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Quality of Life in Buenos Aires Neighborhoods: Hedonic Price Regressions and the Life Satisfaction Approach

by

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Abstract*

This paper studies quality of life in urban neighborhoods in the Buenos Aires Metropolitan Area. First, hedonic price regressions for residential prices are augmented with neighborhood characteristics, based on a real estate database with indicators on each property's distance to public facilities and amenities, and on a smaller survey with greater detail. Second, following recent developments in the field of happiness research, the document assesses the importance of different neighborhood characteristics on quality of life by interacting objective and subjective indicators. Indices of quality of life related to local amenities are derived for the different neighborhoods for both the hedonic regression and life satisfaction approaches. The results indicate a strong but not perfect correlation between real estate prices, income levels and neighborhood characteristics, suggesting scope for welfare-improving policy interventions.

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1. Introduction

The purpose of this study is to provide indicators of quality of life for urban neighborhoods and their determinants in the Buenos Aires Metropolitan Area (AMBA). The disparities in indicators related to living standards and their spatial pattern, which constitute some of the salient features of the Buenos Aires Metropolitan Area, provide the main motivation for this study. While geographical characteristics, such as slopes, rivers and hills, constitute natural boundaries that shape the patterns in other cities in Latin America, the AMBA spatial configuration stems mostly from historic, political and economic factors. Moreover, the overlapping of government jurisdictions and policy responsibilities, and the limited presence of “metropolitan” authorities generate severe coordination problems in policymaking at the urban level, while the overlapping of revenue sources produces important cooperation problems. These characteristics make the Buenos Aires Metropolitan Area an interesting case study for the interaction between urban public policy and quality of life. The analysis presented in the following pages is thus mostly related to areas relevant for quality of life that can be influenced through policy, such as urban infrastructure, service delivery and availability, and crime, among others.

Quality of life is, by definition, a multidimensional concept. The challenge of providing sub-city specific indicators thus resides in the aggregation of measures of living standards and amenities availability. A contribution of this paper is to analyze and compare quality of life indices derived from two alternative methodologies. On the one hand, the analysis follows the urban economics literature by deriving the implicit market valuation of neighborhood amenities through augmented hedonic regressions of property prices. On the other hand, the paper also develops an original extension of the life satisfaction approach, which derives the implicit valuation of public goods and externalities from subjective questions. In this case, the life satisfaction approach is applied to the valuation of neighborhood amenities and characteristics. While the real estate price data necessary for the hedonic price regressions of the first approach is usually available, the second perspective is more demanding since it relies on objective characteristics and subjective evaluations of neighborhoods. The second contribution of this paper is the presentation of the Neighborhood Quality of Life Survey (NQLS), a study carried out in the context of this project which was designed to collect information on a wide range of subjects related to the respondent’s neighborhood, her satisfaction with life, and household and dwelling characteristics, among other information.

The paper is organized as follows. Section 2 provides background information on the Buenos Aires Metropolitan area, and it introduces the two main data sources to be used in the quality of life analysis, the City of Buenos Aires Real Estate database and the Neighborhood Quality of Life Survey.

Section 3 carries out a descriptive analysis of the Metropolitan Area, focusing specifically on the heterogeneity and geographical dispersion of different indicators of socioeconomic outcomes, public service provision and real estate pricing, among others. The evidence on correlations between sub-city socioeconomic level, subjective well-being, satisfaction with one's neighborhood, and objective and subjective indicators of neighborhoods' characteristics motivates the analysis in the following sections.

Section 4 presents the analysis of sub-city quality of life based on hedonic price regressions augmented by neighborhood amenities and characteristics. The first part of the analysis is based on a large sample of selling prices of properties collected by the city's government in 2006, which contains a series of indicators on each property's distance to public facilities and amenities. The second part of this analysis is based on a smaller but more detailed sample from the NQLS, including objective and subjective evaluations of neighborhood characteristics. For both datasets, the impact of the neighborhood characteristics on property prices is analyzed, and indices of neighborhood quality of life derived and compared.

Section 5 studies the relationship of quality of life with subjective and objective evaluations of local amenities and infrastructure. The analysis in this section follows recent developments in the fields of happiness research, and attempts to determine the importance of different neighborhood characteristics on quality of life by interacting objective and subjective indicators. Two alternative indices of neighborhood quality of life are derived from these results.

Finally, Section 6 presents a brief overview of the results, comparing the hedonic regression and life satisfaction approaches, and provides some concluding comments

2. The Buenos Aires Metropolitan Area and Data Sources for this Study

2.1 The Buenos Aires Metropolitan Area

Buenos Aires was founded in colonial times by the Spanish, on mainly flat land on the shore of the Río de La Plata. It evolved as Argentina's main trading port, its financial and economic centre and its political capital. The city expanded and absorbed neighboring localities, and it currently represents the largest urban agglomeration in the country, with almost one third of the total population. As in many large cities, the boundary of the municipal authority does not reflect the whole area of influence which is part of the same urban area. The "Autonomous City of Buenos Aires" (CABA, for its initials in Spanish) is the federal district, capital of Argentina, with clearly delimited boundaries. While it is not straightforward to define the precise boundaries of the whole urban area, Figure 2.1 presents the contiguous urbanized area considered by the national statistical institute (INDEC, 2003) as the "Greater Buenos Aires Agglomerate" ("Aglomerado Gran Buenos Aires") in 2001, which covers CABA and parts or all of 30 surrounding municipalities (or "partidos") in Buenos Aires Province. Most of the available indicators for the whole urban area, however, were compiled for the Greater Buenos Aires, a set comprised by the CABA and the 24 surrounding municipalities with most of their population within the contiguous urbanized area in Figure 2.1 , usually referred to as the "partidos del Gran Buenos Aires" (PGBA).[1] While using the official terminology when citing data sources, this document will refer to the Buenos Aires Metropolitan Area (AMBA, for its initials in Spanish), as a heuristic term which corresponds, roughly, to the definition of the "Greater Buenos Aires Agglomerate," but accounting for the fact that the urban area is "constantly evolving" (INDEC, 2003). According to the 2001 census, the total population of the Greater Buenos Aires (the City and 24 municipalities) amounted to 11,430,000, with 2,770,000 in the CABA.[2] Estimates for mid-2007 indicated a total of about 12,370,000 inhabitants, with just over 3 million in CABA. These figures make the Buenos Aires Metropolitan Area the third largest urban area in Latin America, after Mexico City and Sao Paolo.

Regarding its government, the urban area is divided into multiple municipal authorities, and AMBA lacks a centralized government or major public policy coordination body among the different municipalities and levels of government involved. The "Autonomous City" (CABA) is,

[1] The maps corresponding to these different definitions are provided in the accompanying Data Appendix.
[2] Taking into account the contiguous urbanized area, the total population amounted to 12,045,000 in 2001.

at the same time, the federal capital of Argentina and an autonomous sub-national jurisdiction analogous to a province. Consequently, two levels of government coexist within the city: the sub-national (the "Gobierno de la Ciudad"-GCBA) and the national or federal. The 24 municipalities of the Greater Buenos Aires are part of the Province of Buenos Aires and have thus two levels of government that share policy responsibilities: the provincial government, and the municipalities. For historical reasons,[3] the federal government retains the control over the whole AMBA's fundamental urban policy, such as transport, the police, and port authority, among many others. Responsibility for urban policy is thus dispersed into multiple municipalities (CABA and the "partidos") and at least four levels of government—the national or federal government, the CABA government, the Buenos Aires Province government and the municipal governments ("partidos"). Among many other consequences, this fragmentation of responsibilities implies that there is relatively little comparable geographical and socioeconomic information available for the whole metropolitan area.[4]

2.2 The City of Buenos Aires Real Estate Database

Hedonic price regressions are one of the two alternative approaches to the analysis of neighborhood quality of life developed in this paper. One of the two datasets employed for this purpose on Section 4 is the City of Buenos Aires Real Estate database, collected by the Statistical and Territorial Analysis Unit of the City's government. The dataset contains prices and characteristics for 2,090 houses and 3,448 apartments in November 2006. Each observation was geo-referenced to compute the distance to different facilities.

The data contains two main groups of variables. The first group is the set of housing characteristics, which include information about location, lot size, number of bedrooms, number of rooms, age of the building, bathrooms, and garage, among other features. The second group of variables corresponds to the distance of each property to the center of Buenos Aires and to a series of different facilities: the nearest avenue, school, green areas, freeway, subway station and train station. The summary statistics for the sample are described in Section 4.

[3] The city of Buenos Aires only gained its autonomy with the 1994 Constitutional Reform, but the national government retained power over some key public policy areas.
[4] The "Ciudad Autónoma de Buenos Aires" has a statistical directorate that carries out a series of periodical data collection exercises, ranging from quarterly real estate prices to annual household surveys, although these relatively abundant statistics are not all aggregated at the same level or for the same non-overlapping sub-city units. The appendix of the original proposal for this project contains a series of maps and a brief description of these different sub-city units and their origins.

2.3 The Neighborhood Quality of Life Survey: Sample Selection and Survey Design

The objective of the current study is the evaluation of quality of life in urban neighborhoods, focusing on the interaction of subjective evaluations of living conditions and objective indicators of amenities and service availability. With these multiple purposes in mind, the Neighborhood Quality of Life Survey (NQLS) was designed as a two step data collection process, comprising a household survey and a geographical module with objective indicators collected at the street level.[5] The sample size necessary for attaining a level of representativeness for relevant sub-city levels in the whole Buenos Aires Metropolitan Area (with 12 million inhabitants), or even within the City of Buenos Aires (3 million), was, however, beyond the resources available to this project. The data collection effort was thus conceived as a pilot to be applied only to four selected neighborhoods. The advantage of concentrating in only a few areas is that the team applied a longer household questionnaire and collected more infrastructure data than what would have been the case in a larger study. This rich dataset helps highlight the salient variables and indicators for the computation of quality of life indicators at a sub-city level which should be included in an eventual large-scale deployment.

The high degree of heterogeneity and spatial segregation of the Buenos Aires Metropolitan Area implies strong differences between the City of Buenos Aires and the surrounding municipalities, the "partidos del Conurbano" or Conurbano (these differences are analyzed in detail in Section 3 below). Moreover, there is a greater availability of indicators from secondary sources for the City of Buenos Aires, which has its own official statistics department. The availability of data sources and the difficulties in obtaining a representative sample for the whole Metropolitan Area implied that the four areas selected for the NQLS should be selected to approximate the characteristics of the population of the City of Buenos Aires.

The selected areas are relatively small (roughly one square kilometer, 9x9 or 10x10 blocks),[6] and they all lie within well-defined neighborhoods, so that all interviewees within an

[5] The complete questionnaire for the household survey and the neighborhood characteristics and urban infrastructure input sheet for the geographical component are included in the data appendix to this report.

[6] For further details on these areas and their characteristics, the reader is referred to the Data Appendix, a companion to this document. This appendix contains a map of each of the four selected neighborhoods, depicting the average levels of education in the corresponding census radii, and a table with the distribution of education levels in each selected area according to the 2001 census. It also contains an analysis of the ex ante representativeness of the sample for the City of Buenos Aires.

area have the same reference point when asked about their neighborhood.[7] Three of the selected areas are in the City of Buenos Aires (Caballito, Palermo and San Cristóbal). The fourth area, Avellaneda, belongs to a bordering municipality in Greater Buenos Aires, and its population has characteristics similar to those of the City's population. Its inclusion permits the incorporation of residents from the Conurbano while maintaining a representative sample of the City's population.

The four areas were selected to match, on average, the distribution of education for the City. Palermo represents the area with the highest socioeconomic level, as proxied by the relatively high proportion of residents with some higher education. The area of Caballito also has residents with education levels above the City's average, and thus it represents a relatively high socioeconomic status neighborhood. Finally, San Cristóbal and Avellaneda were selected to represent neighborhoods with low socioeconomic levels at the City level.[8]

For the household component of the survey, about 250 interviews were carried out in each neighborhood in November 2007, with cases selected according to a random walk methodology. The survey was directed at decision-makers in the household—those more likely to make location choices, and pay rent and property taxes—and thus the interviews only included heads of household or their spouses.

A separate team of geographers collected indicators for each block in the selected areas. These indicators included, for instance, the number of trees, lampposts and traffic lights, as well as the availability of shops, public transport and others. This data was geo-referenced and matched to the household surveys by block of residence, although the indicators were collected for all the blocks in the area, irrespective of whether any household in the block was interviewed.[9] Section 3 studies these indicators in depth.

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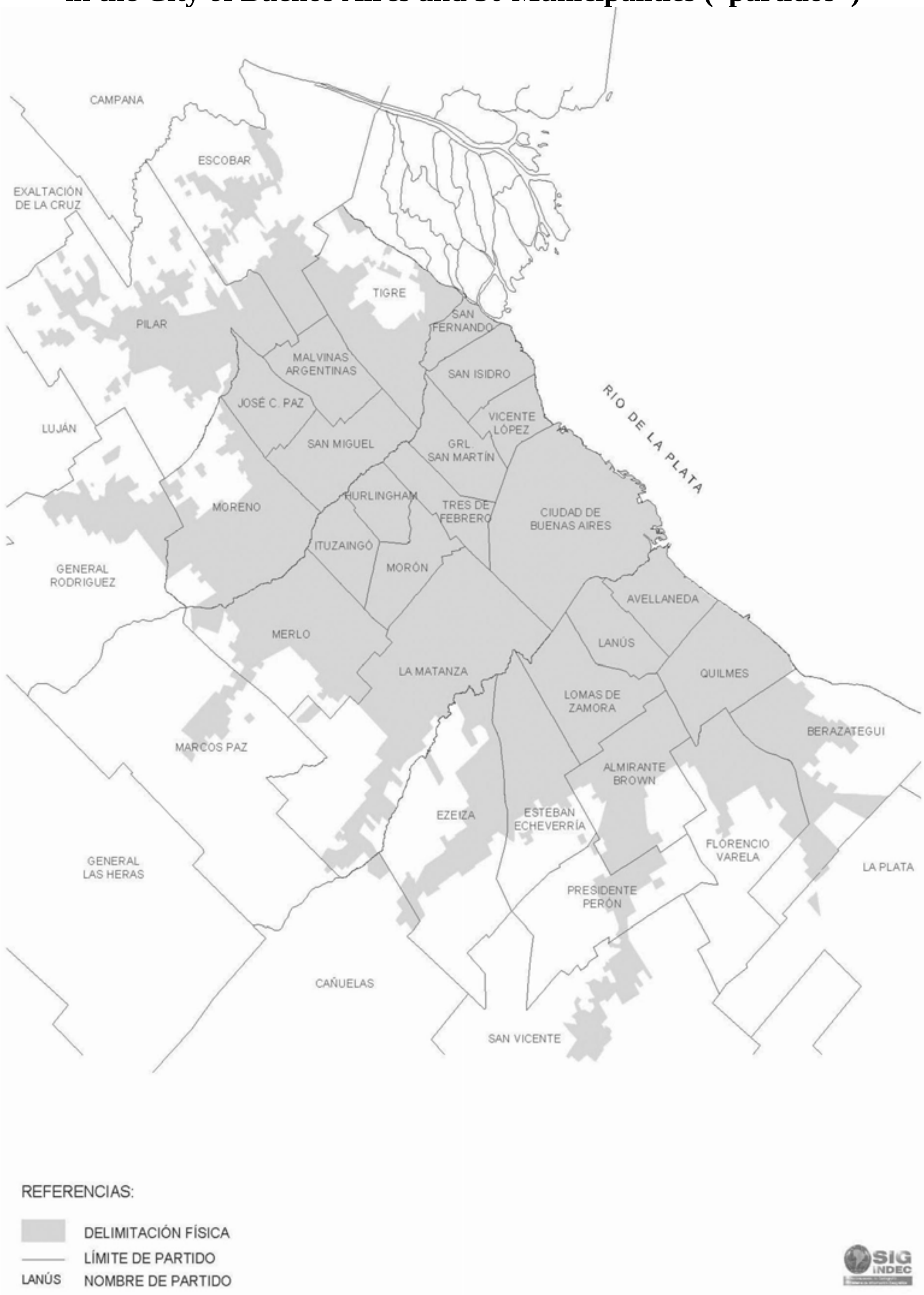
[7] For convenience, the rest of this document will simply refer to "neighborhoods", although the NQLS was carried out in these smaller areas within the actual neighborhoods.

[8] Avellaneda, just south of the City of Buenos Aires, belongs to the first ring ("primer cordón") of the Conurbano. In terms of the education levels of its population, Avellaneda is atypical in comparison to the rest of the Conurbano: it is more akin to the poorer areas in the City of Buenos Aires. A related survey with a subset of the indicators collected for these four neighborhoods was carried out by the team in Cuartel Quinto, Moreno, in the second (outer) ring. This area represents the lowest socioeconomic status in the whole Metropolitan Area. See the Data Appendix for a brief comparison of the main indicators between the five areas.

[9] Buenos Aires's streets follow mostly a grid pattern. A total of 712 blocks were included in the geographical module. There were household surveys in 228 of those—4.3 per block on average, with a maximum of 23 in a single block.

The following section presents a descriptive analysis of heterogeneities in the Buenos Aires Metropolitan area, based on Census data and on NQLS indicators of neighborhood household characteristics, subjective evaluations and urban infrastructure.

Figure 1. Greater Buenos Aires Agglomeration: Contiguous Urbanized Area in the City of Buenos Aires and 30 Municipalities ("partidos")



Source: INDEC (2003).

3. Quality of Life Heterogeneity in the Buenos Aires Metropolitan Area

3.1 The City of Buenos Aires and the "Conurbano": Heterogeneity at the Metropolitan Level

This section presents background information on the Buenos Aires Metropolitan Area, focusing specifically on the heterogeneity and geographical dispersion of different indicators of socioeconomic outcomes, public service provision and real estate pricing. The analysis relies on multiple sources of information covering different geographical aggregates; as discussed above, the fragmentation of government responsibilities over the metropolitan area limits the availability of aggregate and comparable indicators.

The available socioeconomic indicators for the whole Buenos Aires Metropolitan Area originate in the 2001 Census. These indicators reflect Argentina's high levels of inequality at the national level. AMBA presents important disparities in living standards and socioeconomic outcomes by neighborhood and other sub-city areas, a relatively common occurrence in large cities in developing countries,[10] where it is not unusual for affluent areas and slums with low-quality housing and limited or no access to public services to grow side by side. Different aspects of this heterogeneity can be illustrated by means of the available data sources. Figure 2 depicts the proportion of the population with a completed university degree by census radius (a sub-neighborhood level aggregate which represents roughly four high population density blocks within a city) in 2001 for the City of Buenos Aires and the 24 "partidos del Gran Buenos Aires." It is apparent from this figure that within a limited geographical space there are adjacent areas with 25 to 50 percent of its population with a university degree, next to areas with significantly lower levels of the same indicator. Similar patterns emerge from the analysis of the spatial distribution of other educational indicators, such as illiteracy and lower levels of schooling attainment.

Besides the presence of marked within-city disparities, Figure 2 also provides evidence of a strong spatial pattern for the educational outcomes of the inhabitants. Highly educated residents tend to concentrate in the northern half of the City of Buenos Aires and in the three municipalities north of it, which constitute the so-called "corredor norte" (north corridor). It is also possible to observe in Figure 2 a series of rays corresponding to areas with relatively high

[10] Although there are also cases in the recent past of major disparities in living standards in neighboring areas in developed countries, such as the contrast between Harlem and the Upper West Side in Manhattan, or the City of London and deprived neighborhoods of East London.

concentrations of residents with higher education going from the center (the CABA) to the periphery. These rays correspond mainly to the old suburban railway lines and to the highways along which a series of gated communities have developed in the last three decades.

Based on these indicators, AMBA corresponds to a special pattern of central district areas (in this case, the north half of the CABA) with higher socioeconomic levels (as proxied by education) and a relatively less well-off periphery, although with some heterogeneity due to the "rays" and the north corridor.

This pattern emerges clearly from Table 1, which presents the proportion of the population by maximum educational attainment for the City of Buenos Aires and for the 24 municipalities surrounding the city which are part of the "partidos del Gran Buenos Aires." The center-periphery pattern is indeed very strong, with almost one third of the population with some further education in the City of Buenos Aires and only 5 percent with less than primary complete, while in the municipalities of the greater metropolitan area these figures are 14.4 and 19.6 percent, respectively. The contrast is even starker between the City and the first and second areas (or concentric rings—"cordones") in which these municipalities have been traditionally divided.[11]

The disparity of educational attainment and its spatial pattern is also present in other socioeconomic outcomes. Figure 3 presents evidence, also from the 2001 Census, on differential access to public services: while access to water from the public network is relatively high for the whole AMBA (84 to 100 percent), there are still important pockets where more than 10 percent of households are not connected, mostly in the urban outskirts. However, there are also some poorly covered areas within the City of Buenos Aires, corresponding to some of the city's slums (or "villas miseria"). The same pattern is apparent in Figure 4, which depicts the proportion of the population with at least one category of deficit in basic needs, a widely used measure of structural poverty with census data. In 2001, the outer area of the Greater Buenos Aires had by far the highest concentration of population in these conditions.

While data on other socioeconomic outcomes are not available for the whole metropolitan area, Figure 5 presents evidence on child mortality rates for 2006 for the City of Buenos Aires. The figure reveals strong differences in this indicator even within the relatively more affluent

[11] These "rings" correspond, roughly, to the inner and outer "partidos del Gran Buenos Aires". The first group includes the affluent north corridor municipalities, whose population has on average a high educational attainment. See INDEC (2003) for a definition of these two groupings.

City, with a clear spatial pattern with significantly higher levels child mortality rates in the south of the city.

Finally, Figure 6 presents information on another dimension of heterogeneity and geographical patterns, real estate prices of vacant land for AMBA. In broad terms, the same spatial pattern as with other indicators is observed, with higher property prices concentrated along the “corredor norte” and the main rays. However, the Figure also seems to suggest a well-known phenomenon in urban economics, the presence of higher prices near the centre. It is interesting to observe, for instance, that land south of the City of Buenos Aires, considered a lower level socioeconomic area, is still relatively expensive. This effect may be explained by its proximity to downtown Buenos Aires and the north corridor. The outer areas of Greater Buenos Aires, with the exception of a few pockets mostly along the rays, have significantly lower property prices.

These strong geographic patterns are not exclusive of socioeconomic outcomes and service availability. They are also evident in other characteristics, for instance in the urban infrastructure and in the levels of subjective satisfaction with different aspects of life in the population, as discussed below for a subsample of the metropolitan area drawn from the Neighborhood Quality of Life Survey.

3.2 Neighborhood Heterogeneity: Results from the NQLS

3.2.1 Household, Respondent and Dwelling Characteristics

As discussed in Section 2 above, the NQLS included a detailed questionnaire on objective and subjective indicators of quality of life at the sub-city level. The data gathered by this study provide further indicators of heterogeneity in living standards and neighborhood amenities within the Buenos Aires Metropolitan Area.

The survey covered four neighborhoods, which can be divided into two groups, one with higher than average (Caballito and Palermo) and one with lower than average (Avellaneda and San Cristóbal) levels of education among their residents, according to the results of the 2001 census for the City of Buenos Aires. The original ranking of neighborhoods by average education level resulted in the following order (from highest to lowest): Palermo, Caballito, San Cristóbal and Avellaneda. It should be noted, however, that the differences between the first and the second, and between the third and the fourth, are relatively small and might not be accurately captured in the resulting samples.

The household and respondent characteristics presented in the top panel of Table 1 confirm the validity of the survey's sampling criterion, and the heterogeneity of Buenos Aires neighborhoods. Avellaneda has the highest proportion of respondents with only some primary education (9 percent), followed by San Cristóbal (8 percent), Caballito (6 percent) and Palermo (5 percent), while Palermo has by far the highest level of respondents with some tertiary education (71 percent), followed by Caballito (60 percent), Avellaneda (55 percent) and San Cristóbal (45 percent).[12]

Moreover, the households in the two neighborhoods with higher levels of education, Caballito and Palermo, have higher total household income and per capita income than those in Avellaneda and San Cristóbal. While total income is higher in Avellaneda than in San Cristóbal, the former's larger average household size (and higher number of children per household) implies a reversal in the ordering in terms of per capita income between the two. The differences are sizeable, with Palermo's household per capita income more than 60 percent higher than that of Avellaneda.

The average age of the respondents was 44.2, lower than average in Palermo and Caballito and higher than average in San Cristóbal and Avellaneda. Just less than half of the respondents were male, and about 57 percent were heads of households (the differences do not appear to be significant by neighborhood). The variables on the individual and household characteristics in the top panel of Table 2 will be referred to in the regression analysis of Section 5 as the "X variables."

The bottom panel of Table 2 presents a series of housing and dwelling characteristics, and correspond to the "HC variables" in the regression analysis below. Respondents are much more likely to live in houses than apartments in Avellaneda than in the three neighborhoods within the City of Buenos Aires (78 percent versus 27 percent), and these appear to be larger than in the City, with a higher average number of bathrooms and bedrooms and a higher prevalence of garages and gardens. There also seems to be a relatively higher proportion of homeowners among the Avellaneda respondents (65 percent) than among those in the other neighborhoods

[12] The tables in the data appendix correspond to the whole adult population of the neighborhood from the 2001 census. The education levels in the sample are higher because only household heads or their spouses were interviewed. The ranking, however, is still remarkably similar between the census and the survey.

(about 56 percent). Rental prices are highest in Palermo, followed by Caballito, Avellaneda and San Cristóbal, and the same ranking (although with consistently higher values) is obtained when comparing the estimated rent that owners believe they would get for their property. Respondents in Avellaneda have been living in the same neighborhood for 20.7 years, significantly longer than those in the other areas. Finally, respondents in the two poorer areas report a significantly higher desire to change neighborhoods (20 percent versus 14 percent, approximately) when "satisfied with the neighborhood" is the alternative.

As expected from the sample selection process, these characteristics signal the presence of two relatively affluent and high density central neighborhoods, Palermo and Caballito, one central and high density neighborhood with lower socioeconomic levels (San Cristóbal), and a more suburban and less dense neighborhood with lower socioeconomic levels (Avellaneda).

3.2.2 Satisfaction with Different Life Domains

The Neighborhood Quality of Life Survey also collected extensive information on general life satisfaction and subjective satisfaction with a series of life domains. The results from these questions also point to specific patterns among the four selected neighborhoods.

The neighborhood average levels of these questions, on a 1 to 10 scale, are presented in Table 3.3.[13] In line with results from the happiness literature (Di Tella and McCulloch, 2006; Layard, 2005), residents in the two more affluent neighborhoods report significantly higher levels of general life satisfaction than those in the two worse-off areas, although it should be noted that within those two groups Caballito fares slightly better than Palermo and Avellaneda slightly worse than San Cristóbal. The second line in Table 3 presents the levels of another key indicator from the perspective of this paper, the level of satisfaction with quality of life in the neighborhood. Caballito again scores higher when considering the average level of responses, followed closely by Palermo (the difference is not significant) and then by Avellaneda and San Cristóbal, the latter with a significantly lower level than the other three. The ranking is similar for other variables, such as satisfaction with one's own economic situation. The analysis of the other domains presented in the table indicates that, with the exception of satisfaction with friends, where San Cristóbal ranks highest, the lowest levels of satisfaction are in one of the two

[13] In the regression analysis below, the general life satisfaction variable is referred to as GS, the neighborhood quality of life satisfaction variable is NS, and the other life domain satisfaction are referred to collectively as the DS variables.

poorer neighborhoods, and the higher levels in one of the two richest. The following pages attempt to uncover whether there are any significant differences in neighborhood characteristics that can account for the differences in the subjective evaluation of quality of life by area, and Section 5 attempts to establish whether the apparent relationship between quality of life and life satisfaction at the neighborhood level holds in the context of a multivariate analysis at the individual level.

3.2.3 Neighborhood Characteristics: Subjective Evaluation and Objective Indicators

The results by neighborhood, so far, indicate the presence of two distinct sets of areas, two where the rent is higher and residents have higher incomes, higher education levels and higher degrees of satisfaction with their lives and their neighborhoods, and two areas with lower levels of all these indicators. The evidence presented in Tables 4-6 sheds some light on differences in neighborhood characteristics that might explain this polarization.

Table 4 presents a set of in-depth subjective evaluations of neighborhood characteristics relevant for urban quality of life.[14] As in Table 3, the answers are on a 1-10 scale, comprising areas such as sidewalk and street conditions, cleanliness, forestation, security, green areas and cultural activities, among others. The same clear pattern of two distinct groups of neighborhoods emerges, as in previous tables. Considering the average evaluation of these 14 aspects, San Cristóbal and Avellaneda have similarly lower levels than Palermo and Caballito (although the latter has a significantly higher level than Palermo). Neighbors of the better-off areas of the city thus have a higher evaluation of these important aspects of public goods and services than those in worse-off areas. The evaluations in Table 4, however, reflect both subjective satisfaction and objective availability of public goods and services. For instance, Palermo has some of the best and largest green areas in the whole Metropolitan Area, and it is thus not surprising that its residents report a higher level of satisfaction with this characteristic, while of the four neighborhoods Avellaneda is the most suburban and quiet, which is reflected in its residents' average evaluation of traffic, the highest of the four areas. On the other hand, the areas covered in the City of Buenos Aires (San Cristóbal, Palermo and Caballito) have undoubtedly higher availability of public transport than suburban Avellaneda, and nevertheless residents of

[14] These neighborhood evaluation variables correspond to the NE variables in the regression analysis below.

Avellaneda report the highest average evaluation for this aspect, reflecting perhaps its relatively privileged situation with respect to other Conurbano areas outside the City of Buenos Aires.

Table 5 presents the proportion of respondents in each neighborhood that report some problem or characteristic in their area.[15] Reports of annoying levels of noise vary greatly in the city. While Avellaneda seems to be by far the most quiet, at least according to its residents' evaluation, Caballito and San Cristóbal, the two densest areas, have significantly higher levels of reported annoying noise during the day and the night. Reported levels of pollution seem to be relatively high and stable across neighborhoods (around 57 percent of respondents reported them), but visual contamination is significantly higher in the neighborhoods in the City of Buenos Aires compared to Avellaneda. Drug dealing is significantly higher in the two poorest neighborhoods, with around 40 percent of respondents reporting it in Avellaneda and San Cristóbal, compared to 21 percent in Caballito and 24 percent in Palermo. Street prostitution is by far highest in San Cristóbal and lowest in suburban Avellaneda. The latter neighborhood has the highest reports of stray dogs and the lowest proportion of respondents stating that there are "abundant shops" in the area.

While the subjective evaluations of neighborhood characteristics in Table 5 seemed to be clear cut, with two low-evaluation and two high-evaluation neighborhoods, the problems reported by respondents in Table 6 show a mixed pattern. Table 6 in turn presents 21 indicators from the geographical module of the Neighborhood Quality of Life Survey, which was collected by a team independent from the household survey interviewers.[16] These indicators correspond to the average availability of different types of urban infrastructure by block, in the 228 blocks where at least one household survey was carried out.

The heterogeneity among neighborhoods in the indicators in Table 6 is greater than in the previous ones. Only a few of the indicators present the usual pattern. For instance, there are significantly more trees and plants per block, and significantly less broken pieces of sidewalk per block in Caballito and Palermo than in Avellaneda and San Cristóbal. Some of the differences in patterns are due to the fact that Avellaneda belongs to a different jurisdiction (outside the City of Buenos Aires) and has a significantly lower population density: for instance, there are significantly fewer tall buildings, signs of visual contamination, wooden rather than metal posts

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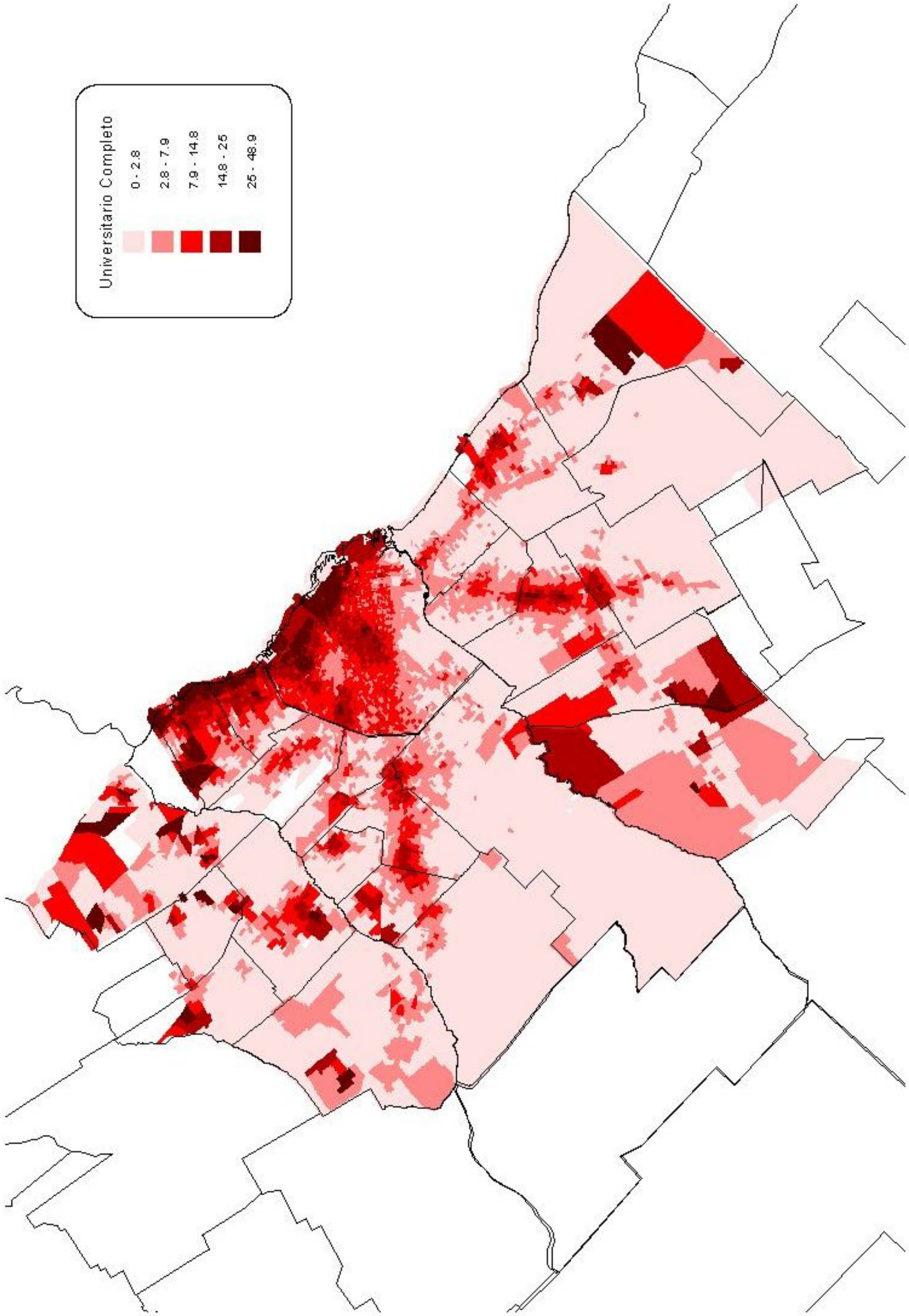
[15] These subjective evaluations of neighborhood characteristics correspond to the SC variables in the regression analysis below.

[16] These objective neighborhood characteristics correspond to the OC variables in the regression analysis below.

for street signs (not common within the City borders), payphones, estate agent signs and garbage bins and containers than in the other three areas, whereas within the City there are significantly more bins in Palermo and Caballito than in San Cristóbal. The relatively higher level of income of Palermo residents and its status as an entertainment area are reflected in some indicators, for instance, in the significantly higher number of leisure-related venues, signs of visual contamination and educational facilities per block. Other indicators single out the more commercial nature of Palermo and San Cristóbal with respect to the other two areas, for instance, the relatively higher number of commercial facilities and policemen on the beat per block. However, other urban characteristics and infrastructure elements do not seem to follow an unequivocal pattern: there are more street signs in corners in Avellaneda than in the other three neighborhoods, and there are more traffic signals ("red lights" in the tables) in Palermo and San Cristóbal than in Caballito (2.07 and 1.79 versus 1.09, respectively), the three areas with dense traffic (there are even fewer—0.5 per block on average—in suburban Avellaneda).

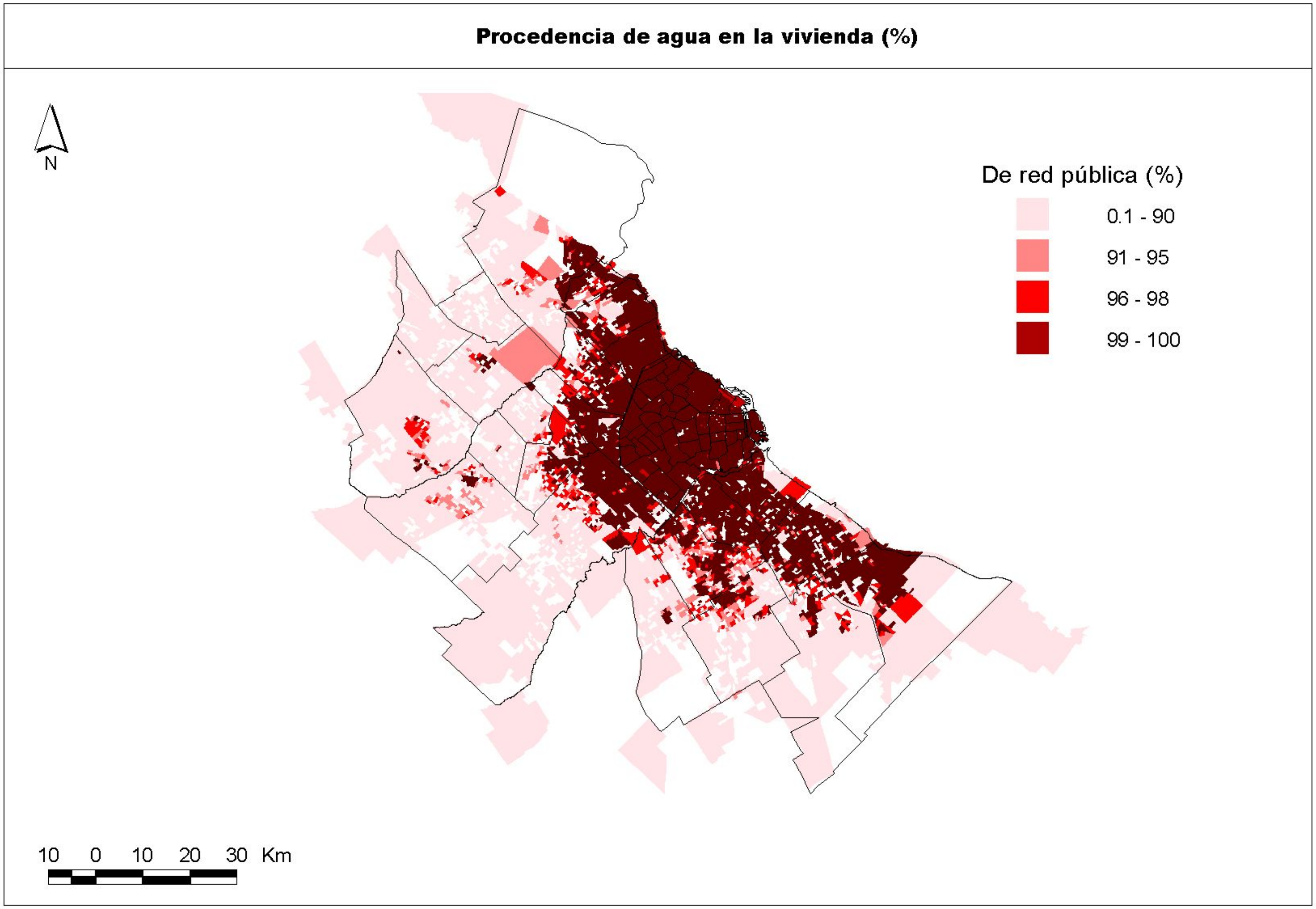
The rest of the paper will use the indicators presented in this section in a multivariate regression context to study urban quality of life through the relationship of neighborhood characteristics with property prices (Section 4) and with life satisfaction (Section 5).

Figure 2. Percentage of the Population with Complete University Studies by Census Radius, Greater Buenos Aires (City of Buenos Aires and 24 "partidos del conurbano"), 2001



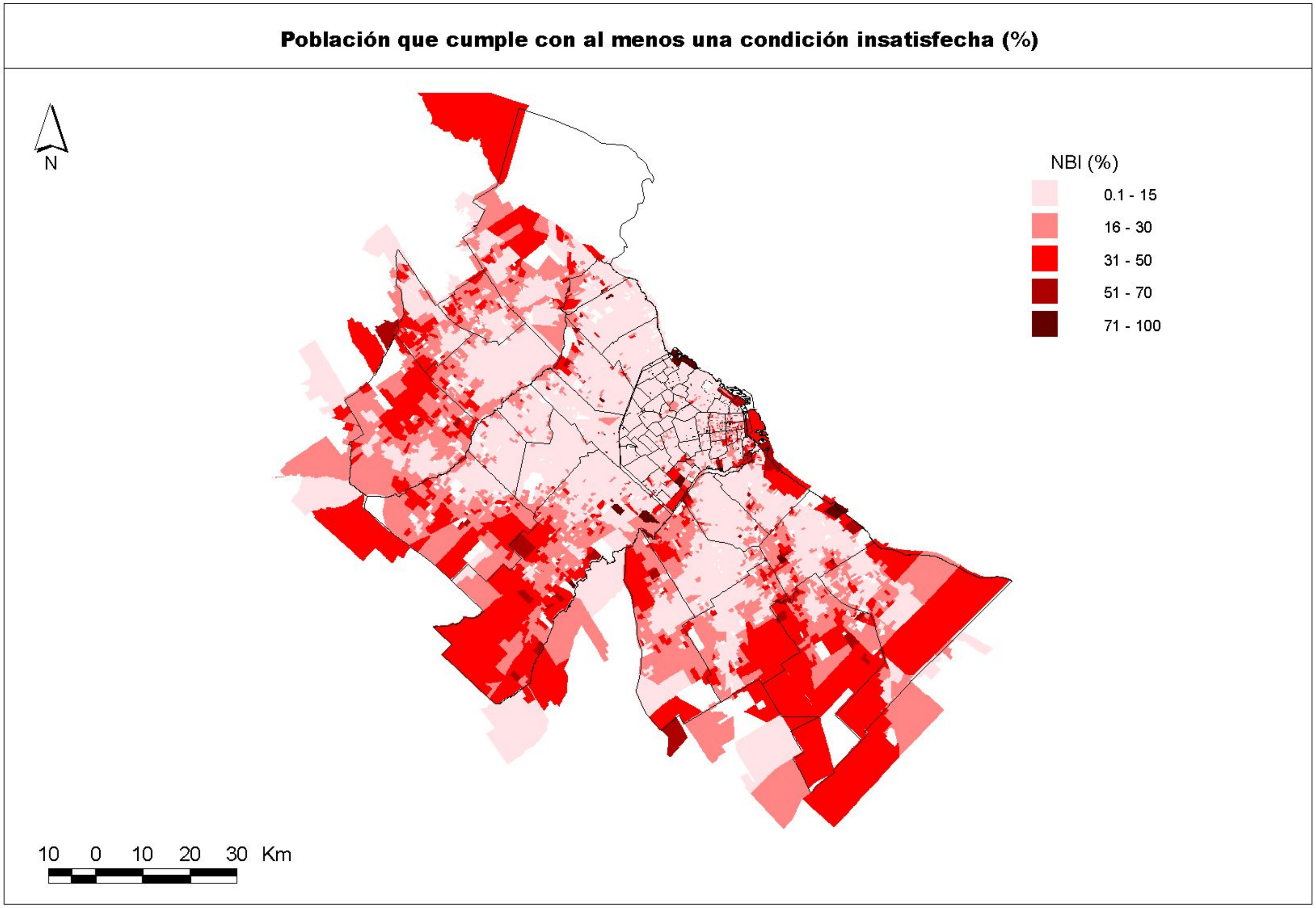
Source: Authors' calculations based on 2001 Census.

Figure 3. Percentage of Households with Water from Public Network by Census Radius, Greater Buenos Aires, 2001



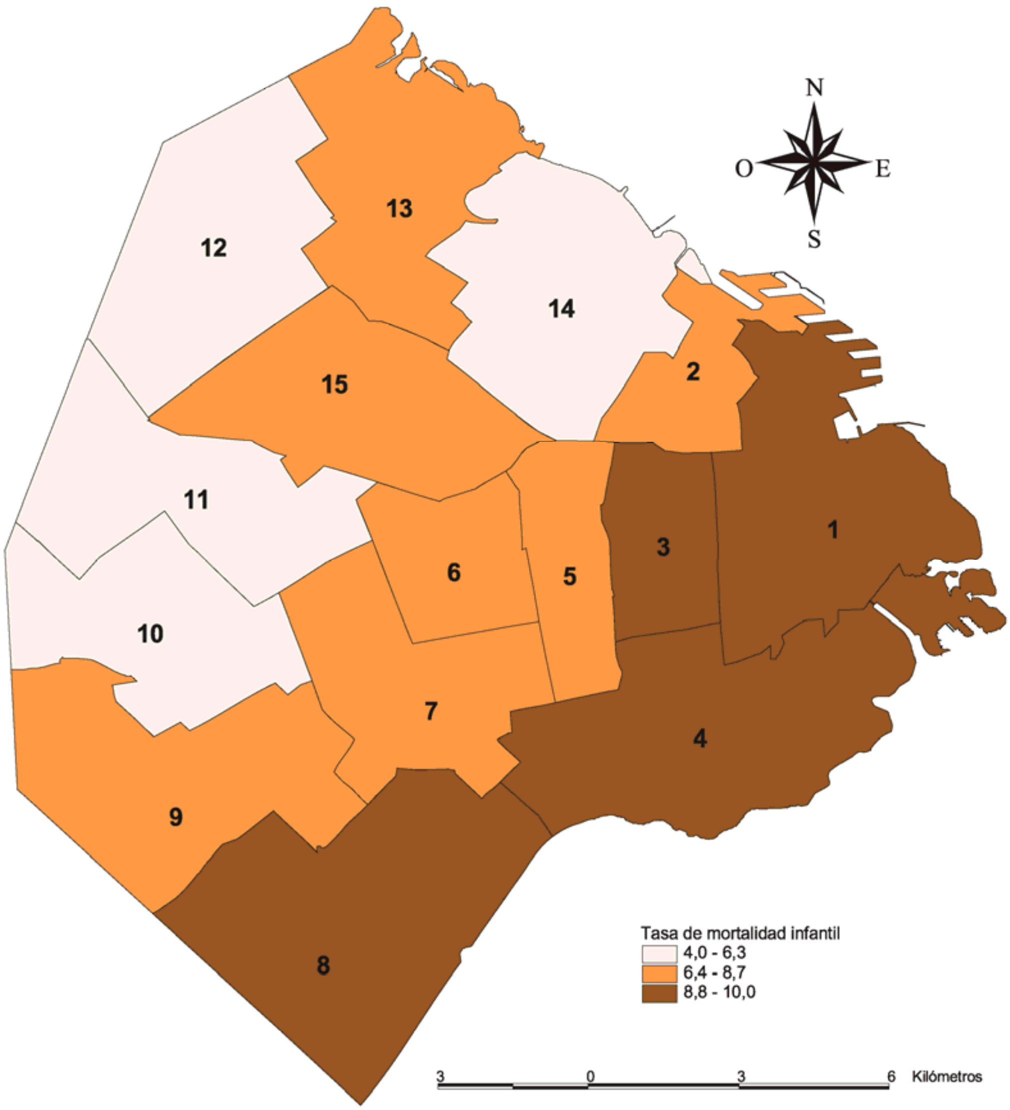
Source: Authors' calculations based on 2001 Census.

Figure 4. Percentage of the Population with at Least One Category of Basic Needs Deficit by Census Radius, Greater Buenos Aires 2001



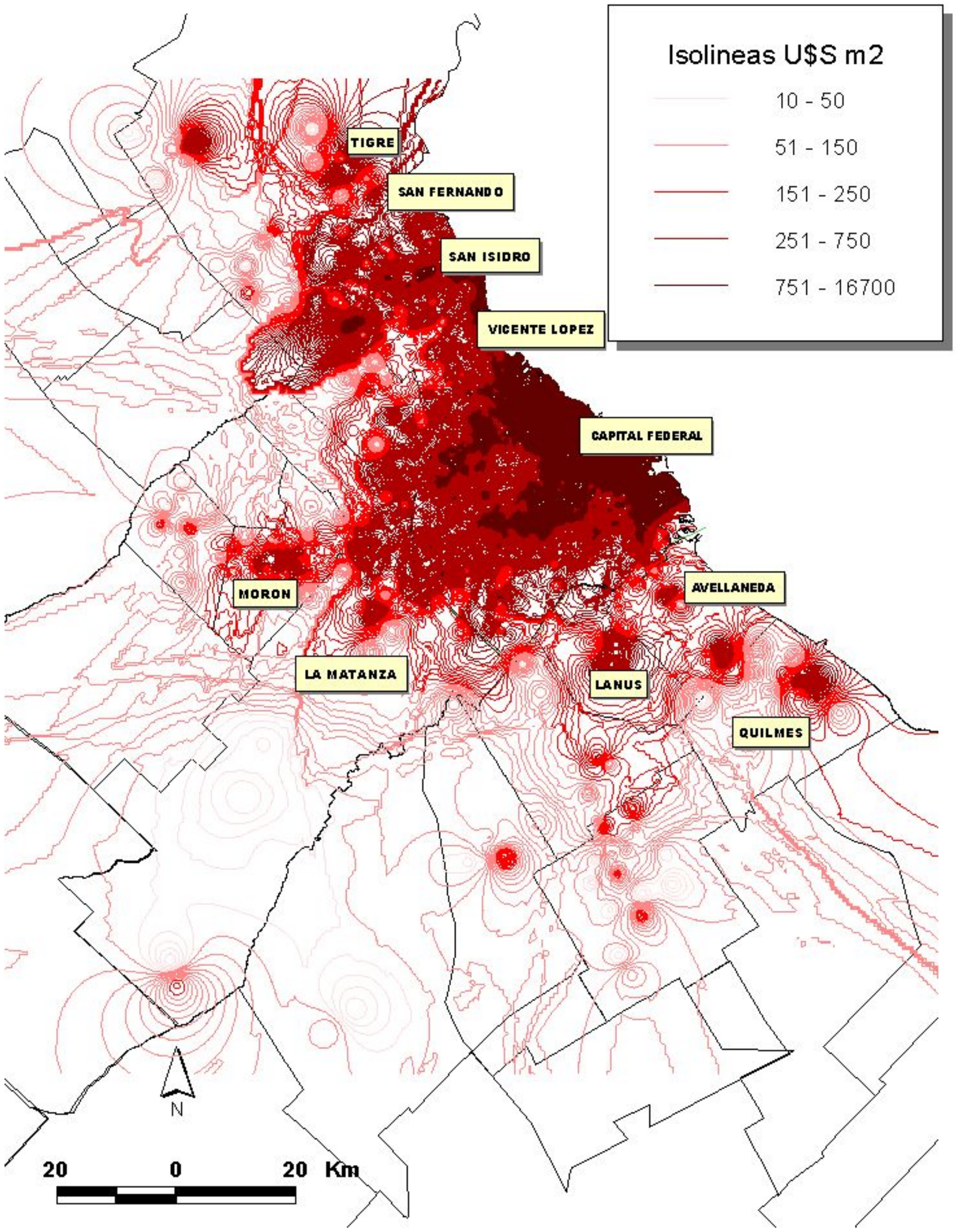
Source: Authors' calculations based on 2001 Census.

Figure 5. Child Mortality Rates by Administrative Area, City of Buenos Aires 2006.



Source: DGEC (2007).

Figure 6. Vacant Land Prices Isocost Lines, in US Dollars per Square Meter, Greater Buenos Aires 2006



Source: Authors' calculations from real estate data, Dirección General de Estadísticas y Censos, Gobierno de la Ciudad Autónoma de Buenos Aires.

Table 1. Educational Attainment, City of Buenos Aires and Greater Metropolitan Area, 2001

Educational attainment	CABA (Buenos Aires City)	"Conurbano" (greater metropolitan area)		
		Total	First area ("primer cordon")	Second area ("segundo cordon")
Primary (incomplete)	5.0	19.6	17.9	24.1
Primary (completed)	21.8	33.4	32.3	36.3
Secondary (incomplete)	14.1	16.2	15.9	16.9
Secondary (completed)	25.0	16.5	17.7	13.3
Tertiary (incomplete)	2.5	4.0	4.4	2.9
Tertiary (completed)	8.6	4.0	4.4	2.9
University (incomplete)	7.1	2.8	3.2	1.7
University (completed)	15.9	3.6	4.3	1.9
TOTAL	100.0	100.0	100.0	100.0

Source: Authors' calculations based on 2001 Census.

Table 2. NQLS Summary Statistics: Household, Respondent and Dwelling Characteristics (X and HC variables)

	Avellaneda	Caballito	Palermo	San Cristobal	Total
Household and respondent characteristics					
Age	45.8	43.0	41.9	45.9	44.2
Male respondent	0.49	0.46	0.47	0.49	0.48
Respondent is head of household	0.55	0.55	0.57	0.61	0.57
Some primary education	0.09	0.06	0.05	0.08	0.07
Some secondary education	0.34	0.30	0.23	0.43	0.33
Some tertiary education	0.55	0.60	0.71	0.45	0.58
Total household income (pesos)	2416	2621	2912	2197	2539
Per capita income	781	1145	1257	892	1012
Household size	3.62	2.87	2.81	2.99	3.08
Number of children	1.77	1.19	1.08	1.50	1.39
Dwelling characteristics					
Owns home	0.65	0.56	0.56	0.57	0.58
Rent for non-owners	1120	1220	1348	966	1164
Own estimate of rent for owners	833	1010	1064	749	924
Home with garden	0.53	0.23	0.31	0.22	0.32
Parking space-garage	0.47	0.29	0.28	0.10	0.29
Home is a house	0.78	0.17	0.36	0.29	0.40
Number of bathrooms/toilets	1.69	1.50	1.54	1.32	1.52
Number of bedrooms	3.02	2.59	2.61	2.63	2.72
Years in neighborhood	20.7	14.2	13.3	15.7	16.0
Thinks about moving (alternative: satisfied with neighborhood)	0.20	0.13	0.14	0.20	0.17

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 3. NQLS: General Life Satisfaction and Satisfaction with Life Domains on a 1-10 scale (GS, NS, DS variables)

	Avellaneda	Caballito	Palermo	San Cristobal	Total
General life satisfaction	7.59	8.00	7.88	7.68	7.79
Satisfaction with neighborhood quality of life	7.08	7.82	7.71	6.75	7.34
Satisfaction with own economic situation	6.99	7.23	7.26	6.68	7.04
Job satisfaction	7.88	7.93	8.27	8.04	8.03
Satisfaction with friends	8.76	9.02	9.05	9.03	8.96
Satisfaction with emotional life	7.94	8.07	8.10	7.85	7.99
Satisfaction with physical health	7.75	8.18	8.11	7.85	7.97
Satisfaction with mental health	7.99	8.16	8.20	7.90	8.06
Satisfaction with home	8.11	8.34	8.12	8.18	8.19
Simple average	7.79	8.08	8.08	7.77	7.93

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 4. NQLS: Subjective Evaluation of Neighborhood Characteristics on a 1-10 scale (NE variables)

	Avellaneda	Caballito	Palermo	San Cristobal	Total
Sidewalk conditions when raining	5.27	5.85	5.37	5.11	5.40
Conditions of pavement-streets	5.74	6.22	5.32	5.65	5.73
Street and sidewalk cleanliness	5.01	6.42	5.83	5.39	5.66
Sidewalk forestation	5.56	6.92	6.58	6.02	6.26
Garbage collection in neighborhood	6.42	7.47	6.95	7.06	6.97
Access to public transport	7.83	7.78	7.47	7.55	7.66
Cultural and sports activities in neighborhood	5.57	6.84	6.13	5.79	6.07
Amount and quality of green areas	5.12	7.07	7.28	5.96	6.36
Police performance in the neighborhood	4.61	5.70	5.88	5.25	5.35
Street and sidewalk lighting at night	6.62	6.81	6.70	6.14	6.57
Traffic in neighborhood	6.13	5.63	5.97	5.03	5.70
Security during the day	5.30	6.49	6.42	5.73	5.98
Security during the night	4.49	5.59	5.33	4.33	4.93
Evaluation of neighbors	7.59	7.77	7.38	7.22	7.49
Simple average	5.80	6.61	6.33	5.87	6.15

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 5. NQLS: Neighborhood Characteristics Indicators (proportion of respondents stating that a characteristic is present, SC variables)

	Avellaneda	Caballito	Palermo	San Cristobal	Total
Annoying noise during the day	0.23	0.49	0.32	0.48	0.38
Annoying noise during the night	0.17	0.28	0.23	0.30	0.24
Annoying noise during on weekends	0.17	0.23	0.25	0.23	0.22
Pollution	0.55	0.61	0.53	0.58	0.57
Visual contamination	0.24	0.42	0.37	0.36	0.35
Stray dogs	0.56	0.21	0.32	0.31	0.35
Beggars	0.54	0.61	0.50	0.59	0.56
Street prostitution	0.04	0.08	0.10	0.23	0.11
Drug dealing	0.42	0.21	0.24	0.39	0.32
Abundant shops	0.40	0.79	0.68	0.63	0.63

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 6. Neighborhood Characteristics per Block with Household Survey, Geographical Module (OC variables)

	Avellaneda	Caballito	Palermo	San Cristobal	Total
Trees and large plants	15.9	19.1	18.5	15.7	17.4
Wooden posts	12.1	0.20	0.90	1.20	3.44
Steel posts	0.76	5.53	7.36	4.47	4.60
Street lighs	3.69	4.43	3.72	2.99	3.73
Public transport stop	0.06	0.17	0.41	0.15	0.20
Garbage bins and containers	0.05	2.60	3.06	2.00	1.97
Policemen	0.00	0.06	0.13	0.13	0.08
Rubbish bags during the day	5.68	2.32	4.70	2.48	3.75
Broken sidewalk	7.06	1.60	2.71	5.99	4.23
Leisure-related venues	0.36	0.80	1.71	0.60	0.88
Residential units (houses, appartment blocks)	11.1	11.6	10.9	8.97	10.7
Tall buildings	0.53	6.95	6.23	6.21	5.07
Health facilities	0.01	0.09	0.18	0.02	0.07
Educational facilities	0.06	0.09	0.11	0.00	0.07
Commercial facilities	0.76	2.55	3.41	4.46	2.80
Parking lots	6.58	6.26	3.79	0.11	4.23
Visual contamination	6.15	2.66	4.89	2.63	4.04
Red lights	0.51	1.09	2.07	1.79	1.37
Payphones	0.13	0.32	0.39	0.29	0.28
Street name posts	2.02	1.35	1.71	1.70	1.68
Estate agent signs	0.34	0.60	0.56	0.61	0.53

Source: Authors' calculations based on Neighborhood Quality of Life Survey (geographical module).

4. Inferring Quality of Life at the Neighborhood Level from Hedonic Price Regressions

4.1 Quality of Life in Urban Economics

Urban economics has taken an increased interest in studying quality of life (QoL). There are two main reasons for this focus: on one hand, policy makers make decisions about environmental, social, and economic issues, which have direct impact over the population's QoL. Studying the differences between local, national or international locations thus allows identification of lagged regions, and serves as a basis to focalize investment and infrastructure spending. On the other hand, QoL is an important factor in determining location decisions of households and businesses.[17] These choices are seized in many cases by city officials to promote certain areas, seeking to attract individuals and investment. Therefore QoL not only has influence in where to live or invest, but also on patterns of urban growth and development.

In urban economics studies, quality of life is examined in an indirect way as a determinant of the urbanization process (particularly in growth, decline and competitiveness), while others favor a more direct approach. The purpose of the first strand of studies is to identify the factors that influence a city's capacity to attract population and economic activity, and considers QoL an indirect determinant in urbanization. This research has highlighted the importance of location-specific attributes in generating urban growth. Glaeser (1999) has also emphasized the role of several "non-market" forces including: information sharing among firms, human capital transfers among workers, peer effects, social capital, the formation of values, and the role of architecture in achieving urban growth. In other research, Glaeser, Kolko and Saiz (2001) focus on the role of urban amenities (viewed as a package of goods demanded by consumers of an urban space) in urban viability and growth.

Other strands of the urban economics literature consider QoL a direct determinant of the decision of where to buy or rent a house. These models follow a revealed preference approach: consumer preferences are estimated by observing their choices. Assuming rationality, consumers will choose to live in areas where they achieve their highest utility. Wall (2001) and Douglas (1997) developed a theoretical model where individuals, facing the possibility of moving to alternative locations, migrate if the perceived QoL (utility) of the alternative is greater than their actual location. Since QoL does not have a market price, a value has to be attached to it. This

[17] For instance, there are a number of city rankings based on diverse QoL indicators.

value is considered to be appropriately proxied by house prices and wages. Rosen (1974, 1979) defined the hedonic price method in order to calculate implicit prices of local attributes that are revealed from observable dwelling prices and wages. Many economists have since followed Rosen, using different functional forms for estimation, in order to rank cities and calculate implicit prices of attributes.[18]

While ensuing studies have found a consensus about the multidimensional nature of QoL, the lack of certainty on which variables are relevant has dis-encouraged measurement. In general, indicators used to measure QoL depend on factors such as data availability, the aims of each study, methodological concerns or the desired level of disaggregation.[19] Biaggi et al (2006) propose a classification of these indicators in six main categories: natural environment (climate, state of natural environment, etc.), constructed environment (type and state of building, etc.), socio-political environment (community life, political participation, etc.), local economic environment (local income, unemployment, etc.), cultural and leisure environment (museums, restaurants, etc.), and public policy environment (safety, health care, education provision, etc.).

The augmented hedonic price approach developed in this section deals mainly with characteristics related to the socio-political and public policy environments in Buenos Aires. The main innovation of this study with respect to previous exercises deriving quality of life indicators from hedonic price regressions is that, rather than augmenting the model with variables fixed at the neighborhood level, the two datasets used in the analysis contain characteristics that vary at the property level, such as the distance of every property to a series of facilities (for the real estate dataset), and the objective characteristics of the neighborhood and their subjective evaluations (for the NQLS data). This level of disaggregation provides a greater deal of variation than in most studies and, most importantly, it permits the analysis of within-neighborhood differences.

The next sub-section discusses a simple hedonic price model and the derivation of quality of life indices based on neighborhood amenities and characteristics at the sub-city level. The rest of the paper presents the regression estimation results and the derived indices for the real estate database and the NQLS data, respectively.

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[18] See Roback (1982), Blomquist, Berger and Hoehm (1988), Gyourko and Tracy (1991), Stover and Leven (1992), Giannias (1998) and Blomquist (2005), among others.

[19] See Biaggi, Lambiri and Royuela (2006) for the QoL indicators used in various studies.

4.2 Hedonic Price Regressions and Indices of Quality of Life at the Sub-City Level

In a summary of findings and methodologies, Blomquist (2005) postulates the derivation of an index of quality of life at the city level from the "full implicit prices" of city amenities. In Blomquist's model, these full prices are derived from the joint location and work decisions of the households. The methodology consists of running separate regressions for the determinants of property prices and wages at the city level and deriving the full implicit prices from the combination of the effect of amenities on property prices and wages.

The adaptation of this framework to the sub-city or neighborhood level implies a simplification of the original model: since all inhabitants participate in the same labor market, the full implicit price of amenities is simply given by their impact on real estate prices. In generic terms, the implicit prices are the coefficients of a regression of the form:

$$P_{ij} = \alpha + \sum_h \eta_h HC_{ij}^h + \sum_n \tau_n NC_{ij}^n + u_{ij} \qquad (1)$$

where P is a measure of the real estate price for property i in neighborhood j, the h HC variables are property characteristics (such as size, number of rooms, etc.) and the n NC variables are a series of neighborhood characteristics, which in this paper vary at the property i level. α and u represent the constant and the error term, respectively.

For each property in the sample, it is possible to calculate the implicit contribution of the NC neighborhood characteristics to its price:

$$V_{ij} = \sum_n \tau_n NC_i^n \qquad (2)$$

A simplified version of Blomquist's (2005) index for sub-city quality of life can be derived from these implicit valuations. To account for difference in sample sizes across neighborhoods, the index can be calculated as the average of the valuations in neighborhood j:

$$QOL_j = \sum_i V_{ij} / N_j \qquad (3)$$

The indices computed in this section and the related monetary valuations are all based on this general form.

4.3 Quality of Life and the Valuation of Distance to neighborhood amenities

The Buenos Aires Real Estate database contains information for more than five thousand properties in 47 neighborhoods within the City of Buenos Aires in November 2006. Table 7 presents the summary statistics of these variables separately for houses and apartments in the household. Besides some standard house and apartment characteristics, such as lot size, number of rooms and bathrooms, and age of the property (the HC variables in the equations above), the dataset contains information on distance to the center of town and on distance to neighborhood facilities: nearest avenue, schools, green areas, freeway, subway station and train stations.

Table 8 presents some of these statistics as neighborhood averages. Property prices in square meters range from 605 (Villa Lugano) to 2,810 (Puerto Madero) US dollars of 2006 (2006 USD). Besides these extreme cases, the price per square meter varies mostly in the sample in the 650-1500 USD range (10^{th}-90^{th} percentiles). There is also significant variation in property sizes, with an average of 133 square meters. Since the area considered is the relatively small City of Buenos Aires, the maximum distance to the center of town (defined as the National Congress) is 14.8 kilometers, with a 7.4 average. The relatively modern origin of Buenos Aires implies that there are many avenues, and the school network is relatively spread out: there is thus relatively little variability in these two indicators in the sample. The subway network, however, has low coverage for a city of this size, and there is much greater variability in the distance to a subway station in the sample.

Table 9 presents the results from two regressions based on the general form described in the previous pages. The dependent variable is the logarithm of the property's price per square meter, since this is considered the standard comparable measure of the value of real estate in Buenos Aires. Since the main interest of this section is the derivation of a quality of life index, the apartment and house data are merged, but only the distance variables (included as logarithms) are considered to have a common effect: for all other variables, an interaction between the nature of the property and the relevant variable has been used in the estimation instead.

The results for the property characteristics are fairly standard. Houses are significantly more expensive than apartments, and houses and apartments command higher prices per square meters with more bathrooms, with more floors (for houses) and with a parking space available (houses). The number of bedrooms does not have a clear relationship with the dependent variable, which is in price per surface terms.[20]

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[20] This Section deals mostly with the construction of a quality of life index, and thus the property-specific variables are only included as controls. A full analysis of the regressions outputs and a complete discussion of the relevant dependent and independent variables is given in Cruces, Fernández and Ham (2008).

Regarding the distance variables, the results indicate that the distance to the center of town has a negative but not significant effect in property prices. This is probably due to the relatively small size of the city of Buenos Aires, the area considered, which implies that there is little variability in distance to the center within the city—as discussed for Figure 6, there seem to be important distance effects on prices when considering the whole Metropolitan Area. The elasticity with respect to the distance to an avenue is 0.5 percent, and with respect to a freeway is 5 percent, which might be explained by the unappealing integration of freeways in the urban grid in Buenos Aires. As expected, the distance to a green area has a negative and significant elasticity of -2.3 percent, as do the distance to train (-4.3 percent) and subway (-5.7 percent) stations. Finally, the relatively even distributions of schools in the city results in a non-significant coefficient for the distance to school variable.[21]

The following step in the construction of a quality of life index is to interact the implicit prices for distance to amenities in Table 9 with the characteristics of each neighborhood. Since the distances vary by property, it is possible to compute the valuation of these distances for each property in the sample (as in equation 2).

Table 10 presents the index (the average value of *V*, as in equation 3) for each neighborhood in the sample, including the distance to neighborhood amenities (avenues, schools, green areas, freeway, and train and subway stations).[22]

Since the dependent variable in the regression is in logarithms, the index can be interpreted as the approximation of the percentage difference in prices given by the amenities considered—that is, if the valuation *V* is 0.05, it implies a premium of 5 percent on the property value, and a penalty for negative values of *V*. To provide a more intuitive formulation, the Table also reports the average of the implicit price differences *V* x *P* for each property in the neighborhood.[23]

The results from the index are fairly intuitive: for instance, Recoleta and Palermo, two of the most coveted neighborhoods in the city, are included in the top 10, while most of the areas of

[21] The impact of including neighborhood controls in the regression and its relationship with the significant between-neighborhood variability in the distance variables is discussed in detail in Cruces, Fernández and Ham (2008). Since the QoL indicators must reflect differences between neighborhoods, the specification reported in Tables 9 and 11 is preferred.
[22] Distance to the center of town was excluded since it is not a neighborhood "amenity". The correlation (and rank correlation) of the indices computed with and without distance to the center is about 0.95. This index was not included in the tables but is available upon request.
[23] The Tables report the exact implicit difference and do not rely on the log-percentage approximation.

the city south are in the bottom 10 (such as Villa Lugano and Mataderos). However, there are some relatively expensive neighborhoods at the bottom of the table (such as San Telmo, Villa Devoto and Saavedra), and some middle-price neighborhoods (such as Balvanera) among the top 10. With respect to the 2006 USD average price per square meter of about 1,041, the implicit price differences given by this index range from 219 to -126 USD, with an average of 72.5, or just under 7 percent of the average property value. For some neighborhoods, such as the new luxury development of Puerto Madero, the index value is not as high (rank 18 of 47), but its high property value implies a price difference among the highest in the sample. The correlation between the price per square meter and the index reflects the significant but imperfect relationship between the index and property prices: for the whole sample, the index/price correlation is 0.31 (0.41 rank correlation). However, this reflects some significant variation within neighborhoods: when computing the correlations based on the neighborhood averages of Table 10, the price/index correlation is 0.43, with a high rank correlation of 0.71.

This within-neighborhood variability is evident in Figure 7, which includes the density of the implicit price differences for Palermo and San Cristóbal (which were included in the NQLS and thus allow a comparison across datasets). The distribution of the price premium is clearly to the right for Palermo than for San Cristóbal, with a much higher average, but it is also much more spread out, with a long positive tail.[24]

Finally, Figure 8 presents the spatial distribution of price per square meter and the index price difference, depicting the correlation between property prices and indices of quality of life at the neighborhood level.

While the results are intuitive, the inclusion of the distance variables was motivated by data availability, as in many exercises of this type in the urban economics literature. The rest of this section computes a similar model based on a richer set of neighborhood characteristics from the Neighborhood Quality of Life Survey.

[24] The Palermo-San Cristóbal comparison will be made throughout this paper. Comparing Caballito and San Cristóbal yields qualitatively similar results.

4.4 Hedonic Price Regressions with Detailed Neighborhood Characteristics and Subjective Evaluations from the NQLS

The data in Table 2 indicated that there were significant differences in the rents paid (or estimated, in the case of owners) by respondents in the four neighborhoods included in the NQLS. A quality of life index can be derived as in the previous pages using the neighborhood variables included in the survey, exploiting the greater availability of neighborhood characteristics in the dataset.

The results presented in Table 11 corresponds to an OLS regression of the logarithm of monthly rent as a function of property characteristics (HC variables from Table 2) and both objective (the OC variables of Table 6) and the subjective evaluations (NS, NE, SC variables from Tables 3-5) in the regression. The regression is of the form:

$$\log(rent) = \alpha + \sum_h \eta_h HC_h + \sum_c \theta_c OC_c + \gamma NS + \sum_n \lambda_n NE_n + \sum_s \phi_s SC_s + u \qquad (4)$$

Since the objective of the exercise is to compute neighborhood indices of quality of life, the regression does not include neighborhood controls.[25] The results for housing characteristics in Table 11 are fairly standard. Better built properties (as assessed by the interviewer) and those with more bathrooms command a higher rental price, and owners tend to report a higher estimated price than renters.

Only four of the objective characteristics (collected by a team of geographers independently from the household survey) are significant. The number of steel posts for lighting and electricity cables (as opposed to wooden posts) and the number of public transport stops per block have both a positive and strongly significant effect on rental prices, pointing towards the importance of infrastructure quality and public transport availability. The number of health facilities also has a positive and significant impact, highlighting the importance of service availability in the neighborhood for rental prices. Finally, there is a negative and significant coefficient for the number of leisure-related venues per block, possibly reflecting the penalty imposed by the relatively lower levels of peace and quiet.

Only a handful of the subjective variables (reported by the interviewees) have a significant effect on rental prices in these regressions. The presence of drug trafficking in the

[25] The regression in the Table includes all the OC, NE and SC variables, but only those significant at the standard levels are reported. Cruces, Ham and Tetaz (2008) provide the full regression output, as well as estimations with neighborhood controls and the discussion of alternative specifications.

neighborhood's streets implies a strong and significant penalty on rental prices (of about 10 percent), which highlights the importance of security-related characteristics of the neighborhoods, and the evaluation (on a 1 to 10 basis) of sidewalk conditions when raining has a positive and significant effect on rents, reflecting the importance of neighborhood infrastructure maintenance. The presence of abundant shops is negatively correlated with rental prices, a result similar to the one reported on leisure-related venues. The neighborhood quality of life satisfaction measure, denoted by the variable *NS*, does not seem to be significantly correlated with rental prices.

There are also some counterintuitive results. The presence of pollution and annoying noises during the weekends have a positive and significant effect on rental prices, while the evaluation of pavement and street conditions has a negative and significant coefficient. These variables could be expected, a priori, to have the opposite effect on rental prices, and the result in the case of pollution and noise is that both factors are probably associated with more fashionable or affluent areas.[26]

As in the case of the regressions based on the real estate database, the results from the augmented hedonic regression can be used to compute the implicit value of neighborhood characteristics. For each property in the sample, the value *V* is computed by multiplying its neighborhood variables by their coefficients, and as in the previous regression, it is also possible to derive the price difference implied by the index as a monetary value. Table 12 reports the results for two indices: the first is based only on the objective neighborhood characteristics (OC variables), while the second is based on the OC variables and all the subjective characteristics (SC, NS, and NE variables).

While the NQLS only covered four neighborhoods, the results are roughly comparable to those obtained with the real estate database. While Avellaneda is outside the City of Buenos Aires and thus not included in the previous sample, the ranking of neighborhoods is the same,

[26] The problem is akin to the difficulties in identifying causal effects, or supply and demand equations. Some negative characteristics (for instance, traffic) might be correlated with more coveted areas: a positive relationship between traffic and prices will be reflecting the latter correlation, or a common causing factor (for example, "desirability" exacerbating traffic problems and increasing housing demand)—the captured relationship represents a market equilibrium, and not a supply or demand function. While this is not an obstacle to computing quality of life indicators (since traffic would be correlated with a more desirable neighborhood), it does affect the possibility of causal interpretation and thus of deriving policy implications: one should probably not conclude that increasing traffic would increase quality of life in the neighborhood. Cruces, Ham and Tetaz (2008) discuss these potential endogeneity biases in detail.

with Palermo first, Caballito second and San Cristóbal third (8, 15 and 27 of 47, respectively, according to the index in Table 10). The sample average rental price was 337 USD (of 2007), and the implied rental differences (for the index based only on objective characteristics) were a penalty of 8 USD for Avellaneda, and premiums of about 8, 35 and 52 USD for San Cristóbal, Caballito and Palermo respectively. The inclusion of the subjective variables in the index implied larger differences and a reordering at the bottom, with Avellaneda slightly better off than San Cristóbal.

The most remarkable result from this section stems from the comparison of Figure 7, which depicts the distribution of the quality of life index based on the real estate database for Palermo and San Cristóbal, and Figure 9, which plots the distribution of the two indices derived from the NQLS for the same neighborhoods. The results for the same methodology but based on different datasets and indicators are remarkably similar from a qualitative perspective: Palermo has a higher level of the quality of life index, but its distribution is also more spread out than that of San Cristóbal, with a significant tail to the right.

The similarity of the results from these two different datasets points out that the methodology is managing to capture some underlying dimension of quality of life at the neighborhood level. However, the derivation of policy recommendations from these results is marred by the fact that some coefficients appear to be of the "wrong" sign, reflecting market equilibrium rather than demand or supply forces.

The following section derives another set of measures of neighborhood quality of life from an alternative methodological perspective.

Table 7. Real Estate Database: Descriptive Statistics, Houses and Apartments

	Houses (n=2079)			
	Mean	Std. Deviation	Min	Max
Price	204,439	209,685	32,500	5,000,000
Log(Price)	12.01	0.60	10.39	15.42
Log(Price/m2)	6.74	0.39	4.56	8.74
Living area	223.79	133.70	51.00	1,400.00
Log (Living area)	5.27	0.52	3.93	7.24
Lot size	241.57	138.48	52.00	1,500.00
Log (Lot size)	5.35	0.52	3.95	7.31
Bedrooms	3.43	1.36	0.0	12.00
Bedrooms2	13.59	13.90	0.0	144.00
Age	32.10	21.08	0.0	109.00
Age2	1,474	1,697	0	11,881
Bathrooms	2.47	1.31	0.0	6.00
Floors	1.92	0.76	0.0	4.00
Garage	0.74	0.44	0.0	1.00
Distance to avenue	0.16	0.14	0.0	0.82
Distance to school	0.19	0.10	0.01	0.60
Distance to green space	0.30	0.19	0.00	1.19
Distance to freeway	1.42	1.10	0.00	4.63
Distance to center	9.29	3.06	0.76	14.38
Distance to subway	2.46	1.71	0.01	6.51
Distance to train station	1.07	0.56	0.01	3.28

	Apartments (n=3413)			
	Mean	Std. Deviation	Min	Max
Price	89,514	102,648	12,300	2,400,000
Log(Price)	11.23	0.49	9.42	14.69
Log(Price/m2)	6.97	0.29	5.66	8.70
Living area	76.74	41.40	16.00	580.00
Log (Area)	4.26	0.38	2.77	6.36
Bedrooms	1.67	1.03	0.00	9.00
Bedrooms2	3.86	3.64	0.00	81.00
Age	13.01	18.71	0.00	100.00
Age2	519	1,059	0	10,000
Bathrooms	0.55	0.87	0.00	5.00
Distance to avenue	0.12	0.11	0.00	0.72
Distance to school	0.15	0.09	0.00	1.09
Distance to green space	0.27	0.17	0.00	0.94
Distance to freeway	1.75	0.97	0.00	4.35
Distance to center	6.18	3.40	0.06	13.90
Distance to subway	1.17	1.23	0.00	6.56
Distance to train station	0.97	0.51	0.02	2.62

Source: Authors' calculations based on Buenos Aires real estate database.

Table 8. Real Estate Database: Descriptive Statistics by Neighborhood

Neighborhoods	Average price per square meter (2006 USD)	Property surface in square meters	Distance to center of town (all in km)	Distance to avenue	Distance to green areas	Distance to school	Distance to train station	Distance to subway station
AGRONOMIA	985	150	9.88	0.104	0.219	0.295	0.635	1.50
ALMAGRO	1047	95	3.78	0.089	0.123	0.324	1.470	0.39
BALVANERA	912	93	2.11	0.105	0.113	0.355	0.834	0.37
BARRACAS	859	141	3.90	0.152	0.191	0.183	0.795	1.45
BELGRANO	1269	128	8.44	0.142	0.140	0.218	0.587	0.69
BOCA	700	116	3.82	0.120	0.156	0.206	1.808	1.98
BOEDO	860	138	4.32	0.080	0.161	0.397	1.838	0.54
CABALLITO	1012	135	5.84	0.125	0.145	0.323	1.003	0.75
CHACARITA	1021	109	6.69	0.056	0.149	0.185	0.631	0.60
COGHLAN	1069	179	9.84	0.122	0.214	0.234	0.734	1.23
COLEGIALES	1174	110	7.24	0.174	0.118	0.257	0.560	0.61
CONSTITUCION	798	111	2.23	0.111	0.135	0.211	0.885	0.36
FLORES	856	147	8.01	0.099	0.156	0.281	0.924	1.35
FLORESTA	905	148	9.67	0.127	0.149	0.289	0.684	2.49
LINIERS	852	138	13.51	0.271	0.205	0.227	0.977	5.40
MATADEROS	754	148	12.46	0.127	0.212	0.300	2.089	3.99
MONSERRAT	1018	86	1.27	0.099	0.099	0.202	1.449	0.36
MONTE CASTRO	862	136	11.64	0.206	0.168	0.326	1.639	4.81
NUEVA POMPEYA	671	184	6.16	0.126	0.255	0.282	0.999	2.56
NUÑEZ	1186	149	9.95	0.167	0.167	0.306	0.512	1.10
PALERMO	1507	120	4.87	0.141	0.144	0.245	0.878	0.60
PARQUE AVELLANED	713	170	10.02	0.077	0.225	0.310	1.571	1.68
PARQUE CHACABUCO	984	180	6.40	0.098	0.182	0.288	1.770	0.64
PARQUE PATRICIOS	800	122	3.77	0.080	0.147	0.204	1.359	1.07
PATERNAL	787	157	7.88	0.124	0.212	0.402	0.620	1.73
PUERTO MADERO	2810	116	2.03	0.169	0.619	0.099	0.949	0.94
RECOLETA	1453	109	2.28	0.117	0.115	0.176	1.486	0.52
RETIRO	1721	115	1.10	0.137	0.136	0.119	0.799	0.50
SAAVEDRA	998	147	11.09	0.129	0.188	0.211	0.868	2.14
SAN CRISTOBAL	877	117	2.75	0.110	0.139	0.287	1.560	0.36
SAN NICOLAS	1159	77	0.63	0.085	0.096	0.166	1.310	0.19
SAN TELMO	1029	83	2.26	0.064	0.113	0.148	1.097	0.79
VELEZ SARSFIELD	788	153	10.65	0.145	0.178	0.305	0.884	3.12
VERSALLES	873	168	13.37	0.145	0.216	0.154	1.027	5.87
VILLA CRESPO	1016	117	5.50	0.090	0.156	0.350	1.122	0.59
VILLA DEL PARQUE	966	147	10.13	0.278	0.192	0.259	0.645	2.97
VILLA DEVOTO	960	190	12.14	0.125	0.186	0.403	0.721	4.31
VILLA GRAL. MITR	862	126	8.10	0.197	0.167	0.361	1.406	2.60
VILLA LUGANO	605	203	11.77	0.183	0.205	0.289	1.007	3.71
VILLA LURO	836	148	11.79	0.129	0.236	0.205	0.775	3.99
VILLA ORTUZAR	1118	178	8.40	0.098	0.179	0.293	1.058	0.56
VILLA PUEYRREDON	927	132	11.38	0.189	0.182	0.383	0.612	2.71
VILLA REAL	850	155	13.42	0.209	0.258	0.274	1.961	6.29
VILLA RIACHUELO	760	161	12.63	0.091	0.188	0.302	1.480	5.23
VILLA SANTA RITA	900	149	9.31	0.194	0.190	0.492	1.528	3.33
VILLA SOLDATI	680	148	8.85	0.094	0.245	0.355	0.756	2.69
VILLA URQUIZA	1066	122	10.16	0.106	0.160	0.325	0.609	1.55
Sample average	*1041*	*133*	*7.38*	*0.133*	*0.161*	*0.281*	*1.006*	*1.66*

Source: Authors' calculations based on Buenos Aires real estate database.

Table 9. Augmented Hedonic Regressions, Real Estate Database

Dependent Variable: Log(Price/Square Meters)	
Variables	
Houses variables:	
Interior surface in m2 (log)	-0.4678
	[0.05149]***
Total property surface in m2 (log)	0.2558
	[0.02654]***
Bedrooms	0.0197
	[0.03298]
Bedrooms squared	-0.0048
	[0.00332]
Age	-0.0067
	[0.00206]***
Age squared	0.0083
	[0.00257]***
Bathrooms	0.0528
	[0.01075]***
Number of storeys	0.0838
	[0.01600]***
Parking space	0.0987
	[0.02565]***
Apartment variables:	
Property is an apartment	-0.4754
	[0.26174]*
Surface in m2 (log)	-0.0168
	[0.04540]
Bedrooms	-0.0404
	[0.01139]***
Bedrooms squared	0.0064
	[0.00403]
Age	-0.0065
	[0.00093]***
Age squared	0.0034
	[0.00140]**
Bathrooms	0.0822
	[0.01990]***
Distance to center of town (log)	-0.0557
	[0.05570]
Distance to avenue (log)	0.0051
	[0.00292]*
Distance to school (log)	-0.0069
	[0.00900]
Distance to green space (log)	-0.0233
	[0.01124]**
Distance to freeway (log)	0.0523
	[0.01606]***
Distance to train station (log)	-0.0427
	[0.02724]
Distance to subway (log)	-0.0569
	[0.01735]***
Constant	7.6717
	[0.28424]***
Observations	5,492
R2	0.30

Robust standard errors clustered by neighborhoods in brackets.

Controls for missing age and bathrooms not reported.

* Significant at 10%; ** Significant at 5%; *** Significant at 1%

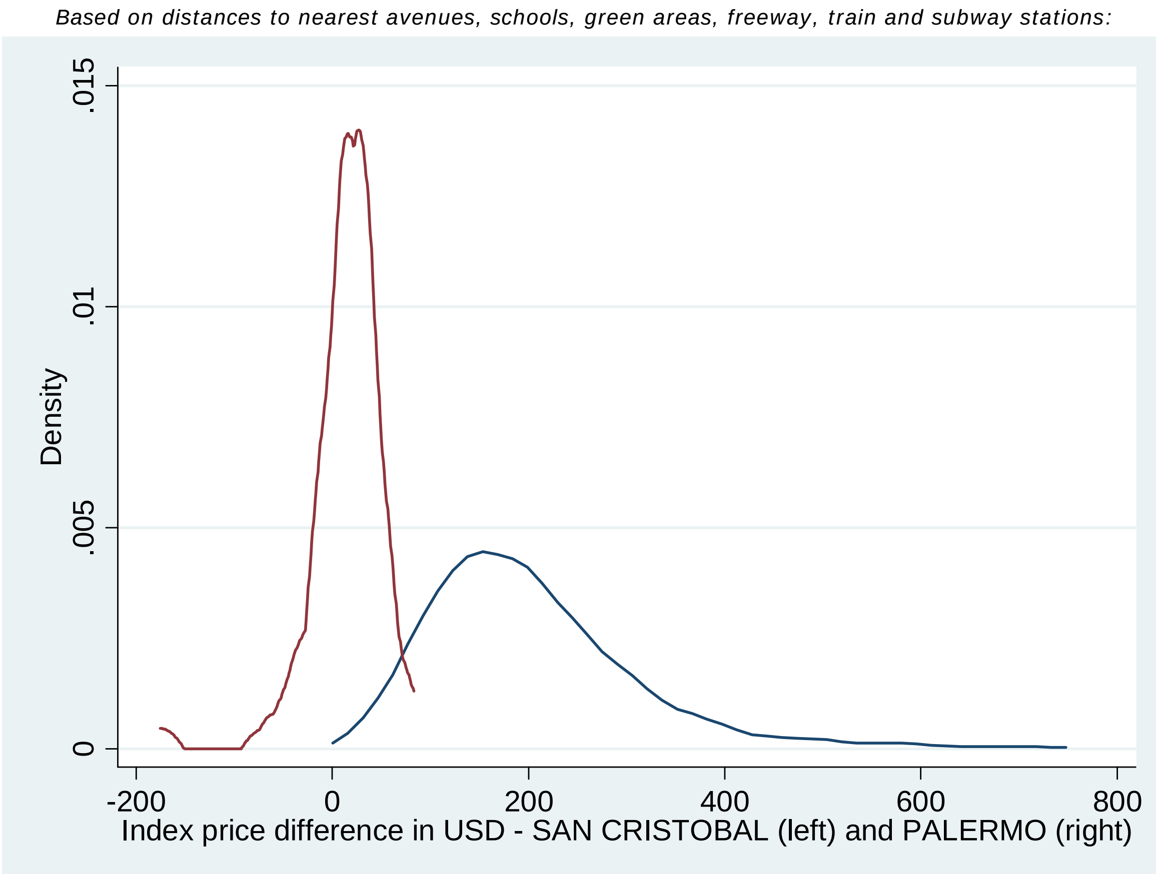
Source: Authors' calculations based on Buenos Aires real estate database.

Table 10. Quality of Life Indices and their Implicit Price Differences, Real Estate Database

Neighborhood	Average amenities index	Average index implicit price difference	Index rank	Average price per square meter (2006 USD)	Price rank
AGRONOMIA	0.099	106.4	11	985	19
ALMAGRO	0.115	128.1	9	1047	12
BALVANERA	0.134	133.5	6	912	24
BARRACAS	-0.002	-1.4	28	859	32
BELGRANO	0.136	184.7	5	1269	5
BOCA	-0.055	-38.2	37	700	44
BOEDO	-0.010	-4.5	31	860	31
CABALLITO	0.085	91.6	15	1012	17
CHACARITA	0.186	218.7	1	1021	14
COGHLAN	0.078	85.8	16	1069	10
COLEGIALES	0.166	214.0	2	1174	7
CONSTITUCION	0.053	44.4	21	798	38
FLORES	0.038	34.3	22	856	33
FLORESTA	0.035	37.5	23	905	25
LINIERS	-0.076	-63.6	41	852	34
MATADEROS	-0.082	-60.4	44	754	42
MONSERRAT	0.095	104.4	12	1018	15
MONTE CASTRO	-0.051	-42.8	36	862	30
NUEVA POMPEYA	0.019	12.9	26	671	46
NUÑEZ	0.062	79.1	19	1186	6
PALERMO	0.129	202.9	7	1507	3
PARQUE AVELLANEDA	-0.066	-41.5	39	713	43
PARQUE CHACABUCO	-0.007	-5.6	30	984	20
PARQUE PATRICIOS	0.023	19.8	25	800	37
PATERNAL	0.091	76.2	13	787	40
PUERTO MADERO	0.064	209.2	18	2810	1
RECOLETA	0.105	158.2	10	1453	4
RETIRO	0.091	154.3	14	1721	2
SAAVEDRA	-0.024	-18.5	34	998	18
SAN CRISTOBAL	0.016	14.8	27	877	27
SAN NICOLAS	0.159	204.2	3	1159	8
SAN TELMO	-0.022	-20.6	33	1029	13
VELEZ SARSFIELD	-0.037	-26.9	35	788	39
VERSALLES	-0.108	-89.0	45	873	28
VILLA CRESPO	0.128	138.8	8	1016	16
VILLA DEL PARQUE	0.058	59.8	20	966	21
VILLA DEVOTO	-0.056	-44.5	38	960	22
VILLA GRAL. MITRE	0.025	21.7	24	862	29
VILLA LUGANO	-0.081	-46.4	43	605	47
VILLA LURO	-0.079	-63.1	42	836	36
VILLA ORTUZAR	0.148	178.0	4	1118	9
VILLA PUEYRREDON	-0.006	-5.1	29	927	23
VILLA REAL	-0.164	-126.6	47	850	35
VILLA RIACHUELO	-0.124	-90.0	46	760	41
VILLA SANTA RITA	-0.014	-10.8	32	900	26
VILLA SOLDATI	-0.070	-44.9	40	680	45
VILLA URQUIZA	0.071	83.5	17	1066	11
Total	0.052	72.5		1041	

Source: Authors' calculations based on Buenos Aires real estate database.

Figure 7. Distribution of Implicit Price Differences for Quality of Life Indices, Real Estate Database, San Cristóbal and Palermo



Source: Authors' calculations based on Buenos Aires real estate database.

Figure 8. Geographical Distribution of Price per Square Meter and Implicit Price Difference Given by Index of Quality of Life

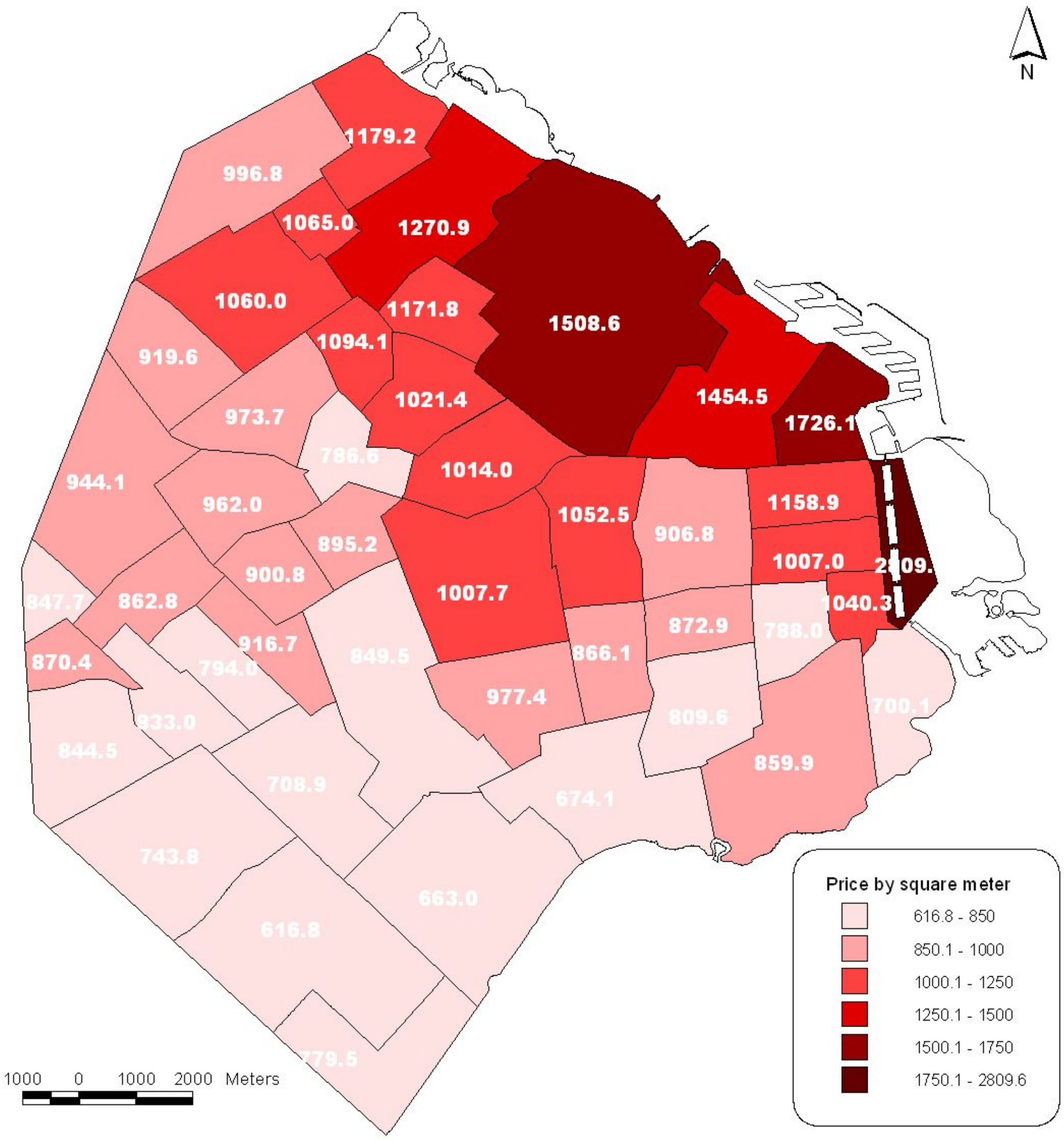


Figure 8., continued

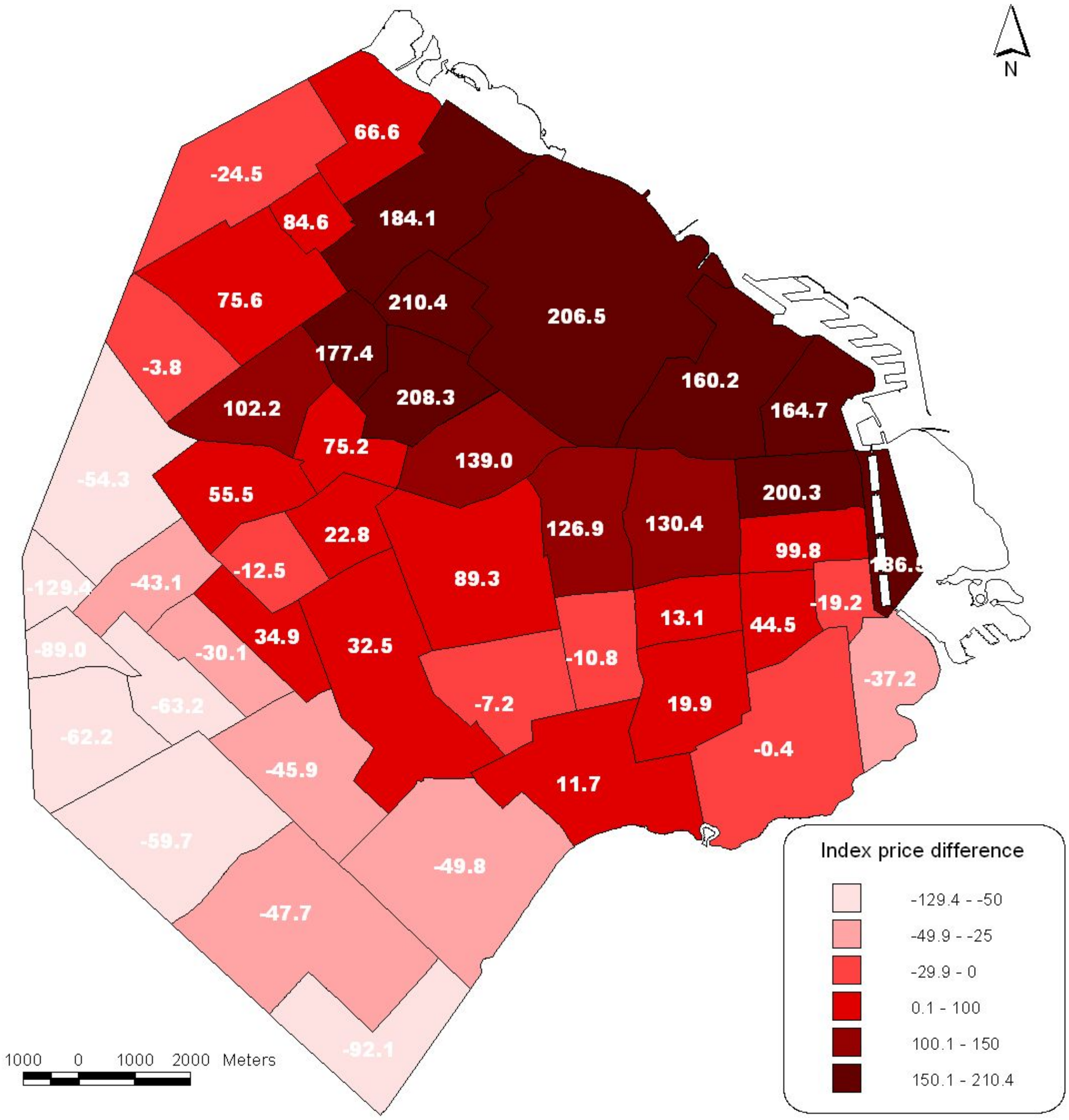


Table 11. Augmented Hedonic Price Regressions for Monthly Rent (NQLS)

Dependent variable: Log of monthly rent	
Property characteristics (HC variables)	
Medium quality construction	0.1388 [1.45]
High quality construction	0.2578 [2.60]***
Garden	-0.0311 [0.84]
Garage	0.1383 [3.56]***
House	-0.0057 [0.13]
Number of bathrooms/toilets	0.1378 [4.60]***
Number of bedrroms	0.0219 [1.45]
Rents the property	-0.1663 [4.60]***
Objective characteristics (OC variables)	
Steel posts	0.029 [3.41]***
Public transport stops	0.1227 [3.03]***
Leisure-related venues	-0.0355 [2.01]**
Health facilities	0.1193 [2.05]**
Subjective evaluations and characteristics (NE and SC variables)	
Neighborhood satisfaction	-0.0076 [0.50]
Annoying noise during on weekends	0.1032 [1.96]**
Pollution	0.0943 [2.58]**
Drug dealing	-0.0978 [2.42]**
Abundant shops	-0.0821 [2.43]**
Sidewalk conditions when raining	0.0238 [2.37]**
Conditions of pavement-streets	-0.0272 [2.64]***
Constant	6.3121 [33.21]***
Observations	616
R-squared	0.37

Robust t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: as per IADB project guidelines, only variables with coefficients significant at the 10% level are reported for neighborhood variables. Complete regression output available in Cruces (2008).

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

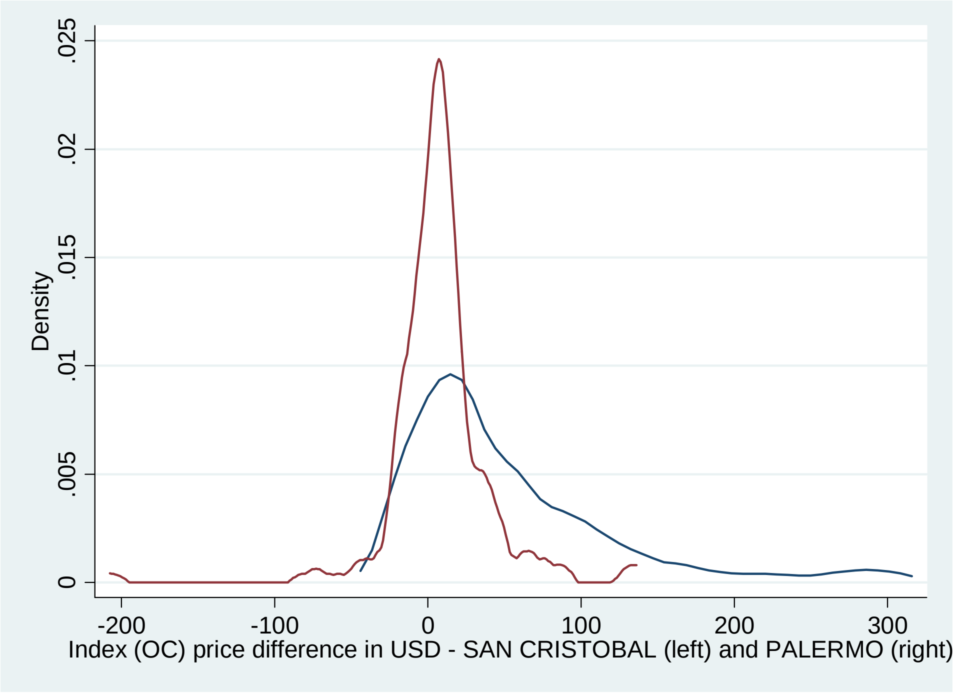
Table 12. Quality of Life Index and Implicit Price Differences for NQLS Neighborhoods

Neighborhood	Monthly rent (USD)	Index based on objective characteristics	Implicit price difference	Index based on all characteristics	Implicit price difference
Avellaneda	339	-0.032	-8.3	0.090	38.8
Caballito	361	0.084	35.4	0.199	88.6
Palermo	368	0.113	51.7	0.249	118.3
San Cristobal	275	0.018	7.9	0.086	34.0
Total	337	0.047	22.2	0.158	70.9

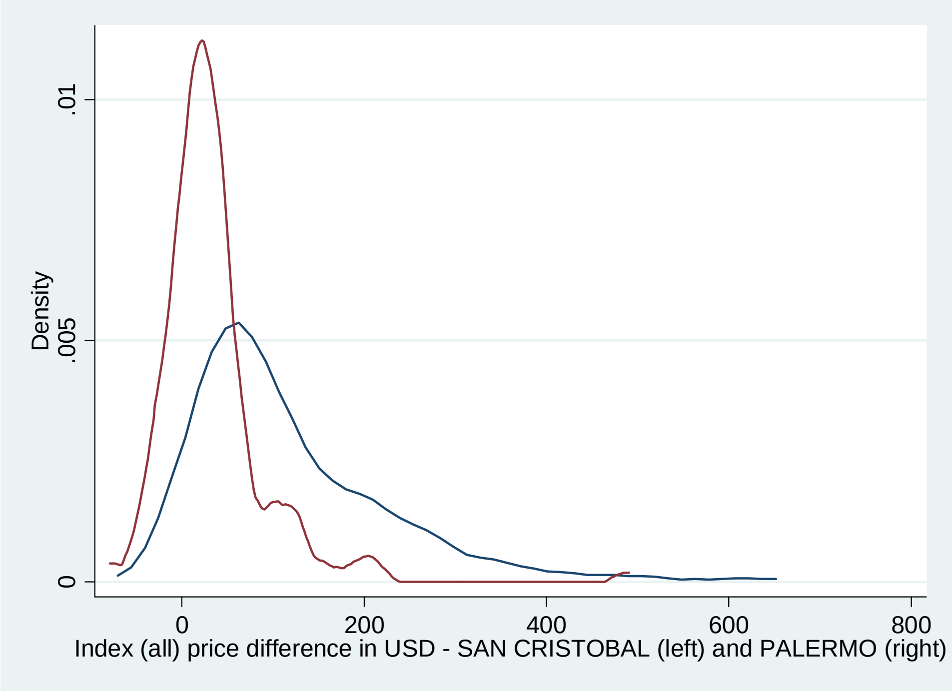
Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Figure 9. Distribution of Implicit Price Differences for Quality of Life Indices, San Cristóbal and Palermo by Neighborhood, NQLS Data

Based on objective neighborhood characteristics:



Based on objective and subjective neighborhood characteristics:



Source: Authors' calculations based on Neighborhood Quality of Life Survey.

5. Quality of Life in Urban Neighborhoods: The Life Satisfaction Approach

5.1 The Life Satisfaction Approach and Quality of Life in Urban Neighborhoods

This section presents a further analysis of quality of life at the sub-city level, focusing on the interaction of subjective evaluations and objective indicators. As discussed in the previous section, the urban economics literature explains differences in quality of life by city or sub-city area assuming that city or neighborhood amenities are capitalized in property prices and wages (Gyourko et al., 1999). An alternative strand of research, related to the happiness literature (Layard, 2005), attempts to derive valuations for intangibles and externalities by studying the impact of the relevant factors on life satisfaction. Van Praag and Ferrer-i-Carbonell (2008) present a series of applications to health and equivalence scales, among others.

The methodology proposed in this section extends a model derived by Van Praag and Baarsma (2005), an elaborate example of the latter strand of research in an urban quality of life context. The authors value the externality of airport noise in the Amsterdam area by means of an indirect methodology, computing first the relationship between the subjective well-being, income and the perception noise, and then between the perception of noise and objective indicators of noise.

The following pages present an extension of this approach. The main difference consists in the joint modeling in this paper of the relationships between income and general life satisfaction, on the one hand, and between life satisfaction and neighborhood quality of life, on the other hand. This methodology computes the impact of the variables related to urban quality of life in monetary terms. In addition to the availability of detailed data on objective and subjective evaluations of well-being at the neighborhood level, the distinguishing feature of this study is the distinction in the analysis between endogenous and exogenous variables, and the resulting estimation of a system of equations that accounts for the potential endogeneity in the variables incorporated into the analysis.

5.2 Estimation: Methodological Issues

Van Praag and Baarsma (2005) derive their pecuniary measures of the airport noise externality by estimating separately the effect of income and the perception of noise on well-being, and the effect of objective indicators on the perception of noise. The regressions they estimate are of the form:

$$GS = \alpha + \sum_c \beta_c X_c + \rho Y + \gamma Noise + u$$
$$Noise = \alpha_2 + \lambda Z + \sum_n \pi_n D_n + v \quad (5)$$

where GS is a subjective measure of general life satisfaction, the *X* variables represent individual and household characteristics, *Y* is income, and *Noise* is a subjective variable, the perceived level of noise. The variable of interest is *Z*, the objective level of noise, and the D variables are other controls included in the regression. Using the coefficient ρ of the income variable as the marginal utility of income, the monetary value of a Z variable is computed indirectly by combining its coefficient λ with the coefficients γ and ρ from the first equation. Thus a change in Z affects *Noise* through λ, and it affects general life satisfaction GS through λγ. Dividing by ρ yields the implicit monetary value of the income compensation necessary to maintain the same level of GS before the change in *Z*. The methodology relies, implicitly, on two assumptions. On the one hand, it is necessary that the *Noise* variable be exogenous in the GS regression, since this is a condition for obtaining an unbiased value of the γ coefficient. On the other hand, the Z variables must be correctly excluded from the determination of GS, that is, they must affect GS only through their impact on *Noise*. While they do not discuss their setting in these terms, the evidence in van Praag and Baarsma (2005) indicates that their most important Z variable, an objective measure of noise, is correctly excluded from the GS regression (it has an insignificant effect on GS) but has a significant effect on the subjective *Noise* variable.

The objective of this paper is to measure the impact of a series of neighborhood characteristics on overall quality of life, and the setting described above provides some guidelines for this context. Quality of life can be approximated through the general life satisfaction (GS) variable included in the NQLS data, while the NS variable provides information on neighborhood satisfaction. Neighborhood characteristics are postulated to have an impact on general life satisfaction only through their effect on neighborhood satisfaction. If this is the case, then it is possible to derive a monetary valuation in a similar way as van Praag and Baarsma (2005), by estimating GS as a function of individual characteristics and NS, and NS as a function of neighborhood characteristics. In the present setting, however, an additional complication might arise: it is likely that neighborhood satisfaction and general life satisfaction are jointly determined, implying a biased coefficient for the NS variable in a GS regression.

A series of conditions need thus to be met to apply the two-equation valuation method to the neighborhood quality of life setting. Firstly, a relationship must exist between general life satisfaction GS and neighborhood satisfaction NS. Secondly, an unbiased estimator of the effect of NS on GS must be available. Thirdly, the neighborhood characteristics must be correlated with neighborhood satisfaction NS. Finally, these characteristics must affect GS only through their effect on NS (that is, they are exogenous to the determination of GS). If these conditions are met, it is then possible to estimate the following system of equations:

$$
\begin{aligned}
GS &= \alpha + \sum_c \beta_c X_c + \rho Y + \gamma NS + u \\
NS &= \alpha_2 + \sum_n \lambda_n NE_n + \sum_s \phi_s SC_s + \sum_c \theta_c OC_c + v
\end{aligned} \qquad (6)
$$

where the X variables represent individual characteristics, Y is the level of income, NS is neighborhood satisfaction, GS general life satisfaction, and the other groups of variables represent objective and subjective neighborhood characteristics: OC_c are c objective geographical characteristics, SC_s are s neighborhood characteristics and the n NE_n variables are subjective evaluations of neighborhood characteristics.

Under the conditions outlined above are met, the two equations above can be estimated as a system, instead of sequentially, correcting for the probable endogeneity of the NS variable in the GS regression. This endogeneity bias is corrected by instrumenting NS with the neighborhood characteristic variables, resulting in an unbiased γ coefficient. A monetary valuation of neighborhood amenities and characteristics can then be derived from their indirect impact on general life satisfaction through their effect on neighborhood satisfaction.

5.3 Estimation: Regression Results

As a first approximation, the two equations in system (6) can be estimated independently. Since the dependent variables are both ordered on a 1 to 10 scale, the model is estimated by Cardinal Ordinary Least Squares (COLS), which first transforms all ordered variables (dependent and independent) to a form similar to the normal distribution and then applies OLS to estimate the model (see van Praag and Ferrer-i-Carbonell, 2008, for details).[27]

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[27] The main advantage of COLS is that IV and 3SLS can be readily applied to the transformed variables, whereas this is cumbersome in nonlinear estimators like ordered probit.

The results from these simple regressions are presented in the first columns of Table 13 (NS regression) and Table 14 (GS regression). Starting by the latter, in accordance to well established results in the happiness literature (see Oswald, 1997, among others), life satisfaction is increasing in income, it is lower for men than for women, and it decreases with age. The marital status, education and household and family size variables do not have a significant effect. Finally, and most interestingly for the purpose of this study, the level of satisfaction with neighborhood quality of life (the NS variable) has a positive and strongly significant effect on GS.[28]

Regarding the determinants of neighborhood satisfaction, the first column of Table 13 presents the estimation results of NS as a function of the OC, SC and NE variables by COLS. Of the objective indicators and neighborhood characteristics, only the presence of payphones and parking lots seems to have a positive and significant effect on neighborhood satisfaction. The subjective variables with a negative and significant effect on neighborhood satisfaction are related to externalities (noise and beggars), while those with a positive effect are related to social interactions (the evaluations of the neighbors), safety (evaluation neighborhood security during the day), as well as neighborhood amenities and infrastructure (evaluation of traffic conditions, of green areas, and of the state and cleanliness of pavement, streets and sidewalks) and the evaluation of local cultural and social activities.

From this preliminary analysis, it appears that there is indeed a relationship between life satisfaction and neighborhood satisfaction (GS and NS), and that the *NE*, *SC* and *OC* variables are relevant determinants of neighborhood satisfaction. The latter result implies that the NE, SC and OC variables might be appropriate instruments to correct for the potential endogeneity of NS in the GS regression.

The overidentification test from the estimation (not reported) of the first equation in the system, instrumenting NS with the NE, SC and OC variables, yields a p-value of the Hansen J statistic of 0.26. The exclusion restriction (null of no overidentification) cannot be rejected at standard levels, indicating that the instruments are correctly excluded from the second stage, the

[28] The idea behind this model is that total life satisfaction can be decomposed into sub-components. GS is thus a function of individual characteristics, and of satisfaction in a series of life domains, such as work, personal economic situation, emotional life and health, among others (Frey and Stutzer, 2002). Using the same data, Cruces, Ham and Tetaz (2008) show that in a regression of GS as a function of the *X* individual characteristics and the *DS* the life satisfaction "domains" (summarized in Table 3), all the domains have a positive and significant coefficient. Neighborhood satisfaction is thus one of the life satisfaction domains.

GS regression.[29] The neighborhood characteristics thus have an impact on general life satisfaction only through their effect on neighborhood satisfaction.

The estimation of system (6) is carried out by three-stage least squares estimation on the COLS transformed variables, and the results validate the intuition that NS is endogenous in the GS regression. The main difference from the joint estimation is the coefficient of the *NS* variable (0.4748), which is significantly higher than the OLS coefficient of the first column (0.334). The endogeneity of the *NS* variable in the GS regression thus implies a downward bias for *NS* in an OLS regression, implying that the two equations in system (6) cannot be estimated independently—and that the quality of life estimates from such estimation would be biased through the NS coefficient. The 3SLS coefficient for income on *GS* is slightly higher than the OLS estimate, and the coefficients of the other *X* variables on *GS* are qualitatively similar to those reported in the first column.

The first regression in the system is reported in the second column of Table 13, and the results are similar to those in the first column (OLS estimation): the same objective and subjective variables have a significant impact on neighborhood satisfaction.

5.4 Estimation: Quality of Life Indices

The estimation results in the second columns of Tables 13 and 14 can be used to compute quality of life indicators for the NQLS neighborhoods. The insight from the life satisfaction approach is that these coefficients can be interpreted in terms of income and subjective well-being. Since NS and GS are jointly determined, the impact of the change in a neighborhood variable, for instance OC_1, can be interpreted in terms of a monetized amount by computing $\partial X_{inc} / \partial OC_1$, the change in income necessary to leave *GS* unmodified. Given the system of equations above, this effect is $\partial X_{inc} / \partial OC_1 = -\gamma\theta_1 / \rho_{inc}$. For instance, there is an average of 0.287 phones per block in the sample. An increase of payphone availability of 5 percent would mean 0.01434 additional phones per block. Using the estimated coefficients, log income would have to fall by:

$$\partial X_{inc} = -\gamma\theta_1 / \rho_{inc}\, \partial OC_1 = -(0.4748*0.0761/0.0882)*0.01434=0.0059$$

which implies a fall in income of about 0.59 percent, or about 4.7 USD given average total income of 793 USD.

[29] These results do not differ significantly from the 3SLS estimation in Table 14. The full IV results are reported in Cruces, Ham and Tetaz (2008).

This computation can be carried out for each neighborhood characteristic. In fact, a valuation of neighborhood characteristics can be constructed for each individual in the sample, using the computed coefficients and the individual values of the characteristics. A reference point is given by the amount of income necessary to compensate an individual to move from her neighborhood to a fictional neighborhood with sample average characteristics—if negative, negative, this would represent how much she would pay to move to a better neighborhood. For an individual *i*, this valuation of objective characteristics would be:

$$\partial X_i^{inc} = \left[-\gamma / \rho_{inc}\right] \sum_c \theta_c [OC_{ci} - \overline{OC}_c] \qquad (7)$$

Table 15 reports the average of these valuations for the four neighborhoods in the NQLS database, using only the objective characteristics OC (first column) and using the objective and subjective characteristics (OC, NE and SC variables, second column).

The first column indicates that objective characteristics are valued relatively little on average for the whole sample—17 USD compared to an average income of 793 USD. This average, however, masks a large variability between neighborhoods: moving from Caballito or Palermo to the synthetic "average" neighborhood would require an average compensation of 125 and 97 USD, respectively, while neighbors of San Cristobal would give up 165 USD to move to the average neighborhood. Neighbors of Avellaneda seem to be close to the average neighborhood in terms of objective characteristics. While Caballito appears to have a higher quality of life than Palermo according to this methodology, the difference is small, and the two are still clearly in the upper group.

The second column of Table 15 computes the compensation based on all neighborhood characteristics, yielding similar qualitative results but with a greater variability: the sample average compensation is 27 USD, with neighborhood averages ranging from -558 USD for San Cristóbal to 463 USD for Caballito.

Figure 10 presents the distribution of these two valuations for Palermo and San Cristóbal. As in the case of the indices based on the hedonic price regressions with the real estate dataset and the NQLS, the average is higher for Palermo, which also has a greater dispersion and a distribution skewed to the right.

Finally, Table 16 computes the correlations between the four indices computed for the NQLS datasets—two based on the hedonic price regressions and two based on the life satisfaction approach, including either objective variables only or all neighborhood characteristics. The correlations between indices based on different methodologies are all positive and in the 0.153-0.248 range, indicating (as the series of Palermo-San Cristóbal figures) that the two methodologies are, at least partially, accounting for some common underlying level of quality of life at the sub-city level.

Table 13. Neighborhood Satisfaction Regressions, OLS and 3SLS with COLS Transformation: NS as a Function of NE, SC and OC Variables

Dependent variable: NS (neighborhood satisfaction)		
	COLS	**3SLS (COLS)**
Objective characteristics (OC variables)		
Parking lots	0.0128 [1.89]*	0.0131 [1.82]*
Payphones	0.0707 [2.05]**	0.0761 [2.26]**
Subjective characteristics (SC variables)		
Annoying noise during the day	-0.0754 [1.95]*	-0.0651 [1.65]*
Beggars	-0.0501 [1.52]	-0.0416 [1.27]
Subjective evaluations (NE variables)		
Sidewalk conditions when raining	0.0793 [2.43]**	0.0865 [2.99]***
Conditions of pavement-streets	0.0668 [1.90]*	0.0557 [1.76]*
Street and sidewalk cleanliness	0.0482 [1.46]	0.0499 [1.75]*
Cultural and sports activities	0.0414 [2.31]**	0.0402 [2.37]**
Amount and quality of green areas	0.0733 [2.60]***	0.0829 [3.44]***
Traffic in neighborhood	0.0533 [1.98]**	0.0616 [2.40]**
Security during the day	0.0895 [2.39]**	0.0927 [2.81]***
Evaluation of neighbors	0.119 [5.35]***	0.1208 [6.62]***
Some subjective evaluation missing	0.2111 [4.57]***	0.2239 [4.87]***
Constant	0.4919 [6.14]***	0.4898 [6.76]***
Observations	938	847
R-squared	0.33	

Robust t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Note: as per IADB project guidelines, only variables with coefficients significant at the 10% level are reported for neighborhood variables. Complete regression output available in Cruces (2008).

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 14. General Life Satisfaction and Neighborhood Satisfaction Regression by OLS and 3SLS (with COLS transformation)

Dependent variable: GS (general life satisfaction)		
	COLS	3SLS (COLS)
Satisfaction with neighborhood quality of life	0.3343 [8.25]***	0.4748 [7.87]***
Log total household income	0.0794 [2.09]**	0.0882 [2.33]**
Household size	-0.0003 [0.02]	-0.0013 [0.09]
Male	-0.0903 [2.31]**	-0.077 [1.92]*
Married	0.0801 [1.61]	0.0728 [1.53]
Age (log)	-3.9599 [3.85]***	-3.4052 [3.53]***
Age (log), square	0.5459 [3.87]***	0.4668 [3.56]***
Number of children	-0.0015 [0.06]	-0.0065 [0.35]
Some secondary education	-0.0549 [0.53]	-0.0528 [0.66]
Some tertiary education	-0.0259 [0.25]	-0.0512 [0.63]
Imputed income	-0.0086 [0.16]	0.0081 [0.16]
Constant	7.1764 [3.85]***	6.0576 [3.46]***
Observations	932	847
R-squared	0.12	

Robust t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: as per IADB project guidelines, only variables with coefficients significant at the 10% level reported for neighborhood variables. Complete regression output available in Cruces (2008).

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Table 15. Monetized Value of Life satisfaction-Based Neighborhood Quality of Life Index: Income Compensation Necessary for Change from Average to Own Neighborhood Characteristics

Neighborhood	Income value of life satisfaction index based on objective characteristics	Income value of life satisfaction index based on all neighborhoods characteristics	Average income (monthly USD)
Avellaneda	-4.9	-319	763
Caballito	125.0	463	807
Palermo	97.0	455	896
San Cristobal	-165.4	-558	704
Total	17.0	27	793

Source: Authors' calculations based on Neighborhood Quality of Life Survey.

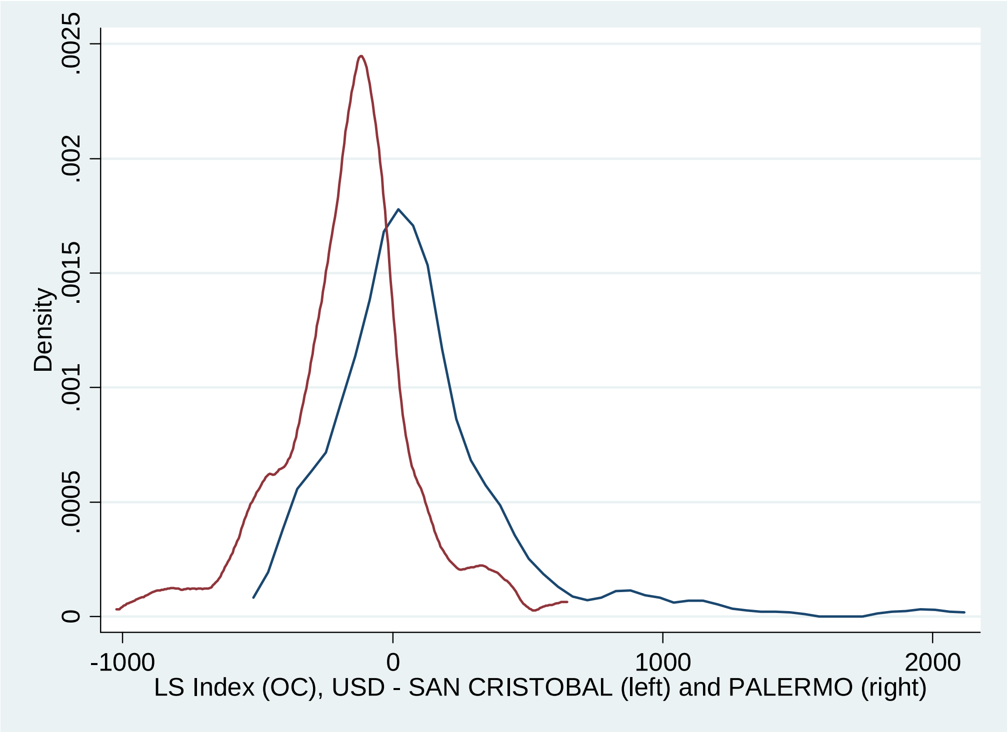
Table 16. Correlation between Hedonic and Life Satisfaction Indices

		Hedonic regressions		Life satisfaction	
		Price difference, index based on objective characteristics	Price difference, index based on all characteristics	Income value, based on objective characteristics	Income value, based on all neighborhoods characteristics
Hedonic regression	Price difference, index based on objective characteristics	1.000			
	Price difference, index based on all characteristics	0.765	1.000		
Life satisfaction	Income value, based on objective characteristics	0.248	0.209	1.000	
	Income value, based on all neighborhoods characteristics	0.153	0.210	0.334	1.000

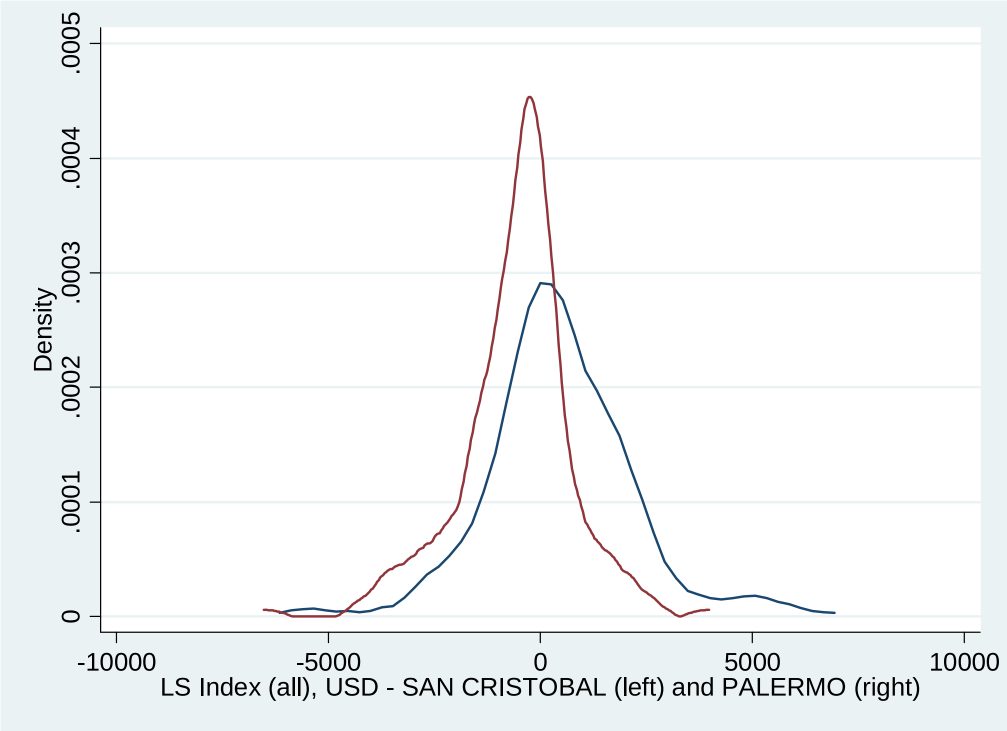
Source: Authors' calculations based on Neighborhood Quality of Life Survey.

Figure 10. Monetized Value of Life Satisfaction-Based Neighborhood Quality of Life Index, Palermo and San Cristóbal, NQLS data

Based on objective neighborhood characteristics:



Based on objective and subjective neighborhood characteristics:



Source: Authors' calculations based on Neighborhood Quality of Life Survey.

6. Conclusion

This paper studied the level and determinants of quality of life at the neighborhood level by means of two alternative methodologies (hedonic price regressions and the life satisfaction valuation) and two alternative datasets (the Buenos Aires Real Estate database and the Neighborhood Quality of Life Survey).

The first conclusion from this variety of empirical results is the existence of a multidimensional underlying quality of life associated with neighborhood characteristics, as witnessed by the similarity in the distribution of indices for different methodologies and from different samples.

The augmented hedonic price regressions highlighted the importance of factors related to local safety, cleanliness, peace and quiet, infrastructure maintenance and transport availability in the determination of rental prices within and between neighborhoods. This approach, however, resulted in some counterintuitive results, which can be attributed to the fact that the observed relationships between prices and characteristics represent supply and demand factors simultaneously.

The subjective life satisfaction approach indicated the presence of a significant and robust relationship between satisfaction with one's neighborhood and satisfaction with one's life. A series of factors were associated with higher levels of satisfaction with neighborhood quality of life. One important aspect was the relevance of the evaluation of the neighbors as a significant factor in neighborhood satisfaction. Other important factors pointed towards items susceptible to policy intervention, such as the availability of public transport, the evaluation of safety, of green areas, of sidewalk maintenance and of cultural and sport activities.

Whether based on the reflection of local amenities and characteristics in property prices or on subjective levels of satisfaction, the two approaches suggest an important role for urban public policy making in improving quality of life at the sub-city level. Moreover, information on the significant variables in the analysis could be collected on a regular basis to monitor the evolution and impact of these urban public policy interventions.

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