



UNIVERSITÉ CATHOLIQUE DE LOUVAIN
ECONOMICS SCHOOL OF LOUVAIN

To what extent are stated preferences consistent with
satisfaction?
An empirical exercise for Belgium

Author:
Flor Picado Garro

Supervisor:
Prof. François Maniquet

Reader:
William Parienté

A thesis submitted for the degree of
Master en sciences économiques, orientation générale, à finalité spécialisée

August 28, 2019

Abstract

In the literature about measuring well-being there is some skepticism towards the equivalent income approach, due to the use of rational preferences when there are differences between perceived utility and real after-decision utility. Focusing on this concern, the present work constructs an empirical model to determine the extent to which stated preferences are inconsistent with satisfaction data.

Using MEqIN data set and satisfaction as a proxy of utility, a regression generates the coefficients that reveal the individual willingness-to-pay for an ideal state, which is compared with the stated value by the person. The differences between the two values highlight the inconsistencies, that are studied by socio-demographic characteristics, in order to find some patterns.

The findings contribute to the existing literature illustrating a large extent of inconsistencies. Despite that, they lead to similar outcomes in different scenarios, which allows methodological comparison. In conclusion, two facts influence the magnitude of the differences. First, a positive correlation with income for a big group of observations: the higher the income, the greater the inconsistency. Second, the exclusion of some variables from the regression increases the weight of non-income variables in the estimated WTP.

On the other hand, a new research question for behavioural welfare emerges, because this positive correlation may stem from changes in the decision-making process when income is high, so the preferences over the well-being dimensions could be different than the values estimated here for all population.

Contents

1	Introduction	3
2	Background	4
3	The model	7
3.1	Stated preferences	8
3.2	Retrieving preferences from satisfaction data	8
3.2.1	Box-Cox Transformation	8
3.2.2	Satisfaction equation	9
3.2.3	Computing WTP from satisfaction data	11
4	Empirical Findings	13
4.1	Finding the best regression to approach WTP	13
4.2	Lambda parameter	17
4.3	Satisfaction equation	17
4.4	Heterogeneity of preferences	21
4.5	Regularities in the inconsistencies	22
5	Conclusion	23
6	Limitations and suggestions for further research	25
	References	26
A	Appendix	26
A.1	The do-file	26

1 Introduction

Well-being measures are essential tools for policymakers. However, the correct tool to analyze a public policy problem depends on the nature of the problem itself. To redistribute income, there are some norms. One is the transfer principle, according to which only transfers from who is better-off to someone worse-off are possible, and the order must be preserved.

Nevertheless such a measure requires to rank individuals and to have knowledge of their differences in wealth. Moreover, as far as the same amount of income can generate different levels of satisfaction, there is a domain of responsibility over the current state. For example, people can prefer more leisure or health than income. To capture it, the well-being measure needs to be respectful of the heterogeneity of preferences. For this, the measure should satisfy interpersonal comparability, defined as what it is meaningful at the moment of comparing individuals.

In the literature, there is one approach that satisfies the aforementioned conditions, namely equivalent income. Defined by [Decancq et al., 2015, p. 94] as "the level of income that would make the individual indifferent (as judged by his own preferences) between his current situation and the hypothetical reference situation where he would be at the reference values for all non-income dimensions of life".

Following these authors, there are 3 methodologies to compute preferences: revealed preferences, stated preferences and retrieved from satisfaction data. The first one is disregarded for this study, given it is not reliable to measure non-income dimensions, because preferences are derived from observed choice behavior, and in some well-being dimensions such as health, sometimes decisions are not made by the individual.

On the other hand, behavioral economics has found transitivity failures in preferences. For instance, in a pairwise comparison, an individual who prefers A over B, and B over C, should choose A over C. However, the inverse has been proved to happen. Besides, researches are skeptical about the differences between perceived utility and real after-decision utility. All this generates skepticism about the use of equivalent income as a measure of well-being.

Therefore, in an empirical exercise for Belgium, this work addresses the second criticism. In this way, preferences are going to be estimated based on satisfaction regression, to compare outcomes with stated preferences. The differences are inconsistencies, that are studied by socio-demographic characteristics, in order to find some patterns. To that, MEqIN data for 2016 is used. It is a set specially designed to measure equivalent income, which contains socio-demographic characteristics, objective and subjective variables about health, housing, consumption, income, use of time and a set of questions about individual's willingness-to-pay (abbreviated from now on as WTP) to reach a hypothetical state, called perfect health, perfect housing and ideal job, which are going to be used as stated preferences.

In connection with other studies using satisfaction data, it is expected a positive correlation between health and housing, as well the opposite for unemployment. Among variables that capture heterogeneity in preferences are awaited: age, presence of children in the household, gender, level of education and region of precedence (rural or urban area). Regarding inconsistencies of preferences, due to the innovation of the research, very little can be expected. Is it anticipated with certainty that they vary across groups of population, young versus elder people, and low income versus high income.

Even though, the nature of the contributions is empirical, this thesis exposes two methodologies in the same context, allowing comparability between them to figure out which is better and

their operational limitations. Additionally, there are more benefits in public policy. Given, that people make mistakes in their decisions, understanding the irrationality in the behavior allows a social planner to define normative criteria of when intervening. Furthermore, an identification of the main concerns per groups of the population, as this research does, favors to settling policy agendas considering the heterogeneity of society, yielding in a more efficient allocation of resources.

Consequently, the work is schemed as following: a chapter with background, then the model is settled. Followed by empirical findings, where several scenarios are conducted to find the best regression that approaches the WTP answers in MEqIN data set. Also, this chapter draws the aforementioned inconsistencies. To finish with the characterization of them in Chapter 5.

2 Background

Focusing on how to measure well-being, two types of variables can be used, subjective (feelings or mental states) and objective (individual outcomes). For example, satisfaction with monthly income is a subjective variable whereas the monthly wage is objective. Regarding the possible approaches to be taken, there are mainly three options. The first proposal was based on subjective welfarism. Then, as a response to some drawbacks, the capabilities approach was presented, merely using objective variables. Finally, there is a third approach which is a combination of both. Here, a brief sum-up of happiness and equivalent income based on [Decancq et al., 2015] is:

Happiness: It has two branches, hedonic welfarism and preference welfarism. Hedonic does not consider preferences to be defined meaningfully, well-being is conceived as an expression of emotions and feelings of happiness, it is considered the modern version of utilitarianism. On the other hand, preference welfarism as its name suggest, is respectful of preferences, generating a consistent ordinal measure.

However, there is not interpersonal comparability, due to inconsistencies at the moment of using different scaling factors. The authors mentioned that when scaling factors are shifted, the approach allows happy peasants and poor millionaires. Also, as it assumes people are held not responsible for their well-being, a transfer from a poor individual to a rich individual is ethically approved, which is controversially. Because it involves taking a position on whether society should compensate someone for their expensive tastes or if adaptation to a physical condition is a sufficient to not redistribute income from advantaged to less advantaged people.

Equivalent income: To simplify, let's to introduce some notation. There are two ways to interpret the concept. The first one is: given a set (y_i, x_i) , where y_i is current income for individual i and x_i the current state in a specific dimension, "the equivalent income y_i^* for individual i is then defined as the solution to the equation $(y_i, x_i) I_i(y_i^*, \tilde{x})$. In other words, the equivalent income is the level of income that would make the individual indifferent (as judged by his own preferences) between his current situation and the hypothetical reference situation where he would be at the reference values for all non-income dimensions of life" [Decancq et al., 2015, p. 94]. The second interpretation comes from WTP concept, "it follows from the expression that $y_i^* = y_i - WTP_i(x_i \rightarrow \tilde{x}; y_i, x_i)$, where $WTP_i(x_i \rightarrow \tilde{x}; y_i, x_i)$ denotes the WTP of individual i for a move from x_i to $\tilde{x}$ " [Decancq et al., 2015, p. 95]

One critical point of this approach is the ideal point. For instance, people can preferred to have a job than being unemployed, but the amount of ideal working hours is different for each other.

Moreover, under this approach, individuals are held responsible for their heterogeneous preferences, which is also a critical point, because there are social factors that affect this heterogeneity.

Nevertheless, its main advantage is the generation of a cardinal measure that can be aggregated to construct a Social Welfare Function with interpersonal comparison, respectful of preferences even though in the presence of different scaling factors. In other words, it does not generate happy peasant and poor millionaires, which is essential to study inequality. Until now, there are 3 proposed methodologies to compute the preferences:

- Revealed preferences: they are derived from an analysis of observed choice behavior. Mainly used for marketable products. As it was mentioned in the introduction it does not work for the purpose of the current research.
- Stated preferences: using surveys, the individual stated his WTP to be indifferent between the current situation and the hypothetical scenario, it is mainly used in non-marketable goods.
- Retrieved preferences from satisfaction data: using satisfaction with life surveys a regression $S(y_i, x_i, z_i)$ is computed, the dependent variable S_i works as a proxy of utility. The independent variables are income, the non-market well-being dimensions, x_i , and individual characteristics that influences in satisfaction, z_i . The regression has to be nonlinear, to allow substitution between dimensions. Then, by solving equation 1, the equivalent income is obtained. Thus, WTP is the difference between y_i and y_i^*

$$S(y_i, x_i, z_i) = S(y_i^*, \tilde{x}, z_i) \quad (1)$$

[Fleurbaey et al., 2015] conducted empirical research in the third methodology. The data set used did not allow them to construct a nonlinear model, so they state the regression as:

$$S_{it} = \alpha_i + \mu_t + \delta' z_{it} + \beta \ln(y_{it}) + (\vartheta + \Lambda z_{it})' f_{it} + d_{it} \quad (2)$$

Where, S_{it} is satisfaction with life of individual i in period t . The individual fixed effects are captured by α_i , whereas z_{it} takes other personal characteristics of the individual. The coefficients are β, ϑ and δ . There is a matrix with interactions effects Λ and f_{it} is the vector of achieved functionings, part of x_{it} . In this work μ_t controls time effects. Solving equation 1, equivalent income was generated by:

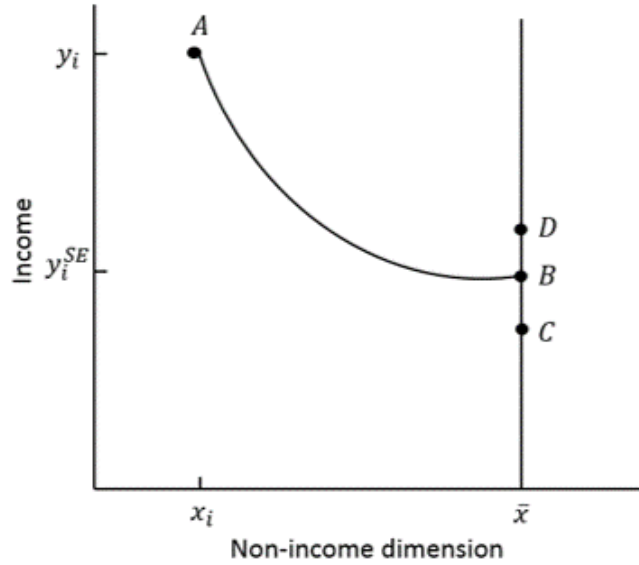
$$y_{it}^* = y_{it} * \exp \left[\left(\frac{\vartheta + \Lambda z_{it}}{\beta} \right)' (f_{it} - \bar{f}) \right] \quad (3)$$

Applying a similar methodology to measure poverty, [Decancq et al., 2019] added box-cox transformations to generate convex indifferent curves. Also, z_i was defined as the set of socio-demographic characteristics independent of the interaction matrix. This last one was a set of dummies that captures the heterogeneity of preferences.

With respect to limitations, the approach demands lots of information, about the current situation of the individual and their preferences, which make it operationally difficult to implement. However, the authors also mentioned skepticism among researches about the use of preferences, because there are differences between perceived utility and real after-decision utility. An argument supported by behavioural findings of irregularities in preferences. The main concern is violations to the transitivity assumption used in the utility maximization process.

Here, the differences between methodologies are covered. To illustrate this point, let's assume in figure 1 point A captures the current situation given by the set (y_i, x_i) . Point B is retrieved from the satisfaction equation (SE), similar to equation 3, that captures the idea of $(y_i, x_i) \sim (y_i^*, \bar{x}_i)$. Labeling y_i^* as y_i^{SE} to differentiate methodologies, y_i^{SE} states the amount of income that makes the person indifferent between his current situation and the hypothetical state. Clearly, A is at least as preferred as B. However, if the surveyed person stated a WTP for $\bar{x}$ leading to point D or C, there is an inconsistency between methodologies to approach the same question.

Figure 1: Equivalent income and inconsistencies of preferences



Source: Own elaboration

In this context, this thesis aims to find the differences between B and D or B and C, labeling them as inconsistencies in preferences. Point B is found simulating the decision making process followed by the person at the moment of answering the WTP question. The methodology to construct the regression is the same used by [Decancq et al., 2019]. Whereas, points C or D are taken from the data set used.

With respect to MEqIN, it is a set of data gathered in the framework of a project that aims to capture all that it is needed to measure well-being from equivalent income approach. The variables collect the subjectivity of well-being, as well as objective outcomes for different dimensions such income, health, consumption, housing, work and use of time. Furthermore, for health, housing and work there is a WTP module, where each person states an amount of money willing to pay for perfect health, perfect housing and their ideal job (from where point C or D will be taken).

As well-being is also affected by personality traits, the module of socio-demographic characteristics includes 10 variables capturing extroversion, a thoughtful person or not, a calm personality or anxious, if the individual is reserved and quiet, creative, religious and so on. This section also includes the traditional socio-demographic characteristics such as age, gender, place of birth, level of education and two subjective question that can be used as dependent variables in the regression, overall happiness and satisfaction with life nowadays.

[Maniquet et al., 2019] develop an extensive description and a summary of the main findings of

the study is developed. The 3,404 answers from individuals belonging to 2098 households are representative of the Belgian population. That is, the conclusions found can be expanded to the total population. The main conclusion drawn by the authors is only income or only satisfaction are not good measures of well-being. "There are many needs and inequalities in many other non-monetary dimensions" (p. 17). Whereas in subjective well-being, the 10% worst-off is a group of people with high levels of consumption, (happy peasants and poor millionaires), the expensive tastes highly influence satisfaction with life and happiness.

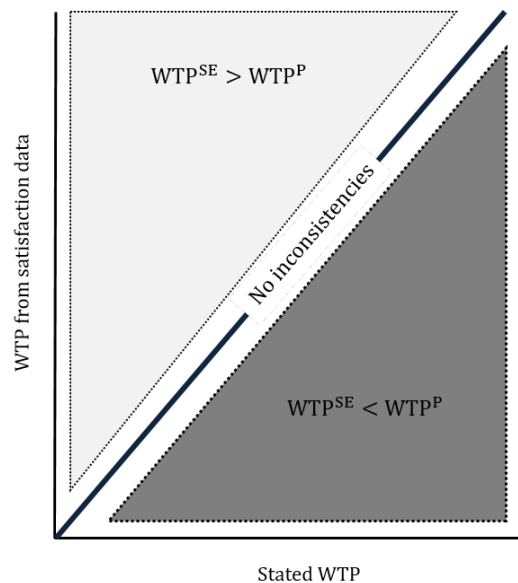
On the other hand, the equivalent income approach works better in a multidimensional way, it "corrects the individual's income or material well-being in function of his or her situation in other dimensions, such as health or quality of housing" (p. 18). Which makes worthy to invest in researching on its methodology, especially if there is data availability.

3 The model

Since the goal of the study is to compare two WTP values in order to see the extent of the inconsistencies generated by methodological differences. One value is a perceived utility, it comes from what the individual stated in the survey. Hence, the goal of constructing a satisfaction equation is not constructing the best possible equation to measure well-being, it is to replicate the context in which the WTP question was done.

If the values are plotted in two dimensions, as depicted in 2, a line of 45 degrees illustrates no inconsistencies. By contrast, if they are above the lines, this implies the satisfaction equation (SE) led to a larger value than the stated value (WTP^P). The opposite holds when they are below the line. If one wants to compare which model approaches better WTP, the inconsistencies have to be measured in absolute terms. If $I = WTP^{SE} - WTP^P = -2$, the extend of the inconsistency is the same to $I = WTP^{SE} - WTP^P = 2$, because the goal is make them closer to 0.

Figure 2: Inconsistencies between stated WTP and satisfaction data



Source: Own elaboration

3.1 Stated preferences

The gathering data process in MEqIN for WTP questions was the following:

- The interviewer makes a set of questions about the different sub dimensions, to get objective variables.
- With these answers, a score between 0 and 100 is generated (a kind of index), where 0 the worse possible state and 100 is the best state. For instance, in the health dimension, 0 is not health and 100 is perfect health.
- In a card the interviewer gives to the surveyed person the score obtained and explains that their ideal state is to be in 100, perfect health. Then, the person is asked:

Now what I am interested in is a new imaginary situation and how it could be equivalent for you to your current situation. In this new scenario, you have perfect health for the next twelve months. To be equivalent to your current situation, you have to reduce your monthly consumption. How much would you have to reduce your monthly consumption in the next twelve months in order to get a new scenario with perfect health to be equivalent for you to your current situation?

3.2 Retrieving preferences from satisfaction data

3.2.1 Box-Cox Transformation

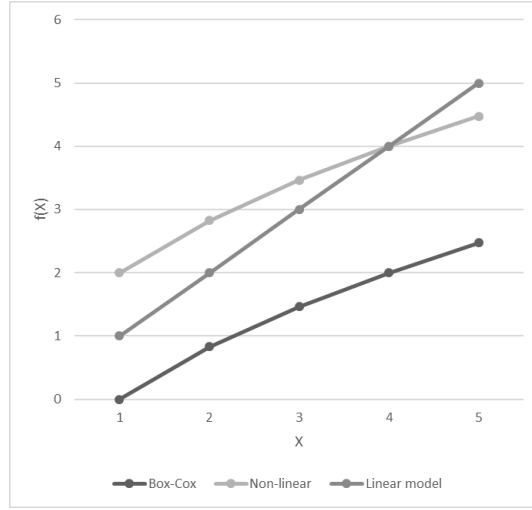
In order to model individual preferences under the shape of a utility function, which is the goal in this study, the utility function representing the preference relation must fulfill two conditions to guarantee a convex indifference curve. These are: to be continuous and quasi-concave. Therefore, applying a transformation to a variable X as X^λ/λ with $\lambda < 1$ we satisfy the convexity requirement. Figure 3 depicts a numerical illustration of a linear, a non-linear and Box-Cox transformation for the values of X ranging from 0 to 5. The figure shows that for a $\lambda = 0.5$, The non-linear model overestimates the smallest values and underestimate the largest ones with respect to a linear model. Following [Decancq et al., 2019] a regression using a Box-Cox transformation in the independent variables satisfies the convexity condition, without overestimating the smallest values. Equation 4 define the transformation.

$$X_i(\lambda) = \begin{cases} \frac{[X_i^\lambda - 1]}{\lambda} & \text{when } \lambda \neq 0 \\ \log(X_i) & \text{when } \lambda = 0 \end{cases}, st. \lambda < 1 \quad (4)$$

For dummy variables $X_i(\lambda) = X_i$

By solving a non-linear least square model, which uses maximum likelihood to find the optimal λ for each variable, it is possible to see whether the parameter is larger than 1. If $\lambda > 1$, preferences are said to be not convex or not well-behaved, being the first key finding of the thesis. Given that Stata works in an environment of 8 digits, the use of $\lambda < -3$ leads to some operational issues. Basically, the value converges to one number. For example, if $\lambda = -3.1$ $X(\lambda)$ for $X=99$ and $X=100$ are equal, when they are not. Implying that for this purpose $\lambda \in [-3, 1)$. Besides, if an observation is 0 and $\lambda < 0$ the model is undefined.

Figure 3: Box-Cox transformation



Source: Own elaboration

3.2.2 Satisfaction equation

Given that utility is non-observable and well-being also depends on non-income dimensions, satisfaction is used as proxy for utility, analogous to preference welfarism. As it was stated in the background, this approach can generate an ordinal measure, to determinate who is worse-off and better-off beyond income. In addition, [Fleurbaey et al., 2015] proved that settling satisfaction (S_i) as a function of income (y_i) and other non-income dimensions (which from now we will refer as X_i) it is possible to add the property of interpersonal comparability. Generating, a consistent measure of well-being suitable to study deprivation and inequality in a broader scope.

In connection, Daniel Kahneman in his Prize Lecture [Kahneman, 2003] states differences between 2 systems of cognitive processes: intuition and reasoning (also referred as emotional and cognitive processes). The first one deals with perceptions and impulses that can be evoked by language, according to the author it has been correlated with happiness. On the other hand, the second process deals with judgments correlated with satisfaction. In this way, satisfaction, S_i is chosen as dependent variable instead of overall happiness.

Currently, MEqIN is only available for 2016, so time effects cannot be considered. These effects are very important if there are unobserved variables correlated with the dimensions. To hedge this issue, personality traits are used, P_i . Besides being constant in time, [DeNeve, 1998] used them as an alternative approach to predict subjective well-being. Based on their research, these characteristics can equally predict satisfaction and happiness, but cannot be substituted for dimensions as health and other socio-demographic characteristics.

Hence, the aforementioned regression also includes a vector Z_i of socio-demographic characteristics, a constant, α , capturing which still unobserved in the model or other factors not related to well-being that influences individual satisfaction. All these covariates plus a matrix of dummies Λ , who captures heterogeneity of the preferences and an error term. From the foregoing, and using i as sub-index of individual, y as super-index of income and j for the non-income dimensions, the equation is settled as:

$$S_i = \alpha + (\theta + \Lambda)y_i(\lambda^y) + (\beta^j + \Lambda)X_i^j(\lambda^j) + \delta P_i + \gamma Z_i + \epsilon_i \quad (5)$$

If $\lambda^y = 0$ is equivalent:

$$S_i = \alpha + (\theta + \Lambda)\ln(y_i) + (\beta^j + \Lambda)X_i^j(\lambda^j) + \delta P_i + \gamma Z_i + \epsilon_i \quad (6)$$

The variables

Focusing on the variables that compound each set, income is captured by equivalised income. A constructed variable according to the OECD criteria of how to distribute the household income within members. Given, there is very little theory in intra-household income distribution, the best is being bound by international criteria. Additionally, there are 4 non-income dimensions: housing, health, use of time and work. For the first 3, the population under study is the whole set $N_1 = 3404$. However, the work module only applies to employed people, 50.76%. Capturing them as dummy variables allows their inclusion in the overall satisfaction for all N_1 . These ones are: physically effort job, dangerous job, worthwhile job, job makes you dirty and mental effort job.

Table 1 depicts the intra-dimension composition. The variables are constructed scores from 0 to 100 for 5 different sub sets of questions about health and housing. They are re-scaled from 1-101 to be compatible with box-cox requirements. The matrix of interactions is compounded by: young (i.e. individuals younger than 30 years), tertiary education, female and region_WAL (person lives in the Wallonia region).

Table 1: Composition of dimensions

Dimension	Variables, (j)
H: Health	h_1 : General health
	h_2 : Absence of limited functioning
	h_3 : Absence of chronic disease
	h_4 : Emotional well-being
	h_5 : Physical well-being
V: Housing	v_1 : Quality of the domicile
	v_2 : Size of the domicile
	v_3 : Quality of the immediate surroundings of the domicile $^\mp$
	v_4 : Services in the immediate surroundings of the domicile $^\mp$
	v_5 : Social relationship with neighbours
L: Use of time	l_1 : Leisure

$^\mp$ the phrase "Immediate surroundings of the domicile" is abbreviated as ISD

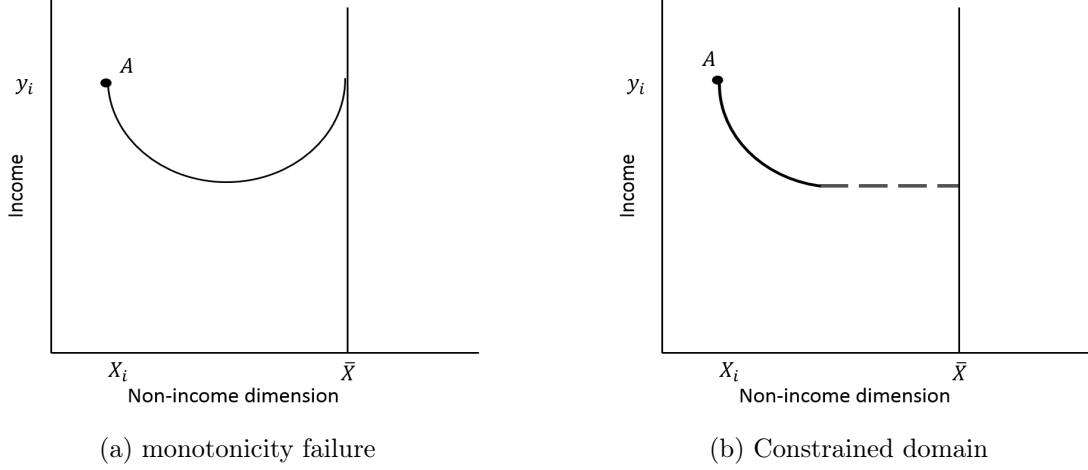
In this research unemployment is a socio-demographic characteristic, instead of a dimension. As a dummy variable faces the same problem mentioned above for work dimension, and it is not acceptable to state perfect substitution between being employed and unemployed. However, being aware of its relevance in similar studies, their interactions with Λ are also included as part of the socio-demographic set. Which is completed by: age, marital status, how religious is the person, part time job, education and children in the household.

Monotonicity failures

The condition $\lambda < 1$ guarantees convexity, but it is possible to have monotonicity failures. People prefer more than less, but it is also possible that after some point they go against this pattern. For example, a person could prefer to get a job that demands mental effort, but after some point it could turn out to be very demanding and they would prefer a lower level of the job, demanding more income to compensate they reduction in satisfaction, as shown in figure 4a. However, in

the health dimension this can be controversial, because it would mean allowing people to be worse-off to get more income. Therefore, a solution is constraining the domain in inflection point of the indifference curve, to make it a straight line, as suggest 4b. With this condition, the assumption is that after some point people are indifferent, instead suggesting that they prefer to be worse-off.

Figure 4: Solutions to monotonicity failures



Source: Own elaboration

3.2.3 Computing WTP from satisfaction data

The predicted value from the regression is equivalent to $\bar{U}$:

$$\bar{U} = S_i(y_i, X_i^j(\lambda^j), P_i, Z_i, \Lambda) \quad (7)$$

The equivalent income retrieved from satisfaction data (SE) is on the same indifference curve. Thus, for health dimension (H), $U = \bar{U} = S_i(y_i^{*SE}, \bar{X}^H(\lambda^H), \bar{X}_i^{j \neq H}(\lambda^j), P_i, Z_i, \Lambda)$. Analogous to [Fleurbaey et al., 2015], if $\bar{X}$ is known, the equivalent income y_i^{*SE} can be computed from the satisfaction equation by solving:¹

$$(\theta + \Lambda^y)y_i^{*SE}(\lambda^y) + \sum_{h=1}^H (\beta^h + \Lambda^h)\bar{X}^h(\lambda^h) = (\theta + \Lambda^y)y_i(\lambda^y) + \sum_{h=1}^H (\beta^h + \Lambda^h)X_i^h(\lambda^h) \quad (8)$$

$$(\theta + \Lambda^y)\ln(y_i^{*SE}) + \sum_{h=1}^H (\beta^h + \Lambda^h)\bar{X}^h(\lambda^h) = (\theta + \Lambda^y)\ln(y_i) + \sum_{h=1}^H (\beta^h + \Lambda^h)X_i^h(\lambda^h) \quad (9)$$

Which yields in equations 11 and 10, to obtain the individual equivalent income and equation 12 to get willingness-to-pay, respectively:

$$y_i^{*SE} = \left(y_i^{\lambda^y} + \sum_{h=1}^H \frac{\lambda^y(\beta^h + \Lambda^h)}{\theta + \Lambda^y} * [X_i^h(\lambda^h) - \bar{X}^h(\lambda^h)] \right)^{(1/\lambda^y)} \quad (10)$$

¹ P_i , $\bar{X}_i^{j \neq H}(\lambda^j)$ and Z_i are equal for both equations, so they cancel each other

$$y_i^{*SE} = y_i * \exp \left(\sum_{h=1}^H \frac{\beta^h + \Lambda^h}{\theta + \Lambda^y} * [X_i^h(\lambda^h) - \bar{X}^h(\lambda^h)] \right) \quad (11)$$

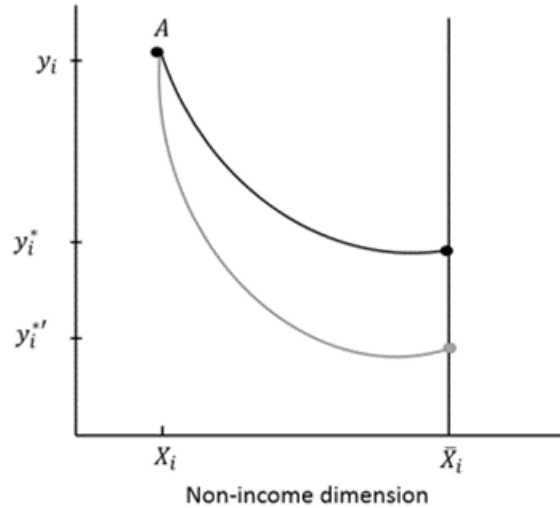
$$WTP_i(X_i^H \rightarrow \tilde{X}^H; y_i, X_i^H) = y_i - y_i^{*SE} \quad (12)$$

If $H=1$, equations 10 and 11 allows drawing an indifference curve for each individual. To explained it with the first equation is more difficult, so first consider the second one. If $\exp(.) < 1$ the indifference curve has a convex contour, as figure 1. For $\exp(.) = 1$, $y_i^{*SE} = y_i$, which means $WTP=0$. Conversely, if $\exp(.) > 1$ the curve is concave. Under monotonicity of preferences, $(\theta + \Lambda^y)$ is always positive, as well $(\beta^h + \Lambda^h)$. So, the difference between $[X_i^h(\lambda^h) - \bar{X}^h(\lambda^h)]$ should be negative. This happens if the ideal state is perfect health. If $(\beta^h + \Lambda^h)$ is negative it means violations to the property of monotonicity of preferences, namely less is preferred than more.

If the domain of λ^h is not bounded in the minimum level, $X_i^h(\lambda^h) = \bar{X}^h(\lambda^h)$ by operational reasons, not because the individual is indifferent. The indifference curve is going to be similar to Leontief contours, when it is not. Reinforcing the need of constraining the domain of λ and testing the robustness of the model due to changes in lambda.

Equation 10 follows the same intuition, but λ^y increases or decreases the convexity of the indifference curve. Assumes that all the components of the curve are equal and only λ^y changes. The larger the parameter the larger the equivalent income. As figure 5 illustrates, the indifference curve is less convex and WTP smaller ($y_i - y_i^*$). Denoting less substitution between income and non-income dimension. To remark, convexity implies dismissing marginal rates. In relative terms, if income is small the differences due to convexity are going to be larger than if income is large. This is key to understand the findings of this work.

Figure 5: Impacts of changes in convexity



Source: Own elaboration

The same analysis applies for housing dimension. However, in the work dimension it could be different. For instance, consider the variable "Mental effort job". If the person prefers a mental effort job, which score should be the ideal state?. On the hand, if the person does not prefer a

mental effort job, it could be very controversial fixing the score 101 as an ideal state. A solution could be to create another ideal state and working in a discrete environment, using dummy variables.

This second state would go in the opposite way of the property of monotonicity of preferences. In other words, determining the inconsistencies between stated preferences with satisfaction data in the work dimension requires one additional previous research before only to determinate the impacts of not using monotonicity of preferences. Therefore, this research will be only focused on the health dimension. Indeed, only one dimension is enough to achieve the goal of this research. But, as far as peoples' preferences are different for the other well-being dimensions, so the remaining ones are suggested as further research.

4 Empirical Findings

The first step is to identify which is the best regression to approach willingness answers. Once it is found, the output is interpreted. The inconsistencies are then characterized accordingly.

4.1 Finding the best regression to approach WTP

Six scenarios were constructed to find the best regression to approach WTP answers. Their differences relies on two traits, the effects of using only one variable as health dimension and the way of approaching income. The first point aims to account the weight of general health in the decision-making process. Regarding income, in [Fleurbay et al., 2015] it was included as log of income, in this context, it is equivalent to use $\lambda = 0$, which constrains the model. A Box-Cox (BC) transformation relaxes that assumption. Finally, for robustness is needed to see what happens if $\lambda \in [-3, 1)$ instead $\lambda \in (\infty, 1)$.

The first four rows of table 2 define the models. The second part summarizes statistics about the inconsistencies generated by each regression. When comparing scenario 1 versus 2 and scenario 3 versus 4, it is possible to conclude that the use of constraints over the domain of λ does not affect the R2. The main difference is the number of observations in which the stated value is greater than the estimated. However, this is neither good nor bad. Hence, regressions 1 and 3 can be disregarded for WTP.

Besides, this statistic indicates that the stated value is larger than the estimated for 12% and 20% of the observations which generates a skewed distribution. The latter pattern results in positive mean (the closer this value to zero the better). The closer this value to 0, the better. Nonetheless, it is not enough to choose regression 5 as the best one to address WTP answers. In all the regressions the minimum value is the same, but in the second regression, the percentile 25 is very close to 0, the inconsistencies are smaller or equal to 28 euros. However, from the 27th percentile onwards, regression (5) and (6) generate smaller inconsistencies. The reason is not straightforward.

For the 3 regressions with Box-Cox transformations, λ^y is around -0.21. So, from equation 10 the ratio between $\lambda^y(\beta^h + \Lambda^h)$ and $(\theta + \Lambda^y)$ is negative, it works as a discount factor of income. When H=1, regression (5), the discount factor is larger for 2,302 individuals, due to a greater $(\beta^h + \Lambda^h)$. So, the equivalent income (equation 10) generated with 1 sub dimension is smaller than when using 5 sub dimensions. In the context of WTP (equation 12), the latter implies that only when using general health as dimension it is possible to achieve a higher estimation

Table 2: Statistics of the inconsistencies generated by the regressions

Scenario:	(1)	(2)	(3)	(4)	(5)	(6)
Constraints over λ	No	Yes	No	Yes	NA	NA
Income included as:	BC	BC	Log	Log	BC	Log
No. sub dimensions	5	5	5	5	1	1
Statistics						
Stated WTP >estimated	483	566	367	456	447	446
Skewness	5.08	5.08	5.66	5.66	5.86	4.77
Mean	1,175	1,175	1,300	1,300	986	1,004
Minimum	(2,000)	(2,000)	(2,000)	(2,000)	(2,000)	(2,000)
Percentile 25	28	28	733	733	408	416
Percentile 50	1,153	1,153	1,239	1,239	945	977
Percentile 75	1,750	1,750	1,800	1,800	1,399	1,432
Percentile 99	4510	4510	4510	4510	3510	3510
Maximum	25,993	25,992	25,993	25,993	23,104	20,987
No of WTP >2000	554	554	585	585	312	325
Kurtosis	84.31	84.30	99.27	99.26	111.35	82.95
Standard deviation	1204	1204	1148	1148	968	944
R2	0.3800	0.3800	0.3799	0.3799	0.3029	0.3028

$WTP^{(5)} > WTP^{(2)}$. Having defined the inconsistencies as the difference retrieved and stated WTP in absolute terms, namely $I^{(5)} = |WTP^{(5)} - WTP^P|$ and $I^{(2)} = |WTP^{(2)} - WTP^P|$, which is greater depends on:

$$\begin{aligned}
\text{If } WTP^{(5)} - \frac{WTP^P}{2} &= WTP^{(2)} - \frac{WTP^P}{2} & \longrightarrow & I^5 = I^2 \\
\text{If } WTP^{(5)} - \frac{WTP^P}{2} &> WTP^{(2)} - \frac{WTP^P}{2} & \longrightarrow & I^5 > I^2 \\
\text{If } WTP^{(5)} - \frac{WTP^P}{2} &< WTP^{(2)} - \frac{WTP^P}{2} & \longrightarrow & I^5 < I^2
\end{aligned} \tag{13}$$

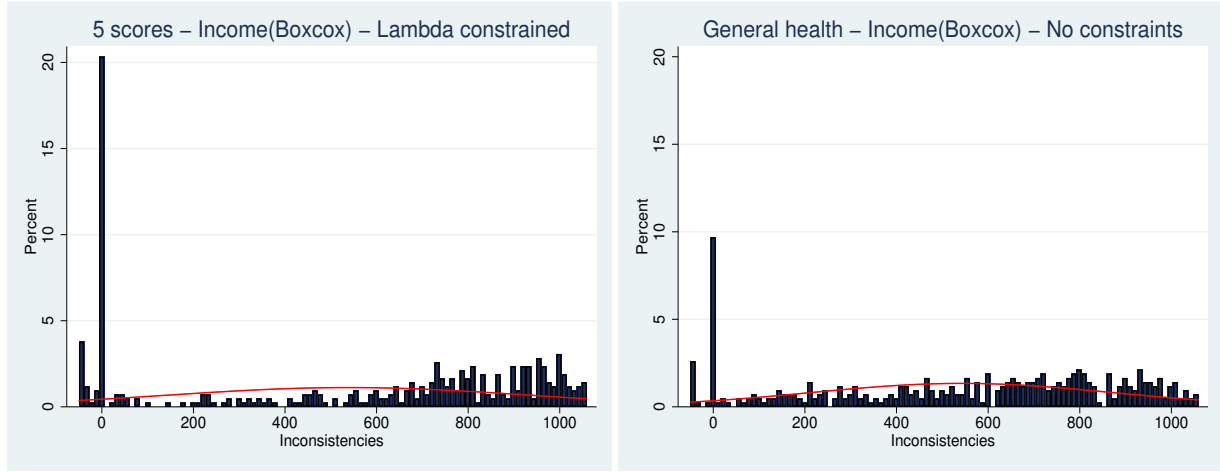
Re stated in terms of the stated WTP, WTP^P it is:

$$\begin{aligned}
\text{If } WTP^P &= WTP^{(5)} - \frac{|WTP^{(5)} - WTP^{(2)}|}{2} & \longrightarrow & I^5 = I^2 \\
\text{If } WTP^P &> WTP^{(5)} - \frac{|WTP^{(5)} - WTP^{(2)}|}{2} & \longrightarrow & I^5 < I^2 \\
\text{If } WTP^P &< WTP^{(5)} - \frac{|WTP^{(5)} - WTP^{(2)}|}{2} & \longrightarrow & I^5 > I^2
\end{aligned} \tag{14}$$

In other words the smaller the WTP^P , the more likely it is to get smaller inconsistencies with scenario (2). And the greater the WTP^P , scenario (5) approaches better. To prove this point figure 6 illustrates the histogram of the inconsistencies for the first quintile of income, if WTP is smaller than 64 euros (number randomly chosen). When 5 scores are used more than 20% of the inconsistencies are 0, whereas using only general health results in less than 10%.

Furthermore, in the satisfaction equation methodology, equivalent income is a function of income, with domain $[0, 26,000]$, while the stated value fluctuates between 0 and 2,000 euros. To put

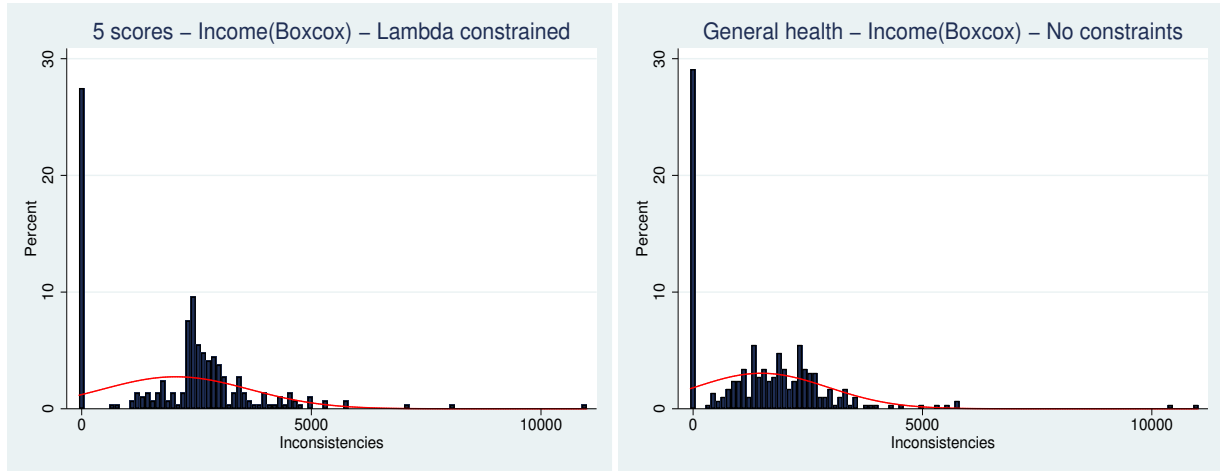
Figure 6: Distribution of the inconsistencies in the first quintile of income for scenario 2 and 5



Source: Own elaboration

it differently, after a certain threshold, the larger the income, the larger the inconsistencies relatively to their size with small income. Moreover, a greater estimation of WTP reduces the inconsistencies. This allows to conclude that regression (5) (only using general health as dimension) results in better estimation of WTP answers, even though the explanatory power in terms of R^2 is smaller. Analogously, to illustrate this point figure 7 depicts the inconsistencies in the fifth quintile of income. Where can be noticed that for regression 5, the values are closer to 0.

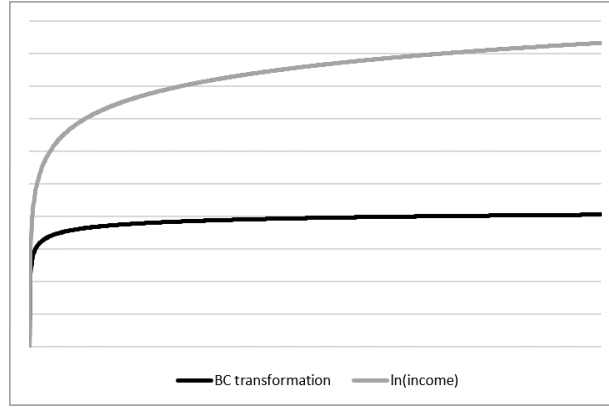
Figure 7: Distribution of the inconsistencies in the fifth quintile of income for scenario 2 and 5



Source: Own elaboration

Focusing on how to include income in the model, log of income has similar effect to the model that the use only one dimension. In (2) and (5) $\lambda^y < 0$. As income grows the variable is flatter respect $\ln$ of income, shown by figure 8. In relative terms, the equivalent income becomes smaller. It yields in a larger WTP than Box-Cox transformations. Which it is good when income is very large. For example, the maximum value of (6) is 2,117 euros less than in regression (5). Also, log gives a less skewed and less volatile distribution. Unfortunately, these benefits emerged only for one observation, when income was almost 26,000 euros.

Figure 8: $\ln(\text{income})$ versus Box-Cox transformation

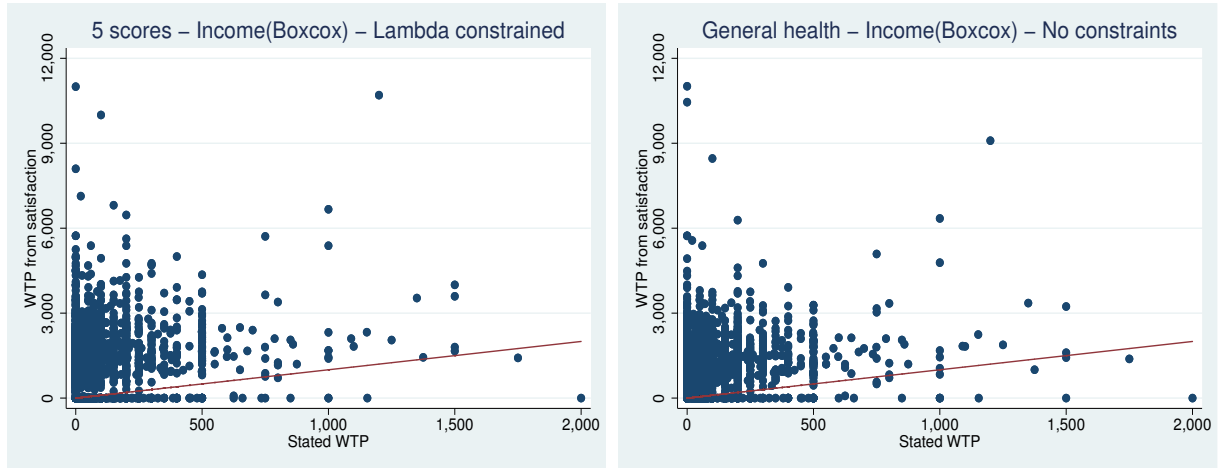


Source: Own elaboration

In conclusion, when income is small, regression (2) approaches better, while regression (5) is better as income grows. Also, if WTP is small, (2) approaches better and if WTP is large, (5) approaches better. For what follows both regressions are chosen as the best ones to approach WTP. Figure 9 plots their inconsistencies. Despite the differences, both regressions generate similar inconsistencies. The extend is large, in the regression with 5 sub dimensions the estimated WTP is larger than the stated for 2,247 of individuals and with only health dimension for 2,370 cases.

This figure also provides evidence that both regressions produced large inconsistencies between the stated value and satisfaction data, but similar, which makes the model robust in some extent. In table 2 the standard deviation of the general health is smaller than for scenario (2). This is difficult to see in the graph but, when the estimated WTP is larger than 3,000, there is more dispersion in the first graph. The latter result, also fits with the aforementioned about figure 7.

Figure 9: Inconsistencies of preferences for scenario 2 and 5



Source: Own elaboration

4.2 Lambda parameter

Table 3 depicts the output from the regressions (each of them has 2 columns, one describing the type of variable, and the second one with the coefficient). In the first column, the word BC depicts the Box-Cox parameter of each regression. All the variables are well behaved, there is not need to add a constraint on the upper bound of lambda domain to construct quasi-concave utility functions. Also, there are not parameters equal to 1, in accordance with some degree of substitution, which nevertheless does not reach perfect substitution. Also, it is needed to constraint the domain in the lower bound for the absence of chronic disease and physical health.

On the other hand, the parameters for the non income dimension work inversely to income in figure 8 (they are in the numerator of the equation). For a given X, the larger the parameter lambda, the greater the effect on satisfaction and the lower substitution of the non income dimension. Also, the changes in variables are going to be larger, (losses weight higher than the gains). This provides the key for the interpretation of the satisfaction equation output.

Despite the model finds the parameters through maximum likelihood, they do not change too much between dimensions with the exception of the health dimension. However, the difference could be meaningfully explained by the exclusion of other variables that might be correlated.

4.3 Satisfaction equation

Regarding the drop of the number of the observations, there are 4 main generators of the reduction in the number of observations. First, income data is only available for 90.96% of the sample, whereas health data is complete for 95.6%. Moreover, housing variables removes around 2% of the observations. A large number of variables obeys to the goal of the thesis. The idea, in fact, is to simulate a decision making process. Moreover, the difference in the constant between regressions is large, which can be explained by the exclusion of 4 explanatory variables in the second scenario and the effect of the BC transformations in the coefficients.

For what concerns age, due to confidentiality clauses of MEqIN, age is only available as categorical variable, in intervals. As it is normally a square variable, it was introduced in the shape of 2 dummies, young and elder people. As expected, the first has a negative coefficient, but it is not the case with the later one. A simulation was carried out defining elderly people as people older than 70 years, but the coefficient was still positive. The big changes between regression are related to the Box-Cox transformations. Given that young is an interaction variable.

There is coherence with what is mentioned in [DeNeve, 1998] about personality traits, being an emotional stable and extrovert person increases satisfaction, whereas being an anxious or easily upset person impacts in a negative way. Comparing this results with the findings in [Decancq et al., 2019] for Russia, leads to similarities in: having relationship increases satisfaction, unemployment has a negative impact with greater effect on people with tertiary education. Here, if the person has a part-time job is added as a dummy variable, capturing an negative effect on satisfaction. Also, in the socio-demographic area, the inclusion of being religious was important, nor the level of education.

On the contrary, for Belgium, the size of the house is not a significant variable as it is for Russia. Similarly, for Belgians, living in large city or small city does not produce heterogeneous preferences, while for Russians living in a rural or urban area is relevant. Nonetheless, regional differences do make a difference (i.e. being from Wallonia or Flanders or Brussels changes the

effect in some dimensions). Unexpectedly, living with children does not generate heterogeneity of preferences, nor is a statistically significant socio-demographic characteristic and, quality of the domicile was not a statistically significant variable.

Given the Box-Cox transformations, the coefficients of the dimensions are difficult to interpreted. For example, the coefficients of General Health are 0.00811 in scenario (2) and 0.419 in scenario (5). But, it is not possible to assume that regression (2) put a higher weight to the variable with only that information. The parameter box-cox also influences. If $X=100$, the effect on satisfaction in the first regression for a non young person, with no tertiary education, male and from the Flanders is $(0.00811 * (100^{0.99} - 1)/0.99 = 0.774$, whereas in regression (5) is $(0.410 * (100^{0.24} - 1))/0.24 = 3.45$.

As the other variables are omitted in the second regression, the effect of general health in the second regression is much higher. On the other hand, if $X=10$, in (2) the effect on satisfaction is 0.072, and in (5) is 1.26. An increase from 10 to 100 with larger λ increases more the effect on satisfaction than the same increase in the with $\lambda = 0.24$. Due to the larger quasi-concavity of the first one.

However, it is possible to compare the sign of the coefficients. The variables were included in the context of monotonicity of preferences, more is preferred than less. So, coefficients are expected to be positive. As the output depicts, this does not hold in all the cases, i.e. income, leisure, absence of limited functioning, absence of chronic disease, physical health, quality of the ISD, and social relationship with neighbours.

About the interactions, it can be said that, young people are the group with more downward corrections. First, concerning gender differences, the female group is the one whose interactions have the largest quantity of statically significant coefficients. Therefore, one can deduce that unemployment and physically difficult job are more adverse for males. In the while, health has a downward correction for females. On the contrary, being close to services, like supermarkets, schools and public transportation, has a very large positive effect for females. Differences between Flanders, Brussels and Wallonia are important in several work-related variables. Unemployment has a minor effect, and more leisure increases satisfaction for them.

A notable fact is the difference in between the R-squared of this regression and the same coefficient in similar studies, which here it is very high. One reason for the differences is the inclusion of emotional health, if this variable is removed, the value in scenario (2) decreases in 6 percentage points (pp). This also explains a large part of the difference between the R-squared of (2) and (5). On the other hand, this larger explanatory power can be a reflection of endogeneity. A second reason because regression (5) was created and chosen.

Table 3: Satisfaction equation

VARIABLES	(2): 5 sub dimensions		(5): 1 sub dimension	
	Type of variable [‡]	Coefficient	Type of variable [‡]	Coefficient
Constant	Con.	-56.54***	Con.	-111.0***
Personality variables				
Extrovert, enthusiastic	Cat.	0.0901***	Cat.	0.119***
Anxious, easily upset	Cat.	-0.0320**	Cat.	-0.0817***
Emotionally stable	Cat.	0.0663***	Cat.	0.113***
Socio Demographic				
Young person	D	-350.2***	D	-55.69

Table 3 continued from previous page

VARIABLES	(2): 5 sub dimensions		(5): 1 sub dimension	
	Type of variable [‡]	Coefficient	Type of variable [‡]	Coefficient
Elder person	D	0.103	D	0.205**
Relationship	D	0.487***	D	0.547***
Religious person	Cat.	0.0248***	Cat.	0.0244***
Part-time job	D	-0.180**	D	-0.175*
Education	Cat.	-0.00359	Cat.	-0.00223
Unemployment	D	-0.558**	D	-0.588**
#Young	I	-0.251	I	-0.228
#Tertiary education	I	-0.747	I	-0.578
#Female	I	-0.146	I	-0.121
#Region Wallonia	I	0.773**	I	0.794**
Equivalised income	BC=-0.2	1.292***	BC=-0.21	1.592***
#Young	I	1.177***	I	0.870*
#Tertiary education	I	-0.144	I	-0.409
#Female	I	-1.553***	I	-1.530***
#Region Wallonia	I	0.192	I	0.211
Leisure	BC=0.49	-0.0207*	BC=0.56	-0.0151
#Young	I	-0.00578	I	-0.0143
#Tertiary education	I	0.0162	I	0.0171
#Female	I	-0.00395	I	-0.00362
#Region Wallonia	I	0.0319*	I	0.0258*
General Health	BC=0.99	0.00811***	BC=0.24	0.419***
#Young	I	-0.000560	I	0.0504
#Tertiary education	I	-0.00330	I	-0.141**
#Female	I	-0.00293	I	-0.155**
#Region Wallonia	I	0.000428	I	0.0916
Absence of limited Functioning	BC=-1.81	-3.839***		
#Young	I	726.4***		
#Tertiary education	I	1.144		
#Female	I	4.715***		
#Region Wallonia	I	1.690		
Absence of chronic disease	BC=-3	0.570		
#Young	I	5.497***		
#Tertiary education	I	-0.740		
#Female	I	-0.483		
#Region Wallonia	I	0.00909		
Emotional Health	BC=0.03	1.712***		
#Young	I	-0.0300		
#Tertiary education	I	0.0243		
#Female	I	-0.410**		
#Region Wallonia	I	-0.203		
Physical Health	BC=-3	1.034		
#Young	I	-231.3*		
#Tertiary education	I	5.426**		
#Female	I	-2.205		
#Region Wallonia	I	3.098		

Table 3 continued from previous page

VARIABLES	(2): 5 sub dimensions		(5): 1 sub dimension	
	Type of variable [‡]	Coefficient	Type of variable [‡]	Coefficient
Quality of the domicile	BC=-0.12	0.518	BC=0.24	0.243
#Young	I	0.143	I	-0.142
#Tertiary education	I	0.170	I	0.119
#Female	I	0.891	I	0.162
#Region Wallonia	I	0.649	I	-0.0397
Size of the domicile	BC=0.73	0.0164	BC=69	0.0246*
#Young	I	-0.00618	I	-0.00201
#Tertiary education	I	-0.00267	I	-0.00398
#Female	I	-0.0109	I	-0.0204
#Region Wallonia	I	0.00816	I	0.00675
Quality of the ISD	BC=-1.2	63.60***	BC=-1.4	153.9***
#Young	I	-2.796	I	29.08
#Tertiary education	I	4.509	I	-16.28
#Female	I	1.169	I	4.690
#Region Wallonia	I	-86.91***	I	-142.5***
Services in the ISD	BC=0.97	0.00777***	BC=0.61	0.0407***
#Young	I	-0.0117***	I	-0.0590***
#Tertiary education	I	-0.00282	I	-0.0241
#Female	I	-0.00271	I	-0.0164
#Region Wallonia	I	-0.00155	I	0.00635
Social relationship with neighbours	BC=-1.19	-3.963***	BC=-1.32	-5.707***
#Young	I	27.84**	I	45.04**
#Tertiary education	I	-6.706	I	18.19
#Female	I	3.356***	I	4.167***
#Region Wallonia	I	80.86***	I	132.1***
Job requires lots of physical effort	D	-0.227	D	-0.274*
#Young	I	-0.0376	I	-0.0963
#Tertiary education	I	0.399***	I	0.463***
#Female	I	0.209	I	0.175
#Region Wallonia	I	-0.239	I	-0.148
Dangerous job	D	0.363***	D	0.356**
#Young	I	-0.288*	I	-0.226
#Tertiary education	I	-0.571***	I	-0.643***
#Female	I	-0.0633	I	0.0224
#Region Wallonia	I	-0.0298	I	-0.0666
Work makes you dirty	D	-0.235	D	-0.230
#Young	I	0.240	I	0.192
#Tertiary education	I	0.417**	I	0.435**
#Female	I	-0.293*	I	-0.317*
#Region Wallonia	I	0.261	I	0.242
Mental effort in job	D	-0.291	D	-0.329*
#Young	I	-0.0636	I	-0.0208
#Tertiary education	I	0.00506	I	-0.0560
#Female	I	0.437**	I	0.423**
#Region Wallonia	I	-0.173	I	-0.111

Table 3 continued from previous page

VARIABLES	(2): 5 sub dimensions		(5): 1 sub dimension	
	Type of variable [‡]	Coefficient	Type of variable [‡]	Coefficient
Worthwhile Job	D	0.130	D	0.248
#Young	I	0.0112	I	0.0377
#Tertiary education	I	-0.202	I	-0.107
#Female	I	-0.193	I	-0.201
#Region Wallonia	I	0.486**	I	0.449**
R-squared		0.380		0.303
Observations		2,883		2,883

Robust standard errors

*** p<0.01, ** p<0.05, * p<0.1

‡ Cat.: Categorical variable

‡ D: Dummy variable

‡ Con.: Continuous variable

‡ BC: Variable with Box-Cox transformation

‡ I: Interaction variable

4.4 Heterogeneity of preferences

According table 3, females have the smallest coefficient of health $(0.419 - 0.155) * (66^{0.24} - 1) / 0.24 = 1.91$ and people younger than 30 years the largest one $(0.419 + 0.05) * (66^{0.24} - 1) / 0.24 = 3.39$. At first glance, this might suggest that young people prefer more health than females, but it is not necessarily the case. The interaction effect with the income dimension is -1.53 vs 0.87, respectively. As consequence, if both are in the same point, females would require a lower equivalent income than young to get perfect health. This illustrates the importance of considering preferences and the heterogeneity of them and captures the importance of multidimensional measures.

Given, scenarios (5) and (6) allow to drawing indifference curves for groups of population, let's to illustrate this point with an example. Consider a person with equivalised income=1,600 and score in health of 66 (the median values). Using equation 10 and defining the following 4 groups:

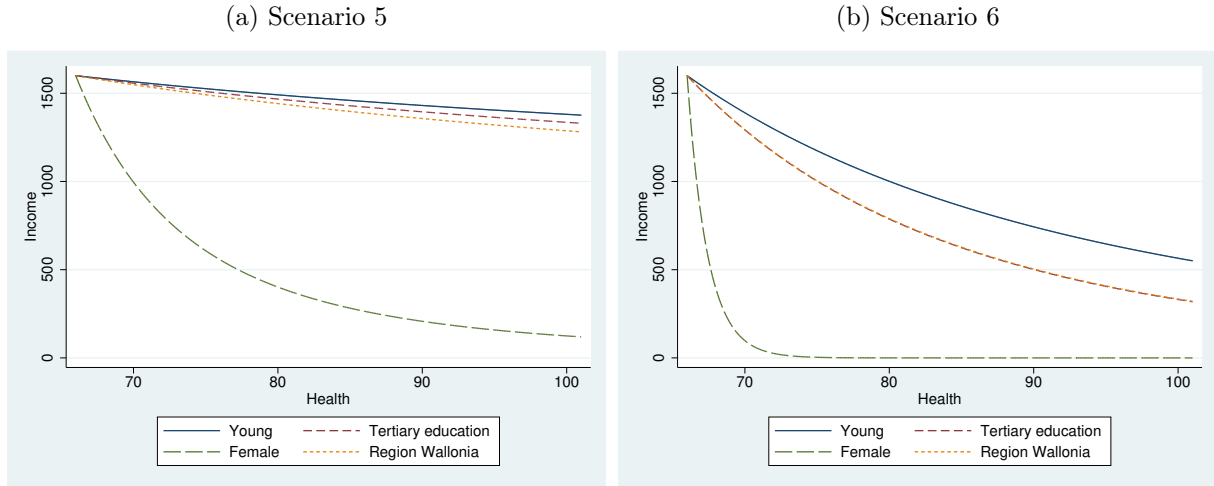
1. Young: people younger than 30 years old, male, no tertiary education and from the Flemish or Brussels region.
2. Tertiary education: people older than 30 years old, with university degree, male and from the Flemish or Brussels region.
3. Female: people older than 30 years old, no tertiary education, female and from the Flemish or Brussels region.
4. Region Wallonia: people older than 30 years old, no tertiary education, male and from the Wallonia region.

As figure 10 illustrates, the heterogeneity of preferences changes the degree of substitution between income and health. Figure 10a, plots indifference curves with regression (5) and figure 10b make it with regression (6). For both the cases, if there are two individuals with the same

characteristics, but one is female and the other is male, the female will require a lower equivalent income to get perfect health. Whereas, young group is the less willing to substitute.

In the second graph, the convexity of the indifference curve is larger than in the first one, which keeps coherence with what it has been aforementioned in the thesis. (6) uses $\ln(\text{income})$ and (5) a Box-Cox parameter of -0.21. As income is steeper in the second case, the indifference curve is more convex, suggesting more substitution of health. This also shows, the size of the error of using the logarithm of income, when maximum likelihood suggests $\lambda^y = -0.21$.

Figure 10: Illustration of heterogeneous preferences



Source: Own elaboration

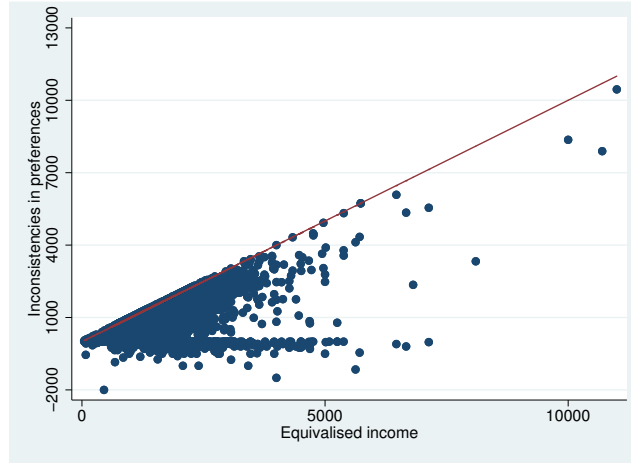
4.5 Regularities in the inconsistencies

To characterize the inconsistencies in coherence with the previous findings, a dummy variable was created. If the inconsistency in (5) is smaller than in (2), the dummy takes the value of 1, indicating that (5) should be used. Otherwise is (2), and the dummy is 0. In that sense this chapter uses the preferences retrieved from the scenario with 5 sub dimensions for 697 individuals and the scenario with only general health for the 2,186. Computing the inconsistency as the difference between WTP from satisfaction data minus the stated WTP and the dummy, the smallest inconsistency is chosen per individual. The inconsistency can be positive or negative. The value 0, is the most frequent value. It is in the second decile of the distribution, as expected given the right-skewed.

Inevitably, if the inconsistencies are studied by group and one of them has larger income, the inconsistencies are going to be larger in that group. However one may question whether they are going to be larger just because of the methodology or because income generates differences in the inconsistencies. Unfortunately, more research is needed to answer this question. Indeed, the correlation between inconsistencies and income is 0.52. If they are plotted in a two graph, the pattern is evident, but there are some exceptions. Figure 11, illustrates a group of people where the inconsistencies are independent of income. They are the dots closer to 0. For them, it is possible to analyze the socio-demographic characteristics to see if there is a pattern.

By consequence, only the inconsistencies equal to 0 are considered. Basically, this group is people who stated 0 WTP and the model also estimate it. There are 246 observations. On average they

Figure 11: Correlation between inconsistencies and income



Source: Own elaboration

declared a lower level of satisfaction, for the entire population is 8.46, whereas in this group it is 8.20. However, since average values do not capture the distribution, the skewness helps to see how concentrated are values to the highest state. For instance, as well-being in Belgium in high, the skewness is negative, -1.30. The more negative is the asymmetry means the values are closer to 10 than to the mean. And in this sub sample it is closer to 0 (-0.99), the opposite.

The composition by socio-demographic characteristics is very diverse. So, this part it is restated in relative terms. Table 4 contains 5 columns, the first are variables that captures different socio-demographic characteristics. The second is the number of individuals with 0 inconsistencies of preferences ($I=0$). Column 3 is the number of individuals with that socio-demographic characteristic in the sample (N). Then, this value is restated in terms of the group of study. The number of individuals with $I=0$ is 246, a 8,53% of the sample. So, the fourth column expresses in the same proportion N . Finally, if the number of people with $I=0$ is larger than $0.0853 * N_Z$, implies they are over-represented in this subgroup of study.

People from the Wallonia region are more likely to state $WTP=0$ and the model captured. The same holds for people with tertiary education, females and people with no relationship. Conversely, for young people, which were an interaction variable to capture heterogeneity with a larger preference for income. Special attention deserves the gender differences. If the inconsistencies are plotted by income in a two-way graph, the pattern followed by the graph of males is very close to the of 45-degree line. By contrast, for females the line has two tendencies, one very close to the same line, and one very close to 0, independently of income.

5 Conclusion

It is possible to compare stated preferences and retrieved preferences from satisfaction data. The later one can be computed with Box-Cox transformations, which generates quasi-concave utility functions if $\lambda < 1$. The larger the parameter λ , the steeper is the curve. In the income dimension, this creates a smaller substitution between income and the non-income variable. The inverse effect is found for non-income dimensions.

Very negative lambdas make the value of the variable very small, so it generates very large

Table 4: Socio demographic composition of the sub group with 0 inconsistencies

Characteristic	No of I=0	N_Z	8.53% of N_Z	Over represented?
Region				
Flanders	63	1772	151.20	No
Wallonia	169	901	76.88	Yes
Brussels	14	210	17.92	No
Education				
High	104	951	81.15	Yes
Middle	60	1017	86.78	No
Low	81	878	74.92	Yes
Age class				
18-29	1	419	35.75	No
30-39	56	459	39.17	Yes
40-49	54	528	45.05	Yes
50-59	44	544	46.42	No
60-69	48	468	39.93	Yes
70-79	26	311	26.54	No
80+	17	154	13.14	Yes
Gender				
Male	1	1353	115.45	No
Female	245	1530	130.55	Yes
Couple				
Relationship	153	2058	175.60	No
No relationship	93	825	70.40	Yes

coefficients. As the coefficient of income remains unaffected to this transformation, the ratio between these coefficients is large, which is not a problem to compute indifference curves, because the small values of X compensate. However, Stata takes up to 8 digits, and these very small values are considered as 0, indicating WTP=0, because of methodological reasons. So, a constraint over the parameters must be added, they cannot be smaller than -3. Fortunately, it does not affect the estimation of inconsistencies.

In this methodology the equivalent income is a function of income, that fluctuates between 0 and 26,000, while the stated value goes from 0 to 2000. Even though, the model allows identifying inconsistencies between stated preferences and those ones retrieved from satisfaction data. In the 2 simulations they have a similar pattern. In the regression with 5 dimensions the estimated WTP is larger than the stated for 2,247 of the individuals and with only one dimension for 2,370.

Nevertheless, their extent is large, and it gives limitations to characterize the inconsistencies, because the size of the inconsistency depends on the magnitude of income. As some socio-demographic groups tend to have a larger income, the larger inconsistency could only obey to methodological reasons. Despite that, it is possible to see smaller inconsistencies in females than in males.

On the other hand, if a larger income generates major inconsistencies, a new research question for behavioral welfare arises. Does it occur because indeed a larger income generates greater inconsistencies between perceived utility and real-after decision utility or the decision-making

process after a certain level of income is different than with small income. Therefore, the utility function for this group should be approached differently or separately, in which case the current difference is due to methodological reasons.

In all at all, there are some methodological facts that make the inconsistencies smaller. The inclusion or exclusion of variables does not change much the value of λ , which makes it robust to the model. Nonetheless, this changes the weight of the coefficients in the regression, which also affects the inconsistencies of preferences. In this exercise, using only one dimension yielded in a higher coefficient for the non-income dimension, increasing the substitution between income and health. This gave a smaller equivalent income, which was good when income was large. But, as preferences are convex, if income is small, the effect over the estimated equivalent income is larger than when income is large, and a larger estimation of WTP gives larger inconsistencies. In this case the model with 5 dimensions estimates a larger equivalent income, approaching better WTP.

Regarding methodological comparison, satisfaction equation provides much richer information about the dimensions, satisfaction equation directs to policy makers where they should to look at, especially in a world of limited resources. But, the coefficients are different to interpret. Also, they are affected by personality traits as it was suggested by the literature. Unemployment has a very negative impact. In some cases preferences failed in being monotonic. In the work dimension, the effect depends on the individual, for some of them a mental effort job has a positive effect but for others it is negative.

Surprisingly, there were not heterogeneity of preferences because of the presence of children in the household, neither if the person lives in a rural or urban area. Interestingly, there is it due to regional differences, especially in the housing dimension. For females, the convexity of the curve is much larger than for other groups, people younger than 30 years old are less willing to change income by non-income dimensions.

In summary, the study supports the methodology of [Decancq et al., 2019], the use of Box-Cox reduces inconsistencies between methodologies. Also, it agrees with [Maniquet et al., 2019] that "equivalent income is a promising new measure", because despite the large extent of inconsistencies the outputs are similar in different scenarios, which is a contribution to the existing literature. On the other hand, this research also contributes highlighting the methodological differences that generates these inconsistencies and brings up a new research question in which behavioural welfare can play a role in solving skepticism towards equivalent income approach.

6 Limitations and suggestions for further research

The main limitation in this study relies on the definition of the ideal state. Here, it was taken from the MEqIN data set. But, in the work dimension preferences are not necessarily monotonic. Before, constructing a measure of equivalent income violating this property it is essential to analyze the impacts of it. In this work, the monotonicity failures corrected, were those ones with theoretical fundamentals to do it.

Second, as the intensity of the inconsistencies increases with income, the model doesn't allow to portray the regularities by socio-demographic characteristics due to positive correlation between income and some of them. But, if changes in the selected variables decrease or increase the inconsistencies, constructing the best satisfaction equation can provide a benchmark. From the exclusion of 4 variables, is possible to hypothesize that some sub-dimensions are not very

important in the decision-making process. And their inclusion is producing noise. However, more research is also needed to study the extent of the aforementioned correlation. In that particular a cause-effect analysis could be a good start. As well a regression only for high income people.

References

- [Decancq et al., 2019] Decancq, K., M., F., & Maniquet, F. (2019). Multidimensional poverty measurement with individual preferences. *The Journal of Economic Inequality*, 17(29).
- [Decancq et al., 2015] Decancq, K., M., F., & Schokkaert, E. (2015). Inequality, income, and well-being. *in: Anthony B. Atkinson and François Bourguignon (eds.) Handbook on Income Distribution.*, Volume 2A Elsevier, 67–140.
- [DeNeve, 1998] DeNeve, K. M., . C. H. (1998). The happy personality: A meta-analysis of 137 personality traits and subjective well-being. *Psychological Bulletin*, 124(2), 197–229.
- [Fleurbaey et al., 2015] Fleurbaey, M., Schokkaert, E., & Decanq, K. (2015). Happiness, equivalent incomes, and respect for individual preferences. *Economica*, 82, 1082–1106.
- [Kahneman, 2003] Kahneman, D. (2003). Maps of bounded rationality: A perspective on intuitive judgment and choice. *Stockholm, SE: The Nobel Foundation*, (pp. 449–489).
- [Maniquet et al., 2019] Maniquet, F., Schokkaert, E., Cantillon, B., & De Rock, B. (2019). Measuring equivalent incomes: final report (meqin). *Brussels: Scientific Policy*, (SP2802).

A Appendix

A.1 The do-file