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11/2016
N° 2016/14

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ABSTRACT

We use a life satisfaction approach for the valuation of public goods and amenities in Latin American cities. We apply a homogenous database of seventeen cities gathered by the Development Bank of Latin America CAF. Using the estimated monetary value for several public goods and neighborhood amenities we construct a city level quality of life index. We find that access to electricity, access to running water and security are the three largest valued urban characteristics in terms of life satisfaction and housing satisfaction. The monetary equivalent valuations represent more than duplicating the household per capita income. Lacking access to them has a tremendous impact on quality of life. We also show that although richer households have more access, public good and amenities are a source for reductions in quality of life disparities.

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VALUACIÓN DE BIENES PÚBLICOS Y DIFERENCIAS EN CALIDAD DE VIDA EN CIUDADES DE AMÉRICA LATINA

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Gandelman, Néstor

CAF - Documento de trabajo N° 2016/14
11/2016

RESUMEN

En este documento estimamos el valor de varios bienes y servicios públicos en América Latina. Usamos una metodología asociada a indicadores subjetivos de satisfacción con la vida y una base de data homogénea para diecisiete ciudades recopilada por el Banco de Desarrollo de América Latina CAF. Basados en el valor monetario equivalente de los bienes y servicios públicos construimos un índice de calidad de vida por ciudad. Encontramos que acceso a electricidad, agua corriente y seguridad son las tres características urbanas de mayor valor tanto en lo que respecta a satisfacción con la vida como a satisfacción con la vivienda. El valor monetario equivalente de estos representa más que el doble que el ingreso per cápita de los hogares. Carecer de ellos tiene un impacto enorme en la calidad de vida. Asimismo, mostramos que a pesar que los hogares más ricos tienen mejor acceso a bienes y servicios públicos, los mismos son una fuente de reducción de disparidades en la calidad de vida.

Valuation of public amenities and differences in quality of life among Latin American cities

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*

November 2016

Abstract

We use a life satisfaction approach for the valuation of public goods and amenities in Latin American cities. We apply a homogenous database of seventeen cities gathered by the Development Bank of Latin America CAF. Using the estimated monetary value for several public goods and neighborhood amenities we construct a city level quality of life index. We find that access to electricity, access to running water and security are the three largest valued urban characteristics in terms of life satisfaction and housing satisfaction. The monetary equivalent valuations represent more than duplicating the household per capita income. Lacking access to them has a tremendous impact on quality of life. We also show that although richer households have more access, public good and amenities are a source for reductions in quality of life disparities.

Keywords: QoL, life satisfaction, public goods and amenities valuation, Latin America

JEL codes: I31, H41, Q51

* The authors thank Santiago Acerenza for his research assistance and the Development Bank of Latin America CAF for financial assistance and access to the ECAF household survey and Eduardo Lora and Pablo Sanguinetti for helpful comments.

1. Introduction

City authorities allocate scarce funds to attend the many needs of its habitants. In this paper we seek to provide guidance on which public goods and other neighborhood amenities have larger potential to impact the wellbeing of the population. To do so, we use the life satisfaction approach for public goods valuation. We address the impact of several neighborhood characteristics on overall life satisfaction and in housing satisfaction in seventeen Latin American cities and construct a city level quality of life index.

There are three standard methods for the valuation of public goods: stated preference methods, reveled preference methods and the life satisfaction approach. The most common of the stated preference methods is the contingent valuation in which individuals are asked hypothetical questions on different combinations of public goods and amenities. Within the reveled preference approach, hedonic estimations are the most prominent. Besides some historical preliminary studies (e. g. Court 1939) the two seminal papers that opened the ground for applied research are Lancaster (1966) with his characteristics approach to consumer theory and Rosen (1974) analysis of hedonic regressions in implicit markets. If consumers and producers are at their optimizing choices, the rental prices of houses can be used to reveal the shadow valuation/prices of housing and neighborhood characteristics. A difficulty with this approach is that it assumes that markets are in full equilibrium. That is unlikely to happen in housing markets at least due to the presence of high adjustment costs and since the feasible set does not provide every possibility (e.g. due to zoning restrictions).

In this paper, we use the life satisfaction approach. Its starting point is asking people how satisfied they are with their lives or with a specific life domain. It does not assume that consumers are in equilibrium; it tries to obtain points within indifference curves. Various authors have used subjective indicators to evaluate wellbeing (see for instance Winkelmann and Winkelmann 1998; Frey et al. 2004). Including income as an explanatory variable of quality of life it is possible to compute the monetary values of significant variables based on compensating differentials.

The literature on Quality of Life (QoL) for Latin American cities is not large.[1] Probably, the most comprehensive reference work is Lora et al. (2010). This book contains several cases studies[2] of the impact of house characteristics and public goods on rental prices and housing satisfaction. Just published, Rojas (2016)'s book present an interesting variety of papers on happiness research elaborated with a focus on Latin America or by Latin American researchers. One of the articles (Lora, 2016) discusses the use of life satisfaction data to monitor quality of life.

Powell and Sanguinetti (2010) summarize the findings of the case studies presented in Lora et al. (2010). They point out that the access to running water, access to sewage facilities and the availability of piped gas are associated with higher house prices. Other neighborhood variables that appeared to significantly affect house prices in some of the studies include proximity to schools, proximity to parks or green spaces, and security. The results of the relationship between public goods and amenities and life satisfaction are less robust than their impact on real estate prices. Nevertheless, security, access to electricity, water, sewage facilities, garbage collection and telephone services seem to be important factors behind differences in people's wellbeing. The micro data used in these case studies come from different sources and have some differences in methodology, differences in the questionnaires and in the subjective wellbeing measures used that could explain the lack of robustness.

A number of studies have also sought to measure the effect of the place where people live (social, economical and political environment) on reported life satisfaction. Dolan et al. (2008) carry out a detailed review of the economics of happiness. Some of the classical public bads that have been found to be negatively associated with subjective wellbeing have to do with climate and the natural environment. For example, the paper by Welsch (2006) explores the relationship between pollution and reported subjective wellbeing in ten European countries, concluding that pollution

[1] See for instance Amorin and Blanco (2003), Cavallieri and Peres (2008) and Acosta et al. (2005).
[2] Cruces et al. (2010) for Buenos Aires, Medina et al. (2010) for Bogota and Medellin, Hall et al. (2010) for Costa Rica, Alcázar and Andrade (2010) for Lima and Ferre et al. (2010) for Montevideo.

plays a significant role as a predictor of inter-country and inter-temporal differences in subjective wellbeing. Van Praag and Baarsma (2005) show that noise pollution can affect subjective wellbeing, Ferrer-i-Carbonell and Gowdy (2007) suggest that environmental problems reduce life satisfaction, as well as living in an unsafe or deprived area (Dolan and Metcalfe 2008). Ferrer-i- Carbonell and Gowdy (2005) go further to examine the relationship between reported wellbeing and attitudes toward pollution and find a negative relationship between wellbeing and concern about the ozone layer. Using data from Montevideo, Gandelman et al. (2012) show that differences in overall happiness and in some domain satisfaction can partly be explained by different levels of access to public goods and amenities. They report that the equivalent monetary value of neighborhood amenities and public goods such as access to electricity, access to running water, access to a sewage system, access to drains, the availability of a garbage disposal system, street lighting, sidewalks in good condition, trees in the street, and the absence of air and noise pollution is considerable.

In this paper we use a life satisfaction methodology similar to the case studies presented in Lora et al. (2010) to focus on the impact of public goods and neighborhood amenities on life satisfaction as a whole and in housing satisfaction. We use the Encuesta CAF (ECAF) that provides a uniform methodology for seventeen cities in Latin America for the years 2008-2014.

We contribute to the literature at least in three dimensions. First, we apply the life satisfaction approach for public goods valuation to a much larger range of cities than ever before. Second, we replicate the valuation of public amenities based on the same questionnaire. Thus, at least for the comparison sake, we minimize differences in the results produced by measurement decisions. Third, we compute city indexes of quality of life based on the valuations and provisions of public goods and neighborhood amenities.

The paper proceeds as follows. Section 2 presents the data and section 3 the methodology. Section 4 presents the results and section 5 concludes.

2. Data

2.1. Coverage

The ECAF surveys are a series of household surveys gathered by the Development Bank of Latin America CAF. They are publicly available at the institutional webpage. The survey covers urban cities of nine countries in Latin America and questions males and females between 25 and 65 years old. Face to face questionnaires are used.

In this paper we use data for the following cities and periods: Buenos Aires (2008-2014), Cordoba (2008-2012), La Paz (2008-2014), Santa Cruz (2008-2013), San Pablo (2008-2014), Rio de Janeiro (2008-2013), Bogota (2008-2014), Medellin (2008-2013), Quito (2008-2014), Guayaquil (2008-2013), Lima (2008-2014), Arequipa (2008-2012), Montevideo (2008-2014), Salto (2008-2012), Caracas (2008-2014) and Maracaibo (2008-2012).

The ECAF sample size for the 2008 and 2009 surveys was 400 households per city, in the 2010 and 2011 surveys it was 600 per city and in 2012 it was 500 per city. In 2013 observations vary from 600 to 800 depending on the city. The 2014 survey reduced the city coverage only to capital cities but expanded the number of observations for each city to 1000 households. Samples for each country are designed using census information of different years and applying multistage sample design to replicate the adult city population. In our estimations we pool all surveys to obtain estimates for Latin America as a whole.

2.2. Definition of variables

Mainly three groups of variables are used in the analysis: variables regarding satisfaction, variables regarding access to public services and neighborhood amenities and demographic variables. Table 1 reports the summary statistics.

Satisfaction variables

Questions on life satisfaction and housing satisfaction are ranked using a 1 to 10 range. 1 being not satisfied at all and 10 being completely satisfied. The question on life

satisfaction that corresponds to a personal assessment of general wellbeing reads: "*In a scale from 1 to 10, where 1 stands for non satisfied and 10 stands for totally satisfied, how satisfied are you with your life?".* Besides overall wellbeing the survey gathers information for housing satisfaction. The question reads: "*In a scale from 1 to 10, where 1 stands for non satisfied and 10 stands for totally satisfied, how satisfied are you with your house?"* According to Table 1 both variables have similar summary statistics with average life satisfaction of 7.3 and average housing satisfaction of 7.6 and a standard deviation of 2.2

Public good and amenities

Unfortunately there were some changes in the questionnaire and some questions on public goods and neighborhood amenities were not included in the 2013 and 2014 surveys. Questionnaires up to 2012 have information on frequency of access to the public goods and neighborhood amenities and how they have access to it (e.g. from a public source or if they had to privately secure its access). This is the most complete way of addressing whether households have covered whatever need the public good is suppose to cover. In the 2013 and 2014 there is only information on frequency of access.

Regarding running water provision, the surveys provides information for both access and frequency. For frequency the dummy variable takes a value of 1 if the household gets running water every day and at any time and 0 otherwise. This variable can be constructed for the whole 2008-2014 period. We construct another indicator variable that considers both frequency and also type of access. This variable gets 1 if running water reaches the household on a permanent basis and the source of water is a public network or aqueduct. This variable can be constructed for the 2008-2012 period. On average 88% of the households have running water on a daily basis and 86% have it from a public network.

We construct similar variables for garbage disposal. A dummy variable capturing frequency takes the value of 1 if garbage is collected either daily or every two to three days. This question does not address the way in which the garbage is

gathered. We construct another variable that takes the value 1 if garbage is collected at least once every three days and if this is done by a public garbage trunk system. The former variable can be constructed for the whole period but the latter only for 2008-2012. On average, in 96% of households there is a relatively frequent garbage recollection system and in 91% of households this is a publicly provided service.

In order to assess electric power coverage, frequency of energy cuts was considered. The dummy variable takes 1 if the household never or seldom suffers energy cuts due to supplying defaults. A second indicator of electricity takes the value 1 if the former condition is met an energy is provided by a public network with meter. The first variable is constructed for 2008-2014 and the second for 2008-2012. Publicly provided electricity in a timely fashion is received by 86% of the households in the survey. It is publicly provided in 84% of cases.

Access to public transport system (such as buses, metro or trains) within a walking distance of three blocks (about 3 minutes) from the household is captured also by a dummy variable. Most households (96%) have one or other form of public transportations available.

We also have a variable partially capturing environmental quality in the form of a dummy that takes the value 1 if there are green areas at a walking distance from household. About 71% of the households live close to a green area. Street lightening may have a direct impact in quality of life and also an indirect impact through security. We define a dummy variable taking value 1 if the street were the household is located has public lightening. On average 88% of households report living in a street that has public lightening. Finally, a variable taking the value 1 reflects whether the street where the household is located is made of asphalt (roads in good condition). On average this happens for 87% of households.

We construct a variable to measure personal security that takes the value 1 if neither the individual answering the survey or any other member of the family

suffered thefts or robberies in the past year.[3] We find that 24% of the respondents suffered themselves of their families of one of these property motivated crimes.

Socio-demographic variables

The questionnaire also includes the typical socio demographic questions of household surveys (age, education, gender, income, etc.). The average age is 42 years old. Females represent 53% of the database. Marital status is classified in singles (24%), married (63%), divorced (9%) or widowed (4%). Education is classified in up to primary education (37%), secondary complete or incomplete (49%) and university education either complete or incomplete (14%). 67% of the sample is employed. In the regressions we use as the omitted category the response that it is likely associated with lower satisfactions (divorced for marital status, up to primary in education and not working for labor market status).

The variable household members per room (2 in average) capture the effects of overcrowding. It is calculated as the ratio between number of persons in the household and the number of sleeping rooms. We do not have variables to capture the construction quality of the houses that could be followed for several years. We present two crude dummies reflecting whether access to the house is through a shared vicinity and another whether it is an independent house or apartment (the omitted category are houses in really bad condition).

Income is reported at a personal and household level in most years. Personal income tends to be reported more accurately than household income. However, it is a poor approximation of the household income situation of those that are not working. Thus, household income is the relevant concept for the compensating differentials exercise performed in this paper.

[3] The difference between thefts and robberies is that while the former has no form of violence involved, the second does. This is explicitly stated in the questionnaire for all years but 2013. In that year there is an abnormal increase in the number of thefts and decrease in the number of robberies. The sum of both for each city is similar to the values we have in previous and latter years. That is why we treat this as an aggregated security variable.

The surveys report gross income in 7 brackets. The questions are asked in local currency but the microdata already provide this information in current US dollars. We use the midpoint of the bracket as the measure of income. For the top bracket we use a value equal to the double of the previous midpoint.[4] The average per capita household income is $381 in PPP adjusted 2011 dollars.

Personal income is reported for the whole period of study but household income is not reported for 2011. We impute household income for this year based on the predicted values following an ancillary regression of household income on personal income, age, age squared, female (and the interactions), marital status, educational level, working condition and city dummies. The estimated coefficients are reported in Table A1 in the appendix and have the expected signs.

[4] Brackets are: $0-$100, $101-$200, $201-$400, $401-$800, $801-$1,600, $1,600-$3,200 and $3,201 and more. The imputed values are: $50, $100, $300, $600, $1,200, $2,400 and $4,800 respectively.

Table 1. Summary statistics

	Mean	Standard deviation	Observations
Life satisfaction	7.3	2.2	51653
Housing satisfaction	7.6	2.2	51653
Age	41.8	11.2	51653
Female	53%	50%	51653
Single	24%	43%	51653
Married	63%	48%	51653
Widowed	4%	19%	51653
Secondary Education	49%	50%	51653
University Education	14%	35%	51653
Employed	67%	47%	51653
Household members per room	2.0	1.2	51653
Household members	4.0	1.9	51653
House in shared vicinity	11%	31%	51653
Independent house or apartment	87%	34%	51653
Water frequency access ok	88%	32%	51653
Water frequency access and form ok	86%	35%	37370
Garbage disposal frequency ok	96%	20%	51653
Garbage disposal frequency and form ok	91%	28%	37370
Electricity frequency ok	86%	35%	51653
Electricity frequency and form ok	84%	36%	37370
Public transportation within 3 minutes	96%	20%	51653
Street lightening	88%	33%	37370
Green spaces in the area	71%	45%	51653
Roads in good condition	87%	33%	37370
Security	76%	43%	51653
Income per capita (PPP adjusted)	381.3	473.9	27533

Latin American is a region characterized by high inequality. Public good provisions have the potential to ameliorate these disparities through their impact in quality of life. In table 2 we divide the sample between those above and below median income and show that richer people have better access to all public goods and amenities (but security) and the differences is statistically significant. Anyway, since the provision of public goods and amenities impacts the life of rich and poor there is still hope that the relative impact is larger for the poor than for the rich and therefore helps ameliorate disparities. We formally test this in the results section.

Table 2. Differences in public provision between rich and poor

	Above median income		Below median income		Difference in means	
	mean	standard error	mean	standard error		
Water frequency access ok	90%	0%	86%	0%	4%	***
Water frequency access ok and publicly provided	88%	1%	84%	1%	4%	***
Garbage disposal frequency ok	96%	0%	94%	0%	1%	***
Garbage disposal frequency ok and publicly provided	92%	0%	90%	0%	2%	***
Electricity frequency ok and publicly provided	88%	1%	82%	1%	6%	***
Public transportation within 3 minutes	96%	0%	95%	0%	1%	***
Roads in good condition	77%	1%	67%	1%	9%	***
Street lightening	89%	0%	83%	0%	5%	***
Green spaces in the area	89%	0%	86%	0%	3%	***
Security	74%	1%	76%	1%	-2%	

Note: *** statically significant at 1%, **statistically significant at 5%, *statistically significant at 10%
Median income is calculated for the 2011 PPP adjusted per capita household income.

3. Methodology

Overall life satisfaction and other life domains such as housing are evaluated with questions that have discrete distributions. The traditional approach is to postulate a latent equation of the following form:

$$QoL^{d*}_{ij} = \alpha + \beta' X_i + \gamma' Z_j + v_{ij} \qquad (1)$$

where QoL^{d*} is a quality of life domain indicator, X_i is a vector of individual socioeconomic characteristics (age, gender, schooling, etc.), Z_j is a vector of neighborhood j amenities (crime rate, green spaces, etc.) and v_{ij} is the composite error term which is a combination of a neighborhood-specific error component and a house-specific error component $v_{ij} = d_j + \eta_i$.[5] The true valuation of the domain cannot be observed. Instead, reported life satisfaction takes 10 values (from 1 to 10). It is assumed that individuals whose life satisfaction level is below a certain threshold μ_1 will report their level of satisfaction to be 1, those between that value and a greater

[5] The city-specific error component (d_j) is common to all houses in the city and represents systematic uncontrolled differences in amenity characteristics across areas. But it may also capture systematic uncontrolled differences in housing quality. Either of these two factors would mean that the composite error term within the same city will be correlated, making for a downwards bias in the OLS based standard errors (Moulton, 1987) that need to be corrected using clustered standard errors.

μ_2 will report a satisfaction of 2, those between μ_2 and an even greater μ_3 will report a satisfaction of 3, etc.

$$
\begin{aligned}
&Qol^d{}_i = 1 \text{ if } Qol^{d^*}_i \le \mu_1 \\
&Qol^d{}_i = 2 \text{ if } \mu_1 \le Qol^{d^*}_i \le \mu_2 \\
&Qol^d{}_i = 3 \text{ if } \mu_2 \le Qol^{d^*}_i \le \mu_3 \qquad (2) \\
&\ldots. \\
&Qol^d{}_i = 10 \text{ if } Qol^{d^*}_i \ge \mu_9
\end{aligned}
$$

Assuming that the error term is normally distributed across observations we have the traditional order probit model. In the estimations we include city dummies for fixed effects and time dummies for business cycle effects.

Ferrer-i-Carbonell and Frijters (2004) show that the estimated coefficients under various alternative estimates are, up to a multiplication factor, almost the same. This implies that the compensated differential exercises explained below will be almost identical irrespective of the estimation mechanism. We show in section 3 that indeed the valuation of public amenities is quantitatively very similar in OLS and ordered probit estimations.

Compensated Differentials

Once we have estimated the determinants of a life domain we can use this regression to address their relative importance and to provide their monetary value. Assume for expositional simplicity that we have a linear regression where the coefficients can be interpreted as marginal effects. The relative size of the estimated coefficients is a measure of their relative importance. For instance, we may find that:

$$QoL^d{}_{ij} = \hat{\beta}_1 z_{ij} + \hat{\beta}_2 income_{ij} + others + \varepsilon_{ij} \qquad (3)$$

where the hat indicates estimated coefficients, *z* is dummy variables indicating access to a public good and ε is the error term.

We can think of the estimated equation as an indifference curve. There are many values for the independent variables that would result in the same quality of life

satisfaction. Therefore, we can calculate how much one factor needs to increase to compensate for a decrease in the other. Other things being equal, two individuals (one with access to the public good and the other without access to it) will have the same satisfaction if:

$$\hat{\beta}_1 + \hat{\beta}_2 income_{with} = \hat{\beta}_2 income_{without}$$

Therefore, the change in income to compensate for the lack of the public good is $\Delta income = \frac{\hat{\beta}_1}{\hat{\beta}_2}$.

Since we are using two quality of life measures these values may differ among life domains. For instance, it may be that having access to a waste disposal system has an effect on housing satisfaction but no effect on life as a whole. Therefore, the monetary interpretation of the public good should be tied to the particular domain that is being considered.

Computing Indexes of Quality of Life

We follow the suggestions of van Praag and Ferrer-i-Carbonell (2010) to compute indexes of quality of life (one for each life satisfaction concept). The computations can be performed at the city and year level.

The steps to construct the index are the following:

i. Estimate the determinants of satisfaction with life or the satisfaction with some specific life domain (hosing in our case). Include household income as a determinant to compute money trade-offs for statistically significant variables as explained in the compensated differentials section. Since our quality of life regressions consider various cities, dummy variables for each city are included to capture the influence of unobserved features that are common to each one. Also time dummies are included to capture common trends.

ii. For each dwelling unit, each feature's equivalent in income can be computed as the product of the respective trade-off ratio and the value of

that feature (less a reference value) for that household. The reference value is the omitted category in the basic regression (e.g. not having access to electricity).

iii. Totaling for each household the contributions attributable to all urban features yields the total contribution (measured in equivalent income) those urban conditions make to life or housing satisfaction of that household.

iv. The final step is averaging households in cities and/or years as desired. The value will be the quality of urban life index (in equivalent income), according to satisfaction with life as a whole or with the housing satisfaction. Using these computations, cities/countries can be ranked. Results should be normalized so that the average individual valuation equals 100.

v. Sample weights ought to be used in computing the city/year means and standard errors. Therefore confidence intervals can also be provided.

4. Results

Table A2 in the appendix reports the regressions for the determinants of life and housing satisfaction for the two different mentioned periods (2008-2014 and 2008-2012) and with the two alternative econometric methods (OLS and Ordered Probit). The estimations are rather robust and explanatory variables present the expected signs. Greater life and housing satisfaction is significantly and positively related to having a greater per capita household income. The significance of this variable is fundamental to perform the public good valuation based on compensating differentials estimates. If income is not statistically significant there are no possible compensations and therefore the whole valuation method fails.

Divorced is the omitted category in marital status therefore the other marital status variables should be interpreted in relation to it. The coefficients are all positive suggesting that divorcees have the lowest life and housing satisfaction levels. The

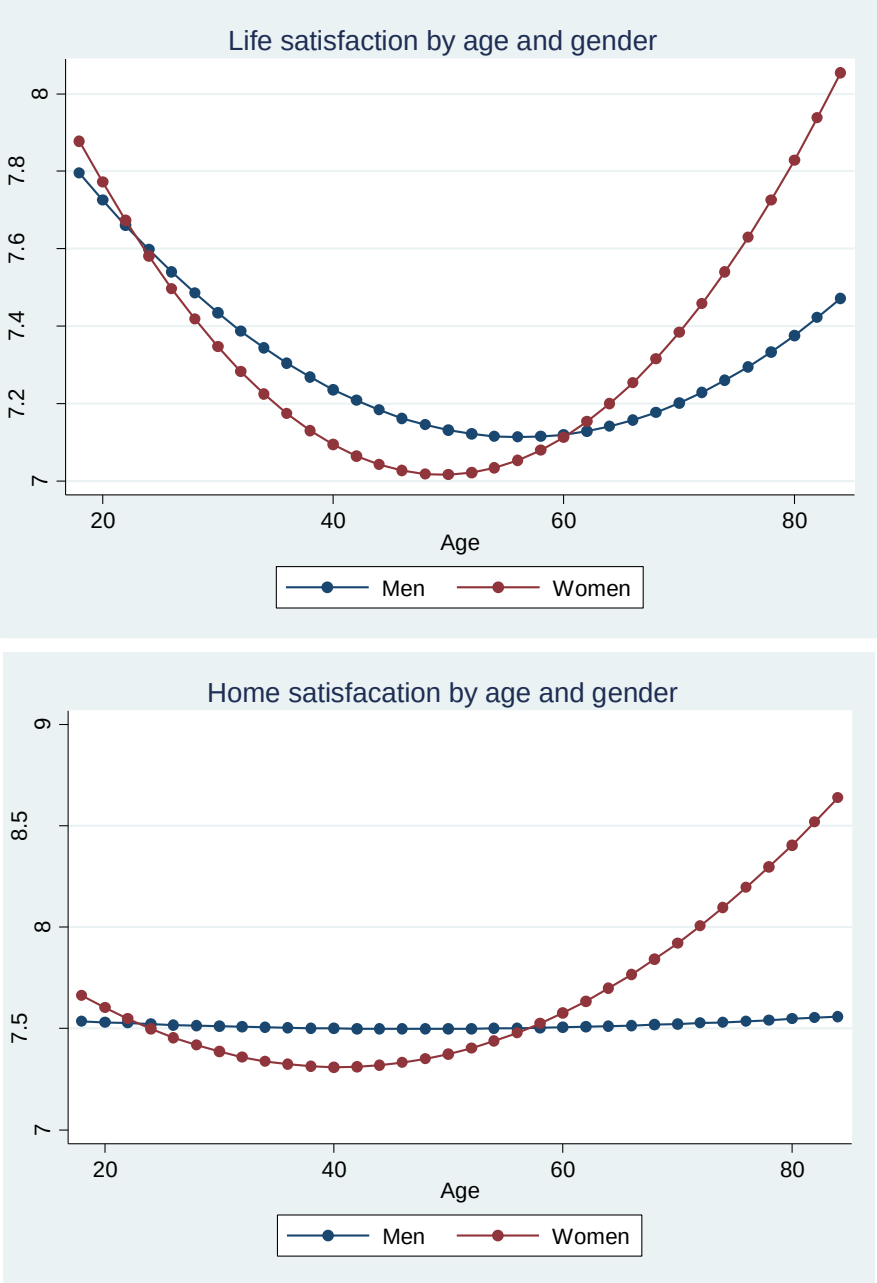
coefficient for singles is not statistically significant different from 0. The coefficient for married is the largest in life satisfaction. Thus our results suggest the following marital status satisfaction ordering: married, widowed, single and divorced.

Having up to primary education is the omitted education level category and not working (unemployed or inactive) the omitted labor status category. After controlling for the other demographic and socio economic indicators, we find no significant differences attributable to education. Being employed is associated with larger life satisfaction but has no significant association with housing satisfaction.

Age and gender are interacted. In the life satisfaction estimations, the age coefficient is negative and its squared positive implying that the relationship between life satisfaction and age is U shaped. Happiness decreases with age up to a turning point when minimum happiness is attained. After that, age and happiness are positively correlated. As seen in Figure 1, this turning point is different for males and females.[6] While women reach this minimum life satisfaction point at about 50 years old men do so in their sixties. Figure 1 also shows that the gender happiness gap changes with age. Between 25 and 55 years old, men tend to be more satisfied with life than females. This are the years were labor market activity is stronger. The opposite happens close and after retirement age.[7]

[6] Results based on OLS and ordered probit estimations are almost equal.
[7] See Arrosa and Gandelman (2016) for an analysis of the happiness gender gap.

Figure 1. Age and gender effects



Regarding housing specific variables, the estimation reports a negative significant relationship between housing satisfaction and household members per room, indicating a negative effect of home overcrowding. On the other hand, life and housing satisfaction are positively related to number of household members. We have a crude proxy for housing quality with two dummies referring to whether the house has access through a vicinity or if it is an independent house or apartment (the omitted variable is very low housing quality). The dummy for independent access to the house

of apartment is positive and statistically significant. It would be desirable to have more detailed information regarding quality of housing like ventilation, illumination, construction materials and eventual housing problems (e.g. humidify) but this information is not available in the ECAF survey.

Starting with public goods and amenities, life satisfaction is positively related with water and electricity regular provision, green spaces in the area, roads in good condition and security. House satisfaction is positively and significantly correlated to water and electricity provision, public transportation within three minutes, green spaces in the area, roads in good condition, street lightening and security.

In Table 3 we present the valuation of public goods and neighborhood amenities for the 2008-2012 period based on OLS and an ordered probit model. We find that estimations are of extremely similar magnitudes. The results (not reported) for the 2008-2014 period using a more restricted list of public goods and amenities is also very similar between both estimations options.

Table 3. Public good valuation based on life and housing satisfaction (2008-2012)

		Based on life satisfaction						Based on housing satisfaction					
		Ordered probit model			OLS			Ordered probit model			OLS		
		Valuation	Standard error		Valuation	Standard error		Valuation	Standard error		Valuation	Standard error	
Water frequency access ok	$	1218	366	***	1315	403	***	1371	614	***	1598	704	***
	%	315%	95%	***	340%	104%	***	354%	159%	***	413%	182%	***
Garbage disposal frequency ok	$	329	244		394	237	*	500	330	**	656	356	**
	%	85%	63%		102%	61%	*	129%	85%	**	170%	92%	**
Electricity frequency ok	$	1262	384	***	1251	367	***	1588	565	***	1682	509	***
	%	326%	99%	***	323%	95%	***	410%	146%	***	434%	131%	***
Transportation within three minutes	$	-99	318		-170	327		294	210		340	215	
	%	-26%	82%		-44%	85%		76%	54%		88%	56%	
Street lightening	$	4	243		3	261		640	368	**	588	361	*
	%	1%	63%		1%	67%		165%	95%	**	152%	93%	*
Roads in good condition	$	456	285	*	493	307	*	423	137	***	519	137	***
	%	118%	74%	*	127%	79%	*	109%	35%	***	134%	35%	***
Green spaces in the area	$	564	281	***	560	281	***	619	398	**	722	443	**
	%	146%	73%	***	145%	73%	***	160%	103%	**	187%	115%	**
Security	$	765	265	***	809	286	***	856	379	***	1047	421	***
	%	198%	68%	***	209%	74%	***	221%	98%	***	270%	109%	***

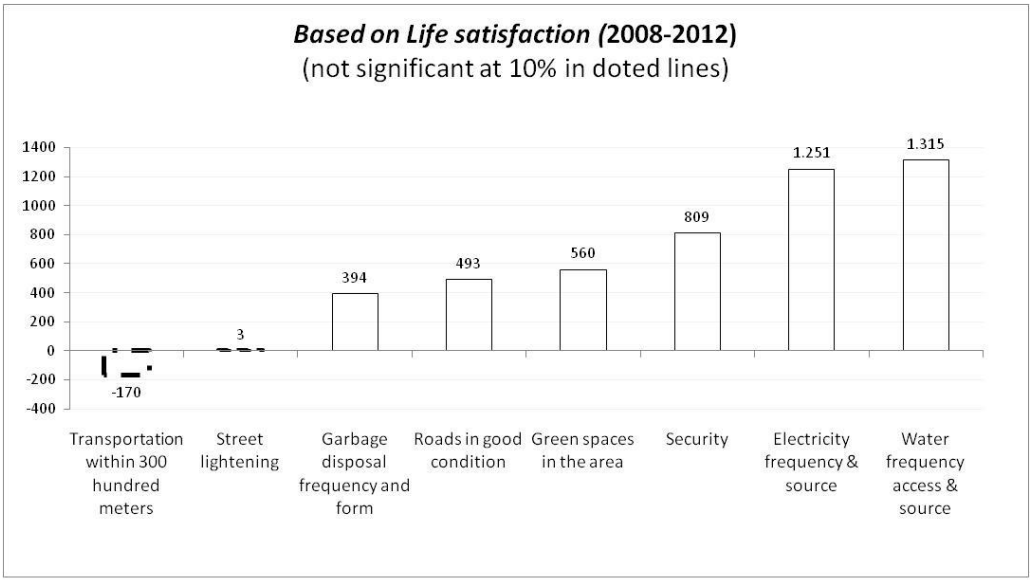
Note: The $-rows show the monetary valuation in 2011 PPP adjusted dollars. The %-rows show the valuation in percentage terms with respect to average per capita household income.

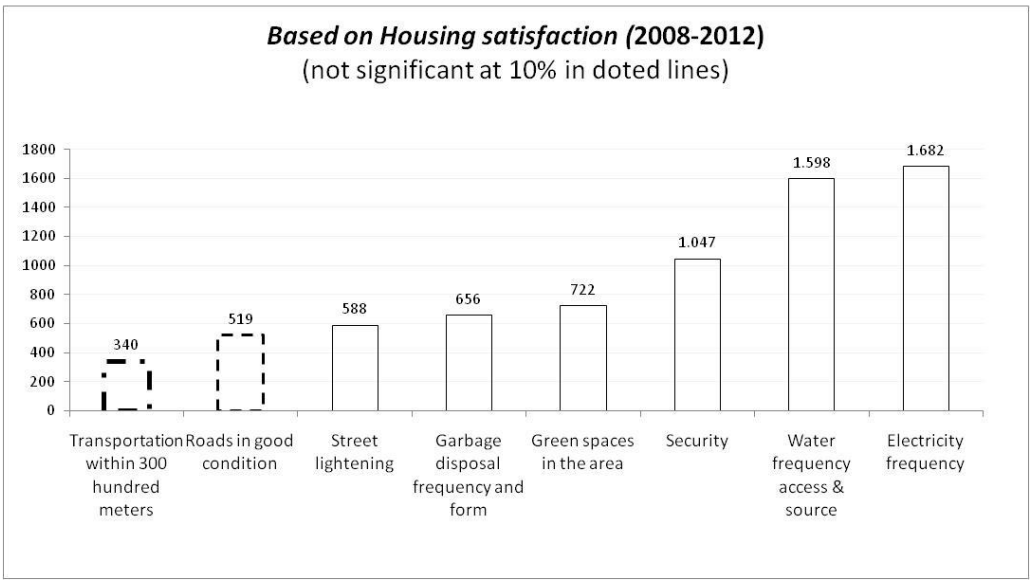
In Figure 2 we graphically report the valuations (form OLS regressions) in ascending order. The order of the magnitudes of impact of public goods and neighborhood amenities in life and housing satisfaction is similar but not equal. Both for life satisfaction and housing satisfaction we find that water and electricity are the ones that have the higher income equivalent value. In the life satisfaction valuations water access is valuated $1,315 and electricity $1,251. In the housing satisfaction valuations electricity is valued $1,682 and water $1,598. These figures are more than three times the average per capita income.

Security is the third in order of importance ($809 is the life satisfaction valuations and $1,047 in the housing satisfaction valuations). These figures represent about two times the average per capita household income. Access to green spaces in the area is the fourth most valued amenity both in the valuation based on life satisfaction and the valuation based on housing satisfaction, $560 and $722 respectively. Garbage disposal is valuated $394 according to the life satisfaction estimates and about $656 in the housing satisfaction estimates.

The valuation of the rest of the public goods and amenities is not statistically significant in either the life satisfaction o the housing satisfaction estimations. Roads in good conditions are valued about $493 in the life satisfaction estimates but are not statistically significant in the housing satisfaction estimates. On the other hand, living in a street with public lightening is valuated $588 in the housing satisfaction estimates but is not significant in life satisfaction. Finally, transportation with 3 minutes is not statistically significant in either valuation.

Figure 2. Valuation of public goods and neighborhood amenities
(annual 2011 PPP adjusted dollars)





In Figures 3 and 4 we present the results for the Quality of life index based on the 2008-2012 and the 2008-2014 periods. The difference is the set of public goods and amenities considered (larger in the first period and shorter in the second). We find that the city rankings based on life satisfaction and housing satisfaction are very similar. Medellin, Salto and Montevideo are the cities with the highest values for both the life satisfaction and housing satisfaction public goods and neighborhood amenities quality of life indicators. Overall, the representative samples of ECAF in these cities have better access to the most valued public goods and neighborhood amenities. On

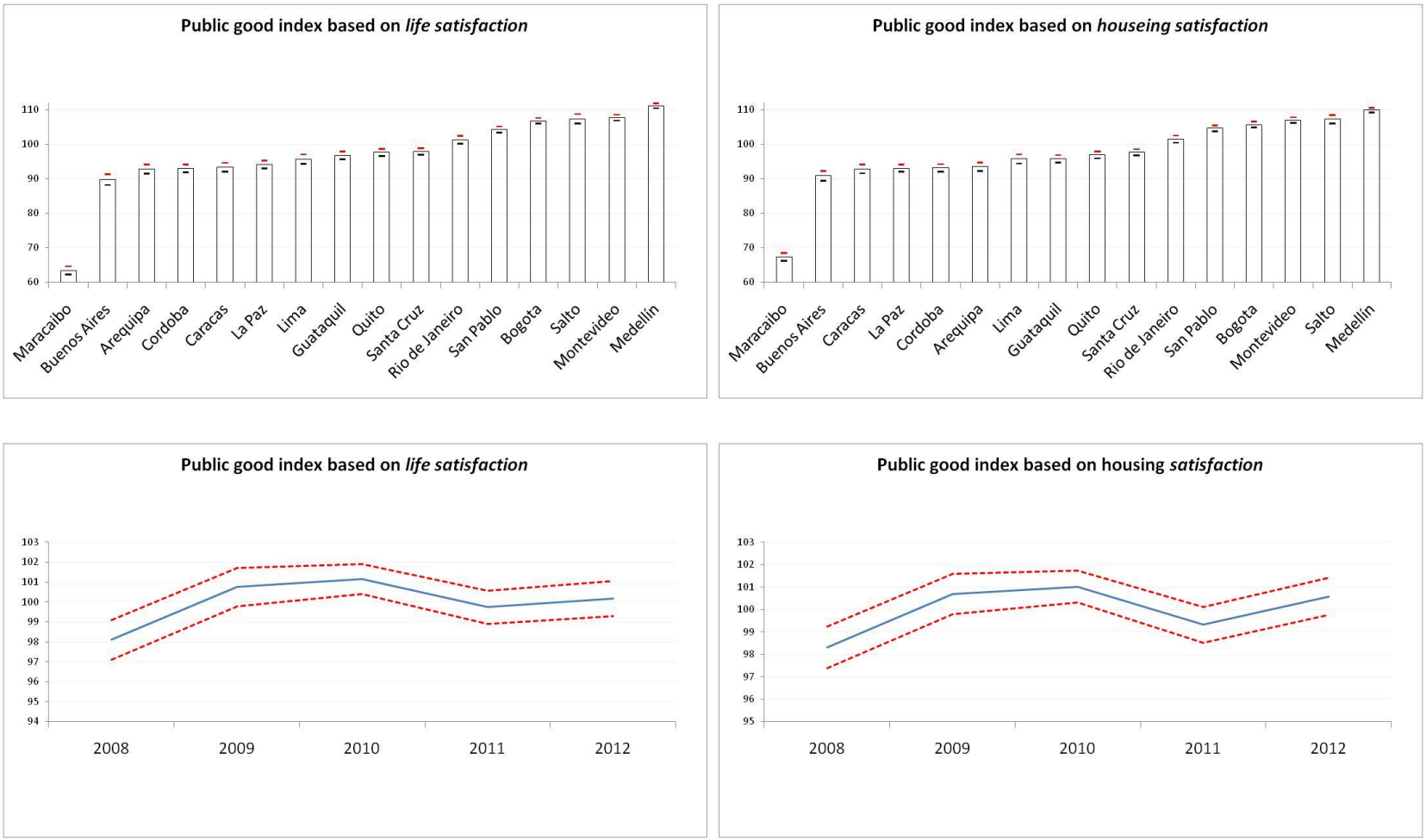
the other hand, Maracaibo has the worse results of public goods and amenities in quality of life. The difference with the other cities is large. According to our data less than 20% of habitants in Maracaibo have regular access to running water. Also, there are sizeable differences with respect to garbage disposal and availability of green spaces. Cordoba, Caracas, Arequipa and Buenos Aires are also at the bottom of the ranking but much closer to the rest of the cities considered in this paper.

In terms of over time evolution we find a decrease in 2013 and 2014 that although it is statistically significant it is not of a high magnitude. In Figure 5 and 6 we present the over time evolution of the quality of life indexes city by city.[8] It should be noted that the index might me not robust to changes in sampling. Therefore, it is important to have caution in the interpretation of the results, especially in changes in yearly relative rankings.

Finally, public goods and amenities have the potential to iron out disparities in life conditions among the population. The Pearson coefficient of correlation between the indexes and household income is positive and statistically significant but of law magnitude, about 0.07. The public goods and amenities considered in this paper are available for most of the population and are very highly valued. The Gini indicator of income inequality is about 0.48 for the overall sample. The Gini indicator for the quality of life index is about one forth of this value. Thus, despite richer individuals having better access, public goods and amenities are an enormous force in reducing inequalities within cities. In other words, deficiencies in the provision of public goods and neighborhood amenities affect much strongly the life of disadvantage sectors of the populations.

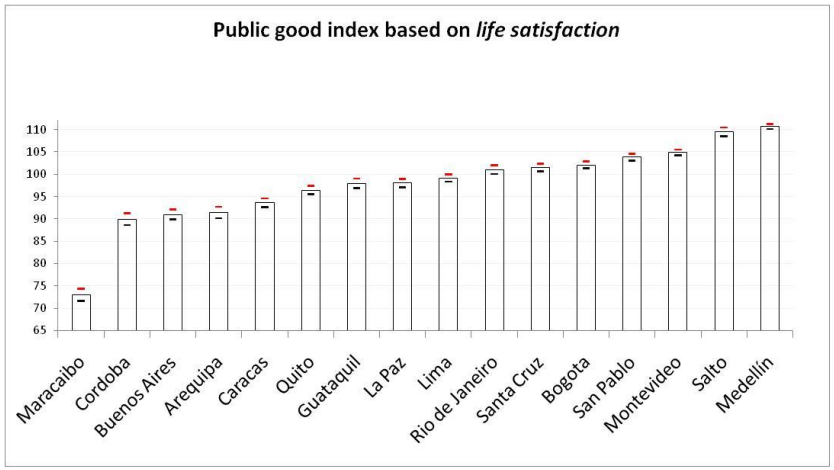
[8] In the appendix we present the mean and standard error used for computing this city indexes for life satisfaction and housing satisfaction and for the two sets of public goods considered (those available in 2008-2012 and those available in 2008-2014).

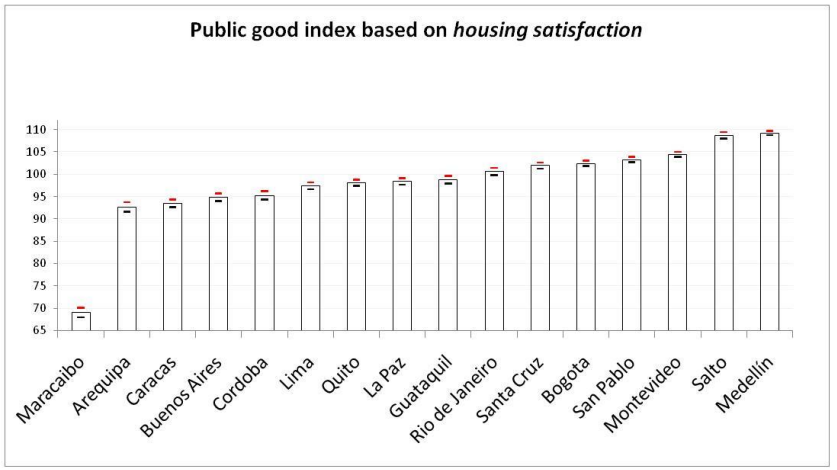
Figure 3. Quality of life indexes (2008-2012)

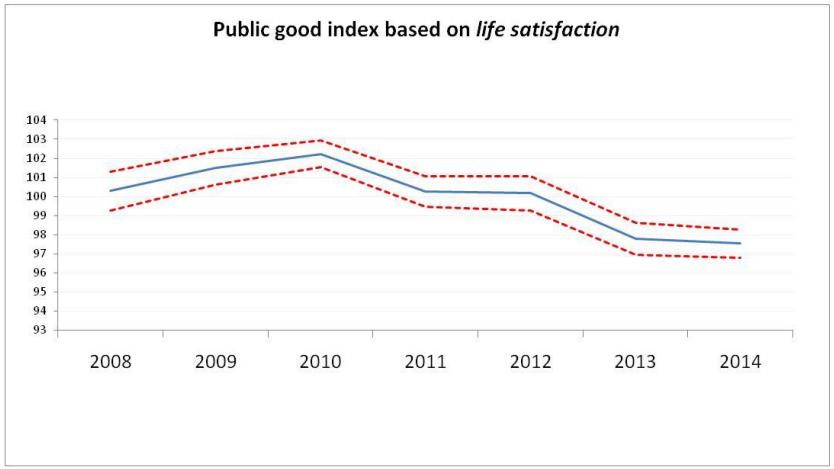


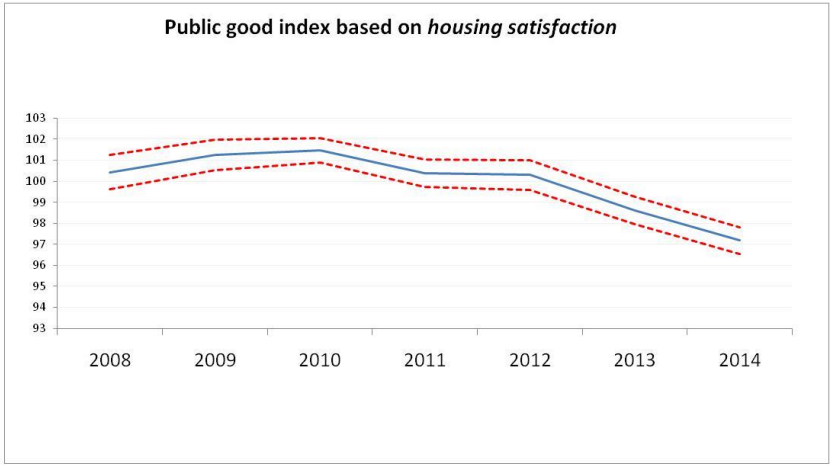
Note: confidence intervals at 95% level in dotted lines.

Figure 4. Quality of life indexes (2008-2014)









Note: confidence intervals at 95% level in dotted lines.

Figure 5. Quality of life indexes (based on satisfaction with life as a whole) by city (2008-2014)

Note: confidence intervals at 95% level in dotted lines.

Figure 6. Quality of life indexes on housing satisfaction by city (2008-2014)

Note: confidence intervals at 95% level in dotted lines.

5. Conclusions

In this paper we implemented a life satisfaction approach to public good valuation in seventeen Latin American cities based on the ECAF survey. We show that access to some basic public goods and neighborhood amenities are highly valuated by the population and lack of access to these basic needs implies a huge decrease in quality of life. In monetary terms, regular provision of electricity and running water are equivalent to more than doubling household income; i.e. for someone lacking either of these goods to be equally off it should have more than two times its household income. We also show that although richer people have better access to public goods and amenities, they are an important source to reduce economic inequality.

We provide evidence that there are no gains in performing the valuations using qualitative dependent variable models. OLS and ordered probit estimates were almost the same up to a scale factor. Therefore, the compensating differential that is at the bases of the valuation mechanism produce the same result in either type of estimation.

Based on the public good valuations, we illustrate how quality of life indexes can be computed to capture the impact of urban conditions on the city population. We argue that changes in sampling within city can affect the over time evolution of the quality of life indexes and therefore this rankings should be regarded with care. We found that Medellin, Salto and Montevideo are the cities with the better performance in terms of the relation between public goods and amenities and quality of life. On the other hand, Maracaibo has the worse results in terms of public good provision and overall quality of life.

Finally, we would like to make two additional suggestions for following up studies on urban conditions and overall quality of life indexes based on the ECAF survey. First, due to changes in the basic questionnaires we have to implement our estimates for two different periods considering more and less public goods and neighborhood amenities, 2008-2012 and 2008-2014 respectively. Regarding running water, electricity and garbage disposal in the shorter period there is information on

frequency of access and whether it was publicly provided. In the larger period there was information only on the frequency of access. We find that considering either definition of access (only frequency or frequency and whether it was publicly provided) produces similar valuations and similar quality of life indexes. Therefore, we consider that the frequency question is enough for the following up or the indexes.

Second, there are some dimensions of urban conditions that could be better measured. It would be advisable to include questions on the characteristics of dwellings, e.g. floor and wall materials or the existence of structural problems in the houses (humidity, problems in doors or windows, illumination and ventilation). It would also be advisable to include more information on pollution (water, air, sound or visual pollution) in the direct vicinity of the house and in the city in general. Availability of public transportation did not turn out significant in our estimates. Also, it would be worth to have better measures of travel times for the most common family destinations and to have measures of distance to work, school and sanitary services.

Appendix

Table A1. Auxiliary regression to estimate household income in 2011

Personal income per household member (PPP adjusted)	0.986***
	(0.011)
Female	-87.288
	(246.042)
Age	-41.951***
	(7.590)
Female*Age	9.900
	(12.018)
Age squared	0.481***
	(0.087)
Female*Age squared	-0.101
	(0.140)
Single	234.979***
	(32.060)
Married	191.257***
	(28.613)
Widowed	182.786***
	(58.128)
Secondary Education	271.001***
	(18.702)
University Education	585.013***
	(25.981)
Working	-2.320
	(43.140)
Constant	1,289.407***
	(171.117)
City Fixed Effects	Yes
Observations	18,318
R-squared	0.419

Note: Robust standard errors in parentheses *** statically significant at 1%, **statistically significant at 5%, *statistically significant at 10%

Table A2. Life and housing satisfaction determinants

	Life satisfaction (2008-2014)		Life satisfaction (2008-2012)		Housing satisfaction (2008-2014)		Housing satisfaction (2008-2012)	
	Ordered Probit	OLS	Ordered Probit	OLS	Ordered Probit	OLS	Ordered Probit	OLS
Household income per capita (PPP adjusted)	0.163***	0.327***	0.156***	0.316***	0.151***	0.293***	0.136***	0.262**
	(0,04)	(0,10)	(0,05)	(0,12)	(0,04)	(0,08)	(0,05)	(0,09)
Female	0,446	0,863	0,255	0,559	0,330	0,566	0.461	0,859
	(0,28)	(0,57)	(0,38)	(0,75)	(0,24)	(0,47)	(0,28)	(0,55)
Age	-0.018**	-0.039**	-0.026**	-0.052*	0.001	-0.003	0.001	-0.004
	(0,01)	(0,02)	(0,01)	(0,03)	(0,02)	(0,04)	(0,02)	(0,04)
Female*Age	-0.024*	-0.048	-0.015	-0.034	-0.022**	-0.040*	-0.027**	-0.053*
	(0,01)	(0,03)	(0,02)	(0,04)	(0,01)	(0,02)	(0,01)	(0,03)
Age squared	0.000188	0.000377	0.000275*	0.000540	0,00000108	0,0000604	0,00000656	0,0000715
	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)
Female*Age squared	0,000278*	0,000538*	0,000149	0,000323	0.000295**	0.000530**	0.000343**	0.000640**
	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)
Single	0.087	0.184	0.076	0.153	0.013	-0.008	0.009	-0.039
	(0,08)	(0,19)	(0,09)	(0,22)	(0,03)	(0,04)	(0,03)	(0,05)
Married	0.217***	0.456**	0.207***	0.435**	0.052***	0.093***	0.058***	0.092***
	(0,07)	(0,17)	(0,08)	(0,19)	(0,02)	(0,02)	(0,02)	(0,02)
Widowed	0.0946*	0,15	0.0977	0,14	0.108*	0,176	0.165**	0,284
	(0,05)	(0,11)	(0,06)	(0,13)	(0,06)	(0,11)	(0,09)	(0,18)
Secondary Education	0,009	0,0835	-0,0281	0,0022	-0,0350	-0,0159	-0,0460	-0,0450
	(0,04)	(0,07)	(0,04)	(0,08)	(0,05)	(0,10)	(0,04)	(0,05)
University Education	0.082	0.248	0.022	0.122	0.046	0.152	0.007	0.062
	(0,09)	(0,15)	(0,09)	(0,15)	(0,09)	(0,14)	(0,08)	(0,14)
Employed	0.0731***	0.140***	0.0574***	0.111***	0,0510	0,117	0,0590	0,139
	(0,01)	(0,02)	(0,01)	(0,02)	(0,03)	(0,07)	(0,04)	(0,09)
Household members per room	-0,0312	-0,07	-0,0330	-0,0740	-0.141***	-0.307***	-0.141***	-0.308***
	(0,03)	(0,07)	(0,03)	(0,07)	(0,02)	(0,03)	(0,01)	(0,02)
Household size	0.0238***	0.0470***	0.0200**	0.0410**	0.0550***	0.129***	0.0480***	0.107***
	(0,01)	(0,02)	(0,01)	(0,02)	(0,01)	(0,02)	(0,01)	(0,02)
Household access trough common vicinity	0,0850	0,178	0,0510	0,094	0.145***	0.365**	0,0679	0,192
	(0,08)	(0,16)	(0,10)	(0,21)	(0,05)	(0,13)	(0,06)	(0,14)
Independent house or apartment	0.256***	0.538***	0.210**	0.430*	0.427***	0.985***	0.304***	0.719***
	(0,07)	(0,17)	(0,10)	(0,21)	(0,03)	(0,10)	(0,04)	(0,11)

Table A2. (continuation)

Water frequency access ok	0,0864	0,178			0.152***	0.337***		
	(0,08)	(0,16)			(0,05)	(0,10)		
Water frequency access ok and publicly provided			0.190***	0.415***			0.186***	0.419***
			(0,02)	(0,04)			(0,03)	(0,07)
Garbage disposal frequency ok	0,0262	0,0840			0,0460	0,121		
	(0,07)	(0,13)			(0,04)	(0,08)		
Garbage disposal frequency ok and publicly provided			0,0511	0,125			0,068	0,172
			(0,04)	(0,08)			(0,05)	(0,11)
Electricity frequency ok	0.208***	0.416***			0.177***	0.350***		
	(0,04)	(0,08)			(0,03)	(0,06)		
Electricity frequency ok and publicly provided			0.197***	0.395***			0.216***	0.441***
			(0,05)	(0,12)			(0,04)	(0,09)
Public transportation within 3 minutes	0,0356	0,0590	-0,016	-0,0540	0.0881***	0.209**	0,0399	0,0897
	(0,04)	(0,08)	(0,05)	(0,11)	(0,03)	(0,09)	(0,03)	(0,06)
Green spaces in the area			0.0880***	0.177***			0.0840*	0.189**
			(0,02)	(0,03)			(0,05)	(0,09)
Roads in good condition			0.0719**	0.156**			0.0580**	0.136**
			(0,03)	(0,07)			(0,02)	(0,05)
Street lightening			0,00100	0,00100			0.0870***	0.154**
			(0,04)	(0,08)			(0,03)	(0,07)
Security	0.114***	0.239***	0.119***	0.255***	0.111***	0.264***	0.116***	0.274***
	(0,02)	(0,05)	(0,03)	(0,07)	(0,01)	(0,03)	(0,02)	(0,05)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28.845	28.845	20.498	20.498	28.932	28.932	20.586	20.586
R-squared		0,116		0,129		0,119		0,121

Note: Robust standard errors in parentheses *** statically significant at 1%, **statistically significant at 5%, *statistically significant at 10%

Table A3: Quality of life index by city and year

		2008		2009		2010		2011		2012	
		Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.
Based on life satisfaction	Buenos Aires	89.0	2.2	91.5	1.6	90.3	1.4	90.7	1.5	87.9	2.0
	Cordoba	89.9	1.3	96.7	1.4	88.6	1.4	94.1	1.1	96.0	1.2
	La Paz	94.3	1.3	89.4	1.6	93.1	1.1	93.3	1.2	100.4	1.2
	Santa Cruz	93.3	1.4	98.3	1.1	101.5	0.8	100.9	0.8	95.3	1.2
	San Pablo	99.3	1.1	104.0	1.2	107.7	0.8	104.4	1.0	106.0	1.0
	Rio de Janeiro	103.6	1.2	101.2	1.4	102.8	1.1	101.2	1.1	98.0	1.4
	Bogota	104.7	1.1	109.9	0.8	105.2	0.8	105.9	0.9	108.4	0.9
	Medellin	109.0	1.0	112.8	0.7	112.7	0.6	108.8	0.9	112.6	0.7
	Quito	92.5	1.4	98.7	1.2	96.1	1.2	99.2	0.9	101.6	1.0
	Guayaqui	96.5	1.5	94.5	1.7	92.7	1.2	101.6	0.8	98.7	1.2
	Lima	92.4	2.2	98.0	1.3	97.9	1.3	93.3	1.5	96.5	1.4
	Arequipa	92.5	1.8	100.1	1.3	91.7	1.3	87.5	1.6	93.0	1.4
	Montevideo	105.0	1.1	108.8	1.0	108.4	0.9	107.7	0.8	108.8	0.9
	Salto	104.2	1.1	107.7	0.9	109.9	0.8	107.8	0.7	107.4	2.4
	Caracas	94.6	1.4	94.5	1.7	88.9	1.3	93.3	1.5	95.7	1.5
	Maracaibo	65.9	1.6	61.7	1.3	74.8	1.1	61.6	1.2	54.3	1.4
Based on life satisfaction	Buenos Aires	89.8	2.0	92.6	1.5	90.8	1.3	92.2	1.4	89.3	1.8
	Cordoba	89.2	1.3	96.7	1.3	89.3	1.3	94.4	1.1	96.3	1.2
	La Paz	92.8	1.3	88.5	1.5	92.5	1.1	91.3	1.1	99.9	1.1
	Santa Cruz	92.4	1.3	98.3	1.1	100.8	0.7	100.6	0.8	95.9	1.1
	San Pablo	100.1	1.0	104.3	1.1	107.9	0.8	104.7	0.9	106.3	0.9
	Rio de Janeiro	104.3	1.1	101.6	1.3	102.3	1.0	100.4	1.1	99.2	1.3
	Bogota	103.8	1.2	108.3	0.8	104.6	0.8	103.8	0.9	108.0	0.9
	Medellin	108.4	1.0	111.6	0.7	110.8	0.6	107.4	0.9	111.4	0.7
	Quito	92.2	1.3	98.7	1.2	94.9	1.1	98.0	0.9	100.8	1.0
	Guayaqui	95.2	1.4	94.5	1.6	91.3	1.1	99.9	0.8	97.9	1.1
	Lima	92.9	2.2	97.7	1.2	98.2	1.2	92.7	1.5	96.8	1.3
	Arequipa	93.7	1.7	100.0	1.3	92.7	1.3	88.0	1.5	93.7	1.3
	Montevideo	104.3	1.1	107.5	1.0	107.9	0.8	106.9	0.8	108.2	0.9
	Salto	104.0	1.0	106.5	0.9	109.7	0.7	107.9	0.7	108.0	2.2
	Caracas	94.0	1.4	93.3	1.7	88.9	1.2	92.7	1.5	95.8	1.4
	Maracaibo	68.4	1.5	66.7	1.2	77.2	1.0	65.4	1.2	60.0	1.3

Table A4: Quality of life index by city and year

		2008		2009		2010		2011		2012		2013		2014	
		Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.
Based on life satisfaction	Buenos Aires	93.4	1.8	99.4	1.4	95.5	1.3	95.5	1.3	87.1	2.2	89.9	1.2	87.8	1.0
	Cordoba	89.5	1.7	90.0	1.7	86.6	1.4	91.4	1.3	92.2	1.6				
	La Paz	100.9	1.4	93.4	1.5	96.3	1.2	95.3	1.3	101.2	1.2	99.8	1.1	99.7	0.8
	Santa Cruz	101.9	1.3	100.8	1.0	104.1	0.8	104.4	0.9	95.3	1.4	102.5	1.0		
	San Pablo	103.7	1.2	105.1	1.1	107.4	0.9	103.8	1.0	103.8	1.2	102.9	1.0	100.3	0.7
	Rio de Janeiro	104.4	1.2	104.1	1.2	105.6	0.9	102.2	1.1	101.4	1.2	89.6	1.2		
	Bogota	99.9	1.3	104.6	1.1	99.4	1.1	102.8	1.0	102.2	1.1	101.8	0.8	103.5	0.8
	Medellin	108.5	1.0	110.6	0.8	111.9	0.5	109.3	0.8	112.1	0.6	111.5	0.6		
	Quito	90.4	1.5	95.9	1.5	95.0	1.3	96.1	1.0	98.9	1.1	95.4	1.2	102.6	0.7
	Guayaqui	95.6	1.4	92.7	1.6	99.9	1.0	103.6	0.8	99.1	1.4	94.5	1.7		
	Lima	92.8	1.8	99.5	1.1	101.2	0.9	97.9	1.1	100.9	1.0	101.6	1.0	98.8	0.8
	Arequipa	89.7	1.8	99.1	1.2	90.1	1.4	87.5	1.5	90.9	1.4				
	Montevideo	107.1	0.9	107.1	0.9	104.8	1.0	100.0	0.9	105.2	0.9	104.4	0.9	105.5	0.6
	Salto	110.0	1.0	111.1	0.8	108.8	0.7	110.1	0.7	107.9	1.6				
	Caracas	98.4	1.3	93.9	1.7	94.8	1.1	91.6	1.4	99.9	1.3	91.9	1.1	86.0	1.1
	Maracaibo	79.8	1.8	73.8	1.5	81.5	1.2	71.2	1.4	62.4	1.6				
Based on housing satisfaction	Buenos Aires	95.1	1.4	101.0	1.0	98.2	0.9	98.6	1.0	92.1	1.6	93.3	0.9	93.8	0.7
	Cordoba	94.5	1.2	95.3	1.2	93.1	1.0	96.6	0.9	96.6	1.2				
	La Paz	101.5	1.0	94.6	1.1	97.3	0.9	96.8	1.0	100.8	1.0	98.8	0.9	99.8	0.7
	Santa Cruz	102.4	0.9	100.8	0.8	103.7	0.6	104.9	0.6	96.9	1.0	102.7	0.8		
	San Pablo	104.4	0.9	104.4	0.9	106.8	0.7	103.6	0.8	104.0	0.9	103.2	0.7	96.9	0.7
	Rio de Janeiro	103.8	1.0	103.8	0.9	102.7	0.9	102.2	0.9	100.4	1.1	91.8	0.9		
	Bogota	99.6	1.0	104.6	0.8	99.5	0.8	103.3	0.9	103.0	0.9	102.4	0.6	103.9	0.6
	Medellin	106.7	0.9	109.2	0.6	110.4	0.4	108.3	0.6	110.6	0.5	109.7	0.5		
	Quito	94.4	1.1	97.4	1.1	95.7	1.0	98.1	0.8	100.4	0.8	96.6	1.0	103.0	0.6
	Guayaqui	96.7	1.2	94.3	1.3	100.0	0.8	103.0	0.7	100.7	1.0	95.9	1.4		
	Lima	92.3	1.6	98.0	1.0	99.4	0.8	95.7	1.0	99.2	0.9	99.2	0.9	96.8	0.7
	Arequipa	91.0	1.5	98.4	1.0	91.8	1.1	90.1	1.2	92.1	1.2				
	Montevideo	105.8	0.8	106.1	0.8	104.9	0.8	99.6	0.7	104.6	0.8	104.8	0.7	105.3	0.5
	Salto	109.3	0.7	109.3	0.7	108.2	0.6	109.2	0.5	107.7	1.1				
	Caracas	96.6	1.2	95.4	1.3	93.3	1.0	92.1	1.1	97.5	1.2	93.2	0.9	87.2	0.9
	Maracaibo	73.8	1.6	66.2	1.2	75.2	1.1	70.7	1.1	61.7	1.2				

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