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Public services and subjective well-being in a European city: The case of Strasbourg metropolitan area[*]

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Abstract

This paper aims to analyze the determinants of individual well-being using a survey database from the Strasbourg metropolitan development council. We focus on the effects of externalities generated by public services (transport, culture and sport) as well as environmental quality and feelings of security in the Strasbourg metropolitan area (Eurométropole de Strasbourg, EMS). Results show that specificities of EMS (in terms of public services, environmental quality perceived as convenient for individual health, safety and security), as well as more individual features like opportunities to laugh or living with children influence significantly individual well-being. These findings are robust when using three subjective measures: feeling of well-being, environmental satisfaction and social life satisfaction. We also show that income may affect perceived well-being for individuals belonging to a low income group, while individuals belonging to a high income group tend to be unsatisfied with environmental quality, but satisfied with their social life. Besides, social comparison in terms of income does not really matter for individual well-being in the Strasbourg metropolitan area.

Key words: *environmental satisfaction, externalities, feeling of well-being, public services, social life satisfaction, utility.*

JEL classification: I31; H72

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1. Introduction

Numerous investigations in the literature of subjective well-being offer interesting hints about the socio-economic determinants of individual well-being. In most studies, the effects of income, age, health, and unemployment status are found to be significant, while education does not exert a significant effect on individual well-being (Senik, 2005). The use of these subjective indicators allows economists not only to investigate the effects of material conditions and socio-economic characteristics, but also to discuss the phenomenon of social comparison, which suggests that having a higher income and consuming more goods will lead to greater well-being. Individual income always represents one of the most important factors explaining well-being. However, this income effect may be mediated by social comparison (e.g. Carlsson et al. 2007; Clark et al. 2017). Some other studies have focused on external factors, such as economic and environmental risks, geographical location and environmental quality, as potential determinants of individual well-being (Ferrer-i-Carbonell and Gowby 2007; Brereton et al. 2008; Rehdanz and Maddison 2005, 2008, Pham et al. 2019).

This paper fits into the literature of subjective well-being using the data from a survey carried out in 2017 in the Strasbourg metropolitan area (EMS). The latter is located in the North-East of France (*Grand Est* region), in Alsace, on the river Rhine. The study concerns 33 municipalities (Strasbourg itself plus 32 smaller sized towns and villages). This survey includes three questions on subjective feelings of individuals: about their well-being, their social life and the environmental quality in the EMS; giving us three different proxies of individual well-being. Our focus is on the influence of externalities generated by local public services and local environmental quality. Our starting point is related to the standard theory of utility indicating that environmental quality and public services are positive externalities. We investigate whether local living environment and public facilities are key elements explaining the individual well-being. To do this, we consider explicative variables representing specificities of EMS in terms of public services (transport, culture and sport), environmental quality perceived as convenient for individual health, safety and security, etc. We also provide a test for relative standing by including in our econometric specification the median monthly household income at the municipality level. A negative effect of this variable on individual well-being implies that the individual compares her/his household income to this reference level, confirming that social comparison does matter.

Our results are as follows. First, public facilities and environmental externalities do matter for individual subjective well-being. Indeed, our findings show that the equipment and programming in sport and culture in the individuals' neighborhood (urban district or village) have positive effect on their subjective well-being. The fact that public transport in EMS satisfies individuals' needs also increases their subjective well-being. These findings are robust for three subjective measures: feeling of well-being, environmental satisfaction and social life satisfaction. Results also indicate that environmental quality (perceived as convenient for individual health) has a significant impact on individual feeling of well-being and environmental satisfaction. Second, individuals' life style does affect their well-being: opportunities to laugh increases the feeling of well-being and social life satisfaction, while a committed life with participation to collective activities (organization of elections, volunteer

activity, civic service, etc.) positively affects individuals' social life satisfaction and negatively affects their environmental satisfaction.

Third, when analyzing socio-economic characteristics, we observe that, compared to house tenants, house owners are more satisfied with their social life but less satisfied with environmental quality. Number of children has a significant effect on individual well-being and this effect is not linear. Concerning income effect, it is different following income group. Indeed, an increase in income may make individuals feel better off if individuals belong to a low income group. However, for individuals belonging to a high income group, they tend to be unsatisfied with environmental quality, but satisfied with their social life. Besides, social comparison in terms of income does not really matter for individual well-being in EMS. The latter result is rather opposite to that found in a large number of analyses (Clark et al. 2008, Fafchamps and Shilpi, 2008, Alvarez-Cuadrado et al., 2015, etc.), which indicates a situation of relative standing.

Our analysis shows that the key factors influencing the individual well-being may be determined by local policies. It sheds light on the role of territorial policies in improving individual well-being and might provide some guidelines for policy-makers concerned about the population's welfare. The remainder of the paper is organized as follows: Section 2 provides a survey on the link between public action via public facilities, living environment and individual well-being. Section 3 presents the data and descriptive statistics. Section 4 presents the econometric specification. Estimation results are presented in Section 5. Section 6 concludes.

2. Individual well-being, public facilities and living environment

Numerous empirical investigations using micro data offer interesting hints about the socio-economic determinants of individual well-being (e.g. Algan et al. 2019, Alvarez-Cuadrado et al. 2015, Senik 2005). Individual well-being can be measured by subjective indicators such as life satisfaction, job satisfaction and income satisfaction. These measurements are collected in different household surveys such as the British Household Panel Survey (BHPS), the American General Social Survey, the German Socio-Economic Panel and the Eurobarometer. Other measurements of individual well-being such as psychological health and the "Eudaimonia" score have been also introduced in economic analyses. For example, Clark (2003) used the General Health Questionnaire (GHQ-12) from the BHPS to study questions related to unemployment (as a social norm) and psychological health (as a proxy of subjective well-being). Clark (2016) evoked the Eudaimonia score as a proxy of individual well-being, and underlined a correlation between hedonic/life satisfaction and the Eudaimonia score, which refers to the idea of flourishing or developing human potential. This score is measured by answers to survey questions on autonomy, determination, aspiration, motivation, etc.

The use of these subjective indicators allows economists not only to investigate the effects of material conditions and socio-economic characteristics, but also to discuss the phenomenon of social comparison, which suggests that having a higher income and

consuming more goods than others will lead to greater well-being. Indeed, individual income always represents one of the most important factors explaining well-being, but this income effect may be mediated by social comparison (e.g. Senik 2005; Clark et al. 2017; Algan et al. 2020; Pham et al. 2019). In particular, the paper *What can we learn from subjective data? The case of income and well-being* (Senik 2005) presents a survey on the link between income and well-being, underlying the effect of other people's income on individual well-being. It provides arguments in favour of using subjective data and illustrates how such data can offer information about aspects of utility and social interactions. Clark et al. (2017) proves that social comparison matters and individuals compare their income with a reference value. The latter study also shows a concordance of results using SWB data and results based on hypothetical discrete-choice questions regarding income comparisons. Pham et al. (2019) use data from surveys on rural households in Vietnam and Thailand and show that income is one of the key determinants of households' subjective well-being. Moreover, households are sensitive to relative poverty. This study shows that earning an income lower than the mean village level makes households feel worse than if compared in time (to the previous year or the previous five years).

Literature on individual well-being recently addressed the role of public facilities and factors other than the socio-economic situation of individuals. In a study prepared for the French Council of Economic Analysis, Algan et al. (2020) identify five local living conditions as factors of dissatisfaction among a proportion of the French population: employment, local taxation, private and public facilities, real estate and social links. This study measures the evolution of these five dimensions for each municipality over recent years, and assesses their influence on three aspects of dissatisfaction: the likelihood of a Yellow Vest event in the municipality, the variation in the abstention rate during presidential elections and the self-reported well-being of citizens. The study also establishes a hierarchy between the five factors by applying the magnitude criterion. It is showed that the loss of health facilities and local shops (i.e. private and public facilities) appears to be the most strongly correlated with French dissatisfaction.

Some other studies have focused on external factors, such as economic and environmental risks, geographical location and environmental quality, as potential determinants of individual well-being (e.g Welsch 2006, Ferrer-i-Carbonell and Gowby 2007; Brereton et al. 2008; Rehdanz and Maddison 2005, 2008, Pham et al. 2019). When using data from the German Socio-Economic Panel, Rehdanz and Maddison (2008) show that local air pollution and noise levels diminish individual well-being. Concerning Ferrer-i-Carbonell and Gowby (2007), they examine the link between individual well-being and individual environmental attitudes using data from the British Household Panel Survey. Their result shows that individuals' concern about ozone pollution and species extinction significantly influences their subjective well-being. This implies the existence of a nexus between individual preferences and environmental factors. This result holds when the authors include in their estimation objective indicators signalling whether individuals live in a polluted environment, whether individuals engage in outdoor leisure activities as well as dummies

indicating the region where individuals live to capture the natural environment at the regional level.

Brereton et al. (2008) focus on the influence of geography and environment at the local level in their analysis using data from the Urban Institute Ireland National Survey on Quality of Life in 2001. It is shown that amenities such as climate and environmental conditions have significant effect on individual life satisfaction: for instance, increases in January minimum temperature and in July maximum temperature have positive effect while wind speed has a negative effect. Other variables indicating location and geographic characteristics, such as proximity to coast, proximity to airport, proximity to main road, have also significant impact on individual life satisfaction. For the case of developing countries such as Vietnam and Thailand, Pham et al. (2019) show that natural risks (drought, flooding, and heavy ice rain) affect households' well-being, but differently in the two countries. More precisely, they find that environmental risks in the past have a positive effect on the fact that households feel better off than the previous year or the previous five years. In other words, when looking at natural disasters in the past, households feel better off in the present. Linked to natural risks, Pham et al. (2019) also shows that households who are more willing to accept risk (i.e. lower risk aversion) feel better off in the present as compared to the previous year or the previous five years.

3. Data and descriptive statistics

The data used in this paper comes from a survey conducted by EMS in 2017, in order to collect information on potential elements relative to individual well-being in the Strasbourg metropolitan area[1]. The online survey collected 2405 responses from 33 municipalities (63% from the municipality of Strasbourg and 37% from 32 smaller sized towns and villages in the rest of EMS). Including the neighboring German town of Kehl[2], just across the Rhine, the agglomeration has 0.55 million inhabitants. More insights and data about this European metropolis are given in Appendix B (Table B1). Out of this database, we got 984 observations suitable for our study. On such a reduced number it was possible to consider additional variables - on individual style life or some specificities of the EMS perimeter - to be introduced in our main econometric estimation.

Table 1 summarizes the definition of variables concerning the socio-economic conditions of the individuals as well as their style life and the specificities of EMS. Three measures of individual subjective well-being were available in the data. First, the *Feeling of Well-being* is measured from a question to which individuals were asked to report their answer on an increasing scale from 0 to 10 where 0 indicates a negative feeling and 10 an excellent feeling ("*Please indicate your feeling of well-being on a scale from 1 to 10*").

[1] The survey area is illustrated in Figure A1.

[2] Kehl is part of the agglomeration and has been interviewed in 2017, but the methodology and the sampling were not very coherent with the main enquiry - on the French side. We therefore decided not to use this additional statistical information in our econometrical analysis of the data base. We hope to design a specific cross-border enquiry in the near future.

Table 1: Definition of variables

Variable	Definition	Type
SWB3	Individual feeling of well-being (1 if bad, 2 if medium, 3 if good)	Discrete
SWB3_SOCIAL	Individual social life satisfaction (=1 if unsatisfied, 2 if satisfied, 3 if very satisfied)	Discrete
SWB3_ENV	Environmental satisfaction (=1 if unsatisfied, 2 if satisfied, 3 if very satisfied)	Discrete
Socio-economic characteristics		
Income Group	Net monthly household income, 1(≤ 1150 euros), 2 (1151-1750 euros), 3 (1751-2300 euros), 4 (2304-3450 euros), 5 (≥3451 euros).	Discrete
# Children	Number of children in log value	Discrete
# Children squared	Squared value of the number of children	Discrete
Age Group	Individuals' age in 4 groups, 1 (18-24 years old), 2 (25-39 years old), 3 (40-64 years old), 4 (≥65 years old)	Discrete
Female	Female (=1 if female, =0 otherwise)	Dummy
Couple	Living with a partner (1 if Yes, 0 if No)	Dummy
House Ownership	House ownership (1 if owner, 0 otherwise)	Dummy
Profession_etu	Profession (1 if student, 0 otherwise)	Dummy
Profession _retraite	Profession (1 if retiree, 0 otherwise)	Dummy
Profession _libre	Profession (1 if independent profession, 0 otherwise)	Dummy
Profession _employe	Profession (1 if wage earner, 0 otherwise)	Dummy
Profession _autre	Profession (1 if other professions, 0 otherwise)	Dummy
Lifestyle		
Laugh	Opportunities to laugh (1 if Yes, 0 if No)	Dummy
Engagement	Participation to collective activities such as election organization, volunteer activity, civic service, etc.	Dummy
SWB_indi_coll	Well-being perceived as individual or collective (1 if individual, 2 if collective, 3 if a balance between both)	Discrete
Perception on Strasbourg metropole characteristics		
Service Sport	The sport equipment and programming in village/district meet individual expectations (1 if No, 2 if Moderately, 3 if Yes)	Discrete
Service Culture	The sport equipment and programming in village/district meet individual expectations (1 if No, 2 if Moderately, 3 if Yes)	Discrete
Service Transport	The public transport satisfy individual needs (1 if No, 2 if Moderately, 3 if Yes)	Discrete
Environment	Environmental quality in EMS is convenient for individual health (1 if No, 2 if Moderately, 3 if Yes)	Discrete
Sense of Security	Sense of security in the agglomeration (1 if No, 2 if Moderately, 3 if Yes)	Discrete
Median Income	Monthly median household income, computed at municipal level in log value	Discrete

Second, the *Environmental Satisfaction* corresponds to the question "*How satisfied are you with the environmental quality in EMS*?" (on a scale where 0 indicates "not satisfied at all" and 10 "very satisfied"). The third subjective measure is the *Social Life Satisfaction* corresponding to the question "*How satisfied are you with your social life*?" (on a scale where 0 indicates "not satisfied at all" and 10 "very satisfied"). Given that for these measures, low categories and very high categories have very few observations, we created a new scale by merging categories 1-4 into one group, categories 5-7 into a second group, and 8-10 for the last group. The first variable *SWB3* is the *Feeling of Well-being*: *SBW3*= 1 if individual feels bad, *SWB3* = 2 if medium and *SBW3* = 3 if individual feels good. Table 2 reports the distribution of the *Feeling of Well-being* (*SWB3)*. We note that a majority of individuals (57.52%) feel satisfied (i.e. medium) with their situation.

Table 2: Distribution of individuals' *Feeling of Well-Being*

Feeling of well-being (SWB3)	***Frequency***	***Percent***
Bad (*SWB3=1*)	67	6.81
Medium (*SWB3=2*)	566	57.52
Good (*SWB3=3*)	351	35.67

Note. Number of observations: 984.

Table 3: Distribution of individuals' *Environmental Satisfaction (SWB3_ENV)*

Environmental Satisfaction	***Frequency***	***Percent***
Unsatisfied (*SWB3_ENV =1*)	153	22.94
Satisfied (*SWB3_ENV=2*)	445	66.72
Very satisfied (*SWB3_ENV=3*)	69	10.34

Note. Number of observations: 667.

Table 4: Distribution of individuals' *Social Life Satisfaction (SWB3_SOCIAL)*

Social life satisfaction	***Frequency***	***Percent***
Unsatisfied (*SWB3_SOCIAL=1*)	21	6.84
Satisfied (*SWB3_SOCIAL=2*)	106	34.53
Very satisfied (*SWB3_SOCIAL=3*)	180	58.63

Note. Number of observations: 307.

The variable *Environmental Satisfaction (SWB3_ENV)* is defined similarly. Its distribution is reported in Table 3 which indicates that 66.7% of individuals are satisfied with local environmental quality. The final dataset included 667 observations for this variable. The *Social Life Satisfaction*, defined in the same way as for the two other subjective variables, is presented in Table 4. We observe that 58.6 % of the individuals are very satisfied with their social life. The final dataset included only 307 individuals for this subjective measure.

However, those few observations may help us to consolidate analyses using two other subjective measures: *Feeling of Well-Being* and *Environmental Satisfaction*. Analysis results with *Social Life Satisfaction* are presented in Appendix B (Table B7).

Figure 1 displays the distribution of net monthly household income for 984 individuals in the survey.[3] We observe that more than 30% of people belong to household income group 2 (between 1151-1750 euros). To estimate the effect of social comparison in terms of income, we use median monthly household income as a reference to which individuals might compare their monthly household income. We consider that individuals have a preference for relative standing (in terms of income) if median monthly household income exerts a negative effect on individual feeling of well-being. We get information on median income of French municipalities in 2015 from the data of the public agency INSEE published in 2018. This variable is measured in Euros per consumption unit (CU). By combining with our data on family composition, we define the variable "Median monthly household income" (*Median Income*) at the municipal level.

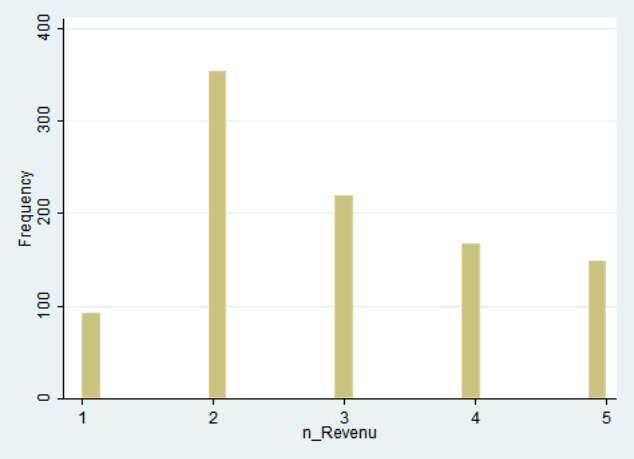

Figure 1: Distribution of *net monthly household income*. 1 ≤ 1150 euros), 2 (1151-1750 euros), 3 (1751-2300 euros), 4 (2304-3450 euros), 5 (≥3451 euros).

Table B1 provides descriptive statistics for three groups of variables: the socio-economic characteristics of individuals, their life style, and some characteristics of EMS. Regarding the socio-economic characteristics, apart from income and reference income as suggested by the theory of utility, we also consider other variables such as the number of children and number of children squared, age group of individuals, gender, living with a partner, housing ownership, and profession. A second group of variables concerns individuals' lifestyle such as opportunities to laugh, participation to collective activities such as organization of elections (e. g. polling stations), volunteer activity, civic services, etc. And finally, we consider the specificities of EMS as externalities in individual utility by using

[3] The survey gives information about five groups of household income, no information about individual income.

variables representing public services (sport, transport, and culture), environmental quality perceived as convenient for individual health, and feeling of security in the agglomeration. The 5 variables in this group take values in an increasing scale from 1 to 10. From initial variables, we create new three category-variables as indicated in Table 1.

4. Econometric modelling

4.1. Utility function and estimation specification

Let us consider the general utility function of individual $i,\ i = 1, \dots, N$:

$$U_i = U(y_i, \bar{y}, Z_i, G, E) \tag{1}$$

where y_i is individual income, $\bar{y}$ is a reference income level used for comparative purposes. This variable may be an average income in the individual i's city or region as mentioned in numerous studies in the subjective well-being literature (Luttmer, 2005, Alvarez-Cuadrado et al., 2015, etc.). A negative impact of $\bar{y}$ on individual utility implies that there is an interpersonal comparison. *G* represents public goods considered as externalities which may have a positive effect on individual utility and *E* environmental externality. Z_i is the set of other control variables. The components of Z_i will be discussed below.

We note that the only information available in our data is a net monthly household income. For the purpose of comparison, we consider the median net monthly household income as a reference level to which individuals may compare their household income. We use the median income of French municipalities in 2015 from INSEE. This variable is measured in euros per consumption unit.[4] By combining with data on family composition, we define the variable "median monthly household income" at the municipality level.

We note that utility of individual *i* is proxied by her/his self-reported subjective well-being in our data. Let U_i^* denote individual i's unobserved (or latent) well-being at the time of the survey, we consider the following conditional model:

$$U_i^* = X_i'\beta + \varepsilon_{i1}, \tag{2}$$

where ε_{i1} is an unobserved error term assumed normally distributed $\mathcal{N}(0,\sigma_\varepsilon^2)$. We can link U_i^* to the observed measures of individual self-reported subjective well-being by using the following formulation of the ordered probit model:

$$U_i = \begin{cases} 1 \text{ if } U_i^* \leq c_1 \\ 2 \text{ if } c_1 < U_i^* \leq c_2 \\ 3 \text{ if } c_2 < U_i^* \end{cases} \tag{3}$$

[4] Note that following INSEE's measure, 1 Adult = 1 consumption unit (CU), 1 person > 14 years old = 0.5 CU, 1 child ≤ 14 years old = 0.5 CU.

where U_i corresponds to the observed subjective well-being reported by individual i (either *SWB3*, *SWB3_ENV* or *SWB3_SOCIAL*) and U_i^* is defined by equation (2). Two parameters c_1 and c_2, to be estimated, are the cutoff values for the latent variable U_i^*.

In our estimation, the set of explanatory variables X_i encompasses all variables mentioned in utility function (1) including household income y_i, median monthly household income $\bar{y}$ and externalities generated by public services *G*, and environmental quality *E*. Other explanatory variables (Z_i in equation (1)) correspond to number of children, number of children squared, age, gender (female), opportunities to laugh, house ownership, participation to collective activities, perception of well-being as collective or individual concern.

We also consider other variables relative to the EMS specificities such as sense of security in the agglomeration. Including these variables in estimation reduces significantly the number of observations which varies from 984 to 307 if considering sense of security in the agglomeration combined with two public services (sport and culture). The number of observations is reduced to only 223 if considering sense of security in the agglomeration and three public services (sport, culture and transport). We prefer then present complementary estimations with more variables in Appendix B (Table B6). We remark that effects of variables mentioned in the first estimation results (Tables 5-8) remain unchanged, showing the robustness of our results.

4.2. Endogenous regressors and specification tests

The issue of endogenous regressors needs to be discussed as its existence can bias the results. More precisely, household income is potentially endogenous as it can be affected by unobserved factors. In order to fix this issue in the ordered probit model, we use the 'variable addition test' based on the control function approach proposed by Wooldridge (2014) to test for exogeneity of explanatory variables in nonlinear models. This can be implemented using the following two-step procedure. First, we made a linear regression of income as it is a continuous variable. Excluded instruments in the first regression correspond to *Profession* (student, retiree, independent, wage earner, others) and *Living with a partner*. These variables are assumed to be correlated with the endogenous regressor (i.e. household income) and uncorrelated with individual subjective well-being reported by individual *i*. Second, we computed the generalized residuals for these regressions of the first step and performed the ordered probit regression using these residuals corresponding to Income. We made a robust t-test for the null hypothesis following to which the coefficients of residuals are zero, as recommended by Wooldridge (2014). The null hypothesis correspond to the exogeneity of Income.

5. Estimation results

For each of the considered dependent variables (*Feeling of Well-Being SWB3* and *Environmental Satisfaction SWB3_ENV*), we run three models. Models 1-3 have the same core group of explanatory variables (*Income, Number of children, Laugh, Service Sport,*

Service Culture, and other control variables). Models 2 and 3 are however different from Model 1 as they include different sets of additional regressors (*Service Transport* for Model 2 and *Environment* for Model 3) at the cost of decreasing the number of observations. We cannot include both sets into the same regression as the number of observations diminishes dramatically in this case.

Before presenting the estimation results, we discuss the specification tests which lead us to the most appropriate econometric model for the data, i.e. regressions with *exogenous* Income. Indeed, the null hypothesis of *Income* exogeneity is not rejected by the variable-addition *t*-test for both dependent variables *SWB3* (*t* statistic = 0.98, 0.86 and 0.58 for Models 1, 2 and 3, respectively) and *SWB3_ENV* (*t* statistic = 0.51, -0.12 and -0.49 for Models 1, 2 and 3, respectively).

Estimation results for *SWB3* and *SWB3_ENV* where all explanatory variables are exogenous are provided in Tables 5 and 6 (more details concerning all variables are reported in Tables B4-B5 in Appendix B). Table B6 also provides estimations with *Feeling of Well-Being* with more variables, but with fewer observations. We observe in Table 5 for *SWB3* that Models 2 and 3 have a higher explanatory power than Model 1 following the pseudo R^2 (0.142 and 0.144 compared to 0.122). The AIC criterion is also favorable to Models 2 and 3 (its value is much lower than in Model 1). The same observation is obtained for *SWB3_ENV* where Models 2 and 3 even have much more explanatory power than Model 1 (pseudo R^2 = 0.145 and 0.325 compared to 0.094).

Let us first consider the effects of variables in the group of *socio-economic characteristics.* We can observe that household income may matter, but in different ways, for individuals' feeling of well-being and their environmental satisfaction. Indeed, *income* has a positive effect on subjective well-being only for individuals belonging to a low income group while individuals belonging to a high income group tend to be unsatisfied with environmental quality. The marginal effects of income reported in Tables 7-8 justify this observation. The results show that a higher income is conducive to a higher probability of feeling "*Good*" and a lower probability of feeling "*Bad*" and "*Medium*" (Table 7, Model 2). When introducing a supplementary variable relative to environment and individual health (*Environment*), this result concerns only individuals having a low household income (Table 7, Model 3). Concerning the individuals' environmental satisfaction, we observe that a higher income may conduce to a higher probability of low satisfaction (Table 8, Model 3).[5]

Still concerning income effect, Table B7 in Appendix B provides complementary estimations using another subjective indicator, *Social Life Satisfaction.* We show that income has a positive effect on individuals' social life satisfaction only for individuals belonging to group 5 (i.e. when monthly household income is higher than 3451 euros). These different estimations show that income effect is heterogeneous following subjective measures and income group. Its effect is not really strong for individuals' subjective perception in our data

[5] The marginal effect of an explanatory variable is calculated by maintaining other variables at their average-values. For more details in the formulas of marginal effect, see Appendix C.

Table 5: *Feeling of Well-Being (SWB3)* and Environment and Public Services

	Model 1		Model 2		Model 3	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Income Group 2	0.460*	0.185	0.5266**	0.229	0.641**	0.305
Income Group 3	0.215	0.180	0.3761*	0.220	0.275	0.279
Income Group 4	0.153	0.180	0.161	0.219	0.223	0.302
Income Group 5	0.143	0.172	0.393*	0.213	0.238	0.277
# Children	-0.878***	0.260	-1.085***	0.327	-0.593	0.390
# Children squared	0.510***	0.190	0.644***	0.236	0.405	0.288
Laugh	0.467***	0.088	0.354***	0.101	0.247*	0.133
Service Sport 2	-0.327**	0.165	0.287	0.201	0.329	0.264
Service Sport 3	0.688***	0.175	0.587***	0.215	0.509*	0.277
Service Culture 2	0.651***	0.199	0.622**	0.2528	0.619*	0.329
Service Culture 3	1.032***	0.208	0.912***	0.265	0.934***	0.340
Service Transport 2	--	--	0.0896	0.146	--	--
Service Transport 3	--	--	0.630***	0.151	--	--
Environnent 2	--	--	--	--	0.424***	0.157
Environnent 3	--	--	--	--	1.167***	0.213
# Observations	984		642		428	
# Parameters	27		30		30	
Log-likelihood	-751.067		-468.234		-314.255	
Pseudo R^2	0.122		0.142		0.144	
AIC	1556.13		996.48		688.51	

Note: Model 1 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*). Model 2 corresponds to regression with the same variables as in the Model 1 and with an additional variable on public transport (*Transport*), this reduces the number of observations from 984 to 642. Model 3 corresponds to regression with the same variables as in Model 1 but with environmental externality (*Environment*). If we keep public transport (*Transport*) in Model 3, there are only 220 observations left. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%. Other non-significant variables used in the estimations are: *Median income, Age, House Ownership, Female, Engagement, SWB_indi_coll.* The complete table with all variables is reported in Appendix B (Table B4).

concerning the Strasbourg metropolitan area. In addition, no social comparison in terms of income is detected: *median incom*e has no effect in different estimations using three different subjective measures.

The *number of children* is another variable in this group of socio-economic characteristics deserving attention. We note that it has a significant and nonlinear effect on the individuals' feeling of well-being. More precisely, results show a convex relationship between the number of children and individuals' feeling of well-being. This convex curve is found in 2 models presented in Table 5 (or B4) and 3 additional models in Table B6.

Table 6: *Environmental Satisfaction* (*SWB3_ENV*) and Environment and Public Services

	Model 1		Model 2		Model 3	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Income Group 2	-0.027	0.211	0.234	0.261	-0.560	0.352
Income Group 3	-0.210	0.206	0.058	0.257	-0.536	0.360
Income Group 4	-0.079	0.203	0.339	0.249	-0.686*	0.367
Income Group 5	-0.526**	0.214	0.012	0.271	-0.862**	0.347
House Ownership	-0.343***	0.115	-0.258*	0.149	-0.362*	0.194
Engagement	-0.199**	0.098	-0.235*	0.123	-0.181	0.167
Service Sport 2	0.671***	0.187	0.645***	0.225	0.693**	0.301
Service Sport 3	0.826***	0.197	0.704***	0.235	0.695**	0.310
Service Culture 2	0.608***	0.226	0.744***	0.284	0.845*	0.453
Service Culture 3	1.001***	0.234	1.118***	0.291	1.255***	0.456
Service Transport 2	--	--	0.398**	0.190	--	--
Service Transport 3	--	--	0.833***	0.197	--	--
Environnent 2	--	--	--	--	1.478***	0.206
Environnent 3	--	--	--	--	2.929***	0.311
# Observations	667		446		296	
# Parameters	27		30		30	
Log-likelihood	-509.152		-321.231		-168.813	
Pseudo R^2	0.094		0.145		0.325	
AIC	1072.305		702.462		397.625	

Note: Model 1 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*). Model 2 corresponds to regression with the same variables as in the Model 1 and with an additional variable on public transport (*Transport*), this reduces the number of observations from 667 to 446. Model 3 corresponds to regression with the same variables as in the Model 1 and with environmental externality (*Environment*). If we keep public transport (*Transport*) in Model 3, there are only 205 observations left. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%. Other non-significant variables used in the estimations are: *Median Income, Age, Female, SWB_indi_coll, Number of children, Number of children squared, Opportunities to laugh*. The complete table with all variables is reported in Appendix B (Table B5).

Others variables such as *house ownership, age*, or *gender* have no effect at all on individual feeling of well-being. However, it is interesting to note that *house ownership* has an opposite effect on environmental satisfaction and social life satisfaction. Indeed, Table 6 (or B5) show that compared to house tenants, house owners are more demanding in environmental quality as they have tendency to be less satisfied with environmental quality than the first group (i.e. house tenants). When considering the marginal effect of house ownership, it has a positive effect on the probability to be "unsatisfied" with environmental quality (Table 8). When looking at estimations with social life satisfaction as dependent variable (Table B7), we can observe that house owners appear to be more satisfied compared to house tenant, all things considered unchanged.

Table 7: Marginal effects with *Feeling of Well-Being (SWB3)* as dependent variable

	Model 2			Model 3		
VARIABLES	P_1	P_2	P_3	P_1	P_2	P_3
Income Group 2	-0.0671*	-0.0858**	0.153**	-0.0732	-0.127***	0.200**
	(0.0376)	(0.0336)	(0.0604)	(0.0512)	(0.0463)	(0.0827)
Income Group 3	-0.0531	-0.0497*	0.103*	-0.0405	-0.0348	0.0754
	(0.0368)	(0.0277)	(0.0559)	(0.0506)	(0.0318)	(0.0763)
Income Group 4	-0.0263	-0.0137	0.0400	-0.0340	-0.0257	0.0597
	(0.0378)	(0.0179)	(0.0529)	(0.0510)	(0.0319)	(0.0777)
Income Group 5	-0.0549	-0.0534*	0.108*	-0.0358	-0.0281	0.0639
	(0.0358)	(0.0303)	(0.0557)	(0.0482)	(0.0270)	(0.0698)
Number of children	0.0313**	0.0612**	-0.0925***	0.00994	0.0220	-0.0319
	(0.0131)	(0.0245)	(0.0345)	(0.0133)	(0.0291)	(0.0420)
Laugh	-0.0378***	-0.0739***	0.112***	-0.0251*	-0.0556*	0.0807*
	(0.0131)	(0.0266)	(0.0354)	(0.0146)	(0.0320)	(0.0443)
Service Sport 2	-0.0440	-0.0307*	0.0747	-0.0467	-0.0451	0.0919
	(0.0359)	(0.0173)	(0.0475)	(0.0453)	(0.0277)	(0.0666)
Service Sport 3	-0.0734**	-0.0992***	0.173***	-0.0639	-0.0884**	0.152**
	(0.0366)	(0.0331)	(0.0560)	(0.0459)	(0.0388)	(0.0730)
Service Culture 2	-0.120*	-0.0160	0.136***	-0.119	-0.0201	0.140**
	(0.0654)	(0.0387)	(0.0431)	(0.0846)	(0.0460)	(0.0582)
Service Culture 3	-0.149**	-0.0812*	0.230***	-0.150*	-0.0935*	0.244***
	(0.0667)	(0.0444)	(0.0489)	(0.0855)	(0.0539)	(0.0645)
Service Transport 2	-0.0141	-0.00873	0.0228	--	--	--
	(0.0237)	(0.0137)	(0.0366)			
Service Transport 3	-0.0678***	-0.130***	0.198***	--	--	--
	(0.0236)	(0.0314)	(0.0430)			
Environnent 2	--	--	--	-0.0638**	-0.0505**	0.114***
				(0.0301)	(0.0228)	(0.0387)
Environnent 3	--	---	--	-0.108***	-0.284***	0.392***
				(0.0337)	(0.0675)	(0.0707)
# Observations		642			428	

Note: P_j is the probability that *SWB3* = j, with j = 1,2,3. Model 2 with three variables representing on public services (*Sport, Culture, Transport*). Model 3 with two variables representing on public services (*Sport, Culture*) and environmental externality (*Environment*) Significance levels: * 10%, ** 5%, *** 1%. Other non-significant variables used in the estimations are: *Median income, Age, House Ownership, Female, Engagement, SWB_indi_coll.*

Let us now consider the effects of two variables in lifestyle's group. We observe that having opportunities to *Laugh* make people more satisfied with their social life (Table B7) and make people feeling good (Tables 5 and 7). In other words, if using feeling of well-being and social life satisfaction as two proxies of happiness, this result shows, not surprisingly, the significant impact of a joyous life with opportunities to laugh on our feeling of happiness. A lifestyle with *Engagemen*t, i.e. participation to collective activities such as organizing elections,

Table 8: Marginal effects with *Environmental Satisfaction (SWB3_ENV)* as dependent variable

	Model 2			Model 3		
VARIABLES	P_1	P_2	P_3	P_1	P_2	P_3
Income Group 2	-0.0710	0.0452	0.0258	0.0814*	-0.00934	-0.0721
	(0.0832)	(0.0582)	(0.0266)	(0.0443)	(0.0387)	(0.0618)
Income Group 3	-0.0189	0.0134	0.00559	0.0767	-0.00653	-0.0702
	(0.0842)	(0.0603)	(0.0240)	(0.0491)	(0.0434)	(0.0610)
Income Group 4	-0.0992	0.0582	0.0410	0.109*	-0.0283	-0.0811
	(0.0777)	(0.0545)	(0.0287)	(0.0612)	(0.0573)	(0.0608)
Income Group 5	-0.00408	0.00294	0.00114	0.155**	-0.0643	-0.0904
	(0.0892)	(0.0644)	(0.0248)	(0.0621)	(0.0701)	(0.0597)
House Ownership	0.0758*	-0.0452*	-0.0306	0.0760*	-0.0479	-0.0281
	(0.0436)	(0.0272)	(0.0192)	(0.0411)	(0.0302)	(0.0174)
Engagement	0.0691*	-0.0412*	-0.0279*	0.0379	-0.0239	-0.0140
	(0.0366)	(0.0238)	(0.0155)	(0.0362)	(0.0248)	(0.0132)
Service Sport 2	-0.224***	0.175**	0.0492***	-0.192*	0.160*	0.0326**
	(0.0865)	(0.0779)	(0.0152)	(0.101)	(0.0953)	(0.0148)
Service Sport 3	-0.241***	0.184**	0.0571***	-0.193*	0.160*	0.0328**
	(0.0876)	(0.0780)	(0.0201)	(0.102)	(0.0955)	(0.0167)
Service Culture 2	-0.280**	0.243**	0.0375***	-0.283	0.261	0.0220**
	(0.111)	(0.106)	(0.0127)	(0.175)	(0.172)	(0.0107)
Service Culture 3	-0.386***	0.300***	0.0856***	-0.365**	0.308*	0.0570***
	(0.113)	(0.108)	(0.0214)	(0.175)	(0.173)	(0.0218)
Service Transport 2	-0.142**	0.114*	0.0278**	--	--	--
	(0.0706)	(0.0615)	(0.0127)			
Service Transport 3	-0.259***	0.171***	0.0883***	--	--	--
	(0.0702)	(0.0646)	(0.0216)			
Environnent 2	--	--	--	-0.483***	0.438***	0.0451***
				(0.0729)	(0.0774)	(0.0171)
Environnent 3	--	---	--	-0.584***	0.177	0.406***
				(0.0778)	(0.133)	(0.0900)
# Observations		446			296	

Note: P_j is the probability that *SWB3_ENV* = j, with j = 1,2,3. Model 2 with three variables representing on public services (*Sport, Culture, Transport*). Model 3 with two variables representing on public services (*Sport, Culture*) and environmental externality (*Environment*) Significance levels: * 10%, ** 5%, *** 1%. Other non-significant variables used in the estimations are: median income, age, female, SWB_indi_coll, number of children, number of children squared, opportunities to laugh.

volunteer activity, civic service, etc., can make people more satisfied with their social life (Table B7) but unsatisfied with environmental quality (Table 6 or B5), while it has no effect on the feeling of well-being (Table B4).

We focus now on the last group of variables which represent the specificities of Strasbourg metropolis *via* individuals' perception on public services (in sport, culture and transport), and their sense of safety in the agglomeration as well as their perception whether environmental quality in the agglomeration is convenient to health. All variables in this group contribute significantly to explain individuals' feeling of well-being, their environmental satisfaction and social life satisfaction. For instance, looking at Table 5 for estimation results using feeling of well-being and Table 7 for marginal effects of explicative variables, we remark that if the sport equipment and programming (*Service Sport*), as well as the culture equipment and programming (*Service Culture*) meet individual expectations, then the feeling of well-being will be better off. The same observation is found for variable *Service Transport* which indicates whether the common transport in the agglomeration of Strasbourg satisfies individual needs. When common transport *satisfies moderately* (i.e. *Service Transport* =2) or *satisfies* (i.e. *Service Transport* = 3) individual needs, this fact contributes to increase individual feeling of well-being, all things remaining unchanged (reference case with *Service Transport* = 1 corresponds to the situation where *Service Transport* does not satisfy individual needs). Analyses of marginal effect clarify this observation. Results from Model 2 presented in Table 7 precise that if common transport *satisfies* individual needs, this has a negative effect on the probability to be "unsatisfied" (i.e. P_1) and "satisfied" (i.e. P_2), and a positive effect on the probability to be "very satisfied" (i.e. P_3). Likewise, if the culture (*Service Culture = 2 or = 3*) or sport (*Service Sport=2 or=3*) equipment and programming meet individual expectations, then this reduce the probability to be "unsatisfied" (*SWB3 =1,* i.e. P_1) and "satisfied" (*SWB3 = 2,* i.e. P_2), and increases the probability to be "very satisfied" (*SWB3 = 3,* i.e. P_3).

The findings mentioned above confirm the hypothesis that public services are positive externalities and affect positively individual utility. Likewise, if we consider individual perception whether environmental quality in Strasbourg agglomeration is convenient for health as a proxy of environmental quality (*Environment),* then observations regarding the impact of variable *Environment* show that this variable is also a positive externality present in utility function as it has a positive effect on individual feeling of well-being (Tables 5 and 7, Model 3).

When using environmental satisfaction as dependent variable, the same observations are made: the effects of public services (i.e. *Culture, Sport* and *Transport)* on environmental satisfaction are positive (Tables 6 and 8). Concerning the variable *Environment* it has, unsurprisingly, a positive effect on individuals' environmental satisfaction as well (Tables 6 and 8, Model 3), but no effect on social life satisfaction (Table B7, Model 3).

Last variable representing specificities of Strasbourg agglomeration concerns the sense of safety in the agglomeration. From answers to the question "How is the level of your sense of safety in the agglomeration", we create a three category-variable indicating the sense of safety: *Sense of security.* This variable takes 1 if the answer is *No,* 2 if *moderately,* and 3 if *Yes.* Introducing *Sense of security* in the estimations reduces the number of observations; however results clearly show that the sense of security increases the feeling well-being (Models 4, 5 and 6 in Table B6, Appendix B). Note that variables representing public services

and environmental quality remain significant in this specification. We do not introduce this variable in estimations using environmental satisfaction and social life satisfaction as the number of observations is considerably reduced to less than 100.

6. Conclusion

This paper sets out to analyze individual subjective well-being using data in the Strasbourg metropolitan area (France). We focus on the effects of externalities generated by public services (transport, culture and sport) and environmental quality as well as sense of security in the metropolitan area. Results show that specificities of this urban area (public services, environmental quality perceived as convenient for individual health, sense of security), opportunities to laugh as well as living with children, have a significant impact on individual subjective well-being. These findings are robust when using three subjective measures: feeling of well-being, environmental satisfaction and social life satisfaction.

Concerning the effect of income, this variable does not have a strong effect on individual subjective perception of happiness. We show that income may matter for feeling of well-being only for individuals belonging to a low income group. Wealthy individuals tend to be unsatisfied with environmental quality, but satisfied with their social life. Contrasting with the standard result in subjective well-being literature, our analyses show that social comparison in terms of income does not really matter for individual well-being in the case of the Strasbourg metropolitan area: the difference between household income and median household income does not affect individual perception of happiness.

The present study contributes to the literature on subjective well-being with a focus on the impact of public services and living environment. Its findings derived from an analysis of three subjective measures of individual satisfaction have policy implications. Policy-makers should give full attention to public services (an important element of public living conditions), and try to improve environmental quality. If they care about the population's happiness, they have to re-orient current policies in this direction. Of course, the Strasbourg agglomeration development council, through the organization of the enquiry, aimed at giving such evidence to the local administration. Nevertheless it happened that the results were a little upsetting for many people in the administrative and political circles, who generally prioritize economic and demographic development, while the citizens' responses to the inquiry have revealed a strong focus on the quality of everyday life in their neighborhood.

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Appendix A

Figure A1: Area of survey, Strasbourg Eurométropole, France. Source: Strasbourg Eurométropole

Appendix B: Data description and additional results

Table B1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Individual feeling of well-being (*SWB3*)	984	2.28	0.58	1	3
Individual social life satisfaction(*SWB3_SOCIAL*)	307	2.51	0.62	1	3
Environmental satisfaction (*SWB3_ENV*)	667	1.87	0.56	1	3
Net monthly household income (*Income Group*)	984	2.92	1.22	1	5
Median household income in log (*Median Income*)	984	7.88	0.341	7.28	8.51
Number of children in log (*# Children*)	984	0.61	0.56	1	1.79
Number of children squared (*# Children squared*)	984	0.69	0.74	0	3.21
Individuals' age in 4 groups (*Age Group*)	984	2.59	0.77	1	4
Female (*Female*)	984	0.68	0.47	0	1
Living with a partner (*Couple*)*	984	0.72	0.45	0	1
House Ownership (*House Ownership*)	984	0.55	0.49	0	1
Profession-student (*Profession_etu*)*	984	0.05	0.22	0	1
Profession-retireer (*Profession_retraite*)*	984	0.14	0.35	0	1
Profession-independent (*Profession_libre*)*	984	0.11	0.31	0	1
Profession-wage earner (*Professiono_employe*)*	984	0.21	0.41	0	1
Profession-others (*Profession_autre*)*	984	0.49	0.50	0	1
Opportunities to laugh (*Laugh)*	984	0.69	0.45	0	1
Participation to collective activities (*Engagement*)	984	0.27	0.44	0	1
Well-being perceived as individual or collective concern (*SWB_indi_coll*)	984	2.018	0.44	1	3
Sport equipment and programming in community meet individual expectations (*Service Sport*)	984	2.32	0.64	1	3
Cultural equipment and programming in community meet individual expectations (*Service Culture)*	984	2.44	0.63	1	3
Public transport satisfying individual needs (*Service Transport*)	642	0.24	0.74	1	3
Environmental quality in Euro metropole perceived as convenient for individual health (*Environment*)	428	1.95	0.63	1	3
Sense of safety in the agglomeration (*Sense of Security)*	307	2.04	0.629	1	3

Note: To test the endogeneity of household income, stared variables are used as excluded instruments in the first regression of a two-procedure estimation. These variables are assumed to be correlated with the endogenous regressor (i.e. *household income*) and uncorrelated with individual *subjective well-being* reported by individual *i.*

Table B2: Distribution of *Feeling of Well-being (SWB3) and Social Life Satisfaction (SWB3_SOCIAL).*

	Social Life Satisfaction			
Feeling of Well-being	Unsatisfied	Satisfied	Very satisfied	Total
Bad	10	3	4	17
Medium	10	82	83	175
Good	1	21	93	115
Total	21	106	180	307

Table B3: Distribution of *Feeling of Well-being (SWB3) and Environmental Satisfaction (SWB3_ENV).*

	Environmental Satisfaction			
Feeling of Well-being	Unsatisfied	Satisfied	Very satisfied	Total
Bad	25	18	1	44
Medium	103	260	19	382
Good	167	21	49	241
Total	153	445	69	667

Table B4: Estimation results for *Feeling of Well-Being* (*SWB3)*

	Model 1		Model 2		Model 3	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Income Group 2	0.460*	0.185	0.5266**	0.229	0.641**	0.305
Income Group 3	0.215	0.180	0.3761*	0.220	0.275	0.279
Income Group 4	0.153	0.180	0.161	0.219	0.223	0.302
Income Group 5	0.143	0.172	0.393*	0.213	0.238	0.277
Median income	0.103	0.131	0.249	0.167	0.175	0.209
# Children	-0.878***	0.260	-1.085***	0.327	-0.593	0.390
# Children squared	0.510***	0.190	0.644***	0.236	0.405	0.288
Age Group 2	0.108	0.171	0.321	0.213	-0.293	0.254
Age Group 3	-0.035	0.185	0.155	0.225	-0.394	0.273
Age Group 4	-0.004	0.211	0.186	0.265	-0.372	0.303
House Ownership	0.113	0.092	0.093	0.120	0.021	0.141
Female	0.002	0.086	0.014	0.105	0.029	0.139
Laugh	0.467***	0.088	0.354***	0.101	0.247*	0.133
Engagement	0.019	0.084	0.072	0.101	0.158	0.125
Service Sport 2	-0.327**	0.165	0.287	0.201	0.329	0.264
Service Sport 3	0.688***	0.175	0.587***	0.215	0.509*	0.277
Service Culture 2	0.651***	0.199	0.622**	0.2528	0.619*	0.329
Service Culture 3	1.032***	0.208	0.912***	0.265	0.934***	0.340
SWB_indi_coll 2	0.131	0.132	0.058	0.163	0.022	0.209
SWB_indi_coll 3	0.061	0.176	-0.272	0.229	-0.081	0.293
Service Transport 2	--	--	0.0896	0.146	--	--
Service Transport 3	--	--	0.630***	0.151	--	--
Environnent 2	--	--	--	--	0.424***	0.157
Environnent 3	--	--	--	--	1.167***	0.213
c_1	0.919	1.063	2.256*	1.363	1.414	1.704
c_2	3.098***	1.068	4.568***	1.376	3.369**	1.716
# Observations	984		642		428	
# Parameters	27		30		30	
Log-likelihood	-751.067		-468.234		-314.254	
Pseudo R^2	0.122		0.142		0.144	
AIC	1556.13		996.48		688.51	

Note: Model 1 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*). Model 2 corresponds to regression with the same variables as in the Model 1 and with an additional variable on public transport (*Transport*), this reduces the number of observations from 984 to 642. Model 3 corresponds to regression with the same variables as in the Model 1 and with environmental externality (*Environment*). If we keep public transport (*Transport*) in Model 2, there are only 220 observations left. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%.

Table B5: Estimation results for *Environmental Satisfaction* (*SWB3_ENV)*

	Model 1		Model 2		Model 3	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Income Group 2	-0.027	0.211	0.234	0.261	-0.560	0.352
Income Group 3	-0.210	0.206	0.058	0.257	-0.536	0.360
Income Group 4	-0.079	0.203	0.339	0.249	-0.686*	0.367
Income Group 5	-0.526**	0.214	0.012	0.271	-0.862**	0.347
Median Income	0.026	0.153	0.149	0.186	0.065	0.269
# Children	0.161	0.339	-0.049	0.319	0.588	0.510
# Children squared	-0.086	0.245	0.027	0.280	-0.172	0.364
Age Group 2	0.147	0.207	-0.071	0.278	-0.035	0.354
Age Group 3	-0.021	0.227	-0.299	0.304	0.004	0.395
Age Group 4	0.037	0.262	-0.236	0.327	-0.174	0.434
House Ownership	-0.343***	0.115	-0.258*	0.149	-0.362*	0.194
Female	-0.004	0.105	0.048	0.126	-0.089	0.185
Laugh	0.139	0.106	0.174	0.129	0.256	0.176
Engagement	-0.199**	0.098	-0.235*	0.123	-0.181	0.167
SWB_indi_coll 2	-0.094	0.163	-0.185	0.209	-0.364*	0.219
SWB_indi_coll 3	-0.216	0.221	-0.395	0.301	-0.583	0.359
Service Culture 2	0.608***	0.226	0.744***	0.284	0.845*	0.453
Service Culture 3	1.001***	0.234	1.118***	0.291	1.255***	0.456
Service Sport 2	0.671***	0.187	0.645***	0.225	0.693**	0.301
Service Sport 3	0.826***	0.197	0.704***	0.235	0.695**	0.310
Service Transport 2	--	--	0.398**	0.190	--	--
Service Transport 3	--	--	0.833***	0.197	--	--
Environnent 2	--	--	--	--	1.478***	0.206
Environnent 3	--	--	--	--	2.929***	0.311
c_1	0.530	1.219	2.086	1.474	1.541	2.117
c_2	2.747**	1.219	4.426***	1.475	4.486**	2.103
# Observations	667		446		296	
# Parameters	27		30		30	
Log-likelihood	-509		-321		-168	
Pseudo R^2	0.094		0.145		0.325	
AIC	1072.305		702.462		397.625	

Note: Model 1 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*). Model 2 corresponds to regression with the same variables as in the Model 1 and with an additional variable on public transport (*Transport*), this reduces the number of observations from 667 to 446. Model 3 corresponds to regression with the same variables as in the Model 1 and with environmental externality (*Environment*). If we keep public transport (*Transport*) in Model 3, there are only 205 observations left. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%.

Table B6: Estimation results for *Feeling of Well-Being* (*SWB3)* with additional variables

	Model 4		Model 5		Model 6	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Income Group 2	0.177	0.369	0.226	0.486	0.350	0.479
Income Group 3	0.086	0.348	0.142	0.445	0.175	0.452
Income Group 4	-0.204	0.349	-0.278	0.462	-0.101	0.435
Income Group 5	0.080	0.333	0.232	0.434	0.115	0.404
Median income	0.192	0.244	0.346	0.286	0.276	0.357
# Children	-1.401***	0.531	-1.583**	0.947	-1.344*	0.768
# Children squared	0.821**	0.415	0.947*	0.487	1.005*	0.587
Age Group 2	0.264	0.322	0.483	0.389	0.102	0.355
Age Group 3	0.077	0.340	0.281	0.400	-0.008	0.405
Age Group 4	0.155	0.397	0.355	0.475	-0.190	0.466
House Ownership	0.060	0.170	0.047	0.209	-0.038	0.248
Female	-0.043	0.165	-0.053	0.181	0.073	0.224
Laugh	0.386*	0.162	0.416**	0.197	0.512**	0.229
Engagement	-0.141	0.148	-0.035	0.172	-0.045	0.194
SWB_indi_coll 2	0.316	0.254	0.119	0.270	0.773**	0.352
SWB_indi_coll 3	0.286	0.345	-0.186	0.404	0.412	0.544
Service Culture 2	0.797**	0.373	0.796*	0.439	1.313**	0.549
Service Culture 3	0.927**	0.402	0.741	0.465	1.287**	0.571
Service Sport 2	0.586*	0.314	0.385	0.366	0.455	0.376
Service Sport 3	0.978***	0.336	0.694*	0.387	0.678*	0.411
Service Transport 2	--	--	0.207	0.273	--	--
Service Transport 3	--	--	0.541*	0.290	--	--
Environnent 2	--	--	--	--	0.169	0.274
Environnent 3	--	--	--	--	1.1165***	0.348
Sense of security 2	0.561**	0.228	0.587**	0.277	0.755**	0.361
Sense of security 3	0.998***	0.265	0.930***	0.321	1.209***	0.390
c_1	2.131	1.945	3.510	2.303	3.954	2.083
c_2	4.654**	1.950	5.998***	2.323	6.707**	2.844
# Observations	307		223		177	
# Parameters	30		33		33	
Log-likelihood	-212.670		-155.433		-111.289	
Pseudo R^2	0.182		0.185		0.229	
AIC	485.339		376.865		288.578	

Note: Model 4 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*) with sense of safety in EMS (*Sense of security*) representing a specificity of Strasbourg metropolitan area. Model 5 corresponds to regression with the same variables as in Model 2 (i.e. 3 public services *Sport, Culture and Transport)* and with sense of security in EMS (*Sense of security*), this reduces the number of observations from 307 to 223. Model 6 with only 177 observations as it considers two public services (*Sport, Culture*), environmental externality (*Environment*) but also *Sense of Security* in the agglomeration. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%.

Table B7: Estimation results for *Social Life Satisfaction* (*SWB3_SOCIAL)*

	Model 1		Model 2		Model 3	
Variable	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	
Income Group 2	0.311	0.351	0.015	0.492	0.029	0.488
Income Group 3	0.447	0.344	-0.049	0.470	-0.169	0.524
Income Group 4	0.429	0.318	0.123	0.456	0.174	0.448
Income Group 5	0.516*	0.301	0.460	0.443	0.054	0.431
Median income	0.024	0.253	0.133	0.321	0.169	0.374
# Children	0.037	0.496	0.461	0.738	-0.923	0.727
# Children squared	-0.111	0.364	-0.506	0.531	0.477	0.526
Age Group 2	0.041	0.277	0.657	0.404	0.287	0.387
Age Group 3	-0.155	0.339	0.542	0.485	0.203	0.521
Age Group 4	0.238	0.404	1.076*	0.532	-0.229	0.665
House Ownership	0.367*	0.182	0.332	0.259	0.701**	0.301
Female	-0.019	0.163	0.179	0.210	0.283	0.253
Laugh	0.809***	0.234	0.993***	0.209	1.086***	0.233
Engagement	0.254	0.158	0.488**	0.205	0.595**	0.237
SWB_indi_coll 2	0.465***	0.179	0.811**	0.378	1.474***	0.377
SWB_indi_coll 3	0.957***	0.322	0.854*	0.504	2.034***	0.582
Service Culture 2	0.431	0.417	0.355	0.478	0.976	0.672
Service Culture 3	0.655	0.431	1.025*	0.494	1.488**	0.680
Service Sport 2	0.369	0.317	0.195	0.396	0.523	0.450
Service Sport 3	0.681**	0.338	0.588	0.434	0.760	0.483
Service Transport 2	--	--	0.258	0.307	--	--
Service Transport 3	--	--	0.123	0.313	--	--
Environnent 2	--	--	--	--	-0.059	0.306
Environnent 3	--	--	--	--	-0.066	0.404
c_1	1.312	2.023	2.951	2.590	3.979	3.006
c_2	2.871	2.031	4.643*	2.591	5.725**	3.014
# Observations	307		177		162	
# Parameters	27		30		30	
Log-likelihood	-227.673		-130.908		-106.709	
Pseudo R^2	0.141		0.189		0.234	
AIC	509.347		321.816		162	

Note: Model 1 corresponds to regression with socio-economic, lifestyle variables and externalities from public services (*Sport, Culture*). Model 2 corresponds to regression with the same variables as in the Model 1 and with an additional variable on public transport (*Transport*), this reduces the number of observations from 307 to 177. Model 3 corresponds to regression with the same variables as in the Model 1 and with environmental externality (*Environment*). If we keep public transport (*Transport*) in Model 3, there are only 99 observations remaining. All explanatory variables are exogenous based on variable addition test (Wooldridge, 2014). Significance levels: *10%, ** 5%, *** 1%.

Appendix C: Marginal effects in ordered probit model

Our estimation provides marginal effects of household income and that of all other explanatory variables. In ordered probit model, three probabilities of our specification are written as:

$$P(U_i = 1) = \Phi(c_1 - X'_i\beta)$$
$$P(U_i = 2) = \Phi(c_2 - X'_i\beta) - \Phi(c_1 - X'_i\beta)$$
$$P(U_i = 3) = 1 - \Phi(c_2 - X'_i\beta)$$

where $\Phi(.)$ is the standard normal cumulative distribution function. The marginal effects of a regressor x_i on probabilities are not represented by the estimated coefficients associated to x_i, but they are calculated as follows:

$$\frac{\partial P(U_i = 1)}{\partial x_i} = -\phi(c_1 - x_i\beta)\beta$$
$$\frac{\partial P(U_i = 2)}{\partial x_i} = -\phi(c_2 - x_i\beta)\beta + \phi(c_1 - x_i\beta)\beta$$
$$\frac{\partial P(U_i = 3)}{\partial x_i} = \phi(c_2 - x_i\beta)\beta$$

where $\phi(.)$ is the standard normal density. We note the opposite sign of $\partial P(U_i = 1)/\partial x_i$ and $\partial P(U_i = 3)/\partial x_i$. However, the sign of $\partial P(U_i = 12)/\partial x_i$ may be either positive or negative. We also remark that the sum of the three probabilities is equal to unity, i.e. $P(U_i = 1) + P(U_i = 2) + P(U_i = 3) = 1$, and the sum of the three marginal effects is equal to 0 :

$$\frac{\partial P(U_i = 1)}{\partial x_i} + \frac{\partial P(U_i = 2)}{\partial x_i} + \frac{\partial P(U_i = 3)}{\partial x_i} = 0.$$

We note that U_i corresponds to the observed subjective well-being reported by individual$i$: either *Feeling of Well-being (SWB3), Environmental Satisfaction (SWB3_ENV),* or *Social Life Satisfaction (SWB3_SOCIAL).*