THE QUALITY OF LIFE OF URBAN NEIGHBORHOODS IN BOLIVIA:
A case of study of the Great La Paz and Santa Cruz *

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Abstract

This paper presents Quality of Life (QofL) estimates at the household and neighborhood levels for the two biggest metropolitan areas of Bolivia: the Great La Paz (the combination of the cities of La Paz and El Alto) and the city of Santa Cruz. We define QofL as a weighted sum of different livability dimensions including (1) housing quality and accessibility features, and (2) environmental amenities such as local public goods and neighborhood externalities. We use two approaches to estimate the weights for the different livability dimensions: (1) an equilibrium-revealed preference approach, that uses hedonic regression models to estimate equilibrium *market* and *implicit* prices; and (2) a disequilibrium-life satisfaction approach, that adds disequilibrium *shadow costs* to the equilibrium prices. Both, our equilibrium price and disequilibrium shadow cost estimates test for problems that may bias point estimates and standard errors including non-random samples, left out environmental amenities and neighborhood specific effects and the spatial structure of the data. Furthermore, our paper explores the contribution of local public goods and neighborhood externalities to the level of inequality of the QofL and the patterns of spatial segregation.

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1 Introduction

Defining an appropriate concept, as well as an appropriate measure, of the *well-being* or the *quality of life* of a given population has been a debated and controversial issue. Between and within-country welfare comparisons are traditionally based on per-capita consumption measures such as averages or poverty rates. These measures assume that well-being is associated with the consumption of *market* goods and services, which are easily aggregated into a composite measure of individual well-being by prices - the individual's relative valuation of goods and services in terms of utility. Social welfare is obtained by aggregating individuals' welfare using an increasing (and usually concave) social welfare function. An alternative approach is the so called "unsatisfied basic needs" (UBN), which defines welfare as a state of satisfaction of basic human needs such as adequate access to housing, basic services, education and health. It is important to notice that the aggregation of different "basic needs" into a composite measure of individual welfare use either arbitrary weights or intersection/union schemes that have neither a justification nor a clear interpretation.[1]

Both approaches have advantages and disadvantages. On the one hand, the aggregation procedures of the traditional approach have a clear justification and interpretation at the cost of leaving aside many *non-market* goods and services, including local public goods and neighborhood externalities. On the other hand, the UBN approach may include many *non-market* welfare domains at the cost of using arbitrary procedures of aggregation. A flourishing literature in urban economics combines the strengths of both methods to compare the quality of life (QofL) across cities[2]. This literature defines the QofL of a city as the livability of its built and natural environment. We use these methods to measure and analyze the QofL of urban neighborhoods in the two biggest metropolitan areas of Bolivia: the Great La Paz (the union of the cities of La Paz and El Alto) and the city of Santa Cruz. The main objectives of our paper are: (1) to analyze the relative importance of different environmental amenities to the QofL; (2) to construct measures of QofL at the neighborhood level; and (3) to analyze the determinants of their inequality and their spatial distribution.

The remaining of the paper is organized as follows. Section 2 discuss the methods for the measurement of the QofL. Section 3 describes the data and the chosen cities. Section 4 and 5 present equilibrium-revealed preference and disequilibrium-life satisfaction estimates of the *market* and *implicit* prices of housing quality and environmental amenities. Section 6 presents our QofL estimates. Section 7 presents some policy implications and potential applications for monitoring the QofL. Section 8 concludes.

[1] See Hernani-Limarino et. al.(2008)[10] for a discussion of the UBN approach for the case of Bolivia.

[2] See Gyourko et. al. (1999) [6] for a review of theory and applications

2 Measuring the Quality of Life

Measuring individuals' and society's well-being or quality of life (QofL) is conceptually and empirically challenging. Three are the main challenges of any measure of QofL:

1. the selection and measurement of QofL domains (or welfare dimensions);
2. the aggregation of the domains into a composite (scalar) measure of individual QofL; and
3. the aggregation of individuals' QofL into a composite (scalar) measure of society's QofL at some particular level such as neighborhoods, cities or countries.

2.1 The selection and measurement of QofL domains

Aristotle, in his *Nicomachean Ethics*, settled on the notion of "eudaimonia", a Greek term often translated as happiness, as central to the measurement of well-being. The neologism livability, from the adjective liv(e)able, is now often applied to the built and natural environment of a town or city. Few would disagree with the importance of environmental amenities, as well as housing quality and accessibility features, to the QofL of individuals. When a household moves to a city and has to choose a residence, it chooses not only space and accessibility features but also environmental amenities. Leaving budget constrains considerations aside, people would prefer better houses as well as better *non- market* spatial attributes such as the availability of educational and health services, a variety of shopping and recreational opportunities, short commutes, a temperate climate, lower crime rates and even a given ethnic composition of the community.

An important research program in urban economics has been to try to infer differences in QofL between cities from the differences in their built or natural environment. Following Fujita (1989), two are the key QofL domains in this literature: (1) housing quality and accessibility features; and (2) built or natural environmental amenities, which includes local public goods[3] and neighborhood externalities. Housing quality features are related to the need of some land as well as the size and quality of the house itself. Accessibility features includes both pecuniary and time costs associated with getting to and from work, visiting relatives and friends, shopping and other such activities. Neighborhood externalities are related to the density and the composition of neighborhoods.

[3] Local public goods can be classified, according to their spatial dimension, as (i) national public goods; (ii) city public goods; (iii) super-neighborhood public goods; and (iv) neighborhood public goods. National public goods are those whose benefits are constant over a nation (e.g. national defense). City public goods are those whose benefits are confined within a city and its service level is invariant within a city. Super-neighborhood public goods are those whose benefits a confined within a city but its service level vary between neighborhoods. Finally, neighborhood public goods are those whose benefits are confined within a neighborhood and its service level is invariant within a given neighborhood.

Crowding externalities are usually associated with the lower environmental quality due to increases in the density of households, partly because of the increase in noise, littering, crimes and so on; and partly because of a decrease in open space and green areas in the neighborhood. *Traffic congestion externalities* arise when additional cars adds to the level of increasing travel time for all other, i.e. to the level of traffic congestion. Finally, *racial externalities* arise when more than one racial or ethnic group lives in a city and some groups have prejudices against others to the level that the prejudice group feels that they suffer from the presence of these other groups in the neighborhood[4].Ideally, we would include all these domains in our analysis of QofL. However, reliable data is available only for some particular domains. As we will discuss later, this omitted variable problem may pose a serious problem for the identification of implicit prices of the included environmental amenities.

In our analysis of the QofL, housing features are measured by the quality of the materials used in the floor, the interior and exterior roofs and the interior and exterior walls; the number of rooms, bedrooms and bathrooms; and the availability of water, sewage and electricity and telephone services. Local public goods included are the availability of public educational and public health facilities, public transportation within the neighborhood; and the neighborhood's access to street lights, paved or stoned streets, waste disposal services, sewage and pipe-water network, phone network and electricity network. We proxy crowding externalities by the number of people per squared kilometer and the neighborhood's reported crime rate. We proxy traffic congestion externalities by the number of cars in the neighborhood (to the squared and fourth power). We test the presence of racial externalities including the percentage of indigenous people in the neighborhood. Finally, we also include the neighborhood's centroid altitude as an externality. A detailed description of the construction and sources of information for each variable can be found in Appendix A.

2.2 The aggregation of QofL domains into an individual QofL measure

We define QofL as the weighted sum of a set of housing quality and accessibility features (h) and a set of neighborhood environmental amenities (A). Formally, the QofL of household i in neighborhood j can be written as:

[4]In the study of racial or ethnic externalities it is important to distinguish between several terms. *Prejudice* is an attitude (or preference) of an individual toward a particular group of people. *Discrimination*, is a behavior that denies one group of people rights and opportunities given to others. Finally, *segregation* is the actual physical separation of different groups of people. For further details, see Yinger (1976, p.383). As recognized by Fujita (1989), a fundamental issue in the study of racial or ethnic externalities is whether we approve of the preferences of individual who are racially or ethnically prejudiced. We avoid such moral and political issues and focus on the economic consequences of racial externalities. However, it should be noted that one should be very careful with the results of economic analysis, since even when complete segregation is economically efficient it could foster racial tensions in the long run.

$$QofL_{ij} = w^h h_{ij} + w^A A_j \tag{1}$$

where w^h and w^A are the weights of the housing quality and accessibility features and the environmental amenities, respectively. It is common practice to make the weights equal to their *market* and *implicit* prices, respectively. This procedure makes easier not only the interpretation of weights -they will represent the benefit, in utility terms, of an additional unit of a given feature or amenity but also the interpretation of QofL indexes. We use two complementary approaches for the estimation of the set of implicit prices: (1) an equilibrium-revealed preference approach, and (2) a disequilibrium-life satisfaction approach.

2.2.1 An equilibrium-revealed preference approach

A popular approach, due to Rosen (1979[15]) and Roback (1980[13], 1982[14]), rest on the idea that households correctly perceive differences in livability across areas and, if migration costs are low, then higher differentiated products will sell for a premium. Therefore, in equilibrium, hedonic methods will reveal the implicit prices of different environmental amenities, which can be used to compare marginal people's valuation of different local public good and neighborhood externalities, and to construct QofL measures. More formally, consider a city-economy where households derive utility from the consumption of a set of housing quality and accessibility features and a set of environmental amenities. Assume that households have a fixed endowment of income, y, which can be used to buy quality and accessibility features in a competitive housing market. Assume also that, once they choose the location, they also receive the benefits of the neighborhood's public goods and the costs of its externalities. In this model prices in the housing market will depend not only on the income distribution but also on the set of environmental amenities[5], i.e. the household's indirect utility function will be given by:

$$W(y, p(A); A) \tag{2}$$

where p represents the rental of housing, which depends on the set of environmental amenities.

Notice that, in equilibrium, all households with the same income level should achieve the same level of utility independently of whether they enjoy the benefits of public goods or suffer the consequences of neighborhood externalities. Notice also that the rental price of housing will reflect not the relative valuation of the housing quality and accessibility features but also the relative valuation of environmental amenities. In other words, the housing market will also function as a market for the environmental amenities, and beneficial environmental amenities will sell for a premium. Formally, we will have that in equilibrium:

[5]Notice that we assume that both, the income distribution and the set of environmental amenities, are exogenously given.

$$W(y, p(A); A) = W(y, p(0); 0) \tag{3}$$

In this approach, rental price differentials, $p(A) - p(0)$, will correspond to household's marginal willing to pay for the set of environmental amenities. Therefore, we can use standard hedonic regression models to estimate the implicit prices of the set of environmental amenities. A standard hedonic regression model can be written as:

$$ln(p_{ij}) = \beta_0 + \beta_1 h_{ij} + \beta_2 A_j + v_{ij} \tag{4}$$

where β_0 is a constant term, β_1 the *market* price semi-elasticity to changes in housing quality and accessibility features, β_2 the *implicit* price semi-elasticity to changes in the set of environmental amenities, and v_{ij} an error term. Notice that once we get estimates of the parameters in equation (4), we can recover *market* and *implicit* prices, in monetary terms, by calculating the benefit for the average household of an additional unit of a given housing quality or accessibility feature, or a given environmental amenity. Formally,

$$\begin{aligned} w^h &= \frac{\partial W_{ij}}{\partial h_{ij}} = \beta_1 * \bar{p} \\ w^A &= \frac{\partial W_{ij}}{\partial A_j} = \beta_2 * \bar{p} \end{aligned} \tag{5}$$

where $\bar{p}$ is the sample mean of the rental price of housing.

Several problems may complicate the consistent estimation of a set of *market* and *implicit* prices. First, notice that the estimation of *implicit* prices for environmental amenities requires not only a representative sample of households but also a representative sample of neighborhoods. We will describe the data in the next section. For now, let us just say that we include 223 neighborhoods out of 441 in the Great La Paz and 125 neighborhoods out of 265 in the city of Santa Cruz. Second, omitted environmental amenities and *neighborhood effects* may result in inconsistent OLS estimates and downward biased OLS standard errors, respectively[6]. Conventional haussman tests can help us determine whether omitted environmental amenities are a problem or not. Third,

[6]Consider the case where the error term in equation (1) is given by $v_{ij} = \mu_j + u_{ij}$, a combination of a neighborhood specific component, μ_j, and an idiosyncratic component, u_{ij}. On the one hand, if the neighborhood-specific component reflects left out local public goods or neighborhoods externalities, then OLS-estimates of the *implicit* prices will be inconsistent. On the other hand, if the neighborhood-specific component represents shocks that are uncontrolled but shared by households within the same neighborhood, i.e. if $\sigma^2_\mu > 0$, then OLS-estimates of the implicit prices will be consistent but their standard errors will be biased downwards. The magnitude of the bias imparted to the OLS standard errors will depend on the importance of "design effects" present in the data. The design effect for the j^{th} neighborhood can be defined as $d_j = 1 + (N_j - 1)\rho$, where N_j is the number of houses in the j^{th} neighborhood sample and ρ is the common correlation coefficient between the household's composite errors within the neighborhood.

the spatial structure of the data may require special estimation procedures to account for potential spatial heterogeneity, spatial lag dependence and spatial error dependence in our models[7].

2.2.2 A disequilibrium-life satisfaction approach

The equilibrium-revealed preference approach assumes not only that the housing market is competitive, with all households having perfect information, but also that the housing market is in equilibrium, i.e. that households continually reevaluate their location and adjust their residential choice to changing circumstances. Certainly, the equilibrium assumption is questionable for owners, some of which had bought their houses many years ago, but is less doubtfully for tenants, as long as monetary and non-monetary switching cost are low. A complementary approach to the equilibrium-revealed preference approach is the so called disequilibrium-life satisfaction approach (See by Frey et. al. (2004)[4] and van Praag and Baarsma (2004)[17], which allow us to test whether the equilibrium condition holds and, in case of rejection of the equilibrium hypothesis, to adjust prices by disequilibrium *residual* shadow costs.

To implement this approach, we need to assume that utility is a cardinal and interpersonal comparable concept and that it can be measured. Notice that if we were able to observe de utility distribution, then we may test whether the equilibrium condition holds. If all differences in local public goods and neighborhood externalities are materialized in price differentials, then we should expect no differences in utility among households with the same income level -i.e. we will observe $W(y, p(A); A) = W(y, p(0); 0)$. On the contrary, if differences in local public goods and neighborhood externalities are not entirely materialized in price differentials, then we will observe $W(y, p(A); A) \neq W(y, p(0); 0)$. In fact, in disequilibrium, price differentials will be an incomplete estimate of the contribution of environmental amenities to households' utility, since there will be a *residual* shadow cost, Δy, that is not arbitraged by the housing market. Formally,

$$W(y + \Delta y, p(A); A) = W(y, p(0); 0) \tag{6}$$

To implement this approach empirically, we need a measure of the households' experienced utility. A standard proxy for households' experience utility

[7]To test the sensitivity of our implicit price estimates due to problems of spatial lag dependence and spatial error dependence we estimate two alternative models, respectively:

$$ln(p_{ij}) = W * ln(p_{ij}) + \beta_0 + \beta_1 h_{ij} + \beta_2 A_j + v_{ij}$$

$$ln(p_{ij}) = \beta_0 + \beta_1 h_{ij} + \beta_2 A_j + W * v_{ij}$$

where W is a spatial weighting matrix. We use two alternative specifications for this matrix: (1) contiguity relationships, and (2) nearest neighborhoods within distance bands. Both specifications are described in detail in Appendix B is the household head perception of *overall life satisfaction* captured by the "cantril-ladder" question:

- *"On the whole, are you completely satisfied (5), very satisfied (4), fairly satisfied (3), not very satisfied (2), or not at all satisfied (1) with the life you lead?"*

Notice that measuring experienced utility in this way let respondents define and aggregate the relevant domains of their *life satisfaction*[8]. Although this approach may seem naive at first, previous literature have found that responses to subjective well-being questions not only are related to individual health outcomes and neurological functionings but also help predicting future behavior [9]. Therefore, they may constitute a good proxy of experienced utility *if* the measurement can be done in a credible way[10].

Let W^* be an unobserved measure of utility which is related to the observed *overall life satisfaction* categorical variable $W \in 1, 2, ...K$. Given the nature of our data, we can use an ordered probit model to estimate disequilibrium marginal utility contribution of housing attributes and environmental amenities. More formally, we estimate the following model:

[8]An alternative approach to the measurement of experience utility is to predefine the domains of life satisfaction (e.g. nourishment, dressing, housing quality and accessibility, local public goods and externalities, job, health, education, transportation, recreation and interpersonal relations among others) and define household's experience utility as the weighted sum of the households' levels of reported satisfaction with each domain with weights equal to the median relative importance given to each domain. In order to construct this *Life Fulfillment index*,respondents are asked to declare the relative importance of several domains, say in a scale from 1 (not important) to 10 (very important); and then to declare their level of fulfillment or satisfaction with each domain, say in a scale from 1 (not satisfied) to 10 (very satisfied).

[9]For example Easterlin (1974) use reported life satisfaction to examine the relationship between economic growth and happiness; Di Tella, MacCuloch and Oswald(2001) use data on life satisfaction from the Eurobarometer to infer how people trade off inflation for unemployment; Alesina, Glaeser and Sacerdote (2005) use the same data to infer whether labor market regulation makes people better off; and Gruber and Mullainathan (2004) examine the effect of cigarette taxes on self-reported happiness to draw inferences about the rationality of smoking.

[10]Measurement error in the reported levels of experienced utility is a serious concern for this literature: (1) the number and the words used to describe the levels of life satisfaction; (2) the demographic profile of the respondents; (3) recent shocks to the household's utility, such as a member's marriage or divorce, or a member's promotion or laid-off; and (4) the context (such as being in a carnival season or in the middle of a political conflict). XXX(200X) shows that the number of categories used to classify different levels of life satisfaction may influence the level of self-reported life satisfaction. Recent shocks to households utility, in particular negative ones such as the death of a close relative, also influence the level of self-reported life satisfaction. Kahneman and Angrist (2006) show that households exposed to some kind of shock give a temporarily greater weight to it in retrospective assessments. Finally, the context may also influence self-reported life satisfaction. For example, Schwarz (1987) found that, in a sample of subjects who fill out a questionnaire of life satisfaction, reported life satisfaction was raised substantially by the discovery of a dime placed on a copy machine for a randomly chosen half of the people.

$$W_{ij} = \begin{cases} 1 & if & & W_{ij}^* & \leq \mu_1 \\ 2 & if & \mu_1 < & W_{ij}^* & \leq \mu_2 \\ ... \\ 5 & if & \mu_4 < & W_{ij}^* \end{cases} \quad (7)$$

where:

$$W_{ij}^* = \delta_0 + \delta_1 h_{ij} + \delta_2 A_j + \delta_3 y_{ij} + v_{ij}$$

To test whether we are in a situation of equilibrium or not will be equivalent to test whether δ_1 and δ_2 are zero or different from zero in equation (8). Whenever we observe a contribution of housing quality and accessibility features δ_1 or the contribution of environmental amenities δ_2 different from cero, once the influence of income has been accounted for, we will have a indication of disequilibrium in the housing market.

Notice that if the equilibrium hypothesis is rejected, then we need to correct our estimated prices for housing market and environmental amenities by *residual* shadow cost estimates in the following way:

$$w^{h*} = \frac{\partial W_{ij}}{\partial h_{ij}} = (\beta_1 * \bar{p}) + \left(\frac{\delta_1}{\delta_3} * \bar{p}\right) \quad (8)$$
$$w^{A*} = \frac{\partial W_{ij}}{\partial A_j} = (\beta_2 * \bar{p}) + \left(\frac{\delta_2}{\delta_3} * \bar{p}\right)$$

As in the equilibrium-revealed preference approach, omitted environmental amenities and neighborhood effects as well as the spatial structure of the data may complicate the consistent estimation of marginal utilities.

2.3 The aggregation of individual QofL measures into a neighborhood QofL measure

The final step is aggregation of individual QofL measures into a social QofL measure at a given level of desegregation. Small areas QofL measures are always preferred because they help to identify and target to poor communities. As we will explain in the next section, we took advantage of the detailed information on housing rental prices available in household surveys and the comprehensive coverage of Census data[11]. Therefore, we can calculate statistically significant QofL measures for small geographical areas such as neighborhoods.

Under the assumption that households have homogenous preferences, i.e. that they have the same utility function, it is possible to calculate the neighborhood's QofL just by averaging out the QofL of their inhabitants. Formally

[11] This procedure is valid as long as the set of housing quality and accessibility features used in both databases are not statistically different

,

$$QofL_j = \sum_{i \in j} \frac{1}{N_j} QofL_{ij} = \sum_{i \in j} \frac{1}{N_j} w^h h_{ij} + \sum_{i \in j} \frac{1}{N_j} w^A A_j \quad (9)$$

where N_j is the neighborhood j population. This way of aggregation gives each individual's QofL the same weight $\frac{1}{N_j}$. Therefore it assumes an increasing, but not concave, social welfare function. Notice that this type of welfare function is additively separable, e.g. it allow us to separate the contribution of housing features and the contribution of neighborhood amenities to the neighborhood's QofL. We will use the separability property to analyze the determinants of QofL inequality in section 6.

3 Data Sources

3.1 The Selection of Cities and Definition of Neighborhoods

Before describing our sources of data, it is important to justify our choice of cities as well as our definition of boundaries for neighborhoods. We restrict the analysis of the QofL of urban neighborhoods in Bolivia to its two biggest metropolitan areas: The Great La Paz (which contains the cities of La Paz and El Alto) and the city of Santa Cruz de la Sierra. The most important reason for this choice are sample size considerations for the rest of the cities. Although we restrict our analysis to only two metropolitan areas they are, arguably, the most interesting cities to analyze. First, together the cities of La Paz, El Alto and Santa Cruz account for 60 percent of the total urban population and near 40 percent of the total population of Bolivia. Second, they are very different in terms of patters of population growth; La Paz has been growing at a 1.5 percent rate and El Alto and Santa Cruz at rates around 3.5 percent - the former due to rural-urban migration and the latter due to intra-urban migration. Third, they have better geographic information systems relative to other cities in Bolivia. Furthermore, we restrict our analysis of QofL in the selected cities to their administrative boundaries, which correspond to a territorial and political division called municipality (a.k.a. section of province). It is important to notice that, since the approval of the Popular Participation Law, on April of 2004, municipalities have both, political and administrative autonomy - i.e. each municipality elects its own authority (the major) and administers its own resources.

Since all environmental amenities are defined at a neighborhood level, the definition of neighborhoods is a key part of our analysis. *Administratively*, municipalities are divided into macro-districts, with delegated authorities called sub-majors; and macro-districts are further divided into districts. Using the administrative division for our analysis have two main problems: First, the distribution of the population into districts will be very uneven -e.g. in La Paz district 22 and 23 of the Hampaturi/Zongo macro-district has less than 4 thousand people, while district 7 of the Max Paredes macro-district has more than 53 thousand people. Second, and most important, some of the data on environmental amenities can not be match to the administrative territorial division. Therefore, we define as neighborhood the collection of houses within a census zone (*zona censal*). Figure 1 presents the neighborhoods borders and centroids in the La Paz, El Alto and Santa Cruz.

3.2 Data Sources

Before describing the sources of information, notice that our method for estimating QofL is a two step procedure: First, market and implicit prices of housing features and environmental amenities are estimated. Then, the estimated prices are used to aggregate QofL domains into a scalar measure of individuals' QofL (which can be aggregated into a scalar measure of neighborhoods' QofL). Therefore, we can use different sources of data for each step as long as the definition and distribution of variables are the same in both data sets. We take advantage of the detail information on housing rental prices and general life satisfaction available in survey data to estimate market and implicit prices, and the comprehensive coverage of Census data to calculate individuals' and neighborhoods' QofL. For the hedonic regression we use pooled set of household surveys for the 2002-2006 period. For the life satisfaction regression we use the 2003-2004 survey since it was the only one with a special module on subjective well-being. All housing quality features were available in both, household surveys and census data. Environmental amenities data come from many sources (See Appendix A for a detail description of data sources) and are merged with households surveys and census data at the census track level.

4 Results

4.1 Hedonic Regressions

Tables 1 and 2 present the results of our hedonic regressions for the Great La Paz (LPZ) and Santa Cruz (SCZ), respectively. Columns (1) and (2) present, respectively, fixed-effects (FE) and random-effects (RE) estimates of housing quality market prices. Column (3) and (4) present RE estimates of both, housing quality market prices and environmental amenities implicit prices, with and without racial externalities[12].

As we mention in section 2, the challenge of the hedonic approach is the identification (and consistent estimation) of housing features' and environmental amenities' prices and not just mere partial correlation coefficients. To see the importance of environmental variables in the determination of the rental price of housing, in both LPZ and SCZ, we compare FE and RE estimates without

[12]FE and RE estimators are calculated taking advantage of the grouping of houses within neighborhoods

environmental features using a Hausman specification test. Under the null of no effect of environmental amenities on the rental price of housing both, the FE and the RE estimates, will be consistent; but under the alternative only the FE estimates will be consistent. [13]. Comparing column (1) and (2) we reject the hypothesis of no systematic differences between de FE and RE estimates in both LPZ and SCZ. Furthermore, the Hausman's χ^2 statistics reveal that environmental amenities are much more important in LPZ than in SCZ (the χ^2 value is 300.9 for LPZ and 49.7 for SCZ). Including environmental amenities improve the odds of finding no systematic differences between the FE and the RE estimates. Comparing columns (1) and (3) we find lower Hausman's χ^2 statistics (the χ^2 decrease to is -106.5 for LPZ and 18.5 for SCZ)[14]. It is also important to note that housing features and environmental amenities seem to be very correlated. Notice that the overall that environmental amenities are strongly correlated with housing features. To see this notice that, although the estimated prices are very different, the between group R^2 coefficient increases by the inclusion of environmental amenities are very small.

Almost all semi-elasticity estimates in column (3) have the expected signs and most of them are statistically significant. In particular note that:

- Apartments are rented for a premium relative to houses in LPZ. Once other housing features (size, quality and access to services) are controlled for, apartments are 26 percent more expensive than houses is La Paz and El Alto.

- Greater spaces, measured by the number of rooms and the availability of a special room for the kitchen, are positively related to the rental price of housing and more important in SCZ than in LPZ. Houses with five rooms are 93 and 107 percent more expensive in LPZ and SCZ, respectively. The availability of a special room for the kitchen increases the rental price of housing in 15 percent in LPZ and in 22 percent in SCZ.

- Better housing quality, measured by the materials of the walls, roofs and floors, is also positively related to the rental prices of housing. In LPZ, the rental price of houses with good quality but unfinished walls and with bad quality walls are 30 and 17 percent cheaper than those with good quality walls, rents of houses with plastic roof tiles are 21 percent cheaper that those with concrete roofs; and rents of houses with wooden parket and ceramic floors are 27 and 41 percent more expensive than those with ordinary floors. In SCZ, the rental price of houses with plastic roofs are 26 percent cheaper than those with concrete roofs, and rents for houses with brick floors are 32 percent more expensive.

[13] Furthermore, under the null the FE estimates is not efficient while the RE estimates is efficient.

[14] In the case of LPZ, we get a negative value for the Hausman χ^2 statistic due to the fact that the difference of the variance-covariance matrix is non-positive definite matrix. Hausman and McFadden (1984) argue that this should be interpreted as a not significant statistic

- Connection to basic services such as water, sewage and electricity are important determinants of the rental price of housing. Houses with outside connection to pipe water are 23 percent cheaper in LPZ and 13 percent cheaper in SCZ, while houses with no connection to pipe water are 33 percent cheaper in LPZ and 29 percent cheaper in SCZ, relative to houses with inside connection to pipe water. Houses with septic-tank cesspit and no sewage connection are, respectively, 21, 6 and 23 percent cheaper in LPZ and 17, 19 and 44 percent cheaper in SCZ than those with pipe connection to sewage. Finally, houses with connection to electricity are 11 and 25 percent more expensive in LPZ and SCZ (although these last coefficients are not significant).

- Surprisingly, the availability of education and health facilities within the neighborhood borders does affect the housing rents. In both, LPZ and SCZ, the coefficients are near zero and not significant. The fact that neither the public education nor the public health systems compel people to attend to the neighborhood's education or health facility may explain why housing rents are insensitive to these variables. It is possible that measures of costs and quality variables, such as distance or time to the attending school or class size ratios, may radically change this result. Unfortunately, this type of data was not available.

- Neighborhoods access to sewage/water and telephone are positively related to the rental price of housing. Neighborhoods without access to the phone network are 56 percent cheaper in LPZ. Neighborhoods without access to sewage network are 34 percent cheaper and those without access to phone network are 26 percent cheaper in SCZ. It is important to note that some neighborhood public goods, such as access to an electricity network or public transportation services were drooped from the estimation due to significant collinearity with these two variables[15]. Most neighborhoods that lack access to either the sewage/water network and the phone network neither have access to the electricity network nor to public transportation services. Therefore it is important to interpret this premiums not as the lack of a given public service but as the lack of composite bundle of public services.

- Other neighborhood local public goods, such as street lights, paved or stoned streets and waste disposal services are also positively related to housing rents. In LPZ neighborhoods with stoned or paved streets are 23 percent more expensive. In SCZ neighborhoods with street lights and stoned or paved streets are 8 and 33 percent more expensive, respectively.

- Interestingly, the neighborhoods' median altitude has an important impact on the rental price of housing in LPZ even after controlling for housing features and other environmental amenities. An increase in a thousand

[15]Simple cross tabulation reveals that access to electricity network and public transportation are linearly related to the access to sewage/water and telephone networks.

meters above sea level (a.s.l.) decreases housing rents in 93 percent. It is important to note that there is a significant variation in altitude in LPZ. The altitude of the neighborhoods in the north-west of El Alto is around 4200 meters a.s.l., while the altitude of the neighborhoods in the south-west of La Paz is around 3200 meters a.s.l. The lower-altitude premium may also be related to temperature, since higher places are usually colder, specially in winter, access to heating systems is scare.

- Finally, crowding and racial externalities, measured by the number of people per squared kilometer and the proportion of indigenous people in the neighborhood, are negatively related to the rental price of housing in LPZ. On the one hand, a one percent increase in the people per squared kilometer reduce housing rental prices in 12 percent. Recall that low density neighborhoods may have less crime and pollution levels relative to higher density neighborhoods which might make them more attractive. On the other hand, the proportion of indigenous people in the neighborhood has an important impact on the rental price of housing in LPZ. Ethnic neighborhoods are 313 percent more expensive than non-ethnic neighborhoods in LPZ - and significant at a 1 percent level; and 140 percent more expensive in SCZ, though this last coefficient is not significant. It is important to point out that the proportion of indigenous population varies between 0 to 100 in LPZ and between 0 to 42 in SCZ.

It is important to point out that a negative premium associated with ethnic neighborhoods does not directly imply sizable ethnic externalities, i.e. sizable prejudice against indigenous people. Ethnic neighborhoods may be capturing unobserved environmental amenities. For example, since indigenous people have higher unconditional probabilities of being poor, ethnic neighborhoods may be capturing lower income levels and potential income-class segregation in the neighborhoods. Richer people may want to segregate themselves to take advantage of their greater social capital or to avoid negative ethnic capital. Furthermore, notice that excluding the ethnic externality does not change much the estimates of the price of housing features but it does change the estimates of environmental variable. In particular, the negative premium associated with no phone network in the neighborhood almost double in LPZ but increase just a little bit in SCZ. Furthermore, a Hausman test between RE estimates that exclude the ethnic externality (column 4) and the FE estimates reveal that including the ethnic externality is very more important in LPZ but not in SCZ (the χ^2 value increase in LPZ but keeps constant in SCZ). Therefore, we use column (3) estimates as our equilibrium price estimates but do not include the ethnic externality in our QofL calculations[16].

[16] For a more detailed analysis of th e price of prejudice against indigenous people see Hernani-Limarino(2008)

4.2 The Disequilibrium - Life Satisfaction Regressions

Before presenting the results of our life satisfaction regressions, it is useful to describe the behavior of our life satisfaction index. Figure 2 presents its probability mass function (pmf). Notice that responses to the *cantril-ladder* question are concentrated in the "very satisfied" (6 percent),"fairly satisfied" (64 percent) and "not very satisfied" (26 percent) categories -i.e. the LS *pmf* is slightly right-skewed. Figure 3 presents a scatter plot of the LS index vs. the standardized per-capita household income. Clearly, there is some positive association between both variables, i.e. people who declare to be more satisfied with their overall life also have above average levels of per-capita household.

Table 3 present estimates of equation (8). Due to sample size considerations we estimate the LS regression using the samples of LPZ and SCZ together. Column (1) presents the estimated coefficients and cut-points of the ordered probit. Columns (2) to (6) presents the marginal effects - i.e. the change in the probability of being in a given category due to a marginal change in the explanatory variable (a change from 0 to 1 in the case of a *dummy* explanatory variable)[17]. We also estimate life satisfaction regressions using the *Life Fulfillment* index - a weighted average of the household level of satisfaction with several predetermined dimensions of QofL. The results were very similar and are available from the authors upon request.

First, notice that per-capita income has a statistically significant impact on the self-reported level of life satisfaction. A one percent increase in per-capita income decrease the probability of being "not very satisfied" and "fairly satisfied" in 2 and 13 percentage points, respectively; and increase the probability of being "very satisfied" in 16 percentage points. Second, notice that once per capita income has been accounted for, almost none of the included housing features and environmental amenities affect the perception of life satisfaction. The exceptions being having *other* type of floors and having no sewage but septic tank. Having *other* type of floors, relative to having floors of *cemento*, increase the probability of being "not very satisfied" and "fairly satisfied" in 7 and 8 percentage points, respectively, and decrease the probability of being "very satisfied" in 15 percentage points. Having no sewage but septic tank, relative to having sewage, increase the probability of being "not very satisfied" and "fairly satisfied" in 9 percentage points each, and decrease the probability of being "very satisfied" in 18 percentage points.

The fact that most housing quality and accessibility features are not sig-

[17]The marginal effects are calculated taking the partial derivatives of the following equations:

$$
\begin{aligned}
Prob(W=1) = & \quad \Phi\left[\mu_1 - (\delta_0 + \delta_1 h_{ij} + \delta_2 A_j + \delta_3 y_{ij})\right] \\
Prob(W=1) = & \quad \Phi\left[\mu_2 - (\delta_0 + \delta_1 h_{ij} + \delta_2 A_j + \delta_3 y_{ij})\right] \\
& -\Phi([\mu_1 - (\delta_0 + \delta_1 h_{ij} + \delta_2 A_j + \delta_3 y_{ij})] \\
... & \\
Prob(W=1) = & \quad 1 - \Phi\left[\mu_4 - (\delta_0 + \delta_1 h_{ij} + \delta_2 A_j + \delta_3 y_{ij})\right]
\end{aligned}
$$

nificant may suggest either that the differences in most housing quality and accessibility are capitalized in rental price differentials in the housing market; or that the life satisfaction index, in this particular sample, is not a good proxy of the household's experienced utility. In our opinion, both alternatives are very likely. On the one hand, the competitive and equilibrium assumptions on the renting-housing market are likely to be true, at least in the Bolivian case. Potential tenants do have a good deal of information on amenities and certainly can check by themselves the housing quality and accessibility features before renting a house; renting contracts are frequently made on a one year basis; and monetary moving cost are not very high. On the other hand, it is possible that the LS index does not work as a proxy of experimental utility in our survey due to problems in the sample design and sample size of the survey module that contain the *cantril-ladder* question[18].

4.3 Estimated Market and Implicit Prices

Table 4 present equilibrium and disequilibrium market and *implicit* prices of housing quality and environmental amenities calculated according to equation (5) and (8), respectively. Column (1) present equilibrium prices for the Great La Paz. Column (2) present equilibrium prices for Santa Cruz. Finally, column (3) present disequilibrium prices for the pooled sample -i.e. the residual contribution of housing quality features and environmental amenities to households' utility. All prices are measured in constant *bolivianos* at December of 2004 and were calculated using the pooled housing rent average.

The magnitudes of the equilibrium prices presented in Table 4 are just another way of interpreting the results of the hedonic regression. To avoid repetition, we will just compare our equilibrium prices to their disequilibrium counterparts, even when most of them are not statistically significant. Notice that the life satisfaction approach contradicts some results of the revealed preference approach: it value houses more than apartments, does not value the availability of an special room for kitchen, gives a positive premium for ground floors and a negative premium for wooden parket and ceramic floors, a positive premium for no sewage connection and a positive premium for no access to sewage network. In addition, it value household size more than the traditional approach and also give higher premiums and penalties to the other housing features and environmental amenities. We believe that part of this issues should be attributed to the small and pooled sample used is this exercise. Therefore, we will based our QofL measures in our equilibrium price estimates.

[18] The survey module was applied not to the entire 2003-2004 survey, but only to a proportion of the sample. Furthermore, the survey was design to use *indirect* informants which may be affecting our results.

5 The QofL of Urban Neighborhoods in Bolivia

5.1 QofL Estimates

5.1.1 Households" QofL

We use the estimated equilibrium prices to aggregate housing features and environmental amenities into a (scalar) QofL measure for each household. Notice that since we have negative prices for some housing features and environmental amenities, our QofL measure may have negative values. To avoid confusion with negative QofL values, we transformed the *scale* of our QofL index to have a positive range by adding up a positive constant. Notice that, absolute differences in QofL can still be interpreted as the monetary monthly values, in *bolivianos* of December 2001, of the differences in housing features and environmental amenities[19] Figure 5 presents the households' QofL densities for La Paz (Panel a), El Alto (Panel b) and Santa Cruz (Panel c). Table 5 presents some descriptive statistics.

Households' QofL is unambiguously higher in Santa Cruz than in La Paz. At all percentiles of the household distribution the QofL index is larger in Santa Cruz than in La Paz, e.g. the difference in housing features and environmental amenities between the median household in La Paz and in Santa Cruz is equivalent to 51 bolivianos. QofL is also unambiguously higher in La Paz than in El Alto, e.g. the difference in housing features and environmental amenities between the median household in La Paz and El Alto is equivalent to 249 bolivianos. There are also significant differences between households within cities. On the one hand, the differences in QofL between a household in the 90^{th} percentile and the median is 383, 360 and 424 bolivianos in La Paz, El Alto and Santa Cruz, respectively. On the other hand, the differences in QofL between the median and a household in the 10^{th} percentile is 281, 190, and 249 bolivianos in La Paz, El Alto and Santa Cruz, respectively. The higher differences at the right hand side of the density implies that a larger fraction of the QofL inequalities between households can be explained by the differences among households with higher QofL. This fact is confirmed by the positive skewness measures in La Paz (0.15), El Alto (0.77), and Santa Cruz (0.40)[20]. Finally, notice that Households' QofL densities in La Paz are platykurtic -i.e. they have a smaller "peaks" around the mean than a normally distributed variable, but the households' QofL density in El Alto is leptokurtic, i.e. it has a smaller "peak" than a normally distributed value[21].

[19] At the same time, we must note that such as transformation impede relative comparisons, e.g. we can not say that QofL is two times as high in one place than another.

[20] A density is said to be positive skew if the right tail is longer, i.e. the mass of the distribution is concentrated on the left side; and it is said to be negative skew if the left tail is longer, i.e. the mass of the distribution is concentrated on the right side.

[21] A density is called *leptokurtic* if its kurtosis values are above 3. In terms of shape a leptokurtic distribution has a more acute "peak" around the mean (that is, a higher probability than a normally distributed variable of values near the mean) and "fat tails" (that is, a higher probability than a normally distributed variable of extreme values). A density is called platykurtic if its kurtosis values are below 3. In terms of shape, a platykurtic distribution has

5.1.2 Neighborhoods' QofL

Households' QofL were aggregated into neighborhoods' QofL using an utilitarian non-concave welfare function, as described in equation (9). Figure 6 present the estimated densities for La Paz (panel a), El Alto (panel b) and Santa Cruz (panel c). Table 5 presents descriptive statistics of their distribution. At the neighborhood level QofL is also unambiguously higher in Santa Cruz than in La Paz. At all percentiles of the neighborhood distribution the QofL index is larger for Santa Cruz than in La Paz, e.g. the difference in housing features and environmental amenities between the median neighborhood in La Paz and in Santa Cruz is only 12 bolivianos. At the neighborhood level, QofL is also unambiguously higher in La Paz than in El Alto, e.g. the difference in housing features and environmental amenities between the median neighborhood in La Paz and in El Alto is equivalent to 285 bolivianos. There are also significant differences between neighborhood within cities. On the one hand, the differences in QofL between a neighborhood in the 90^{th} percentile and the median is 208, 279 and 308 bolivianos in La Paz, El Alto and Santa Cruz, respectively. On the other hand, the differences in QofL between the median and a household in the highest10^{th} percentile is 305, 106 and 176 bolivianos in La Paz, El Alto and Santa Cruz, respectively. These differences suggest a larger fraction of the between-neighborhood QofL inequalities can be explained by the differences among higher QofL neighborhoods in La Paz and by the differences among lower QofL neighborhoods in El Alto and Santa Cruz. A fact that is confirmed by the negative skewness measures in La Paz (-0.40), and the positive skewness measures of El Alto (1.07) and Santa Cruz (0.37).

Notice that the there are significant differences in shape between the households' QofL density and the neighborhoods' QofL densities. Such differences reveal a pattern of residential sorting by QofL. To analyze this issue in more detail, we construct the following measure of segregation by QofL:

$$S_j = \left[1 - \frac{CV(QofL_{ij}|i \in j)}{CV(QofL_{ij}}\right] \tag{10}$$

where $CV(QofL_{ij}|i \in j)$ and $CV(QofL_{ij})$ are the coefficients of variation for the neighborhood and the city, respectively. If households are randomly selected into neighborhoods, then the distribution of QofL in the neighborhoods will be as diverse as the cities and our segregation index will tend to zero. However, if households are sorted into neighborhoods by their levels of QofL, then the distribution of QofL will be more homogeneous in the neighborhoods than in the cities and our segregation index will tend to one. Finally, if a neighborhood is more diverse than the population, then the segregation index will be negative. Figure 8 present a scatter plot and quartic kernel regression fit of the neighborhoods' segregation index and their QofL levels. Interestingly, residential sorting

a smaller "peak" around the mean (that is, a lower probability than a normally distributed variable of values near the mean) and "thin tails" (that is, a lower probability than a normally distributed variable of extreme values).

appears to be low, on average, in the three cities that we analyze. The exceptions are relatively low QofL neighborhoods in La Paz, which are more diverse, and relatively high QofL neighborhoods in El Alto and Santa Cruz, which are more homogenous. The significant within-neighborhood QofL inequality have important implications for the design of appropriate targeting schemes. We come back to this issue later.

5.2 Determinants of QofL Inequalities

5.2.1 Within and Between-Neighborhoods QofL Inequalities

To analyze the determinants of QofL inequality further, we present the result of the inequality decomposition by population subgroups. Although these decompositions are valid for all inequality measures that belong to the class of Generalized Entropy inequality measures, we present the results of the decomposition only for the GE(2) measure - half of the squared coefficient of variation[22]. Panel A of Table 7 present the results. We find that within within-neighborhood and between-neighborhood inequalities are equally important to explain the overall inequality in QofL. Within-neighborhood inequalities explain 52, 47 and 56 percent of overall inequality in La Paz, El Alto and Santa Cruz, respectively.

5.2.2 Sources of Between-Neighborhoods QofL Inequality

Since our QofL measure is additively separable, the inequality components can also be decomposed by the source of inequality. We use the Shorocks (1992) factor inequality decomposition to see whether housing features or environmental amenities are more important to explain the between-neighborhood QofL inequality. Again, we focus on the GE(2) measure - half of the squared coefficient of variation[23]. Panel B of Table 7 present the determinants of the between-neighborhood inequalities. We find that housing features are slightly

[22] Notice that total inequality, I, can be decomposed into a between-group inequality, I_b and a within-group inequality I_w. The decomposition by population subgroups for the GE-class is defined as:

$$I = I_w + I_b = \sum_{j \in J} v_j^{\alpha} f_j^{1-\alpha} GE_j(\alpha) + \left[\frac{1}{\alpha - \alpha^2}\right] \left[\sum_{jinJ} f_j \left(\frac{y_j}{y}\right)^{\alpha} - 1\right]$$

where f_j is the population share of neighborhood j, $j = 1, 2, ..J$; v_j is the QofL share of neighborhood j; and y_j is the average QofL in group j.

[23] The decomposition for the GE-measure with $\alpha = 2$ can be written as:

$$I = \sum_{f \in F} S_f = \sum_{finF} \rho_f \left(\frac{\mu_f}{\mu}\right) - GE(2) * GE_f(2)$$

where S_f is the contribution of component f; ρ_f is the correlation between component f and total QofL; and $\frac{\mu_f}{\mu}$ is the share of component f in total QofL. If S_f is large, then component f is an important source of total QofL inequality; if S_f is small, then component f is not an important.

more important than environmental amenities in La Paz and Santa Cruz -they account for 66 and 62 percent of the between-neighborhoods inequality. Furthermore, in both cities housing size differences are more important than housing quality and access to basic services. In El Alto housing features are equally important than environmental amenities - housing features account for 52 percent of the between-neighborhood inequality. Two important policy implications can be derived from these results. First, commonly used indicators that rely exclusively in housing quality features, such as the Unsatisfied Basic Needs index, exclude important QofL domains. Second, the set of welfare improving policy interventions in urban areas is larger than housing infrastructure interventions.

To explore the potential gains in QofL of increasing the availability of local public goods in the neighborhood Figure 7 constrast the observed QofL distribution with the QofL distribution that would be observed if all neighborhoods would have a full provision of public goods. Notice that in all cities, but specially in El Alto, the QofL of poor neighborhoods will improve significantly if they would be given similar levels of local public goods as rich neighborhoods.

5.3 The Spatial Distribution of Neighborhoods QofL

An important characteristic of our QofL estimates is its spatial dimension. Figure 9 maps the spatial distribution of QofL across neighborhoods. Clearly, there are systematic patterns of spatial distribution. Although visualizing the spatial distribution of Neighborhoods' QofL is interesting, it is much more informative to measure the degree of spatial correlation. In order to do this, we use two commonly used measures of spatial auto correlation: the Moran's I and the Geary's C measures[24]. Table8 present our calculations. There are strong spa-

[24]The Moran's I measure is defined as:

$$I = \frac{N \sum_{j \in J} \sum_{k \in K} w_{jk}(x_j - \bar{x})(x_k - \bar{x})}{\sum_{j \in J} \sum_{k \in K} w_{jk} \sum_{j \in J}(x_j - \bar{x})}$$

where N is the total number of neighborhoods, x_j is the variable value at a particular location j, x_k is the variable value at another location $k \neq j$, $\bar{x}$ is the mean of the variable, and w_{jk} is a weight applied to the comparison between location j and location k - defined in terms of the weighting matrix. The Geary's C measure is formally defined as:

$$C = \frac{(N-1) \sum_{j \in J} \sum_{k \in K} w_{jk}(x_j - x_k)}{2(\sum_{j \in J} \sum_{k \in K} w_{jk}) \sum_{j \in J}(x_j - \bar{x})}$$

The Moran's I measure compares the value of a variable at anyone location with the value of variable at all other locations. It varies between -1 and 1. Positive values indicate positive spatial autocorrelation - i.e. nearby neighborhoods tend to be similar. Negative values indicate negative spatial auto correlation - i.e. nearby neighborhoods tend to be dissimilar. Values near cero are evidence of no spatial auto correlation - i.e. QofL tend to be randomly arranged over space. The Geary's C coefficient measure spatial auto correlation by using deviations in intensities of each observation location with one another instead of using the cross product of deviations from the mean. It typically varies between 0 and 2. Large values - usually bigger than 1, indicate positive spatial auto correlation. Smaller values - usually lower than 1, indicate negative spatial correlation. Values near one are evidence of no spatial auto correlation. Both the Moran's I and the Geary's C measures of spatial auto correlation require the definition of a tial segregation of neighborhoods into low and high QofL regions in La Paz and Santa Cruz. The Moran's *measure* show that neirby neighborhoods, measured by contiguity relationships and distance bands, tend to have the same QofL levels. In La Paz high QofL neighborhoods are concentrated in the southwest area, while in Santa Cruz they are concentrated on the center of the city.

6 Policy Implications

We believe that our QofL measures may be useful instruments for monitoring the evolution of QofL, targeting disadvantage communities and designing local policy. This section discuss these issues and gives some examples.

6.1 Monitoring QofL

Monitoring the evolution of the QofL at the neighborhood level is extremely important not only for policy makers but also for the citizenry. Tracking the differences between neighborhoods over time will give policy makers better instruments to design and implement local policies, and will also provide the citizens better information on the overall progress of the city and whether their neighborhoods are leading or lagging behind this progress. However monitoring instruments, such as the one presented in this paper or the well known Unsatisfied Basic Needs (UBN) index, can only be constructed at the neighborhood level using census data. Inevitably, this creates a problem for monitoring since census data is available, at best, once every decade. Therefore, for monitoring, it is necessary to look at other sources of information that can be updated more frequently. Cadastral records are a potential alternative.

In the case of Bolivia, cadastral records contain not only cadastral property values - which can be transformed into rental price estimates, but also a much richer set of housing size and quality features (such as land and construction size) and the availability of public goods in the neighborhood (such as street lights and type of roads)[25]. Furthermore, once cadastral information is match to Geographical Information Systems (GIS) they can provide detailed information on housing accessibility features. Constructing QofL indexes, and monitoring their evolution, using cadastral information is feasible and have a high probability of being a good investment.

6.2 Targeting Poor Communities

Another potential use of our neighborhoods' QofL index is targeting. The government's National Development Plan incorporate a Social Protection and In-

spatial weighting matrix. We use two alternative specifications for this matrix: (1) contiguity relationships, and (2) nearest neighborhoods within distance bands. Both are described in detail in Appendix B.

[25] It is important to point out that measurement error may be an issue in the cases where cadastral information comes from self declared tax records due to potential under-reporting of housing size and quality characteristics.

tegrated Community Development Strategy (*Estrategia de Proteccin Social y Desarrollo Integral Communitario*) that gives a greater focus to the role of communities. In particular, it promotes a multi-sector approach to tackling social exclusion based on "community programs" (*Comunidades en Accion* for rural areas, *Comunidades Reciprocas* for urban areas, and *Comunidades Solidarias* for vulnerable groups), instead of interventions focused on individuals. However, neither of these three programs is explicit on the mechanisms that will be used to select treatment communities.

A major challenge for local and national programs aimed at improving the QofL of disadvantaged communities is to identify them. On the one hand, disaggregate traditional consumption and income based measures at the neighborhood level have prohibiting costs[26]. On the other hand, the available disaggregated measures, such as the UBN index, have many problems as both, welfare measures and target instruments[27]. Our QofL estimates, or QofL estimates constructed on the basis of cadastral information, may be a good alternative for geographical targeting in urban cities. In fact, Figure 8 present a selection of the neighborhoods in the lowest quartile of the overall QofL distribution.

6.3 Designing Local Policy

Local policies, such as municipal property tax or local investments, are usually guided by the easily available numbers ignoring other measures that are difficult to asses or plan for. We believe that our QofL index has potential uses in both, the design of property tax and the prioritization of investments[28]. Local property tax in most Bolivian cities are weighted averages of a set of housing attributes and local public goods very similar to the one used in our estimations. Therefore, the use of our QofL index to asses the distributional consequences of the property tax structure, to design a more progressive tax structure, or to provide tax incentives for the improvement of housing facilities is straightforward[29].

Figure 9 provides an illustration. It graphs the ratio of the estimated average property tax in each neighborhood[30] and their average QofL. To make

[26]Small area procedures that combine detailed survey information with comprehensive Census data require at least five hundred household to get statistically significant estimates

[27]Hernani-Limarino et. al. find that the weights used in the aggregation of UBN indexes do not correspond to neither the equilibrium not the disequilibrium weights. Furthermore, they find a low correlation coefficient between UBN index and other measures such as per capita consumption and poverty status

[28]According the Popular Participation Law, local governments in Bolivia are in charge not only of the design of local tax policies but also of the provision of local public goods such as education and health facilities, and roads and streets infrastructure, among others.

[29]For example a house with unfinished exterior walls may pay as low as half the property tax a house with the same characteristics but finished exterior walls. This type of tax policy distortions may not only reduce housing investments in exterior walls by the owners (who may be willing to sacrifice the beauty of his house in order to save in property taxes), but also reduce QofL of the overall city inhabitants who will rather enjoyed a view with colorful and finished exterior walls.

[30]To calculate this number we used the average housing features of the neighborhood as

the comparison meaningful we have transformed the *scale* of our QofL index so that the QofL of the median neighborhood match its expected tax, i.e. we force the ratio of the neighborhood QofL and its expected tax for the median neighborhood to be equal to one. Deviations above or and below the value of one for the neighborhoods to the left or to the right of the median neighborhood will indicate distortionary taxes. Specifically, deviations below the value of one to the left of the median neighborhood and deviations above the value of one to the right of the median neighborhood are progressive - lower QofL neighborhoods have lower taxes rates and higher QofL neighborhoods have higher tax rates relative to the median neighborhood. Conversely, deviations above the value of one to the left of the median neighborhood and deviations below the value of one to the right of the median neighborhood are regressive - lower QofL neighborhoods have higher tax rates and higher QofL neighborhoods have lower tax rates relative to the median neighborhood. Although this exercise is made just to illustrate potential applications of our QofL index, it suggest significant distortions in the property tax structures in the municipalities of La Paz, El Alto and Santa Cruz.

Finally, recall that our implicit price estimates can be interpreted as the willingness to pay for a specific public good or the willingness to avoid a certain neighborhood externality. Estimating these prices may provide useful information to prioritize public investments. For example, an ongoing debate in the city of La Paz is whether the increasing availability of green spaces is necessary relative to the inadequate access of basic services of some neighborhoods. Adequate implicit price estimate for green spaces, may help sort out this type of controversies.

7 Conclusions

This paper presents Quality of Life (QofL) estimates, at the household and neighborhood levels, for the two biggest metropolitan areas of Bolivia: the Great La Paz (the combination of the cities of La Paz and El Alto) and the city of Santa Cruz. We define QofL as a weighted sum of different livability dimensions including (1) housing quality and accessibility features, and (2) environmental amenities such as local public goods and neighborhood externalities. We use two approaches to estimate the weights for the different livability dimensions: (1) an equilibrium-revealed preference approach, that uses hedonic regression models to estimate equilibrium *market* and *implicit* prices; and (2) a disequilibrium-life satisfaction approach, that adds disequilibrium *shadow costs* to the equilibrium prices.

Our equilibrium-revealed preference estimates reveal that both, housing attributes and environmental amenities, are important determinants of the rental price of housing facilities. Households are willing to pay higher rents for greater

well as information of their environmental amenities. Since we lack some of the information required to make these calculation (such as land and construction areas) this estimates are crude estimates of the actual tax values spaces (measured by the number of rooms and the availability of a special room for kitchen), better quality of housing construction materials (measured by the construction materials in the wall, roof and floor) and access to basic services (such as water, sewage and electricity). Households are also willing to pay higher rents for neighborhoods with access to local public goods such as street lights, paved/stoned streets, disposal services and to avoid neighborhoods with no coverage of basic public services (such as sewage/water and phone networks). Surprisingly, the availability of education and health facilities in the neighborhood does not affect housing rents, possibly because neither the education nor the health systems compel people to attend the facility in their neighborhood. Altitude and crowding externalities affect housing rents in LPZ, i.e. households are willing to pay more for housing facilities at low altitude and low density neighborhoods. Finally, we find a sizable negative premium associated with ethnic neighborhoods, which may be capturing prejudice against indigenous groups.

Our disequilibrium-life satisfaction estimates reveal that, once the level of per-capita household income is accounted for, almost all housing characteristics and environmental amenities are not related to the perceived levels of overall life satisfaction (measured by the cantril-ladder question). This result suggest that either the housing market is in equilibrium - in the sense that all differences in housing attributes, local public goods and neighborhood externalities are entirely materialized in the housing rental price differentials; or that the life satisfaction index, in this particular sample, is not a good proxy of the household's experienced utility.

On the basis of our equilibrium price estimates we constructed QofL indexes at the household level, and use a non-concave utilitarian function to aggregate them into a neighborhood QofL index. We find significant differences in QofL both, between cities and within cities. On the one hand, Santa Cruz shows better QofL than La Paz, and La Paz shows better QofL than El Alto, at both the household and neighborhood level. On the other hand, we find that within within-neighborhood and between-neighborhood inequalities are equally important to explain the overall inequality in QofL. Furthermore, we find that housing features (in particular housing size differences) are slightly more important than environmental amenities to explain the between-neighborhood inequalities in La Paz and Santa Cruz, while housing features are as important as environmental amenities in El Alto. Finally, we believe that our QofL index is a useful instrument for monitoring the evolution of QofL, targeting disadvantaged communities and designing local policy. Furthermore, we believe that our index is superior to alternative measures, such as the Unsatisfied Basic Needs poverty measures, since it can incorporate environmental amenities and avoid the use arbitrary aggregation procedures.

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A Variables

Dependent Variables

- Housing market rental price. Declared rental price of housing for those actually renting housing. In *bolivianos* of December 2001 (Source: Household Surveys).

Set 1: Land and Housing Size and Quality

- Quality of floor materials.
- Quality of interior roof materials.
- Quality of exterior roof materials.
- Quality of interior walls.
- Quality of exterior walls.
- Number of Rooms.
- Number of Bedrooms.
- Number of Bathrooms.
- Water. Availability of pipe water inside the house
- Sewage. Availability of sewage service inside the house
- Electricity.
- Gas Network.
- Telephone.
  Source: Household surveys and census data

Set 2: Local Public Goods and Neighborhood Externalities

- Availability of at least one public educational facility in the neighborhood.
  Source: Cartographic actualization for the 2001 Census.
- Availability of at least one public health facility in the neighborhood.
  Source: Cartographic actualization for the 2001 Census.
- Availability of public transportation point within the neighborhood
  Source: Own calculations based on Transportation Regulatory Office records.
- Street lights.
  Source: Municipal records
- Paved/stone street.
  Source: Municipal records

- Waste disposal services.
  Source: Municipal records

- Median altitude. Climate Departmental Service
  Source: Own calculations based on GIS data.

- Density of the neighborhood (number of people per squared kilometer)
  Source: 2001 Census for the number of people and GIS data for the neighborhood area

- Reported crime rate.
  Source: Police reports

- Number of cars. Own calculations based on 2001 Census.

- Percentage indigenous people.[31]
  Source: Own calculations based on the 2001 Census.

- Median altitude (in thousands of meters).
  Source: Own calculations based on GIS data.

B The Spatial Weighting Matrices

It is usual in the spatial literature to take into account the spatial structure of this type of data defining contiguity relationships among spatial units. Let -i.e. neighborhoods in terms of sets of neighbors of neighborhood i, denoted by N(i). Contiguity relationships are usually coded in the form of a weighting matrix W_{ij}, with zero diagonal elements and non-zero off-diagonal elements (often scaled to sum to unity in each row). Formally, we define a weighting matrix as $w_{ij} = \frac{c_{ij}}{\sum_j c_{ij}}$

where:

$$c_{ij} = \begin{cases} 1 & if \quad ilinkedtoj \\ 0 & \quad otherwise \end{cases}$$

Notice that this implies no use of other information than that of neighborhoods set membership. Set membership may be defined on the basis of shared boundaries, of centroids lying within distance bands, as exemplified in Figure B1. Panel A shows the way in which the sets of contiguous neighborhoods of each zone are constructed. Panel B, neighborhoods are defined within a fixed distance from the zone in question.

Criteria for defining contiguity relationships

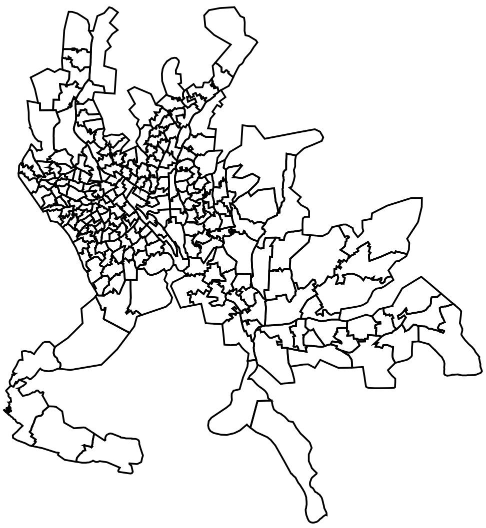
As Getis and Ord (1992) point out, there are good reasons for examining patterns of spatial dependence at a more local scale. If we do not have good

[31] Following Hernani (2006), we define as indigenous those who learned to speak in an indigenous language, speak an indigenous language and consider themselves part of an indigenous population

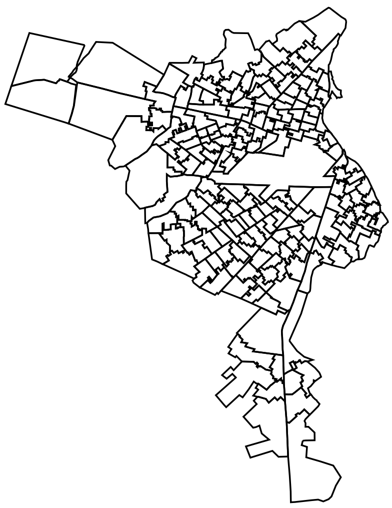
reason to suppose that the process in question is *spatially stationary*, then it seems natural to apply distance-based tests to the observed spatial series. To define distance statistics, one defines a symmetric one/zero spatial weighting matrix using the distance between the coordinates of a point associated with the observations. The choice of point for non-neighborhood series is not arbitrary, nor is the choice of the distance metric. We take the administrative centre of the observation units as adequately representing the location of the observation and the simple Euclidean distance between points as our distance measure, i.e. we ignore geographic barriers and other factors. Distance has further been banded on the basis of the frequencies of inter-point distances, and the furthest nearest neighborhood distance as shown in Figure D2. Panel A, shows the nearest neighbors of each zone. Panel B illustrates the use of distance bands, at different radius. A typical element of the non-standardized spatial weight matrix $c_{ij}(d)$ for distance d is defined as:

$$c_{ij}(d) = \begin{cases} 1 \quad if \quad hypot(ij) \leq d, i \neq j \\ 0 \qquad\qquad otherwise \end{cases}$$

where $hypot(ij) = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$



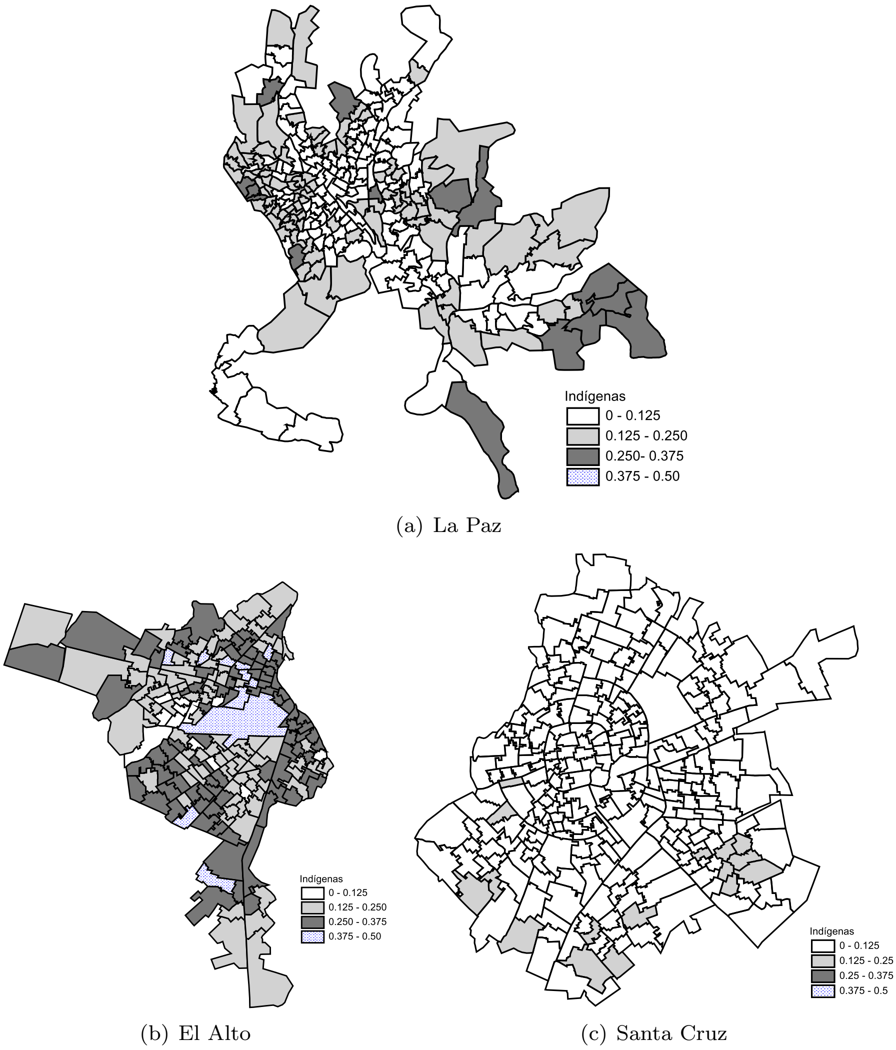
(a) La Paz



(b) El Alto

(c) Santa Cruz

Figure 1: Neighboorhoods' Borders and Centroids



(a) La Paz

(b) El Alto

(c) Santa Cruz

Figure 2: Indigenous Population in the Neighborhood (in percentage)

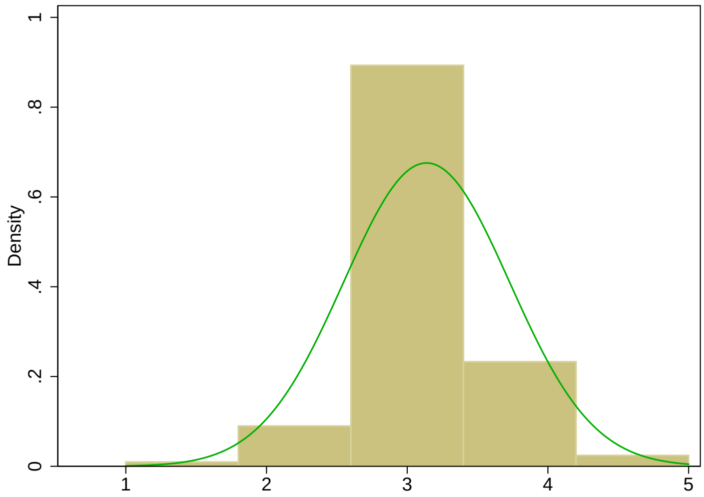


Figure 3: Life Satisfaction Probability Mass Function, Great La Paz and Santa Cruz 2003-2004

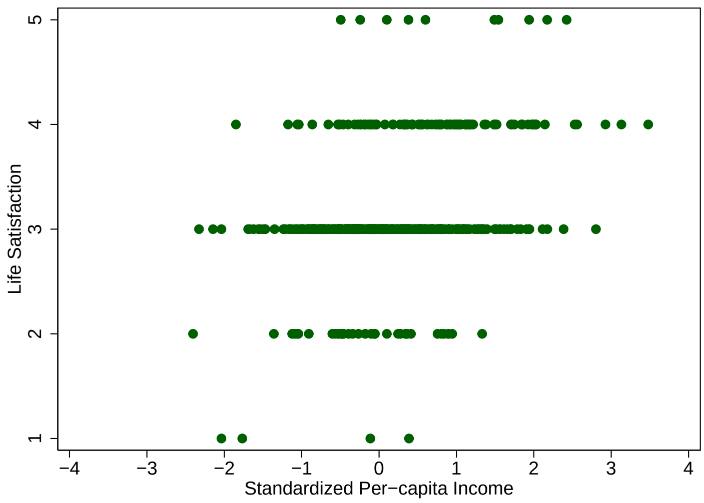
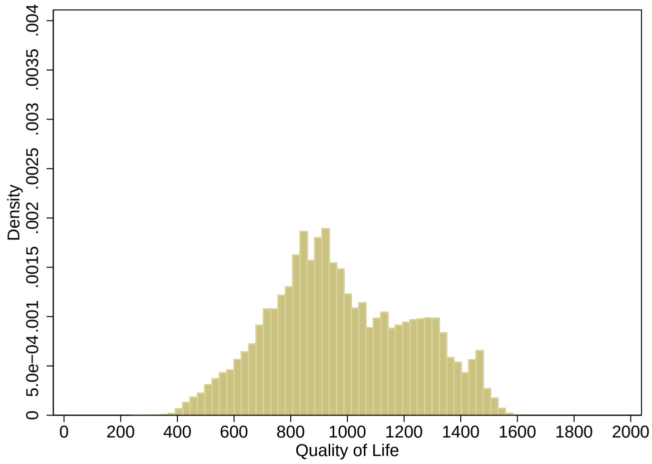
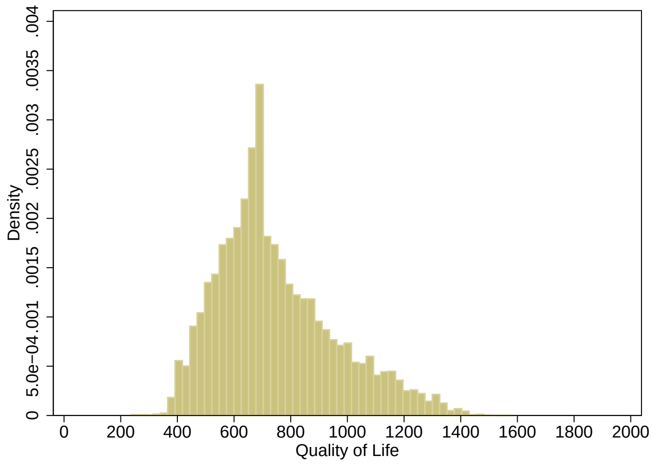


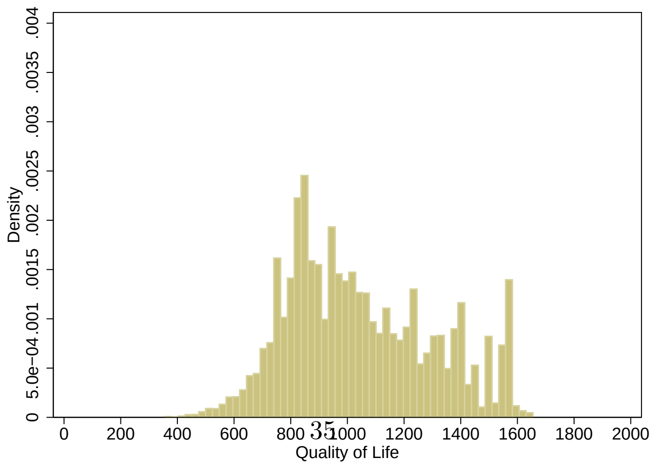
Figure 4: Life Satisfaction vs. Standardized Log of Per-capita Income, Great La Paz and Santa Cruz 2003-2004



(a) La Paz

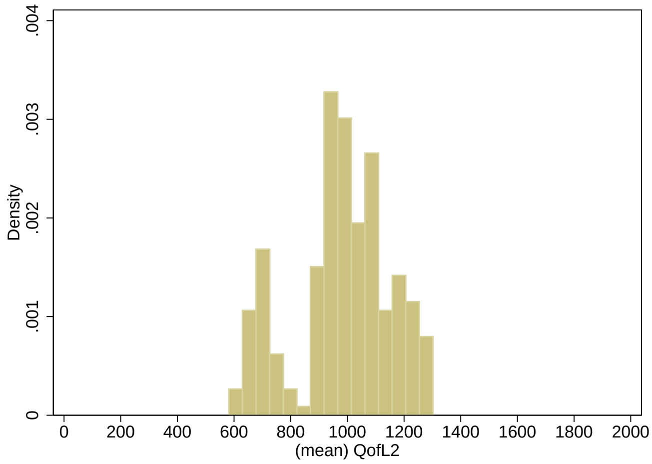


(b) El Alto

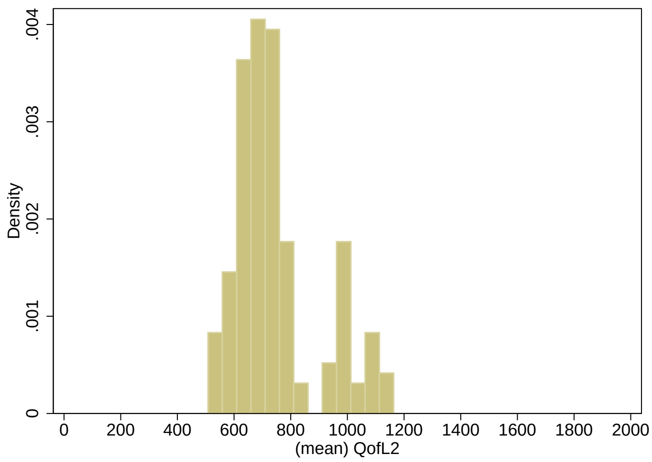


(c) Santa Cruz

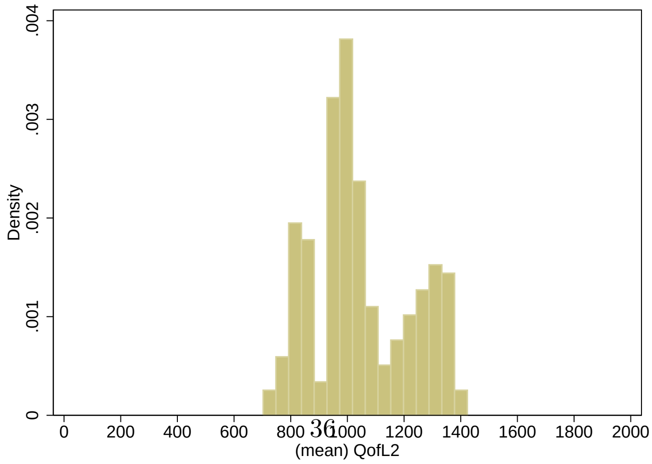
Figure 5: Individuals' Quality of Life Probability Density Functions



(a) La Paz

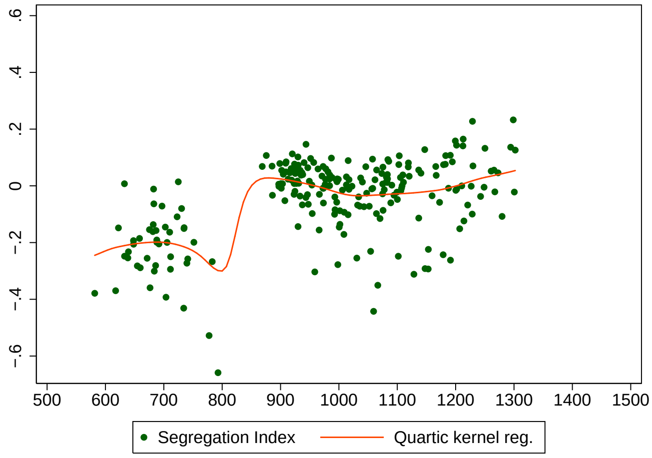


(b) El Alto

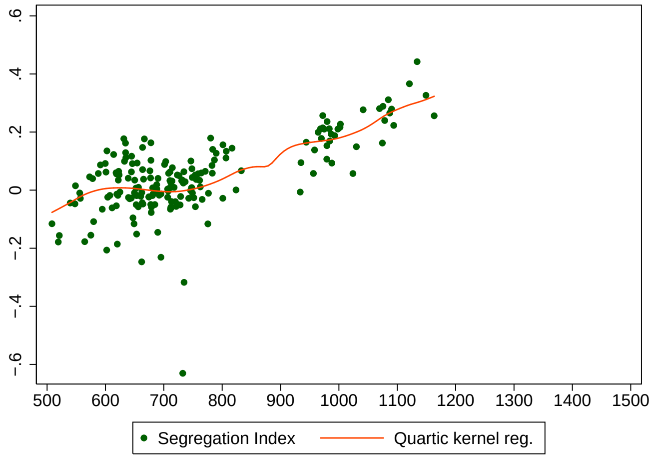


(c) Santa Cruz

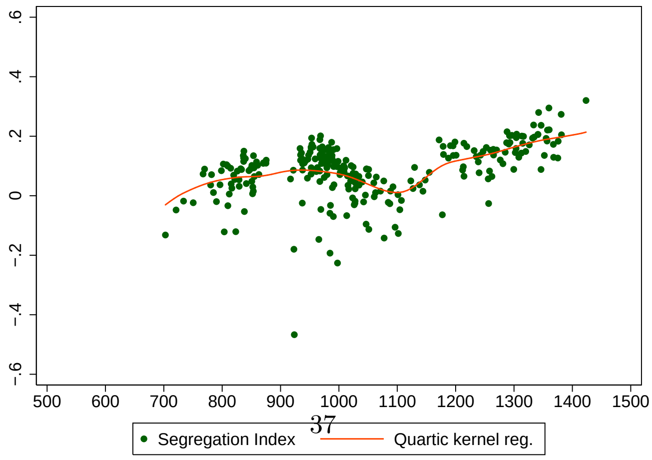
Figure 6: Neighborhoods' Quality of Life Probability Density Functions



(a) La Paz

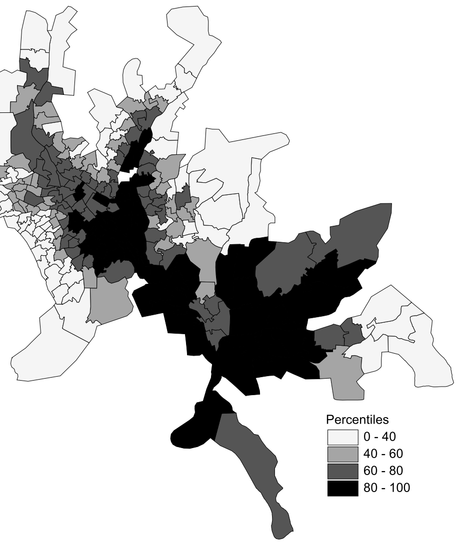


(b) El Alto

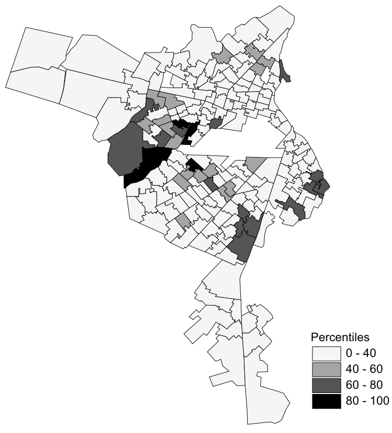


(c) Santa Cruz

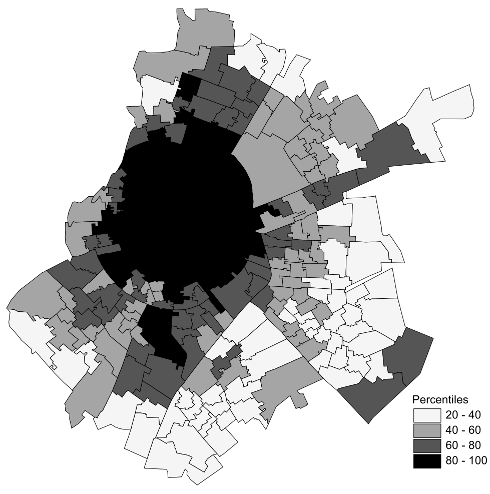
Figure 7: Neigborhoods' Segregation Indexes by QofL



(a) La Paz

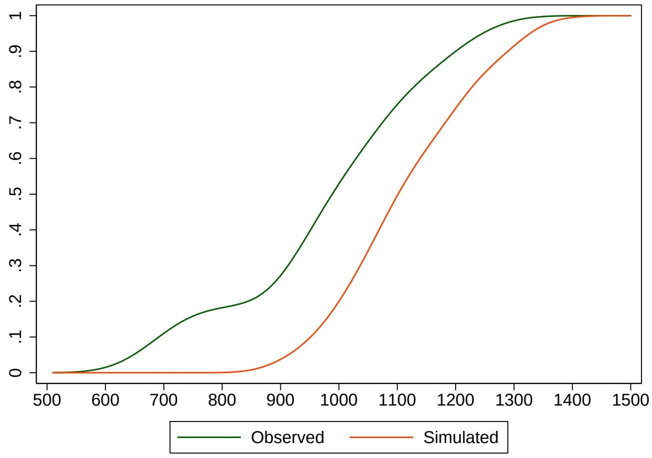


(b) El Alto

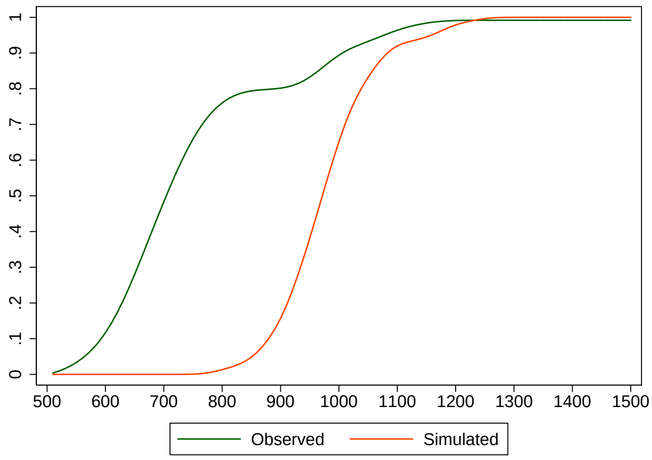


(c) Santa Cruz

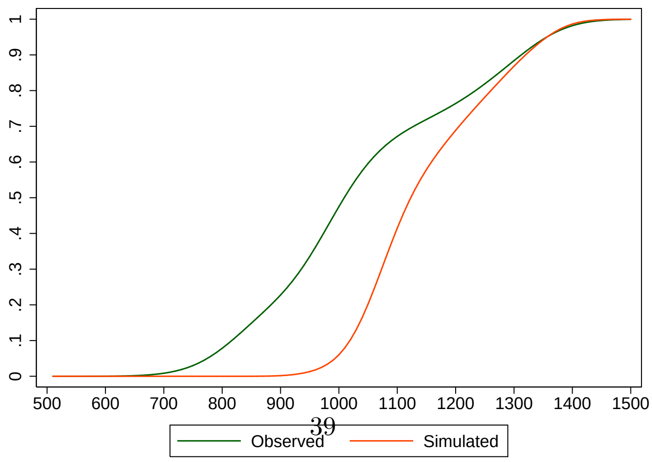
Figure 8: Neighboorhoods' Quality of Life Spatial Distributions



(a) La Paz



(b) El Alto



(c) Santa Cruz

Figure 9: QofL Gains of Full Local Public Goods Provision

Table 1: Equilibrium-revealed preference estimates, Great La Paz
Dependent variable: *Ln(Montly Housing Rental Price)*

	(1)	(2)	(3)	(4)
Housing Size				
Apartment	0.189***	0.305***	0.260***	0.270***
	(0.055)	(0.057)	(0.054)	(0.055)
2 rooms	0.193**	0.162**	0.174**	0.165**
	(0.059)	(0.061)	(0.059)	(0.059)
3 rooms	0.440***	0.402***	0.403***	0.394***
	(0.063)	(0.066)	(0.063)	(0.063)
4 rooms	0.549***	0.543***	0.530***	0.521***
	(0.066)	(0.069)	(0.066)	(0.066)
5 or more rooms	0.870***	0.932***	0.934***	0.925***
	(0.068)	(0.071)	(0.068)	(0.068)
Kitchen	0.148*	0.128*	0.153*	0.148*
	(0.062)	(0.064)	(0.062)	(0.062)
Housing Quality				
Good q.but unfin.	-0.198	-0.291*	-0.301*	-0.310*
	(0.142)	(0.147)	(0.140)	(0.141)
Bad q.	-0.140***	-0.200***	-0.171***	-0.184***
	(0.041)	(0.043)	(0.041)	(0.041)
Plastic roof tile	-0.192***	-0.254***	-0.216***	-0.217***
	(0.056)	(0.058)	(0.055)	(0.055)
Ceramic roof tile	0.044	0.027	0.054	0.033
	(0.081)	(0.083)	(0.079)	(0.079)
Other	-0.638	-0.671	-0.587	-0.617
	(0.689)	(0.734)	(0.705)	(0.709)
Ground floors	-0.137*	-0.145*	-0.106	-0.120
	(0.069)	(0.071)	(0.068)	(0.069)
Wooden plank	0.047	0.104	0.096	0.095
	(0.073)	(0.076)	(0.073)	(0.073)
Wooden parket	0.213***	0.338***	0.270***	0.274***
	(0.046)	(0.047)	(0.045)	(0.045)
Ceramic floors	0.217	0.477***	0.410**	0.411**
	(0.135)	(0.140)	(0.133)	(0.134)
Brick floors	0.223	0.306	0.256	0.269
	(0.221)	(0.231)	(0.220)	(0.222)
Other	0.317	0.556	0.456	0.515
	(0.323)	(0.337)	(0.322)	(0.324)
Housing Services				
Out.pipe water	-0.225***	-0.350***	-0.231***	-0.247***
	(0.046)	(0.046)	(0.045)	(0.045)

Continued on next page

Table 1 – continued from previous page

	(1)	(2)	(3)	(4)
No pipe water	-0.369***	-0.326***	-0.332***	-0.359***
	(0.100)	(0.099)	(0.093)	(0.094)
Septic tank	-0.249	-0.385*	-0.214	-0.208
	(0.167)	(0.173)	(0.165)	(0.167)
Cesspit	-0.027	-0.274***	-0.062	-0.065
	(0.083)	(0.081)	(0.079)	(0.080)
No sewage	-0.225**	-0.421***	-0.230***	-0.255***
	(0.069)	(0.067)	(0.066)	(0.066)
Electricity	0.011	0.252	0.115	0.171
	(0.171)	(0.173)	(0.165)	(0.166)
Neighborhood public goods				
Pub.edu.faci.			0.125	0.187
			(0.173)	(0.174)
Pub.health.faci.			0.015	0.015
			(0.076)	(0.076)
No sewage net.			-0.081	-0.179*
			(0.083)	(0.085)
No phone net.			-0.561***	-0.951***
			(0.092)	(0.072)
Street lights			0.054	0.054
			(0.039)	(0.040)
Paved/ston.st.			0.230**	0.247**
			(0.156)	(0.156)
Neighborhood externalities				
Altitude			-0.932***	-0.976***
			(0.287)	(0.307)
ln(people/sq. km)			-0.117***	-0.093**
			(0.031)	(0.032)
Perc.indigenous			-3.131***	
			(0.486)	
Const.	5.160***	4.966***	6.066***	5.633***
	(0.191)	(0.197)	(0.220)	(0.212)
Obs.	1982	1982	1982	1982
Groups	214	214	214	214
R-within	0.285	0.277	0.283	0.282
R-Between	0.760	0.787	0.822	0.805
R-Overall	0.583	0.607	0.685	0.671
Haussman		300.92	-106.54	166.12
		0.0000	-	0.0000

Table 2: Equilibrium-revealed preference estimates, Santa Cruz
Dependent Variable: *Ln(Montly Housing Rental Price)*

	(1)	(2)	(3)	(4)
Housing Size				
Apartment	0.031	0.151	0.130	0.128
	(0.114)	(0.108)	(0.107)	(0.107)
2 rooms	0.397***	0.376***	0.384***	0.385***
	(0.071)	(0.070)	(0.069)	(0.069)
3 rooms	0.623***	0.602***	0.599***	0.600***
	(0.075)	(0.073)	(0.072)	(0.072)
4 rooms	0.889***	0.880***	0.866***	0.867***
	(0.083)	(0.080)	(0.079)	(0.079)
5 or more rooms	1.081***	1.089***	1.077***	1.078***
	(0.082)	(0.080)	(0.079)	(0.079)
Kitchen	0.207**	0.205**	0.215**	0.215**
	(0.071)	(0.070)	(0.069)	(0.069)
Housing Quality				
Good q.but unfin.	0.055	0.035	0.035	0.037
	(0.077)	(0.075)	(0.074)	(0.074)
Bad q.	-0.176	-0.196	-0.190	-0.185
	(0.137)	(0.134)	(0.133)	(0.133)
Plastic roof tile	-0.240*	-0.270**	-0.259*	-0.257*
	(0.106)	(0.104)	(0.103)	(0.103)
Ceramic roof tile	-0.109	-0.155	-0.140	-0.137
	(0.090)	(0.088)	(0.087)	(0.087)
Other	0.011	-0.154	-0.103	-0.106
	(0.329)	(0.320)	(0.316)	(0.316)
Ground floors	-0.186	-0.177	-0.209	-0.207
	(0.157)	(0.151)	(0.150)	(0.150)
Wooden plank	-0.082	-0.201	-0.086	-0.078
	(0.482)	(0.479)	(0.474)	(0.474)
Wooden parket	-0.032	0.009	-0.024	-0.018
	(0.386)	(0.386)	(0.382)	(0.382)
Ceramic floors	-0.389	-0.414	-0.455	-0.450
	(0.493)	(0.484)	(0.479)	(0.479)
Brick floors	0.297***	0.351***	0.325***	0.329***
	(0.056)	(0.054)	(0.054)	(0.053)
Other	-0.115	-0.107	-0.110	-0.108
	(0.073)	(0.071)	(0.070)	(0.070)
Housing Services				
Out.pipe water	-0.137*	-0.150**	-0.130*	-0.131*
	(0.056)	(0.053)	(0.053)	(0.053)

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Table 2 – continued from previous page

	(1)	(2)	(3)	(4)
No pipe water	-0.318	-0.272	-0.287	-0.286
	(0.180)	(0.173)	(0.171)	(0.171)
Septic tank	-0.107	-0.431***	-0.179*	-0.174*
	(0.103)	(0.070)	(0.089)	(0.089)
Cesspit	-0.129	-0.460***	-0.196*	-0.193*
	(0.104)	(0.072)	(0.091)	(0.091)
No sewage	-0.372	-0.685***	-0.438*	-0.432*
	(0.218)	(0.203)	(0.208)	(0.208)
Electricity	0.232	0.230	0.220	0.224
	(0.189)	(0.184)	(0.182)	(0.182)
Neighborhood public goods				
Pub.educ.fac.			0.115	0.071
			(0.076)	(0.066)
Pub.health fac.			0.021	0.032
			(0.096)	(0.129)
No sewage net.			-0.344**	-0.373***
			(0.109)	(0.106)
No phone net.			-0.261**	-0.308***
			(0.101)	(0.092)
Street lights			0.082**	0.086**
			(0.050)	(0.051)
Paved/ston.st.			0.328***	0.350***
			(0.167)	(0.159)
Waste dis.ser.			0.120	0.190
			(0.107)	(0.157)
Neighborhood Externalities				
ln(people/sq. km)			0.031	0.026
			(0.047)	(0.047)
Perc.indigenous			-1.403	
			(1.289)	
Constant	5.348***	5.588***	5.745***	5.692***
	(0.229)	(0.218)	(0.245)	(0.240)
Obs.	1086	1086	1086	1086
Groups	125	125	125	125
R-within	0.391	0.383	0.390	0.390
R-Between	0.665	0.710	0.718	0.718
R-Overall	0.510	0.548	0.571	0.569
Haussman		49.73	18.55	18.38
		0.0010	0.7268	0.7363

Table 3: Life Satisfaction Ordered Probit Estimates
Dependent variable: *Ordered Life Satisfaction Responses*

	(1)	(2)	(3)	(4)	(5)	(6)
Percapita Household Income						
ln(y)	0.484***	-0.001	-0.027*	-0.117**	0.139***	0.006
	(0.128)	(0.002)	(0.013)	(0.036)	(0.039)	(0.003)
Housing Size						
Apartment (d)	-0.154	0.000	0.009	0.034	-0.043	-0.002
	(0.325)	(0.001)	(0.022)	(0.067)	(0.086)	(0.003)
2 rooms (d)	0.296	-0.001	-0.014	-0.079	0.089	0.005
	(0.302)	(0.001)	(0.013)	(0.089)	(0.095)	(0.006)
3 rooms (d)	0.210	-0.000	-0.011	-0.054	0.062	0.003
	(0.371)	(0.001)	(0.017)	(0.102)	(0.113)	(0.006)
4 rooms (d)	0.725	-0.001	-0.028	-0.218	0.229	0.017
	(0.453)	(0.001)	(0.016)	(0.158)	(0.150)	(0.020)
5 or more rooms (d)	0.755	-0.001	-0.028	-0.228	0.239	0.018
	(0.428)	(0.002)	(0.016)	(0.147)	(0.141)	(0.019)
Kitchen (d)	-0.516	0.001	0.020	0.155	-0.164	-0.011
	(0.383)	(0.001)	(0.010)	(0.139)	(0.132)	(0.015)
Housing Quality						
Good q.but unfin. (d)	0.507	-0.001	-0.018	-0.157	0.163	0.012
	(0.357)	(0.001)	(0.011)	(0.129)	(0.123)	(0.015)
Bad q. (d)	-0.357	0.001	0.022	0.080	-0.099	-0.004
	(0.293)	(0.001)	(0.024)	(0.059)	(0.078)	(0.004)
Plastic roof tile (d)	-0.584	0.002	0.030	0.148	-0.171	-0.009
	(0.358)	(0.002)	(0.022)	(0.097)	(0.109)	(0.007)
Ceramic roof tile (d)	-0.328	0.001	0.021	0.069	-0.088	-0.003
	(0.382)	(0.002)	(0.030)	(0.071)	(0.098)	(0.003)
Ground floors (d)	0.286	-0.001	-0.012	-0.080	0.088	0.005
	(0.379)	(0.001)	(0.015)	(0.118)	(0.123)	(0.009)
Wooden plank (d)	-0.500	0.003	0.043	0.075	-0.118	-0.003
	(0.968)	(0.011)	(0.119)	(0.057)	(0.178)	(0.004)
Wooden parket (d)	-0.098	0.000	0.006	0.023	-0.028	-0.001
	(0.273)	(0.001)	(0.016)	(0.063)	(0.077)	(0.003)
Ceramic floors (d)	-0.982	0.014	0.123	0.049	-0.181	-0.004
	(1.280)	(0.047)	(0.271)	(0.204)	(0.116)	(0.003)
Brick floors (d)	0.265	-0.000	-0.012	-0.074	0.081	0.004
	(0.498)	(0.001)	(0.017)	(0.157)	(0.162)	(0.011)
Other (d)	-0.500	0.003	0.042	0.077*	-0.119	-0.003
	(0.350)	(0.005)	(0.043)	(0.032)	(0.066)	(0.002)
Housing Services						

Continued on next page

Table 3 – continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)
Out.pipe water (d)	-0.031	0.000	0.002	0.007	-0.009	-0.000
	(0.269)	(0.001)	(0.015)	(0.065)	(0.077)	(0.003)
No pipe water (d)	-0.470	0.003	0.039	0.076	-0.113	-0.003
	(0.476)	(0.005)	(0.054)	(0.045)	(0.095)	(0.003)
Septic tank (d)	-0.915*	0.009	0.099	0.085	-0.189***	-0.005
	(0.364)	(0.010)	(0.066)	(0.046)	(0.051)	(0.003)
Cesspit (d)	-0.161	0.001	0.010	0.036	-0.045	-0.002
	(0.309)	(0.001)	(0.020)	(0.065)	(0.083)	(0.003)
No sewage (d)	0.034	-0.000	-0.002	-0.008	0.010	0.000
	(0.314)	(0.001)	(0.017)	(0.079)	(0.092)	(0.004)
Electricity (d)	0.883	-0.010	-0.103	-0.062	0.171	0.004
	(1.110)	(0.033)	(0.212)	(0.133)	(0.115)	(0.003)
Neighborhood Public Goods						
Pub.educ.faci. (d)	0.073	-0.001	-0.024	-0.056	0.054	0.027
	(0.281)	0.000	(0.013)	(0.142)	(0.124)	(0.026)
Pub.health faci.(d)	0.048	-0.001	-0.011	-0.052	0.061	0.003
	(1.199)	(0.001)	(0.013)	(0.073)	(0.081)	(0.005)
Street lights (d)	0.122	-0.000	-0.012	-0.091	0.099	0.004
	(0.241)	(0.001)	(0.016)	(0.101)	(0.131)	(0.008)
Paved/stoned st. (d)	0.056	-0.000	-0.024	-0.070	0.078	0.016
	(1.125)	(0.002)	(0.015)	(0.132)	(0.129)	(0.024)
No sewage net. (d)	0.463	-0.001	-0.024	-0.118	0.137	0.007
	(0.322)	(0.001)	(0.021)	(0.082)	(0.096)	(0.005)
No phone net. (d)	-0.716*	0.003	0.048	0.150*	-0.192*	-0.008
	(0.344)	(0.003)	(0.038)	(0.059)	(0.085)	(0.006)
Neighborhood Externalities						
ln(people/sq. km)	-0.144	0.000	0.008	0.035	-0.041	-0.002
	(0.118)	(0.001)	(0.007)	(0.029)	(0.034)	(0.002)
Perc.indigenous (d)	-0.000	0.000	0.000	0.000	-0.000	-0.000
	(0.207)	(0.001)	(0.011)	(0.050)	(0.059)	(0.003)
Other Controls						
Santa Cruz (d)	-0.325	0.001	0.021	0.068	-0.087	-0.003
	(0.462)	(0.002)	(0.039)	(0.080)	(0.115)	(0.004)
Woman (d)	-0.178	0.000	0.009	0.044	-0.052	-0.002
	(0.166)	(0.001)	(0.009)	(0.043)	(0.049)	(0.003)
Age	-0.015	0.000	0.001	0.004	-0.004	-0.000
	(0.034)	(0.000)	(0.002)	(0.008)	(0.010)	(0.000)
Age squared	0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Spouse (d)	0.412*	-0.001	-0.020	-0.107	0.122	0.006
	(0.206)	(0.001)	(0.014)	(0.057)	(0.065)	(0.004)

Continued on next page

Table 3 – continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)
Other member (d)	0.478	-0.001	-0.019	-0.141	0.151	0.010
	(0.291)	(0.001)	(0.012)	(0.098)	(0.100)	(0.009)
Household size	0.027	-0.000	-0.002	-0.007	0.008	0.000
	(0.055)	(0.000)	(0.003)	(0.014)	(0.016)	(0.001)
Cut Points						
cut1	-0.828					
	(2.027)					
cut2	0.368					
	(2.020)					
cut3	3.092					
	(2.013)					
cut4	4.973*					
	(2.042)					

Table 4: Prices of Housing Features and Environmetal Amenities

	Equi. prices		*Disequi. prices*
	G.La Paz	S. Cruz	Pooled S.
	(1)	(2)	(3)
Housing Size			
Apartment	83.1***	41.5	-101.6
2 rooms	55.6**	122.7***	195.4
3 rooms	128.7***	191.4***	138.6
4 rooms	169.3***	276.7***	478.5
5 or more rooms	298.4***	344.1***	498.3
Kitchen	48.9*	68.7**	-340.6
Housing Quality			
Good q.but unfin.	-96.2*	11.2	334.6
Bad q.	-54.6***	-60.7	-235.6
Plastic roof tile	-69.0***	-82.7*	-385.5
Ceramic roof tile	17.3	-44.7	-216.5
Other	-187.5	-32.9	-
Ground floors	-33.9	-66.8	188.8
Wooden plank	30.7	-27.5	-330.0
Wooden parket	86.3***	-7.7	-64.7
Ceramic floors	131.0**	-145.4	-648.2
Brick floors	81.8	103.8***	174.9
Other	145.7	-35.1	-330.0
Housing Services			
Out.pipe water	-73.8***	-41.5*	-20.5
No pipe water	-106.1***	-91.7	-310.2
Septic tank	-68.4	-57.2*	-603.9*
Cesspit	-19.8	-62.6*	-106.3
No sewage	-73.5***	-139.9*	22.4
Electricity	36.7	70.3	582.8
Neighborhood Public Goods			
Pub.edu.faci.	39.9	36.7	48.2
Pub.health.faci.	4.8	6.7	31.7
No sewage net.	-25.9	-109.9**	305.6
No phone net.	-179.2***	-83.4**	-472.6*
Street lights	17.3	26.2**	80.5
Paved/ston.st.	73.5**	104.8***	37.0
Waste dis.ser.	-	38.3	-
Neighborhood Externalities			
Altitude	-297.7***	-	-
ln(people/sq. km)	-37.4	9.9	-95.0
Perc.indigenous	-1000.2***	-448.2	0.0

Table 5: Households' QofL Descriptive Statistics

	La Paz	El Alto	Santa Cruz
Obs	217,538	174,694	267,739
Mean	982	746	1,046
Std. Dev.	250	208	257
Skewness	0.15	0.77	0.40
Kurtosis	2.32	3.21	2.30
F(x)=0.05	585	464	695
F(x)=0.10	668	508	752
F(x)=0.25	806	601	840
F(x)=0.50	950	699	1,001
F(x)=0.75	1,177	865	1,235
F(x)=0.90	1,333	1,058	1,424
F(x)=0.95	1,422	1,157	1,555

Table 6: Neighborhoods' QofL Descriptive Statistics

	La Paz	El Alto	Santa Cruz
Obs	235	191	262
Mean	980	747	1,046
Std. Dev.	173	150	174
Skewness	-0.40	1.07	0.37
Kurtosis	2.50	3.24	2.13
F(x)=0.05	660	573	804
F(x)=0.10	688	603	829
F(x)=0.25	909	649	938
F(x)=0.50	993	709	1,005
F(x)=0.75	1,100	783	1,196
F(x)=0.90	1,202	988	1,313
F(x)=0.95	1,243	1,076	1,346

Table 7: Determinants of QofL Inequality

	La Paz	El Alto	Santa Cruz
Panel A	*Group Ineq.Decomposition*		
Within-neighborhood	52.3	46.6	55.9
Between-neighborhood	47.7	53.4	44.1
	100	100	100
Panel B	*Factor Ineq.Decomposition*		
Housing Size	30.3	17.9	27.5
Housing Quality	21.1	15.8	15.1
Housing Services	15.0	18.4	19.0
Neighborhood Public Goods	34.5	47.2	37.1
Neighborhood Externalities	-0.9	0.7	1.3
	100	100	100

Table 8: Spatial Correlation Measures

	La Paz	El Alto	Santa Cruz
Weight	*Contiguity Relationships*		
Moran's I Measure	0.71	0.23	0.73
Geary's C Coefficient	1.52	1.12	1.61
Weight	*Distance Bands*		
Moran's I Measure	0.79	0.43	0.82
Geary's C Coefficient	1.61	1.22	1.71