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A PROPOSAL FOR MEASURING QUALITY OF LIFE IN SPANISH MUNICIPALITIES

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Abstract

This paper measures the quality of life (QoL) in the biggest Spanish municipalities in 2011. We follow recent descriptions of QoL to propose an integrated framework composed of eight dimensions. We combine different sources of information to construct 16 subindicators. Weight constrained Data Envelopment Analysis is then used to estimate the composite indicator of the QoL. Results show that the Northern and Central regions in Spain attain the highest levels of QoL, while the Southern and Mediterranean regions report lower scores. The results also show important differences between per capita gross domestic product and QoL at the provincial level.

1. **Introduction**

The progress and development of society should be the ultimate goal of public policy decision making. Social progress has been traditionally associated with economic macro-indicators, being Gross Domestic Product (GDP) the most extended one[1]. However, the creator of GDP, Simon Kuznets warned against the potential misuse of GPD as a measure of well-being: "the welfare of a nation can scarcely be inferred from a measurement of national income" (Kuznets, 1934: 7). A wide consensus exists today in social science research on the need to complement income indicators, such as GDP, with additional social and environmental dimensions that complete the assessment of social progress (Costanza et al., 2009; Fitoussi and Stiglitz, 2011). This enhanced view of well-being goes far beyond wealth and material standards of living. It includes a list of items which are not traded in markets but make life worth living (a clean environment or social relations, for instance).

Research on quality of life (QoL) can be traced back to the early works of Easterlin (1974), Campbell et al. (1976) or Andrews and Withey (1976), who showed that economic growth (i.e., GDP growth) was not necessarily accompanied by the corresponding growth in well-being (the well-known Easterlin paradox). In the 1990s, the United Nations created the Human Development Index, complementing GDP with measures of health and education, with the aim of tracking social progress in developing and underdeveloped countries. The academic interest on the topic increased rapidly during the 1990s and 2000s. Institutions such as the OECD and the European Commission also showed strong interest in developing statistical tools for the assessment of the quality of life in their respective domains. The influential report of the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) placed the topic in the centre of the social sciences agenda (Stiglitz et al., 2010).

Applied research in QoL has placed countries and individuals as the preferred units of analysis[2]. In contrast, the municipal level has received much less attention. Data limitations partly explain this situation, since the indicators required to measure the different domains of QoL are only available for the largest cities. This is unfortunate, since the municipal level can be even more relevant for the assessment of QoL than the regional or national levels (González et al., 2011).

According to economic indicators, the recent financial crisis started in 2008 had a profound impact in Europe and, in particular, on the Spanish population (Guardiola et al, 2015; Méndez et al., 2015). With negative growth of GDP (from 2009 to 2013) and

[1] We must note that GDP was not originally designed as a measure of social progress or well-being, but simply as a measure of economic activity. However, it has been and still is commonly used by both economists and politicians as a proxy of well-being.

alarming unemployment figures (peaking 27% as of January 2013), the risk of poverty and social exclusion has increased dramatically. It is estimated that 20% of the Spanish population was below the poverty line in 2013, five points more than in 2004[3]. The severe material deprivation rate also rose from 4.8 in 2004 to 6.2 in 2013[4]. Our intention in this paper is to revisit the situation of the biggest Spanish municipalities in terms of QoL in 2011 (i.e., ten years after our previous study). For this purpose, we have carefully collected a comprehensive set of social and economic indicators covering all the relevant dimensions of QoL in 2011. This update may illustrate the impact of the crisis across the territory, not only in terms of GDP but also in terms of well-being.

Measuring quality of life in municipalities is a demanding task. The dimensions of quality of life are many and varied, but data at the municipal level is scant. While it is almost impossible to collect precise indicators to measure every single angle of QoL, we propose using various proxies that can be obtained from different sources. In order to aggregate this information into a composite index of QoL, we rely on Data Envelopment Analysis (DEA). DEA is a frontier technique that has been extensively used for the measurement of efficiency in production. While DEA was not initially designed for the measurement of QoL, its use within the social indicators literature has become increasingly popular, giving rise to the Benefit of the Doubt (BoD) approach (Cherchye et al., 2007). After the pioneering work of Hashimoto and Ishikawa (1993), who applied DEA to estimate quality of life in Japan, more than 50 papers have applied this methodology for the measurement of QoL. See Mariano et al. (2015) for a comprehensive review.

The paper is structured as follows. Section 2 briefly reviews the literature on the measurement of the quality of life and, in particular, its application to municipalities. Section 3 presents the data and describes the indicators used to approximate each of the 8 dimensions of QoL considered. Section 4 describes the weighted constrained DEA model proposed. Section 5 shows the results obtained and concluding remarks are provided in a final section.

2. The measurement of quality of life in municipalities

Social welfare is a central topic in Economics and other social sciences. Unfortunately, aggregate market-based indicators (GDP most notably), and not well-being measures, have traditionally guided policy decision making. The flaws of GDP are well known to economists (see Stiglitz et al., 2010) and there is growing consensus that the excessive political emphasis on aggregate market transactions is misplaced.

[2] See Somarriba et al. (2015) for a recent example that measures trends in QoL for European countries.
[3] Data obtained online from the official statistics of the Instituto Nacional de Estadística.

Human and not economic development should be the ultimate goal of society. Furthermore, human development has a positive impact on economic growth, while the opposite is not necessarily true (Ranis et al., 2000).

During the last decade, the European Commission and the OECD have promoted some interesting initiatives to introduce QoL into the political agenda, starting off with the 2007 conference "Beyond GDP" and the 2009 conference "GDP and Beyond", which challenged authorities and institutions to extend the focus of statistical information and political action beyond macroeconomic figures. The influential report of the French Commission on the Measurement of Economic Performance and Social Progress (CMEPSP), elaborated by Stiglitz, Sen and Fitoussi in 2009, highlighted the multidimensional nature of QoL and sustainability and specified the type of statistical information that should be developed to obtain useful indicators. Several institutions took the challenge of developing such indicators, most notably the OECD and the European Statistical System (ESS). Since 2013, the OECD publishes the Better Life Index and How is Life, addressing quality of life along 11 dimensions (housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance). In turn, closely following the CMEPSP recommendations, the ESS Sponsorship group on Measuring Progress, Well-being and Sustainable Development, recommended 8+1 dimensions along which QoL should be addressed (material living conditions, productive or main activity, health, education, leisure and social interaction, economic and physical safety, governance and basic rights, natural and living environment, overall experience of life).

While these efforts seem promising, the current application of the statistical information developed is still far from reaching the municipal level of analysis. Not surprisingly, most studies focus on the national or regional level. Local information about the different dimensions of QoL is still scant and dispersed within Europe. A notable contribution to extend the assessment of QoL to the local level is the Urban Audit Project (UAP), which started in 1999. The UAP compiles data in 9 dimensions (demography, social aspects, economic aspects, civic involvement, training and education, environment, transport and travel, culture and leisure, innovation and technology) with more than 300 variables corresponding to 284 European cities. It is an ambitious project and has compiled a comprehensive collection of data which is very useful to construct meaningful indexes of QoL. Unfortunately, the scope of the project is not yet enough to allow the analysis of QoL at the municipal level within a given European country, since only the biggest cities are included in the database.

Despite data limitations there is a growing body of empirical literature estimating QoL in cities (Ballas, 2013). Some international early examples include estimations of

[4] Data obtained online from the official statistics of Eurostat.

QoL for US metropolitan areas (Becker et al, 1989), Japanese prefectures (Hashimoto and Ishikawa, 1993) or US counties (Marshal and Shortle, 2005). Within Europe, Morais and Camanho (2011) used the Urban Audit data to compute composite QoL indicators for an extensive sample of 206 cities belonging to 25 countries. Within country analyses in Europe are still scant. Poldaru and Roots (2014) is a recent example. In the case of Spain, the most comprehensive analysis measured QoL in a sample of 643 municipalities for 2001 (Gonzalez et al., 2011). Other authors have estimated QoL indexes for smaller intraregional samples, including Martin and Mendoza (2013) for Canarias, Royuela et al (2003) for the province of Barcelona, Zarzosa (2005) for the province of Valladolid or López and Sánchez (2009) for Galicia. Some recent research has estimated QoL indirectly by analyzing migration patterns in a sample of 700 Spanish municipalities (Navarro and Artal, 2015).

In this paper, we try to overcome the data availability limitation by making a considerable effort to collect data from sources containing information capable of approximating most of the dimensions of QoL identified in the literature. While there is no complete consensus about which dimensions are these, we follow the guidelines provided in the influential Stiglitz et al. (2010) report and the subsequent work of the ESS Soponsorship group and the OECD's "Better life" initiative. Following these sources, we propose an integrative framework that considers 8 dimensions[5], for which information at the municipal level in Spain can be obtained. Table 1 shows the relationship between our proposal and the three sources just mentioned:

<<<<<<<<<TABLE 1 ABOUT HERE>>>>>>>>>>>>>>

While there is no precise one-to-one link among the three specifications of QoL considered, they all focus on the same underlying factors. Of the eight dimensions, four are very precise and almost identically specified in the three proposals: health, education, environment, safety. We take sides with the ESS sponsorship group in combining economic and physical safety within the same dimension. The material living conditions dimension accounts for the income and housing dimensions suggested by the OECD's Better Life Index, since they all refer to material conditions. In turn, personal activities accounts for the activities other than work and is related with the OECD's work-life balance. In the same manner, social interaction accounts for the concern and connection with the community, which has been identified as a critical

[5] The ESS sponsorship group proposes a 9th dimension (Overall Experience of Life) to account for the subjective perception of the own QoL. So does the Better Life Index of the OECD. While we sympathize with the life satisfaction dimension, in this study we only have access to objective dimensions (not self-reported perceptions). Therefore, our QoL index will be constructed in the tradition of the Scandinavian welfare research (Erikson, 1974, 1993) that bases QoL exclusively on objective indicators. It can also be understood in terms of the capabilities approach (Sen, 1993).

component of QoL. Finally, governance and political voice will account for the participation of the people in the political life of the municipality and the quality of public governance. In the following section we describe the data and the indicators used to assess each of the eight dimensions at the municipal level in Spain.

3. Data and partial indicators of QoL

Our objective in this paper is to propose a methodology to measure QoL in Spain using different available sources and to update our results for the biggest Spanish municipalities from 2001 to 2011. Our previous paper (González et al., 2011) relied mainly on data obtained from the census for a sample of 643 municipalities over 10000 population[6]. The census is elaborated every 10 years by the Spanish *Instituto Nacional de Estadística* and contains varied information about the people and the dwellings. Unfortunately, only the municipalities over 20000 population are identified in the 2011 census microdata. For this reason, we have limited the current study to a reduced sample of 393 municipalities. Next we describe the battery of indicators that will be used to approximate each of the eight dimensions of QoL shown in Table 1.

Material Living Conditions

The first dimension in Table 1 focuses on the material or economic aspects of well-being and is strongly related to poverty and social exclusion. While we don't have information on per capita income at the municipal level for the entire sample, the census microdata provides a good proxy that is called Average Socioeconomic Condition (ASC). This variable measures (on a scale) the socioeconomic status of every individual registered. Its municipal average is a reasonable proxy of material living conditions. A second element related to this dimension is housing, which is also partially associated with health concerns. From the census microdata we computed the Average Net Surface (ANS) and the average Living Conditions of the Dwellings (LCD)[7]. By multiplying both variables we computed a combined indicator of the overall Quality of the Dwellings (QD=ANS·LCD).

Health

Health is perhaps the most straightforward addition to GDP that is needed for obtaining a measure of well-being that goes beyond material concerns. Not surprisingly, health and education were the two key dimensions originally added to GDP by the

[6] This census is named "Censo de Población y Viviendas" and is elaborated by the Spanish National Statistics Office (INE) every ten years. The last one was referred to 2011.

[7] This index ranges from 0 to 100 and takes into account factors of the buildings as the age of construction, tumbledown status, hygienic conditions, running water, indoor toilet, accessibility, heating, etc.

United Nations in the Human Development Index. We use two health indicators based on mortality data[8]. The first one is Excess of Mortality (EM) adjusted by age. To construct this indicator for each municipality, we divided the population into age groups of five years (0-5, 6-10….) and then computed mortality rates within each age group. These rates were adjusted by weighting each age group rate by the national norm. The age-adjusted mortality rate of the municipality was then divided by the aggregate national mortality rate. This ratio reflects whether age-adjusted mortality in the municipality is higher or lower than the national norm. Then, we constructed a second indicator using mortality microdata called Avoidable Mortality (AM). We counted the number of deaths that can be classified as avoidable following a consensus of Spanish health experts (Gispert et al., 2006). These include, for instance, breast cancer for women (not for men) in ages between 0 and 75. Health services should monitor women for breast cancer and available health services technology should be able to prevent this source of death for patients younger than 75. Our AM variable is the ratio of avoidable deaths to total population in the municipality[9].

Education

The third component of the Human Development Index and a key dimension for a composite indicator of QoL is Education. The level of education increases subjective QoL (Ross and Van Willigen, 1997) and additionally generates positive externalities on the community (Grace, 1989). Therefore, it is not only the own education level what influences QoL but the joint education level of the community. The census microdata contains two relevant indicators of educational attainment. The first, and most informative one, is the overall level of education (OLE), in a scale from 0 (illiterate) to 10 (PhD). The census also provides a dummy variable indicating whether the individual completed a university degree (UD) or not.

Environment

The physical urban environment plays a central role in limiting the potential for the development of good quality of life and is also strongly related to sustainability. Environmental quality refers mainly to aspects such as the existence of clean green areas and unpolluted air and water, apart from other aspects more difficult to quantify as the visual perception of the environment. Since 2007, the Spanish Ministry of Agriculture, Food and Environment publishes data on the quality of air, obtained from a

[8] Mortality microdata include the complete registry of deaths including the cause of death, age and residence. The microdata identifying the municipality of residence are not publicly available. We thank the INE for facilitating these data for our research.

[9] To be exact, we used the data of population under 75, since most cases of death are only considered to be avoidable for individuals below that cut-off age.

network of stations for air quality measures. We compiled data on two different pollutants which are subject of big concern for health according to the World Health Organization (WHO, 2006): 1) Particulate matter (PM_{10}, average daily value), which, according to the WHO, affects more people than any other pollutant. It is composed of small particles which can penetrate and lodge deep inside the lungs, contributing to many health problems such as lung cancer, and 2) Ozone (O_3, 26^{th} maximum 8-hour mean), which is one of the main components of photochemical smog and is associated with varied health problems such as heart and lung diseases[10].

Economic and Physical Safety

Both economic and physical safety have been stressed as relevant components of the QoL. A usual indicator of economic safety is the Unemployment Rate (UR), a well-recognized source of economic insecurity and social exclusion. Further, unemployment is associated with a deterioration of physical and mental health (Lahelma, 1992; Janlert, 1997) and psychological well-being (McKee-Ryan et al. 2005). People who become unemployed report lower subjective quality of life even after controlling for the loss of income (Fitoussi and Stiglitz, 2011). Physical safety is also important, not only because of its most obvious effect on physical integrity, but also because of the effect of perceived insecurity in emotions (Stiglitz et al., 2010). Upon request, the Spanish Ministry of Home Affairs provided disaggregated crime data for all the municipalities in the sample except those in País Vasco and Cataluña. Unfortunately, for these two regions we only had access to aggregate data[11]. Therefore, we use the total number of crimes divided by total population (CRI).

Governance and Political Voice

The quality of local governance greatly affects the quality of the public services received by the citizens and, therefore, is of paramount importance to QoL. The financial condition of the local government can be used as a proxy of the quality of public management (e.g., Groves et al, 1982; Zafra-Gómez et al, 2009; Cuadrado-Ballesteros et al., 2012). Along this line, the financial result or cash surplus is a key indicator of financial health. In order to avoid the size effect in this indicator, we take the ratio of the cash surplus on the total budget of the local government (CS). In the same way, active participation of citizens in public decision making is a sign of freedom and concern about quality of life. Political voice is critical for public policy accountability. The only available indicator of political voice for the whole sample of municipalities was

[10] The WHO also stresses the importance of Nitrogen Dioxide (NO_2) and Sulfur dioxide (SO_2). Unfortunately, data for these two elements were not available for the entire sample.

[11] The data for País Vasco are publicly available online. In the case of Cataluña the data were provided by the Autonomous Government upon request for this research.

the percentage of participation in municipal elections in 2011 (PME). Voter turnout is a common indicator for this dimension and has been used, for instance, in the OECD's better life index within the civic engagement and governance.

Social Interaction

The existence of places and institutions that facilitate social interaction can be beneficial to QoL since they ease developing social and cultural relations (Lloyd and Auld, 2002). Involvement towards the community is also an important part of social interaction that contributes to QoL. Two indicators are available to be used as proxies for this dimension. The first one, included in the census microdata, is the participation in volunteering activities (VA), which shows the degree of commitment with the most needed in the community. The second variable is the total number of cultural and social centers available in the municipality, divided by the population (CSC)[12].

Personal Activities

Related with the previous dimension is the time devoted to non-working pleasant activities. Our municipal database contains two variables that reasonably approximate this dimension of QoL. The first one is the commercial market share (CMS), a variable included in the Anuario Económico de España 2011 which is elaborated by La Caixa[13]. As some of the pleasant personal activities identified by Stiglitz et al. (2010) imply consumption, they will also contribute to the commercial market share of the municipality (e.g., shopping, traveling, eating, exercising). The second proxy is commuting time (CT), which negatively affects QoL since it withdraws time from pleasant personal activities[14]. Commuting has been consistently associated with reduced subjective well-being even after compensating for the increased income or better housing that can be obtained from the extra income associated with larger commuting times (Stutzer and Frey, 2008).

<<<<<<<<<TABLE 2 ABOUT HERE>>>>>>>>>>>>>

[12] This variable was obtained from the municipal database of CajaEspaña.

[13] To compute this index, La Caixa takes into account the population, number of phones, automobiles, trucks and vans, banking offices and retail activities. In order to make this index comparable across municipalities we divided it by the population.

[14] The raw data distinguishes between two destinations (job or school). Our variable is the arithmetic average of both. We also must indicate that INE does not compute an index associated with these variables. Instead the report includes the percentage of people on seven intervals that go from "less than 10 min" to "more than 90 min". We took mark classes in the mean of the intervals (90 for the last interval) and weighted each class mark by the percentage of population within the interval. The weighted sum can be interpreted as the average time employed to get to the school or job and is the variable used in this paper.

Table 2 shows the complete list of indicators used to approximate the 8 dimensions of QoL[15].

4. Methods

The first step to estimate the composite indicator of QoL was to compute the 16 partial indicators listed in Table 2 for each of the 393 municipalities in the sample, as explained in the previous section. Then, these partial indicators need to be aggregated into a single composite indicator. The OECD's Handbook on Constructing Composite Indicators (Nardo et al., 2005) describes different methodologies that can be applied to combine varied information into a QoL index. In this paper we follow the DEA approach, that was originally proposed by Hashimoto and Ishikawa (1993) for measuring QoL. In order to compute the DEA scores, the first step is to construct a frontier containing the municipalities that must be considered as the best referents. Let's follow the traditional specification of Charnes et al. (1978) with an output orientation, which requires solving the next mathematical program for each municipality *i* in the sample:

$$\begin{aligned} &\min \frac{\sum_{m=1}^{M} v_m x_{im}}{\sum_{s=1}^{S} u_s y_{is}} \\ &s.a: \\ &\frac{\sum_{m=1}^{M} v_m x_{jm}}{\sum_{s=1}^{S} u_s y_{js}} \geq 1 \quad , \quad \forall j \\ &u_s, v_m \geq 0 \quad , \quad \forall s, m \end{aligned} \tag{1}$$

where x_{im} represents the amount of input *m* in municipality *i*, y_{is} represents the amount of output *s* in municipality *i*, v_m is the weight of input *m,* and u_s is the weight of output *s* and *j* represents any municipality in the sample[16].

To avoid the arbitrary definition of the different dimensions as inputs or ouptuts (bads and goods), we transform all the variables into outputs (i.e., more is better). For this purpose, we followed the distance to the group leader normalization method

[15] Many of these variables (or similar indicators) are proposed by the EU Sponsorship Group on measuring social progress and by the OECD Better Life Index. For instance, the unemployment rate, excess mortality, quality of dwellings, overall level of education, air quality (PM_{10}, O_3), voluntary work, crime rates and polls numbers can be found in very similar or identical form. There are also indicators which are similar to the average socioeconomic condition and commercial market share. Even though our selection of indicators is constrained by data availability, we believe it offers a close description of the QoL dimensions in a similar way as they are specified in those initiatives.

proposed by Cherchye et al. (2004). In the case of goods, we divided the value of the variable by its maximum (ASC, QD, OLE, UD, CS, PME, VA, CSC and CMS). In the case of bads, we divided the minimum of the variable by its value (EM, AM, PM_{10}, O_3, UR, CRI and CT). All the transformed variables vary from 0 to 1 and higher values indicate better QoL. After these transformations, we can compute a DEA composite indicator in which all the sub-indicators are ouptuts (more is better) and we include an additional fictitious input dummy variable which takes the same value 1 for all municipalities. The resulting DEA model is equivalent to the estimation of the following composite indicator (Cherchye et al., 2007):

$$\max \sum_{s=1}^{S} u_s y_{is}$$
$$s.a:$$
$$\sum_{s=1}^{S} u_s y_{js} \leq 1 \quad , \quad \forall j$$
$$u_s \geq 0 \quad , \quad \forall s$$

Since the program is solved independently for each municipality, optimal weights may be completely different from one municipality to another. The main argument favouring this extreme weight flexibility is that, given that we know nothing about the appropriate weight structure, this procedure will produce an evaluation of the municipality under its most favourable scenario (Benefit of the Doubt, BoD). It could be the case that the population of a particular municipality places more value on the dimensions in which the data reflect a better behaviour of the municipality. The DEA index will be conservative enough to allow for this possibility. On the other hand, complete weight flexibility may be seen as unreasonable. In practice, we end up with completely different sets of weights across municipalities, and these sets often include weights equal to zero (to neutralize dimensions in which the municipality has a poor value). This is a well-known inconsistency in the DEA literature and many different solutions have been suggested in the literature, which imply restricting the range of acceptable values for the weights (Thompson et al. 1986; Dyson and Thanassoulis, 1988; Allen et al. 1997; Roll et al. 1991; Wong and Besley, 1990; Pedraja et al. 1997; Sarrico and Dyson, 2004).

A controversial issue in weight restriction literature is how to decide which the acceptable range of weights is. We propose a classic weight restrictions scheme, which combines a degree of flexibility with an equivalent degree weight consistency.

[16] DEA was developed to measure efficiency in production, where a set of inputs (resources) are combined to produce a set of outputs (products and services).

The basic idea is to impose 50% consistency, while allowing for 50% flexibility. While unconstrained DEA would represent 100% flexibility, equal weighting would represent 100% consistency. We propose a balanced trade off by imposing the constraint that each partial indicator must have at least one half of the weight it would have under an equal weighting scheme and no more than one half more. This imposes that, at least, half of the weighting will be common for all the municipalities in the sample (16·3.125%=50%) while the other half can be discretional for each municipality. In order to introduce these restrictions we will add the following constraint to the mathematical program for each partial indicator *k*:

$$0.03125 \leq \frac{u_k y_k}{\sum_{s=1}^{16} u_s y_s} \leq 0.09375 \quad , \quad k = 1 \ldots 16$$

The resulting weights will therefore be halfway between equal weighting and complete BoD weighting.

5. Results

Before presenting the results of the DEA model, we will briefly describe the geographical differences that can be directly appreciated from the analysis of these 8 dimensions. In order to simplify the presentation of this information, we have aggregated the municipal data at the level of the Autonomous Community (AC) [17]. Table 3 shows descriptive statistics for the 8 dimensions. The first column shows the number of municipalities in the sample belonging to the AC and the percentage of the population of that AC represented in the sample (in brackets). On average the 393 municipalities of our sample cover 68% of the Spanish population, even though they only represent a 5% of the 8122 municipalities in Spain[18]. Although our sample offers a fairly good representation of the Spanish population, some ACs are better represented than others, because they concentrate larger fractions of the population in densely populated areas. Madrid is the best represented AC in our sample, with more than 90% of the population, followed by Murcia (82.5%), Canarias (76.8%) and Comunidad Valenciana (72%). In contrast, more rural ACs are not so well represented in the sample, especially Navarra (39.4%), Extremadura (40.1%) and Castilla-La Mancha (40.5%).

In order to aggregate the municipal data at the AC level, we computed a weighted average of each partial indicator for each AC, using population figures as weights. The table shows the averages for each QoL dimension and, also, an arrow indicating whether the value is higher than the national average plus 1 standard

[17] The political-administrative structure of Spain clusters municipalities into provinces and provinces into Autonomous Communities (ACs). There are 17 ACs and two autonomous cities (Ceuta and Melilla).

deviation (↑) or lower than the national average less 1 standard deviation (↓). Navarra emerges as the AC with the best overall profile, since it shows an upward arrow in 5 of the 8 QoL dimensions. It is closely followed by La Rioja and País Vasco. All these three ACs share the same geographical area in the central north of Spain and obtained very high QoL scores in our previous study for 2001 (González et al., 2011). The most negative profiles are observed in the Autonomous Cities of Ceuta/Melilla and Canarias (4 downward arrows) and Andalucía (3 downward arrows). This is also consistent with our previous results for year 2001. In between, we observe ACs with intermediate profiles, i.e. not too high and not too low in most of the 8 QoL dimensions (Aragón, Castilla y León, Extremadura and Galicia).

<<<<<<<<<<TABLE 3 ABOUT HERE>>>>>>>>>

<<<<<<<<<TABLE 4 ABOUT HERE>>>>>>>>>>>>>

Table 4 shows the results of the weight constrained DEA analysis. Navarra and La Rioja still lead the QoL frontier. País Vasco, Castilla-León, Aragón and Extremadura are also close to the frontier. In contrast, Canarias, Ceuta/Melilla, Andalucía and Cataluña obtain the lowest QoL averages. Paradoxically, the municipalities with the highest QoL are located in the AC of Madrid, which has a moderate average of only 0.811. The high standard deviation of Madrid (0.090) is indicative of an uneven distribution of QoL within this AC. Only Canarias, Madrid and Aragón have higher internal dispersion than the average in Spain (0.075), reflecting high internal inequality.

The only municipality obtaining a QoL score equal to 1 (i.e., the maximum possible value) is Pozuelo de Alarcón, closely followed by Boadilla del Monte, Tres Cantos and Mahadahonda with 0.985. All these municipalities belong to the AC of Madrid. Behind them, there is a group of 6 very high QoL municipalities (with scores above 0.95) from the ACs of País Vasco, Madrid and Aragón: Teruel (0.982), Zarautz (0.974), Huesca (0.964), Leioa (0.956), Las Rozas de Madrid (0.953) and Arrasate/Mondragon (0.952). At the bottom we find municipalities from Canarias (Mogán, 0.417), Andalucía (La Línea de la Concepción 0.438; Cártama, 0.506) and Cataluña (Salt, 0.521).

Table 5 shows the top 10/bottom 10 QoL ranking for the 81 municipalities which are either provincial capitals, AC capitals or have population over 100000. The table shows the QoL score and the position of the municipality within the overall ranking of the 393 municipalities included in the sample. Teruel is the first provincial capital to appear in the ranking, while it occupies the fifth position in the overall ranking with a

[18] Many of these are very small municipalities. The smallest one has only 3 citizens registered.

score of 0.982. In the top ten we find all similar small and medium sized capitals from the central and northern regions of Spain. Of this list, only San Sebastián, Pamplona and Logroño are over 100000. In contrast, in the bottom ten we find big and medium sized municipalities which are not provincial capitals (except Málaga and Huelva). They locate principally in the Southern regions (including Canarias), and the ACs of Cataluña and Madrid.

<<<<<<<<<TABLE 5 ABOUT HERE>>>>>>>>>>>>>

If we focus on the ten biggest municipalities, Valencia and Zaragoza obtain the highest QoL with scores of 0.838 and 0.836, respectively. They are followed by Bilbao (0.832), Murcia (0.823) and Madrid (0.816). In contrast, Málaga (0.743), Sevilla (0.758) and Las Palmas de Gran Canaria (0.774) obtain the lowest scores.

Figure 1 shows the geographical distribution of the QoL in the 52 Spanish provinces. The lowest levels of QoL (yellow areas) are displayed in Canarias, the provinces of Andalucía and the provinces in the Mediterranean coast except Valencia and Murcia (Alicante, Castellón, Tarragona, Barcelona and Gerona). The provinces in red achieve the largest QoL indices and are concentrated in the central north part of Spain (Guipuzcoa, Navarra, La Rioja, Soria, Huesca, Teruel and Cuenca) and the western provinces of Cáceres and Orense. The northern west obtains in general terms a good evaluation. This distribution is similar to the one depicted for 2001 by González et al. (2011). The main difference is observed in the Mediterranean provinces of Cataluña and Valencia, which performed fairly well in 2001 and turned to yellow in 2011. The deterioration in the QoL of the Mediterranean regions has also been noted by Navarro and Artal (2015). The high degree of vulnerability of the Mediterranean regions to face the economic crisis, as reported by Méndez, Abad and Echaves (2015) for the period 2006-2012, explains this negative trend in that part of Spain.

<<<<<<<<<FIGURE 1 ABOUT HERE>>>>>>>>>>>>>

Finally, we want to explore the relationship between GDP and QoL. For this purpose, we will use per capita GDP data at the provincial level. Figure 2 shows the relationship between our QoL index and per capita GDP in the 52 Spanish provinces. While we find a statistically significant inverted U-shape correlation between the two variables, the figure also shows large departures from the regression curve. Central-Western and Central-Northern provinces like Teruel, Huesca or Cáceres have QoL well above the line, while Southern and Mediterranean provinces are considerably below

the line. The biggest provinces, those with more than 1 million population (Madrid, Barcelona, Valencia, Alicante, Málaga, Sevilla, and Cádiz), are all below the line, reflecting the costs of large urban areas in terms of QoL. In contrast, the smallest provinces (Teruel, Soria, Huesca, Segovia, Cuenca, Ávila, Zamora, Palencia and Lugo) are mostly above the line.

<<<<<<<<<FIGURE 2 ABOUT HERE>>>>>>>>>>>>>>>

6. Concluding remarks

Measuring QoL involves collecting information on a wide variety of indicators covering the different facets of well-being. Traditionally, economic indicators adjusted with health and education variables have been used extensively, inspired by the Human Development Index of the United Nations. Today, that approach is clearly incomplete. Different experts and institutions recommend using an exhaustive list of indicators covering the most material aspects of well-being, health and education, but also the environment, safety, governance, social interaction and personal activities. The problem with this approach is that when the unit of analysis falls from nation to region and from region to municipality it becomes increasingly difficult to obtain the data which is needed in order to cover all those dimensions of QoL appropriately.

Throughout this research, we have systematically revised all the available data sources that contained potentially useful information in order to assess the 8 dimensions of QoL proposed at the municipal level in Spain. While some indicators can be easily obtained from conventional official statistics (unemployment or political voice, for instance), other were obtained after soliciting microdata from different sources and after complex statistical treatment of those data (avoidable mortality, excess mortality or quality of dwellings, for instance). The final outcome of this arduous work was a complete set of 16 indicators, two per each of the 8 dimensions of QoL considered, for all the Spanish municipalities with population over 20000. This sample represents 68% of the entire Spanish population, although some unpopulated regions are underrepresented given their rural municipal structure (for example, Navarra or Extremadura).

Through a DEA program, we combined these 16 variables into a composite indicator, following the transformations proposed by Cherchye et al. (2007). To avoid the well-known deficit in the discriminating power of DEA when there is total weighting freedom, we imposed a structure of weight restrictions forcing 50% of the weighting vector to be common across municipalities. We believe this structure allows for enough discretion (needed to account for differential priorities in different municipalities under a

"benefit of the doubt" scenario), assuring at the same time a minimum desirable consistency in weighting.

We find the Central Northern regions comprising the highest QoL averages and the Southern and Mediterranean regions showing the lowest performance. This finding is consistent with the identification of the Mediterranean and Southern regions as the most exposed to the financial crisis. Future research should establish a direct comparison with the situation in 2001. This comparison will allow identifying catching up movements and also shifts in the QoL frontier.

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Table 1. Eight dimensions of QoL

	Our proposal	**Stiglitz et al (2010)**	**Sponsorship group**	**OECD**
1	Material living conditions	Economic insecurity	Material living conditions	Income, Housing
2	Health	Health	Health	Health
3	Education	Education	Education	Education
4	Environment	Environmental conditions	Natural & living environment	Environment
5	Economic & physical safety	Personal insecurity	Economic & physical safety	Safety, Jobs
6	Governance & political voice	Political voice & governance	Governance & basic rights	Civic engagement
7	Social interaction	Social connections	Leisure & Social interaction	Community
8	Personal activities	Personal activities	Productive & valued activities	Work-Life balance

Table 2. Partial indicators of the QoL dimensions

QoL dimension	**Indicators**
Material Living Conditions	Average Socio-economic Condition (ASC) Quality of Dwellings (QD)
Health	Excess Mortality (EM)I Avoidable Mortality (AM)
Education	Overall Level of Education (OLE) Population with a University Degree (UD)
Environment	Particulate Matter (PM_{10}) Ozone (O_3)
Economic & Physical Safety	Unemployment Rate (UR) Crime rate (CRI)
Governance & Political voice	Local government Cash Surplus (CS) Participation in Municipal Elections (PME)
Social interaction	Population participating in Volunteering Activities (VA) Cultural and Social Centers (CSC)
Personal Activities	Commercial Market Share (CMS) Commuting Time (CT)

Table 3. Eight QoL Dimensions by Autonomous Community

	N (Coverage %)	Material Living Conditions	Health	Education	Environment	Economic and Physical Safety	Governance and Political Voice	Social interaction	Personal Activities
Andalucía	81 (67.7)	0.631↓	0.373↓	0.544	0.564	0.282↓	0.654	0.457	0.681
Aragón	4 (58.5)	0.738	0.409	0.622	0.522	0.387	0.700	0.480	0.654
Asturias	7 (69.4)	0.695	0.363↓	0.588	0.539	0.438↑	0.720	0.396↓	0.660
Baleares	12 (70.8)	0.699	0.406	0.538	0.594↑	0.392	0.646	0.461	0.754↑
Canarias	25 (76.8)	0.588↓	0.396	0.517↓	0.472↓	0.294↓	0.710	0.426	0.680
Cantabria	5 (54.0)	0.728	0.407	0.597	0.590↑	0.403	0.740	0.376↓	0.706
Castilla y León	15 (50.8)	0.726	0.436	0.611	0.520	0.382	0.698	0.437	0.708
Castilla-La Mancha	15 (40.5)	0.730	0.447	0.572	0.528	0.345	0.727	0.442	0.702
Cataluña	63 (70.3)	0.712	0.418	0.580	0.562	0.333	0.637	0.479	0.628↓
Com. Valenciana	63 (72.0)	0.675	0.388	0.548	0.541	0.297↓	0.723	0.453	0.691
Extremadura	7 (40.1)	0.684	0.406	0.601	0.553	0.326	0.763	0.478	0.715
Galicia	22 (51.4)	0.722	0.412	0.591	0.520	0.388	0.717	0.415	0.686
Madrid	32 (90.3)	0.740	0.508↑	0.672↑	0.535	0.376	0.695	0.416	0.574↓
Murcia	17 (82.5)	0.679	0.397	0.520↓	0.517	0.378	0.708	0.436	0.710
Navarra	3 (39.4)	0.774↑	0.450↑	0.673↑	0.540	0.439↑	0.722	0.567↑	0.743
País Vasco	18 (64.4)	0.727	0.406	0.630	0.588↑	0.423↑	0.693	0.492	0.653
La Rioja	2 (55.2)	0.735	0.436	0.598	0.605↑	0.402	0.741	0.529↑	0.762↑
Ceuta/Melilla	2 (100.0)	0.536↓	0.346↓	0.513↓	0.530	0.229↓	0.653	0.473	0.787

Table 4. Summary of weight constrained QoL scores grouped by Autonomous Region

	n	Average	Min	Max	SD	Coverage %
Andalucía	81	0.750	0.438	0.897	0.069	67.7
Aragón	4	0.851	0.835	0.982	0.079	58.5
Asturias	7	0.823	0.744	0.890	0.055	69.4
Baleares	12	0.802	0.680	0.887	0.066	70.8
Canarias	25	0.768	0.417	0.947	0.088	76.8
Cantabria	5	0.842	0.806	0.881	0.032	54.0
Castilla y León	15	0.851	0.676	0.925	0.055	50.8
Castilla-La Mancha	15	0.827	0.722	0.921	0.064	40.5
Cataluña	63	0.777	0.521	0.875	0.061	70.3
Com. Valenciana	63	0.795	0.696	0.873	0.042	72.0
Extremadura	7	0.858	0.825	0.913	0.033	40.1
Galicia	22	0.845	0.720	0.948	0.062	51.4
Madrid	32	0.811	0.665	1	0.090	90.3
Murcia	17	0.800	0.623	0.850	0.054	82.5
Navarra	3	0.909	0.873	0.938	0.033	39.4
País Vasco	18	0.857	0.774	0.974	0.064	64.4
La Rioja	2	0.910	0.857	0.917	0.042	55.2
Ceuta/Melilla	2	0.735	0.720	0.750	0.021	100
Total	393	0.790	0.417	1	0.075	68.0

Table 5. QoL ranking of large municipalities and provincial capitals 2011

Municipality TOP 10	Rank	Score	Municipality BOTTOM 10	Rank	Score
Teruel	5	0.982	Huelva	300	0.747
Huesca	7	0.964	Málaga	309	0.743
Santiago de Compostela	13	0.941	Jerez de la Frontera	326	0.735
Soria	16	0.925	Fuenlabrada	333	0.730
San Sebastián	17	0.922	Ceuta	344	0.720
Cuenca	18	0.921	Badalona	356	0.709
Toledo	19	0.919	Telde	361	0.704
Logroño	20	0.917	Santa Coloma de Gramenet	367	0.693
Pamplona	21	0.913	Algeciras	374	0.677
Cáceres	22	0.912	Parla	380	0.665

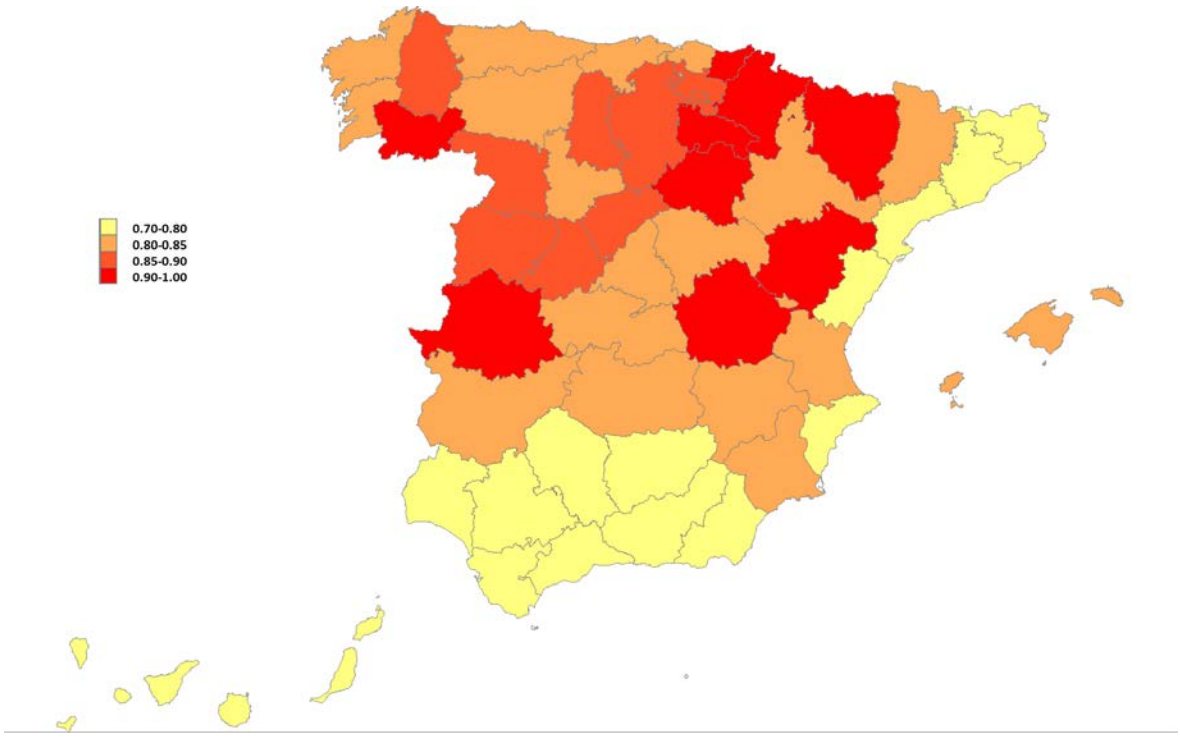

Figure 1. QoL in Spanish provinces

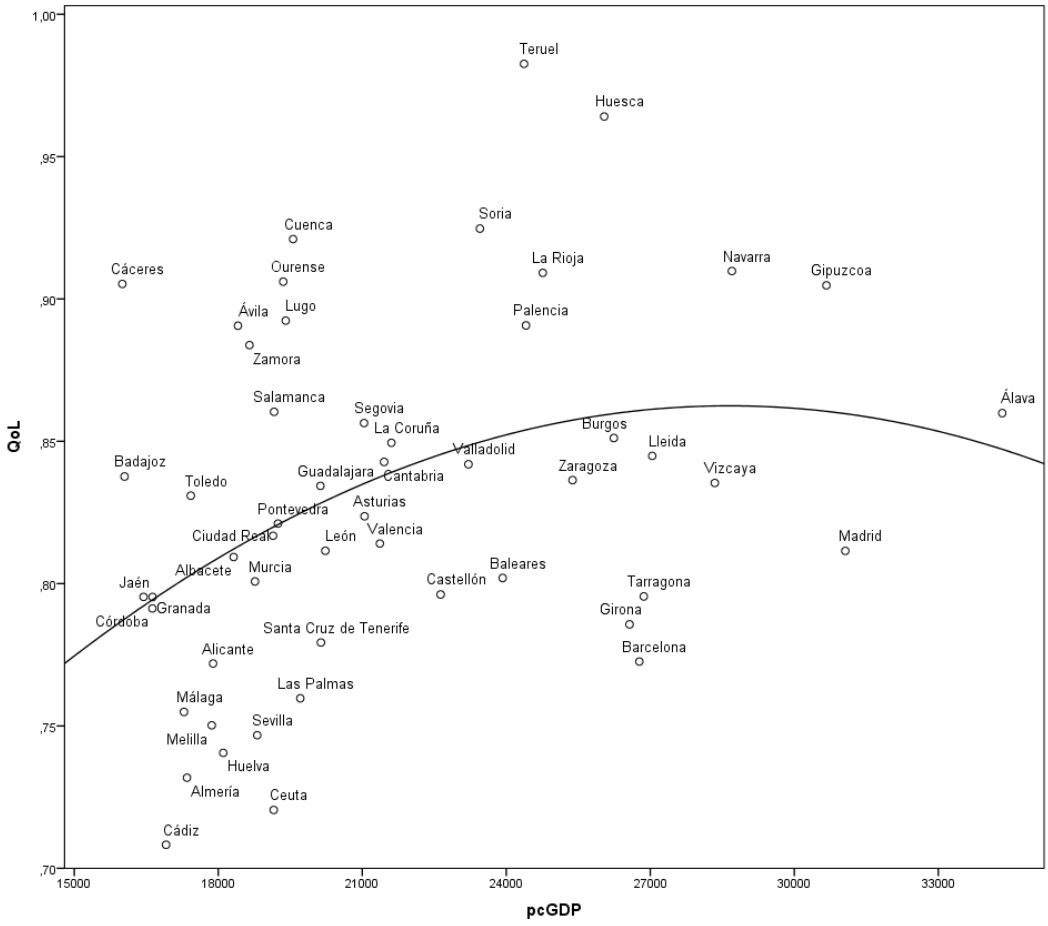

Figure 2. Relationship between provincial per capita GDP and QoL