Looking beyond Averages: Quantile Regression Approach to Model Older-Adult Europeans' Quality of Life

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1. Introduction and Background

The nature of ageing in Europe is changing. A combination of diagnostic and therapeutic procedures, greater access to quality of health services, as well as rising living standard, lifestyle and education levels, reduce mortality rates at all ages, leading to the increase in life expectancy also at middle age. Consequently, a greater proportion of older adults is nowadays in good health and capable of participating in a variety of activities. In this framework of *active ageing* (WHO 2002), former notions of old age and health conditions have to be reconsidered: the increasing number of older people, higher disability-free life expectancy at older ages, as well as policy interest in the potential reduction of public expenditure demand for predictor others than chronological age or the purely absence of disability. Accordingly, the importance of enhancing, monitoring and evaluating quality of life as perceived by individuals themselves is increasingly emphasized. In particular, this approach gained increasing attention in studies focused on population needs and well-being to supplement traditional indicators of health status, according to the general statement that adding life to years is as important as adding years to life (Broccoli, Cavrini, and Zoli 2005; Cavrini 2010; Eurostat 2015; Mollenkopf and Walker 2007).

Quality of life can be view as a subjective and multidimensional concept that places emphasis on the self-perception of an individual's current state (von dem Knesebeck et al. 2005; Bonomi et al. 2000; Fayers and Machin 2000; Sarvimäki and Stenbock-Hult 2000). Following the broad classification given by Sarvimäki and Stenbock-Hult (2000), the factors associated with QoL can be classified into intra-individual and external conditions. According to their proposal, health, functional abilities and coping mechanisms could be classified as intra-individual conditions, while work and housing, as well as social network, could be viewed as external conditions for quality of life. More in general, QoL might be defined in macro and micro terms (Bowling 1995a, 1995b; Bowling and Windsor 2001; Rosenberg 1992). Macro terms, objective and society-related, include factors such as income level, employment, housing and other environmental conditions, so that they can be seen in parallel to the external conditions defined by Sarvimäki and Stenbock-Hult. Micro terms, more subjective and individuals-related, include people's perceptions of their own QoL, experiences and values.

Together, the concept of QoL involves individuals physical and psychological health conditions, autonomy, social and environmental relations (WHO 2006). In general, in early old age, the term QoL identifies and quantifies those aspects that are specific to a stage in the life course characterized by transition from work to retirement, by an increase of personal freedom and by new option of social activism (Bowling and Windsor 2001). Starting from cross-sectional European data coming from the Survey on Health, Ageing and Retirement (SHARE), the present study aims to investigate whether and how several older-adult individuals' characteristics are associated with reported QoL.

2. Methodology

We analyze the variation in the associations between QoL and older-adults' characteristics taking into consideration the full QoL distribution. In doing so, we propose the use of quantile regression as alternative method of analysis compared to standard linear regression models such as ordinary least squares (OLS). In our models, the 10 percent quantile estimates correspond to the lowest life quality 10 percent of the sample (conditional on the explanatory variables), the 25 percent quantile to the life quality of the lower 25 percent of the sample, and so on. Hence, analysis investigate possible heterogeneous associations between dependent and independent variables at different segments of the conditional QoL distribution. The underling hypothesis is that the common right skewed distribution of QoL might be better analyzed through a semi-parametric model that focuses on the entire outcome distribution, while mean-based models could hide potential specific associations.

Data from the 2013 Survey of Age, Health and Retirement in Europe are used for the analysis. The models are restricted to respondents with complete data on the variable of interest, who answered the interview directly and not living temporary in a nursing home. We end up with 51,248 respondents. To examine individuals' quality of life we use the SHARE CASP-12 scale. This measurement is based on 12 Likert scaled items crossing four theoretically derived dimensions of QoL that are particularly important in early old age: (C)ontrol, (A)utonomy, (S)elf-realization and (P)leasure. Each Likert scale question (three for each dimension) was recoded so that the most positive response scores 4 and the most negative 1. Further, some of the items were reverse coded so that all responses are in the same direction. Following a non-hierarchical approach, the CASP-12 final score is the arithmetic sum of the scores of each item, thus ranking from 12 to 48. High values indicates higher QoL.

We fit multiple quantile regression models with CASP-12 score as dependent variable. Overall models for the entire sample are run, followed by separated estimation by gender and age specific groups. Results are compared with OLS estimates. Variables related to health, functioning, social relations and material circumstances are considered as predictor variable. Quantile regression are applied as cross-sectional estimators. Consequently, the paper focuses on the heterogeneity between individuals and not within, and coefficient estimates report the association between variables, where other factors are controlled. Thus, results cannot be interpreted as causal effects in any strict sense.

3. Main results and discussion

Focusing on general results, data support many of the expected relationships. Perceived economic difficulties, disability and health illnesses report negative and highly significant association with QoL, while better functional abilities are positively related. Foreign-born status also have a negative association with QoL. Likewise, job related dummies, along with education level, do not reveal surprising new results: being unemployed or homemaker are negatively associated with QoL compared to retired, while being employed present a slight positive association, as well as being higher educated. Social participation and neighborhood cohesion are, on the contrary, positively associated with QoL. A part from social relationships, all partnership

status different from being married and living with the partner are negatively associated with QoL and having two or more children is also positively associated with QoL in later life. While gender differences are not detected in overall models, age reveals a negative association with QoL. Country dummies show that nearly all countries report lower levels of QoL compared to Denmark.

These finding by themselves are unsurprising and have been reported in other studies. However, turning to the quantile regression analysis and looking at the full distribution of the dependent variable, several variables play a different role in the reported quantile. The associations between QoL and perceived income adequacy, working conditions, as well as education level lose magnitude over quantiles, or even their statistical significance. Moreover, even if for some variables the estimates across quantiles remain statistically significant, they do often change their magnitude and the differences between coefficients are also statistically significant. As an example, while unemployment is associated with nearly 2.5 points of decrease in QoL for the 10th quantile, this negative association do not exceed value 1 for the 90th quantile. The declining relationship can be clearly seen in Figure 1, where coefficients for the whole QoL distribution are plotted: the grey-shaded area depicts the 95 percent confidence bands of the estimated quantile regression coefficients, while the horizontal line depicts the OLS coefficients estimates and dotted black lines OLS 95 percent confidence intervals. From the graphs one can observe if the quantile regression estimates lie outside the confidence intervals of the OLS regression, this shows that associations with this variable are not constant across the conditional distribution of the independent variable. Similar decreasing coefficients estimates over the conditional QoL distribution emerge for variables related to family structures, country of residence, social participation, home ownership and neighborhood quality. Moreover, in all models the pseudo R-squared estimates, whose interpretation is similar to the R-squared in regular regressions (Hao and Naiman 2007), decrease with increasing quantiles. In order to test the robustness of results we repeated the analysis on subsamples disaggregated by gender and age groups. In most cases, similar results emerge.

Statistical analysis testing linearity and normality assumptions about OLS estimates explain that, generally, mean-average coefficients are reliable and give a good approximation of the overall associations. However, quantile regression estimates demonstrate significant variation over quantiles and significant differences emerge with regard to material circumstances and social relationships. In many cases, reported associations lose their statistical significance, or come closer to zero, for individuals reporting high QoL.

As a next stage of the current study, we plan to update the analysis to the more recent SHARE data (wave 7 – 2017) and to increase the sample of analysis, when necessary, pooling multiple waves of SHARE. Further extensions of the models could test whether and how the emerged relationships behave in each single country. Secondly, additional information should be considered in the models, such as the quality of social relationships (e.g. perceived quality of relationships, the existence of close or confiding relationships, frequency of contacts and so on). Further, separated analysis that considers different dimension of the QoL scale (i.e. control, autonomy, self-realization and pleasure) could increase the understanding of which factors mostly affect individuals' QoL.

Figure 1. Point estimates and 95% confidence intervals from quantile regression of the QoL distribution, overall sample: perceived income adequacy and working conditions variables
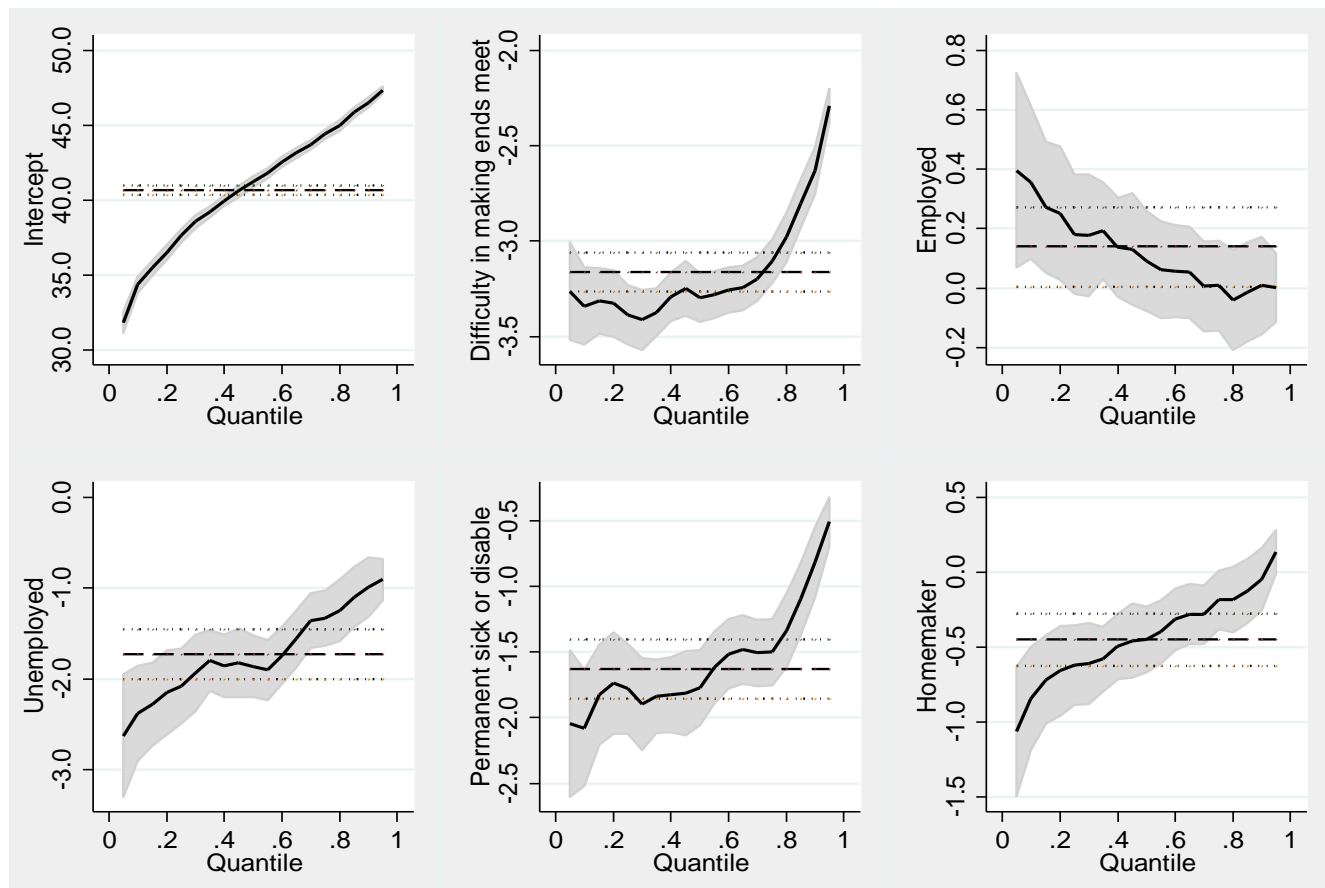
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