the coastline and creating open-
22 air leisure areas are paying back in terms of improving quality of life and as such
23 residential satisfaction of residents, by allowing them to enjoy the above average number
24 of days with good weather and hours of light when compared with cities of Northern
25 Europe. This result also differs from assessments of residential satisfaction in deprived
26 areas, and reinforces the argument that shrinkage and decay contexts are not similar. In
27 contrast, those inhabitants that do not value city safety and the closeness to schools (node
28 6) are less satisfied with their city (33%), and are mostly older citizens (Table 3).
29 Furthermore, residents who reported feeling mainly satisfied with their city of residence
30 (node 8) also prefer the city to regain inhabitants, whereas mainly dissatisfied residents
31 (node 6) desire the population to stay the same (28%) or to decrease further (10%).

32 It is worth noting that only 11% of the respondents in the sample indicated that a city's
33 sense of safety was not important to their assessment of residential satisfaction (node 2).
34 Citizens in such circumstances can become accustomed to the occurrence of crime, and

thus become less responsive to it (Parkes et al. 2002; Bonaiuto et al. 2004). Further, only 4% of residents surveyed do not consider the proximity to schools to be important for the assessment of residential satisfaction (node 6) (Figure 1). The majority of inhabitants in node 6 are older citizens and have lived longer in the city (Table 3), supporting previous findings that age and the length of residence can explain residential dissatisfaction (Lu 1999; Aiello et al. 2010). Moreover, because inhabitants in node 6 are mainly retired citizens, there is a split between those who value and those who do not value the proximity to schools (a functional aspect), which is dependent on whether these citizens live nearby their family and/or are responsible for caring for their grandchildren (Gradstein and Kaganovich 2004; Strömberg 2006). Thirty-eight percent of the inhabitants in node 6 preferred their city to remain stable or even shrink, which is consistent with previous empirical studies reporting residential satisfaction in cities with fewer inhabitants (Delken, 2008; Hollander, 2011).

The cause of shrinkage has an impact on citizens' assessment of residential satisfaction, with the inhabitants of Barreiro, a former industrial city, being less satisfied by living in that city compared with the levels of residential satisfaction reported in the other three studied cities (Table 3). This is most likely connected to the deindustrialized profile of the city, with derelict industrial sites that attract vandalism constituting a source of displeasure to inhabitants. Such conditions are not found in the other three cities, none of which has been affected by deindustrialization: Peso da Régua has a beautiful landscape, Oporto has an internationally recognized heritage centre, and the layout and appearance of Moura benefits from being a small city.

The different results found for cities with contrasting causes of shrinkage suggests that the underlying reasons for the decline in population affect the way in which inhabitants perceive their city. Brownfields (vacant and derelict land and buildings), a common feature in old industrial cities, explain the lower satisfaction found in cities affected by deindustrialisation. Policy-makers should pay particular attention to cities that are shrinking as a result of economic transformation in order to avoid both a loss of social cohesion and an increase in the degree of deprivation and decay, which is not inevitably associated with population decline as verified in the other three case-study cities, each affected by a different cause (Peso da Régua – satellite effect, Oporto – suburbanisation, and Moura –severe climatic conditions).

The study of shrinking Portuguese cities presented here supports previous investigations that have found that gender (Bonaiuto et al. 1999; Oh 2003), education

level (Lu 1999; Oh 2003), homeownership (Ringel and Finkelstein 1991), and income (Mohan and Twigg 2007; Dassopoulos et al. 2012) do not explain residential satisfaction.

6. Conclusion

Shrinking cities represent a particular context for studying inhabitants' level of residential satisfaction. Contrary to what is usually predicted for cities facing population decline, citizens living in shrinking cities reveal satisfaction with their place of residence. Thus, a decline in the number of inhabitants does not necessarily mean a decrease in the level of satisfaction achieved from place of residence, meaning that there is a substantive difference in the assessment of residential satisfaction in an urban shrinkage context compared with an urban decay context. This result challenges the current paradigm of policy-makers that a city with a declining population is necessarily an unfavourable phenomenon.

A lower level of residential satisfaction with a shrinking city is only relevant for the case emerging from a process of deindustrialization, as in the case of Barreiro. Thus, this reason for shrinkage constitutes a specific shrinking city typology that requires special attention from policy-makers because of the high probability of the population loss being perpetuated and social problems being aggravated, as lower residential satisfaction is associated with a higher intention to move out compared with other cities where different reasons explain population loss.

A spatial aspect of the urban environment, namely, the sense of safety, emerges in shrinking cities as the main feature in explaining differences between inhabitants reporting to feel satisfied with their city and those who do not. Human aspects related to mutual aid and trust in neighbours also explain the level of residential satisfaction. By reinforcing social networks, the existence of spaces for the practice of outdoor sports (a functional aspect of a city) is revealed to improve the sense of belonging to a place and to decrease the perception of crime, thus increasing the level of residential satisfaction.

Age and length of residence were the two socio-demographic variables found to be relevant in explaining different cities' features that influence inhabitants' assessment of residential satisfaction. An essential element of restricting a decline in population is to ensure the residential satisfaction of the cities' younger inhabitants. The results demonstrate that safety, social trust, and neighbourly cooperation, along with good outside sports areas, assist in attaining such a goal. Accordingly, policies should be oriented towards reducing the perception of decay in a place (which augments the sense

of insecurity), towards the revitalisation and rehabilitation of abandoned houses and degraded neighbourhoods, and towards the maintenance of open spaces to reduce feelings of constriction in the built urban environment and to promote healthier life-styles.

An important conclusion of this study is that the majority (78%) of the predominantly satisfied inhabitants state a preference for their city to increase in population, which means that most citizens living in shrinking cities have not yet accepted shrinkage; this is helping to reinforce the prevalence of growth-oriented policies generally adopted by policy-makers. Because population decline will become more acute in Portuguese cities, given the demographic trends related to the decreasing fertility rate and higher emigration caused by the ongoing economic crisis, the stated desire for city populations to return to past figures is unrealistic. The low level of awareness of shrinkage shown by the inhabitants of shrinking Portuguese cities implies an urgent need for further dissemination of information about the issue by the media, as well as more research on the phenomenon and processes of shrinkage.

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