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**The propensity to adaptation under the new era of climate changes**

Ary José A. de Souza-Jr[1]. Flávio Terto[2]

**Abstract:**

Decision utility or experienced utility: which one of them helps us better understand how it will occur the process to the adaptation of behavior's consumer regarding the impact of climate change? This paper argues how each one of the aforementioned concepts most may affect the consumer's routine as "decision-makers", within the context that disturbances and scarcity must narrow their available options. For this, we use the individual's choice reported in the 8th wave of European Social Survey, based on the choice-oriented perspective, which establishes a link between well-being and the propensity to adapt within this scenario. For this, an ordered logit model is applied upon environmental and socio-economic variables. In the end, our findings are consistent with a strong presence of rationality in the decision process towards adaptation.

## Introduction

Nowadays, most agents have been warned about how dangerous the effects of climate change could be to the whole society. Even though the experts have highlighted that these events (such as air pollution, droughts, floods, global warming, and sea level increases) may rule out some species of animals and crops (Tol, 2008), understanding how this process towards (possible) adaption will flow, it is not easy. Then, based on the assumption that the consumers are willing to adjust their habits within the newest restrictions, which kind of parameter more aids us to understand this trend: Decision Utility or Experienced Utility? To our knowledge, none other paper has proposed to discuss the relationship amongst these parameters and the propensity to adaptation due to climate changes. Our question is relevant to give subsidies to policymakers in understanding the evolution of this process to adaptation with aiming to ensure a great level of well-being in the society, despite the many challenges posed by the current scenario. These contributions become even higher when we analyze them in the European Union context, due to its historical tradition in implementing directed agreements and policies to reduce the effects of such phenomenons.

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Climate change occurs when differences in the state of climate are observed, i.e., its mean or variation in its properties, due to internal (natural) or external forcings (IPCC, 2014). Despite its big variety of effects and interconnections, we don't choose only one for exploring since our main question has established relationships with all of them. Besides, there are plenty of studies related to climate change, generally, with a focus on macro questions, such as impacts on GDP or links between poverty and high temperatures (Tol et al., 1998), which inspires us to go further and assess the subjects' behavior into this scenario.

Recently, analysis of consumer behavior has been seen by the lens of welfare, instead of only variations in income. By hypotheses, we take into account a relationship between the level of welfare and the possibility of consumers´ habits adaptation. Our assumption is supported by Preference Theory, which posted that if preferences are fully satisfied, such a situation creates well-being (Bernheim & Taubinsky, 2018). If most individuals keep the same level of well-being despite facing scarcities and new restrictions, it will be deduced that they adapt their choices, so as not to alter their preferences. Likewise, as an individual is the owner of his choices, any decision conditioned by new challenges in fulfilling their baskets could increase or reduce their satisfaction. As noticed by Diener (2000), such a process occurs because people can adapt themselves speedily within any new circumstance. Our proposal relies on the logic that choices are done consistently, so, for assumption, their choice indicates their preferences[3].

In this paper, we also assume a direct relationship between the level of well-being and the odds of adaptation. Our methodology relies on two theoretical strands. The first aims to deduce the readiness in changing habits, but not equal to the contingent valuation approach[4], since part of this paper takes into account a questionnaire provided by an external institution[5]. However, we build one structure able to elicit such disposition based on the available questions, without asking the willingness to pay or accept something. Then, we focus on the power of the choice, whereby it acts as the main direction. For this, we consider some premises for basing this argument (Bernheim, 2016): 1) each individual can do his/her best judgment of his/her own well-being. Consequently, it defines who can to decide about his/her improvements toward the

[3] As Goldin & Reck (2015), here the concept of preference covers the relative consistency in relation to the objectives of the decision makers within the available options;
[4] The main difference is about the inexistence of that common question: "What is your willingness to pay for…?" because here the responders were not provoked with this goal while the ESS survey was going on;
[5] We mean, these questions were already conceived at the beginning of this paper, so, this precluded us to make any mechanism design of the survey.

superior status of happiness; 2) all judgments are compound by coherent and stable preferences, which means that each individual logically takes decisions and elaborates alternatives correctly; 3) preferences determine our choices, which provides great enforcement to our purpose.

The second one is related to the concept of the Subjective Well-Being (SWB), which has been used as an alternative method to value amenities (Diener et al., 1999; Frey and Stutzer, 2002; Dolan et al., 2008). However, our target is not exactly to measure how happy those individuals are, but how satisfied they could be at facing a new set of restrictions due to climate changes. Thus, by allowing to explore the link between well-being and propensity to adaptation, the Life Satisfaction approach provides a great proxy for an individual's utility. In addition, despite mostly effects of climate change has been seen only as macro impacts, according to frame monotonicity[6], if frame impacts choice, so it will occur in the same way for each decision-maker (Goldin & Reck, 2015).

In this sense, the individual judgment can be direct and indirect: "A direct judgment pertains to outcomes we care about for their own sake – our 'ultimate objectives' – whereas an indirect judgment involves alternatives that lead to those outcomes." (Bernheim, 2016, p.17)[7]. So, as here it has been debated a trend, both judgments will be considered as useful for accepting the construction of well-being, and, consequently, adaptation. Thus, our question is driven by the choice-oriented welfare framework, whereby beliefs and perspectives about their future in front of these restrictions allow us to comprehend how Decision Utility or Experienced Utility impacts on their welfare while they are facing such limitations.

Regarding our focus, the main inspiration was given by Chetty (2015), who discusses how optimal policies could be achieved by new insights into Behavioral Economics (BE), such as experienced utility and nudges. In this seminal paper, the author compared decision utility with experienced utility, and he concluded that for not using some tools provided by BE, there is a lost surplus from failure to optimize. Other papers were done nearby of our subject mainly based on the SWB approach, despite having a different focus. For example, in Diener (2000),

[6] Regarding the number of available frames, for this study is considered only one, that is, the year's survey, 2016. So, there are no questions about several frames and how these can imply consistency or inconsistency of preferences;

[7] Bernheim (2016) highlights the importance of differentiating each kind of judgment. For instance, about indirect one, he explained that not all ones are created equally.

the analysis of SWB over years has shown that people adapt mostly situations, in a fast way, due to several reasons, like a change of goals or specific contexts. According to the author, SWB is treated in different ways, according to religion, the level of wealth, and other features. Then, these specifications imply not only in the SWB but also in their ability to adapt.

According to Kahneman and Sugden (2005), the subject has a trend to adapt himself, by two main mechanisms: changing of evaluation and redeployment of attention. Both lead the consumers to capture new scenarios and rethink his behavior within each one. So far, we don't find any paper related to this point, in such a way that we feel comfortable in assuming that both types of mechanisms could be able to explain the odds to adaptation. Equally relevant, in a longitudinal research project of SWB and personality, Diener et al. (1996) point out that bad and good events are important, despite the last one seems to be experienced with more intensity. The authors still highlight the impacts of the recent events on the SWB levels are more relevant than the former ones, which sheds light on our problem due to the impact of past experiences on the individual's behavior. In our opinion, this last paper gives us important guidance to understand the propensity to adaptation since climate changes haven't occurred with the same intensity over the whole of Europe. Although, studies of SWB dedicated to the adaptation of consumer's habits in facing some adversities due to climate changes are rare.

On the other hand, the current literature has a high variety of studies related to the environmental variables and SWB[8]. Even though none of them does not discuss adaptation related to those concepts aforementioned, they also are suitable to shed light on the effect of environmental variables and socio-economic characteristics. In the first group, a great amount of papers has shown that several different factors of environmental quality have an impact on well-being in the expected way. For instance, negative impacts of air pollution (Apergis, 2018; Smyth et al., 2008; Luechinger, 2009, 2010; Ferreira et al., 2013) and positive for precipitation (Frijters and van Praag,1998; Brereton et al., 2008[9]). Undoubtedly, bad air quality decreases well-being due to its hazardous relationship with health. But precipitation remains partially answered since it could be linked to scenic beauty (Brereton et al., 2008). For the rest of the environmental variables that it will be used in our paper (such as waste production and burnt area), so far, we don't find studies whereby there is some link between SWB and them.

[8] This field focuses on the SWB like a level a general satisfaction with life or just "happiness";
[9] In Brereton et al. (2008), there are results with both signs. At using the probit model, they found out a positive impact; but, a negative one for the OLS model. As in our paper, we focus on the first, the second one was ignored.

Regarding socio-economics characteristics, they have been analyzed in alternative contexts, with different explanations, which created either positive or negative effects. About age, mostly researches showed negative impacts (Ferrer-i-Carbonell and Gowdy, 2007; Smyth et al., 2008; Cuñado and Gracia, 2013; Luechinger, 2009, 2010; Ferreira et al., 2013). For the variable gender, there is almost an unanimity according to what type assumes the value 1 in the dummy: if male, negative (Brereton et al., 2008; Smyth et al., 2008); female, positive (Ferreira and Moro, 2010). Then, women have a slightly higher proportion to be satisfied with life. From another standpoint of view, having children (or its total amount) has been demonstrated by controversial results (negative: Ambrey et al., 2014; Ferrer-i-Carbonell and Gowdy, 2007; Ferreira et al., 2013 – positive: Luechinger, 2009). Without consensus about these differences, this result could be due to the variety of research drawings and contexts. Equally, the number of years after the last academics degree or (just) years of study also showed double impacts according to each study (Ferreira et al., 2013; Ambrey et al., 2014).

Meantime, talking specifically about climate change has been seen as a hard task, either for its huge extension or for its complexity (IPCC, 2014). Frequently, these features led to several studies, which have discussed this topic in a macro view. For instance, Nordhaus and Boyer (2000) point out that the first models were done in the framework of national economic accounts. Despite the research within this topic have expanded its range by encompassing more complex analysis, the review of the literature showed uncertainty, much more differences in aiming, analyzes of impacts in several unlikely models and sectors (Tol, 2008). For example, Tol (2002) focus on the damage of climate change and demonstrates that the increase of 2.5º Celsius in the global average temperature can reduce up to 0.25% of the gross agricultural product ("best guess"). Similarly, the author showed the effects on forestry, sea-level rise, unmanaged ecosystems, human mortality, energy consumption, and water resources.

Researching about adaptation due to climate change, even though using random methodologies (different from SWB), Adger et al. (2005) explain how these adjustments could be evaluated by its effectiveness, efficiency, equity, and legitimacy throughout its judgment of success. Their main inference is to identify a complex process of steps ("cornerstones of adaptation"), which varies according to lapse time and scale of experienced events. From a more practical view, Sahakian and Wilhite (2014) identify sequential stages, by using a social practice theory, which ones can create pitfalls, demanding efforts from important intuitions and, in the end,

adding extra complexity due to dimensions of time and space. Otherwise, they warn about how completely different roles must be enrolled to reach sustainable forms of consumption (not only habits).

In a more microeconomic view, Young et al. (2010) evaluate the green consumer decision process when purchasing products in Yorkshire (UK), which evidence a great role for situational context, time for research, product´s price, available information about environmental/social performances of products and cognitive efforts for researching. Despite highlighting each variable alongside green criteria, the consumer must apply much more effort for handling key factors, such as purchase experience, plenty of time, and knowledge of the relevant environmental issues (Young et al., 2010).

Our study also has some limitations. The first is the high amplitude of subjects in the questionnaire done by the European Social Survey (ESS). This feature ends up encompassing a quite different range of topics related to climate changes, from just perceptions about the environment to specific questions (e.g., better source of energy). Second, the edition of 2016 reached 23 countries, which offers a huge variety of tastes and idiosyncrasies, for each country as well as for each interviewed group. For this reason, it's normal to wait for a huge endogeneity in the econometric outputs. Third, our methodology only captures the role of each environmental and socio-economic variables for both concepts, explaining how each subject "organize" his/her self-propensity to adapt him/herself. We mean, there is none unified index that can offer us an exact measure for adaptation, then, our findings will be done based on the global influence and significance of estimates.

Taking into account our limitations, this paper still provides contributions to the public policies[10] since it adds elements to its reasoning, mainly for European Union[11], not only because of its leadership within ambitious climate policies[12], but also due to its high impact on the global economy. Moreover, this paper offers additional findings for three major fields. First, for the behavioral economy, since we established a link between the power of choice and

[10] For example, Spinnewijn (2015) discusses how biased beliefs about the likelihood of employment can impact unemployment policies. This study highlighted that different levels of pessimism or optimism, also with a specific degree of paternalistic´s government, implies in many designs of unemployment policies;
[11] We highlight the European Union because, as it'll be shown soon, the ESS' survey in 2016 encompasses 22 European countries and Israel;
[12] For a broad view about the development and implementation of climate policies in the EU, see Delbeke and Vis (2015).

the odds of adaptation in the context of climate change. The guidance comes from the assumption of SWB, which indicates that more welfare leads directly to a bigger likelihood of adjusting their consumption habits. The second field is the economics' climate change. Our paper also adds findings in offering a new view about the impacts of climate change from a microeconomic perspective. Thus, we innovate for assessing the propensity to adaptation based on a behavioral framework, which is directly personal, even if evaluated in large groups. Lastly, our finding offers a general inference to the discussion about consumer behavior, due to its ability to assume their posture regarding new challenges generated by climate change. Knowing how each key variable impacts the decision or experienced utility also allows us to go deeper into forecasts about public policies and market strategies.

Beyond this introduction, our paper is divided into five parts. The first handles the conceptual approach. Section 2 gives relevant details about the data and explanatory variables. The third one shows the methodology, offering a good explanation to allow us to reach our purpose. Fourthly, a discussion about the main outcomes and implications. The last one, a conclusion.

**1 – Conceptual approach**

In this section, we explore conceptual frameworks for apprehending how the propensity to adaptation will be assessed. First, Decision Utility[13] refers to the common judgment of mainstream microeconomic, which relies on the existence of a utility function, $U_t$, that embodies all possible preferences, aiming to maximize well-being. In the spirit of Von Neumamm and Morgenstern (1953), individuals can make decisions upon comparisons between events, as well as combinations of their likelihoods, whereby they compute their better possible payoffs. For this view, it is supposed to deal with rational individual, who is able to take optimal decisions due to the market with symmetric information. As Simon (1955), these consumers must gather all possible payoffs according to each outcome, which is related to knowing the nature of circumstances[14]. In a general way, for Kanheman and Sudgen (2005), it represents an individual's preferences related to his mental capacities. Additionally: "A common practice (…) is to posit the existence of a utility function, U(x;f) (where *x* is the chosen item and *f* is the decision frame) that rationalizes decisions. This function summarizes all

[13] To simplify, from now on, it will be used decision utility for representing the traditional utility theory, which is always present in the microeconomics handbooks;

[14] Here it will be considered the traditional concept of the expected utility model, even though Kahneman and Tversky (1979) had noted violations of its axioms as a descriptive model, such as certainty, isolation, and reflection effects.

positive knowledge about choice. For obvious reasons, many behavioral economists call it decision utility (or sometimes ex-ante utility)." (Bernheim & Taubinsky, 2018, p.11). Even though this approach has been considered the base for several studies, some researchers observed that utility theory was unable of describing the whole phycological process, once it does only a small part of it (Frisch & Clemen, 1994).

Second, for Kahneman et al. (1997), Experienced Utility (EU) denotes an instant utility, as a type of measurement of hedonic and affective practice. Similarly, Bernheim (2016) posted it as feelings´ and event´s records whereby consumers actually experienced some decision. Then, due to its amplitude, he called it "subjective sensation". Therefore, we cite Experienced Utility (EU) as a function $U_t^e$, which encompasses, for definition, all past experiences of consumers (objective and subjective). Also, any trial of detailing such fact within this concept will be completely no success, because that one contains instantaneous hedonic sensations as well as the aspect of culture and heritage. Furthermore, as a decision-maker, the consumers´ habits embodies their history and some type of compacted past opportunities: "habitus conceptualizes biographical and historical experience (…)" (Sahakian & Wilhite, 2014, p.28). Therefore, new contexts don't ignore the fact that experience is a relevant element in the decision-making process since it influences our current views about possible judgments.

For both parameters, it is posited the existence of a virtual welfare function, *V (x)*. Next, for identifying how each parameter allows us to understand about well-being, and so, the propensity to adaptation, we assume that: i) each consumer is the best arbiter of his well-being; ii) at choosing, we aim to reach the best options which induce us to expand our comprehension about their well-being (Bernheim, 2016). Also, we identify some answers as possible mistakes (Bernheim, 2016). For this purpose, we consider a mistaken choice when: a) it is chosen an inconsistent option within all available alternatives[15]; b) supposedly, people do not understand particular decision problems, for not knowing exactly how to answer such questions, despite having a range of verifiable answers and information.

Third, the concept of climate change encompasses all types of alterations in the environment, which creates a flow of natural sequences amongst enrolled sides. "Climate change refers to a

[15] According to Bernheim (2016), this situation also encompasses a type of indirect judgment reported incorrectly. But this paper won't assess if the individual chooses an option for the right or wrong reasons.

change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer." IPCC (2014, p. 120). Also, it may be generated by a natural internal process or external forcings, which could be attributed directly or indirectly by human actions (UNFCCC, 1992). For instance, the trend over 1901-2012 shows an increase up to 2º degrees Celsius in most of the world, while some regions reached 6º degrees of raising (IPCC, 2014). Furthermore, from observed data in 2010, other phenomenons give us clear signs: increase in the global sea level, more intensity and duration of droughts, reductions in the permafrost regions and, elevations in ocean acidification (IPCC, 2014).

Finally, adaptation is related to the process of adjustment or reorganization according to actual or expected effects of climate changes, either for human systems (seeking for moderation) or natural ones (facilitating adaptations) (IPCC, 2014). Notably, the first is promoted by intentional movements, while the second could exist in the self-governing (autonomous process). Likewise: "the capacity to adapt is dynamic and influenced by economic and natural resources, social networks, entitlements, institutions and governances, human resources and technology" (IPCC, 2014, p.839). For Adger et al. (2005), adaptation shows the capacity of individuals and institutions in creating such ability into new scenarios. So, this is a continuous process, for all agents in the society, which encompasses a stream of steps (activities, actions, attitudes, etc.) related to several aspects of life (Adger et al., 2005). According to Gibson et al. (2011), even if society accepts such a process, it does not mean that people are able to change themselves, because of some dilemmas of sustainability. As a result, regardless of which concept best applies, it is not possible to state any direct relationship between acceptance of climate change and adaptation.

From the standpoint of adjusting habits, movements to a more sustainable world depend on how to redefine postures, positions, and opinions. Then, it involves a new characterization of routines and the reconstruction of the set of behavioral practices (Sahakian and Wilhite, 2014). Despite lacking available information on the environmental and social performance of products, in general, green consumers have done a great effort in choosing the likely best option (Young et al., 2010). In sum, these concepts will guide us to develop a reasonable analysis of the propensity of consumers in adjusting their habits of consumption within a scenario that considers the impacts of climate change.

## 2 - Data

Our data was taken partially from the European Social Survey (ESS), which did a great questionnaire in 23 countries, most of them in Europe[16], in 2016. In this specific year, ESS innovated its scope of topics by adding a rotating module called "Climate change and energy, including attitudes, perceptions and policy preferences". This new block has 32 questions of multiple formats and settings, but only 30 were used in our paper[17], being its answers used as the base for our dependent variable. As a result, this paper uses approximately 44,378 observations from ESS.

On top of that, a second part of the explanatory variables was taken from PORDATA[18], mainly for the topic environment, energy, and territory. These are divided into two groups. First, the environmental variables, settled by country, whereby we follow just two common measures present in the previous papers: greenhouse gas emissions (air pollution, see Apergis, 2018) and precipitation (Brereton et al., 2008). The other ones represent additional contributions that our study aims to explore, namely: waste production, energy production, energy consumption, burnt area, and carbon intensity (PORDATA, 2020); since we do not find any studies about them. The second groups encompass the socio-economic characteristics at the individual level, taken from ESS, which has been found in the current literature with relative impact on SWB (for example Dolan et al., 2008). Both groups work like indicators for signaling the strength and the sorting in the scale of propensity to adaptation. Table 1 contains the variable descriptions and their labels used in the econometric model.

## 3 - Methodology

Our methodology is divided into three parts. The first explains how the concepts of Decision and Experienced Utility will be tested. The second gives us more details about the choice-oriented perspective. Lastly, the econometric approach explains our estimation strategy based on discrete choice models.

[16] The full list of countries in the ESS 2016 is: Austria, Belgium, Czechia, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Russian Federation, Slovenia, Spain, Sweden, Switzerland and United Kingdom;

[17] There were two exclusions because they were out of our focus.

[18] PORDATA is a database on contemporary Portugal with official and certified statistics on Europe, divided into a wide range of themes, such as environment, energy, territory, employment, population, etc. Also, it is organized and developed by the Francisco Manuel dos Santos Foundation. The statistics released come from official and certified sources, with information production skills in the respective areas. All of its information comes from official entities, such as the National Statistics Institute or Eurostat.

| Group | Variable | Label | Description | Source |
|---|---|---|---|---|
| Environmental | Waste production | Waste | Linear, the average per capita, in tonnes (t). | PORDATA |
| | Greenhouse gas emissions | Emissions | Linear, the average per capita, by the ratio of t $CO^2$eq (tonne equivalent of carbon dioxide) | PORDATA |
| | Contribution of renewable energies to primary energy production | Energy production | Percentage in the energy production | PORDATA |
| | Precipitation | Precipitation | Linear, millions of $m^3$. | PORDATA |
| | Contribution of renewable energy to the final energy consumption | Energy consumption | Percentage in the final consumption | PORDATA |
| | Burnt area | Burnt Area | Burnt area per 100 thousand $km^2$ of surface | PORDATA |
| | Carbon intensity of the economy | Carbon intensity | Linear, $CO^2$ tons per million GDP | PORDATA |
| Socio-economic | Gender | Gender | Binary: 1, if female; 0, otherwise | ESS 2016 |
| | Number of children | Children | Linear | ESS 2016 |
| | Age | Age | Linear | ESS 2016 |
| | Number of years after the last academic degree | Last Degree | Linear | ESS 2016 |
| | Years of study | Years of Study | Quadratic | ESS 2016 |

**Table 1 – List of variables**
Source: Self elaboration.

### 3.1 – Decision utility and experienced utility

In this step, we detail each parameter as well as become more comprehensible their broad meaning. For simplicity, this study considers a customer with no availability of additional options, unlike Gul & Pesendorfer (2001)[19]. First, Decision Utility (DU) includes all true preferences, which relates all compiled experiences and their capacity to taking better decisions, due to rational behavior. By Simon (1955), a pool of pay-offs must be listed to

[19] Such an assumption aims to rule out situations whereby customer could deep within several psychological aspects, as self-control, passion, culture, religion, etc.

organize their capacity of establishing comparisons, of course, in a consistent way[20]. In the presence of these features:

$$U_t = f\left(\sum_{s=0}^{\infty} \delta\ U_{t+s}^{f}\right) \quad (1)$$

In Equation (1), the term $\sum_{s=1}^{\infty} \delta\ U_{t+s}^{f}$ shows the amount of expected utility based on their knowledge of doing great predictions by rational action; adjusted by a discount factor δ. The last one, we assume being positive, neutral, equal for all parameters, and undetermined[21]. By Bettman et al. (1998), applications of rational theory can occur since well-done preferences become a viable choice, due to their familiarity with the determined object. Besides that, our study does not suffer any violation regarding the framing effect, as there is only one macro and wide "framing", which is the year's survey (2016). Finally, as in Kanheman and Sudgen (2005), decision utility relates to judgments before experience events, namely, *ex-ante* any choice.

By Experienced Utility (EU), the main goal is to capture how records of feelings and experiences (properly) can imply in their current behavior. In the meantime, we assume that decision-makers are capable to elicit deterministic forecast based on their past events. Besides the answer *per si*, several internal psychological features and geographical positions[22] are implicit in the respondents' behavior. In other words, Experienced Utility takes into account lived experiences for deciding about how to behave within each context. Furthermore, these records of past experiences allow that either decision-maker better posit himself in front of his doubts or being fully sure of how to choose. As a consequence, some questions are taken as objective and clear decisions. Then, neither loss in determining how welfare occurs, nor doubts about its power of explanation arise. In sum, the EU creates judgments only after experiencing events, we mean, *ex-post* tried out them (Kanheman and Sudgen, 2005). So:

$$U_t^e = f\left(U_t^s + \sum_{s=0}^{t} \delta\ U_s^p\right) \quad (2)$$

[20] Following Simon (1955), this capacity of doing comparisons drives us to those well-known vocabularies in microeconomics: "*better than*", "*worse than*" and "*as good as*";

[21] For sake of simplicity, this paper does not need to establish any assumptions regarding its absolute value as well as any difference of each parameter in equation 1, due to the type of our data. In doing so, the delta can be considered indexed to "*s*";

[22] For instance, past bad experiences in their usual restaurants or markets, as well as influence's family. In which country you are in is important too, because you can have different opinions depends on how the availability of products works.

where $U_t^s$ is the utility based on the number of subjective experiences, which cannot be captured explicitly by any SWB; and the term $\sum_{s=0}^{t} \delta \ U_s^p$ defines the forecast about well-being regarding their capacity of adaptation, through the utility of their past events (discounted by a factor, equal to that used in Eq. 1). In other words: the "experienced utility is an *ex-post* concept: it reflects the hedonic experiences that result from acts of choice" Kahneman and Sudgen (2005, p. 167).

In general, consumers are used to facing each consumption choice with a common position, whereby they try to do their better forecast about future decisions. However, it doesn't only consider their capacity to assess welfare (*ex-ante*) due to hypothetical unlimited rationality, but also take into account their abilities to deal with known situations by their past experiences (*ex-post*). Then, based on a choice-oriented framework, a habit of consumption is a mixture of *ex-ante* and *ex-post* skills' assessment of well-being.

### 3.2 – A choice-oriented perspective

Our purpose is to analyze the relationship between DU and EU with the explanatory variables by a choice-oriented perspective[23], whereby welfare is the main guidance for signaling about the propensity to adaptation. For instance, while other studies assess happiness, our paper seeks a relationship between satisfaction, well-being, and adaptation. Satisficing strategy was elicited as a mechanism of decision making, which is based on alternatives, aiming select better option and discard any compensation: "If any attribute fails to meet the cut-off level, the processing is terminated for that option, the option is rejected, and the next option is considered." Bettman et al. (1998, p. 190). According to Simon (1955), such analysis aims to gather the most viable alternative. After choosing a certain option, the level of satisfaction is reached. Sequentially, as Figure 1 shows, we hypothesized that each step drives to another one, only in one way, as more satisfaction means more well-being, which in turn generates more propensity to adaption. As Firsch & Clemen (1994) note, such a logic-sequence induce us to a type of consequentialism's process, since a decision must be chosen according to the expected consequences, based upon its course of action[24].

[23] Here, for assumption, choices are not dependent. So, if there is an option as default, the order in which other options are presented or their main features don't matter;

[24] Despite not highlighting inferences related to irrational behavior, Dawes (1998) find evidence of decisions made under various non-consequential arguments, for example, habits, religion, repetition, and tradition.

In Figure 1, the logic is to deduce that consumers can adjust their habits of consumption with the scarcity of goods (due to climate changes) till a certain threshold which allows them to remain a level of satisfaction, so, their well-being, which displays their propensity to adaptation. For assuring the stability of the last concept, some assumptions were necessary for Figure 1: i) there is only one way, from the left to the right, coming from the chosen choice to final ability to revise their habits; ii) the procedure begins at choice, which establishes the notion of satisfaction; iii) there are no other phenomena that could disturb the relationship between well-being and adaption; iv) it is attributed absolute value only to the first step[25], according to the level of satisfaction. For assumption, based on Köszegi & Rabin (2008), even though satisfaction might receive influences by other features of context, in this work we abstract these possibilities and consider that satisfaction relies only on the choice set[26].


**Figure 1 – Relationship between satisfaction, well-being, and adaptation**
Source: Self elaboration.

In a specific manner, for computing the first step ("level of satisfaction") - and so, reaching the propensity to adaptation – two adjustments were done. First, each chosen question received a "tag", which indicates whether they can measure Decision Utility or Experienced Utility (Appendix I). Following Kanheman and Sudgen (2005), the reasoning here was based on the assumption that some answers might be affected by previous experiences, which allows us to assume importance for this feature. Although, there are other ones whereby prior knowledge doesn't reach relevant influence. Thus, if the answer is mostly influenced by past experiences, it receives the tag "Experienced Utility", otherwise, "Decision Utility". In the second adjustment, the answers were adapted in a way of generating a common scale for capturing the level of satisfaction. A new scale has a range from 1 to 5, whereby 1 means "minimum" and 5

[25] This assumption avoids that appears such questions positing scenarios regarding differences in levels of welfare or propensity to adaptation. For sake of simplicity, in our analysis is supposed that more satisfaction means more well-being, which means, in its turn, greater propensity to adaptation;
[26] Other types of outcomes were discarded because when consumers are trying to perform some foreseen about how climate changes will impact on their usual baskets, it is too hard to understand clearly what type of result such adjustment can influence. Then, due to its vast amplitude and manifold possibilities, one only choice set was taken as part of this paper.

"maximum" propensity to adaptation. In other words, chosen options can vary from low to high propensity to adaptation. Worth highlighting that such adjustment was done since neither all questions have an equal number of available options, nor equal aims[27]. Thus, we use this scale to determine the level of satisfaction, which in its turn becomes our dependent variable[28].

In doing so, the questions from ESS's survey were considered this away:

i) Welfare relevant domain: for evaluating welfare consequences of the newest restrictions due to climate challenges, it was used the rotating module of ESS 2016. Our choice mapping encompasses questions from D1 to D32[29], including attitudes, perceptions, and policy preferences;

ii) Welfare criterion: As in Bernheim (2016), we considered that always one option is undoubtedly superior to another one. So, if an individual chose one alternative, he cannot select the second one, if the best option is available (unambiguous choice relation). Then, if the consumer has great satisfaction for adjusting his habits of consumption, he has great well-being, and, at last, a high propensity of adapting himself.

Moreover, as relevant welfare choices were shown by answers, they give us some possible interpretations of such a relationship between satisfaction, well-being, and adaptation. In consequence, we exclude those answers with no logic or no relationship with our aim (mistakes). For these cases, such information neither is available to some interpretation nor advance into our proposals[30].

To sum up, we thereby take into account those questions as consistent due to a direct contextualization between choice functions and several climates changes[31] (Sen, 1993).

[27] It was made a proportion among both scales, keeping the maximum equivalence. When the question has the option "0" as a possible answer, it was doubled the minimum or maximum score (according to the way of adaptation in front of climate change). The questions generate answers that are classified in a decreasing or increasing way; thus, the new scale was organized for capturing such effect according to the nature of each situation. The only exception was for question D22, where the respondent can choose the option "I don't think climate change is happening", which received the score 1 ("low capacity of adaptation").

[28] Then, in our study, satisfaction was not measured by the level of happiness (as usual). In doing so, the SWB literature provides the main idea, by the concept of satisfaction is measured by other way, that is, our scale.

[29] Again, there were two excluded questions.

[30] For instance, some questions have an option "Refusal" or "Don't know". The problem is that in both cases is not possible to extract any interpretation about how an individual thinks in adjusting his habits of consumption;

[31] As explained by Sen (1993), a huge number of feelings impacts individual judgments toward external correspondences for assessing consistency. Despite having such complexity, our study is supposed that all feelings are equal within each option inside its corresponding answer.

Meaning choices are equivalent to how it will be the self-power of inner adaption in referring to each stage of the path. Even though such part of the questionnaire does not capture fully feelings regarding all effects of climate changes in Europe (and this survey has been shown as deputy of populations as a whole), it helps us to better understand the operating mechanism that involves choices and welfare related to our problem. "(…) this into choice functional terms, we can concentrate on the power of a group to reject a dispreferred alternative." (Sen, 1993, p. 509).

Finally, as our purpose is to assess the propensity to adaptation of consumers due to new restrictions due to climate changes[32], we hypothesized that:

i. The individual is immune to all features that can impact their ability to understand how the process of adaptation occurs;
ii. Our estimation may be accepted as valid, which means that our sample leads to a whole population opinion;
iii. Choices done by those individuals are equated to the view of the total amount of citizens in each country. So, it is supposed to exist homogeneity in opinion within each nation[33].

However, we know that in the real world there is a vast heterogeneity of household´s willingness to pay for any adjustment that products and services could suffer. But, for sake of simplicity, it was assumed that all citizens have the same availability to fit their cash flow according to each change. Further, unlike Shapiro et al. (2015), for assumption, it is considered that the pool of respondents has the same knowledge about features' products (level of information about it).

### 3.3 - Econometric approach

Our empirical application is centered on the analysis of the factors that influence the propensity to adaptation. We gather the answers from the chosen questions into two indexes (groups): Decision Utility (DU) and Experienced Utility (EU), which becomes our dependent variable

[32] Our study goes beyond from the current views as the influence of weather on purchases (such in Busse et al., 2015) for assuming as a presumption that climate changes are a huge mass of variations in nature, in the way of the definition given by Tol et al. (1998);

[33] This assumption rules out any doubts about the level of information within individuals, whether for their major field (formation, work, experience, etc.) or for the ability to distinguish each effect in several scenarios. In the end, neither indirect knowledge proxy (as in Shapiro et al., 2015) nor idiosyncrasies were considered as able features of interfering in such questions.

(each index was made using the weighted average of the questions that compose them). Due to the deterministic construction of the indexes, they also have a distribution between 1 and 5, whereby 1 means "minimum" and 5 means "maximum" propensity to adaptation. As a result, the dependent variable works like a proxy of well-being since their satisfaction (welfare) was converted into their level of odds in adapting themselves[34]. Thus, it was established a link between satisfaction (or SWB) and propensity to adaptation by each chosen question, which picks up the individuals' concerning the damages due to climate changes in different contexts.

Then, it will have an ordered distribution of the data, not in a linear way, but to rank the possible results. Next, we thereby add the environmental variables and socio-economic characteristics of subjects as explanatory parameters, which allows us to elicit the individual's preferences for each index, and then, their behavior. It is worth mentioning that despite the grouping of questions in DU or EU, our database remains separated by year (i.e., 2016), by country, and by an individual (if applicable). Consequently, one of the main models indicated to be used in this case is the Ordered Probit Model (e.g., Brereton et al., 2008; Smyth et al., 2008; Ambrey et al., 2014).

We choose this model because the linear regression is not able to treat the difference between 4 and 3 in the same way that one among 3 and 2. Therefore, it is necessary to use an appropriate methodology for the variable discrete and orderly dependent. However, these models do not directly estimate the vector $\beta$, but rather $\frac{\beta}{\sigma}$, since $Var(\varepsilon_i|\bar{x}_i) = \sigma^2$. Therefore, to estimate it is necessary to specify a conditional distribution of $\varepsilon_i$ in $\bar{x}_i$. In the case of our study, the standardized normal functional form was considered.

According to Maddala (1983), the Ordered Probit Model is a multinomial model whose value is limited and known. As stated earlier, the dependent variable takes on values that establish a data order. In the case of our data, the latent variable $Y$ associates individual numbers and

[34] For example, as shown in Appendix I, in the question D15: "How worried are you that energy supplies could be interrupted... by natural disasters or extreme weather?", according to the original scale, the subject could choose from 1 to 5, where 1 means "not at all worried" and 5 means "extremely worried" (those options "Refusal" or "Don't know" were ignored). Its new scale (adapted) works in the same way, but for it, score 1 means "low" and the 5 one means "high" propensity to adaptation. Then, if the subject chooses 1, the fact of he/she is "not at all worried" indicates that he/she is satisfied with the odds of having some disruption in the energy supplied by natural disasters or extreme weather, consequently, he/she reaches a low capacity of changing habits. Otherwise, if it was chosen 5 ("extremely worried"), his/her satisfaction or well-being with this possibility is lower, which increases the chances of adaptation ("high").

orders them, such as 1 for “minimum” and 5 for “maximum” propensity to adaptation. Thus, the unobserved latent variable is expressed by:

$$Y_{ij}^{*} = \alpha + \beta' X_{ij} + \theta' Z_{ij} + \epsilon_i \tag{3}$$

Where the propensity to adaptation, $Y_i^*$, of individual $i$, in the level of adaptation $j$; which depends on a vector of environmental variables ($X_{ijt}$) and socio-economic characteristics ($Z_{ijt}$). Lastly, $\epsilon_i$ is the idiosyncratic term determined by unobserved factors of individuals. Particularly, for our development, where $y \in J = \{1,2,3,4,5\}$, the unknown parameters $\alpha_m$ with $m = 1,2,3,4$ are considered such that:

$$\alpha_1 < \alpha_2 < \alpha_3 < \alpha_4 \tag{4}$$

While the ordinal dependent variable checks:

$$Y = \begin{cases} 1, if\ y^* \leq \alpha_1 \\ 2, if\ \alpha_1 < y^* \leq \alpha_2 \\ 3, if\ \alpha_2 < y^* \leq \alpha_3 \\ 4, if\ \alpha_3 < y^* \leq \alpha_4 \\ 5, if\ y^* > \alpha_4 \end{cases} \tag{5}$$

The probabilities of observing each value of $y$ are, respectively:

$$\begin{aligned} Prob(y = 1) &= \Phi(\alpha_1 - \beta' X) \\ Prob(y = 2) &= \Phi(\alpha_2 - \beta' X) - \Phi(\alpha_1 - \beta' X) \\ Prob(y = 3) &= \Phi(\alpha_3 - \beta' X) - \Phi(\alpha_2 - \beta' X) \\ Prob(y = 4) &= \Phi(\alpha_4 - \beta' X) - \Phi(\alpha_3 - \beta' X) \\ Prob(y = 5) &= 1 - \Phi(\alpha_4 - \beta' X) \end{aligned} \tag{6}$$

In this model, following Maddala (1983), the unknown parameters $\alpha_m$ are estimated by the Maximum Likelihood Method (MLM), which consists of finding the estimate of the parameters in the model that maximizes the likelihood function or, in an equivalent way, minimizes the function of negative log-likelihood. Domingos (2018) describes that unlike what happens in the simple Probit (where the answer is only binary) when there is a change in the independent

variables ($x$), the interpretation of the coefficients ($\beta$) in the model is not restricted to your signal and its effect on $Prob(y = J|X)$. Therefore, only for $J = \{1,5\}$ can be said that the direction of the effect from a variation in $x_k$ is determined by the $\beta_k$ sign, *ceteris paribus*, for $Prob(y = 1|X)$ and $Prob(y = 5|X)$. For intermediate values, the effect of the $x_k$ variation may not follow the direction of $\beta_k$ since it depends on the sign of $[\Phi(\alpha_j - \beta'X) - \Phi(\alpha_{j-1} - \beta'X)]$.

To assess the quality of the estimated models, our study applied the *Link Test* introduced by Tukey (1949) and expanded by Pregibon (1979). This test can verify any single-equation estimation and it is based on the idea that if a regression equation is properly specified, no additional independent variables should be significant. The *Link Test* adds the squared independent variable to the model and tests for its significance versus the non-squared model. If a squared model has a nonsignificant *t-test* versus the unsquared one, thus, our model is good. Additionally, since the data is spread across several countries, it is expected that the observations will not be independent within countries. For this reason, the models were estimated with robust cluster variance (Cameron and Miller, 2015), which fits the fact that the observations are independent between countries, but not necessarily within.

**4. Outcomes and discussion**

The results from Eq. (3) are shown in Table 2. Overall, there is a clear pattern of outcomes per each index either for environmental or socio-economic variables. In DU, all coefficients are significant, the most at the 1% level, whereas in the EU we found out an opposite scenario. At the first glance, these estimates suggest a strong weight in favor of rationality against experience when the subjects are elaborating their behavior regarding the propensity to adaptation to climate change. These outcomes demonstrate the prevalence of a type of behavior whereby the subjects are choosing options in line with the possible better odds of happening (Von Neumamm and Morgenstern, 1953), which are related to their individual preferences according to their mental capacity (Kahnemam and Sudgen, 2005).

Although we can interpret only the sign of the probit coefficients, the statistical pattern observed in each index allows us to infer a relative consistency in the decisions when the subjects are assessing their propensity to adaptation due to climate changes (Goldin and Reck, 2015). On the other hand, the fact of the EU has reached a small number of significant

coefficients might be related to the high variety of how the individuals see what welfare is, due to their psychological features (Diener, 2000). Similarly, as EU sums up a set of subjective feelings - generally linked to the culture and heritage (Kahnemam et al., 1997), each level of subjectivity might drive the respondents to different views at realizing the evolution of climate changes. This phenomenon could establish a great amount of welfare, but not towards to strive a continuous change in the habits since they might feel secure with their real behavior. In addition, accepting the challenge of adjusting their habits due to several restrictions imposed by climate change doesn't mean change themselves, due to the dilemmas of sustainability (Gibson et al., 2011).

Meanwhile, as DU represents a taken decision *ex-ante* to experiment an event, the individuals when are assessing about the climate changes' impacts, they observe the weight of uncertainty in two ways: either concerning how they must adapt themselves or the lasting of those changes (even how hard or easy, they will be). Thus, the performance of its coefficients could be related to some type of encouragement, whereby the subjects are boosted in trying new mechanisms of adaptation, such as changing of evaluation and redeployment of attention (Kahneman and Sudgen, 2005). Speaking freely, the statistical significance of DU's coefficients still highlights the weight of the concept *ex-ante* the choice in comparison to the *ex-post* one, which creates a good link between satisfaction, well-being, and adaptation; in such a way that the rationality seems to reach more importance than subjectivity. Beyond the role of idiosyncrasies in the EU, the fact of our database is fully from the same year (2016), some type of contemporaneity might also disturb the outcomes.

Regarding to environmental variables, those able to be compared have their signs in line with the existing literature. Although, there is an important distinction to be made: in our study, a positive effect means a greater propensity to adaptation, while a negative one, the opposite. The reasoning here allocates well-being according to the scale of adaptation applied to each question[35]. The coefficient of greenhouse emissions has a positive sign in DU, which indicates that more pollution leads people to find a way to a greater adaptation.

[35] This is one relevant difference to be highlighted, because in studies that relate SWB ("happiness") and environmental variables (e.g., Ambrey et al., 2014; Smyth et al., 2008) if the coefficient has a negative sign, this means that the individual will be less happy with an additional unit of that variable;

| Group | Variable name | DU Model | EU Model |
|---|---|---|---|
| | | **Coefficient (standard error)** | **Coefficient (standard error)** |
| Environmental | Waste | 0.0148*** (0.0051) | 0.0018 (0.0096) |
| | Emissions | 0.0119*** (0.0041) | -0.0082 (0.0105) |
| | Energy Production | 0.0125** (0.0054) | 0.0111* (0.0061) |
| | Precipitation | -7.8407*** (2.0207) | 5.9507 (4.5307) |
| | Energy Consumption | -0.0073** (0.0037) | -0.0014 (0.0061) |
| | Burnt Area | 0.0163** (0.0083) | 0.0085 (0.0072) |
| | Carbon Intensity | -0.0012*** (0.0001) | -0.0003** (0.0001) |
| Socio-economic | Gender | 0.2032*** (0.0336) | 0.1664*** (0.0285) |
| | Children | 0.1153*** (0.0265) | 0.0615* (0.0318) |
| | Age | -0.0058*** (0.0010) | 0.0012 (0.0009) |
| | Last Degree | 0.0233*** (0.0041) | -0.0014 (0.0068) |
| | Years of Study | 0.0032*** (0.0009) | 0.0015 (0.0013) |

**Table 2 – Ordered Probit Model Results**
Source: Self elaboration
* Significant at the 10% level; ** Significant at the 5% level; ***Significant at the 1% level;

Indirectly, though some differences regarding the unit of measure used in other studies[36], this result complements the prevailing findings because more presence of harmful gases decreases the well-being, prompting the subjects to rethink their posture at facing climate changes. Similarly, Cuñado and Gracia (2013) assess the impact of air pollution on welfare across Spanish regions by using the ESS survey, and they also found out a negative impact on personal happiness. The coefficient of precipitation in DU is -7.84. This indicates that 1 extra million

[36] Other papers used: i) sulfur dioxide ($SO^2$); see Smyth et al., 2008; Ferreira et al., 2013; Luechinger 2009, 2010; ii) just carbon dioxide ($CO^2$) per regional area, see Cuñado and Gracia (2013); iii) $PM_{10}$ (see Levinson, 2012).

$m^3$ in the interviewed countries reduce the probability of respondents classifying themselves as able to adapt. We thereby elicit that more rainfall days let people more comfortable or maybe they feel less needs to change their consumption habits. In other studies, a higher level of precipitations is also related to more well-being, either by reducing costs (Fritjers and Van Praag, 1998) or by a positive correlation between rain and scenic beauty (Brereton et al., 2008).

The reaming environmental variables are divided into two sets. The first is compound by waste, energy production, and burnt area. They showed a positive impact on the subjects' behavior, which suggest that additional units of them increase the trend to new habits in the direction of adaptation. These results seem clearer for these variables due to its direct effects on human beings and the environment since it's possible to watch its trajectory over the last decades. We may relate this result as a consequence of the expansion of institutional strengthening carried out by governmental and non-governmental institutions over the past few decades, to raise environmental awareness in modern society.

The second group encompasses energy consumption and carbon intensity. Both tend to reduce the odds of adaptation, being that the last one also has significance in the EU. About energy consumption, such a result may be driven by a positive correlation between the increase in the contribution of renewable energy to the final energy consumption (nowadays frequently shown in the electricity bills) with a feeling of lower obligation to accept more changes[37]. On the other hand, carbon intensity assumes a striking position, not only for being highly significant for DU and EU but also for proposing a decrease in the probabilities to adaptation, whose signal is contrary to what was expected. It is worth to highlight that the nature of the variable carbon intensity is not easy to understand for the whole households, being even worse to realize its relationship with the changes of habits.

Usually, the subjects experience bad events with more intensity (Diener et al., 1996). However, coefficients like emissions of $CO^2$ and burnt area don't reach statistical significance in the EU, even though its impacts are more direct and easier to be felt. Therefore, our test doesn't offer any inference about the role of the intensity of experienced events, regardless of its nature.

[37] This perception resembles some type of duty partially done, since the consumer can see in his bill that at least part of your electricity is coming from the natural source. Then, this could be understood as a "first step" towards adaptation.

Concerning socio-economic variables, the results are similar to the findings in other studies in the area. Gender is a significant coefficient at a 1% level for DU and EU, with a positive trend towards adaptation in both. Ferreira and Moro (2010) argue the usage of SWB techniques for valuing environmental attributes in Ireland. They also used female as 1 for a dummy variable and found out a positive correlation between gender and SWB. Having children is also associated with more ability to change habits, in both indexes, which is similar to Luechinger (2009), at valuing air quality in Germany.

| | | Marginal Effects (standard error) | | | |
|---|---|---|---|---|---|
| **Type** | **Variable** | **DU Model** | | **EU Model** | |
| | | **Outcome 2** | **Outcome 5** | **Outcome 1** | **Outcome 5** |
| Environmental | Waste | -0.02%** (0.00008) | 0.02%*** (0.00009) | -0.001% (0.00004) | 0.00003% (0.0000) |
| | Emissions | -0.02%** (0.00006) | 0.03%*** (0.00007) | 0.003% (0.00006) | -0.00001% (0.0000) |
| | Energy Production | -0.02%** (0.00008) | 0.02%** (0.0001) | -0.004% (0.00003) | 0.0002% (0.0000) |
| | Precipitation | 0.0000%*** (0.0000) | 0.0000%*** (0.0000) | 0.0000% (0.0000) | 0.0000% (0.0000) |
| | Energy Consumption | 0.001%* (0.00006) | -0.01%** (0.00006) | 0.001% (0.00003) | 0.0000% (0.0000) |
| | Burnt Area | -0.02%* (0.0001) | 0.03%* (0.0001) | -0.004% (0.00004) | 0.0001% (0.0000) |
| | Carbon Intensity | 0.001%*** (0.0000) | -0.002%*** (0.0000) | 0.0002% (0.0000) | 0.0000% (0.0000) |
| Socio-economics | Gender | -0.27%*** (0.007) | 0.35%*** (0.0006) | -0.07%*** (0.0002) | 0.01% (0.00003) |
| | Children | -0.15%*** (0.0003) | 0.19%*** (0.0005) | -0.02%* (0.0001) | 0.001% (0.0001) |
| | Age | 0.007%*** (0.00002) | a-0.01%*** (0.00002) | -0.001% (0.00001) | 0.0000% (0.0000) |
| | Last Degree | -0.03%*** (0.00006) | 0.04%*** (0.0001) | 0.001% (0.0000) | 0.0000% (0.0000) |
| | Years of Study | -0.004%*** (0.00001) | 0.001%*** (0.00002) | -0.001% (0.00001) | 0.0000% (0.0000) |

**Table 3 –Ordered Logit Model - Marginal Effects. (in %)**
Source: Self elaboration
* Significant at the 10% level; ** Significant at the 5% level; ***Significant at the 1% level;

On the opposite side, the coefficient of age is negative (-0.0058), indicating that older people are less susceptible to adapt themselves in comparison to the youngest. This result still is shared

by several other studies (e.g., Ferrer-i-Carbonell and Gowdy, 2007; Smyth et al., 2008, Cuñado and Gracia, 2013; Luechinger, 2009, 2010; and Ferreira et al., 2013), sometimes being even with no significance for individual above 40 years (Ambrey et al., 2014). About last degree and years of study, both have a positive impact on adaptation (as in Ferreira et al., 2013), which may suggest that more knowledge regarding general topics allow the citizens to be more capable to realize the link between the new adjustments and the restrictions due to climate changes.

Looking at marginal effects in Table 3[38], mostly values are quite small, regardless of the boundary, group of variables, or index. For example, in DU, per each 1% increase in greenhouses emissions, the respondents are 0.02% less likely of being prone to adaptation, whereas, at the same time, it has 0.03% more chances of being fully able to accept such changes. Still in DU, energy production has a negative correlation with the adaption, which means that the subjects have 0.02% of being less likely to adjust habits, at a 5% significance level. The results for gender in DU demonstrate that women are 0.35% more likely to be completely capable to adapt their habits in comparison to men. While in the EU, the same variable shows 0.007% less probabilities of accepting such restrictions. Both are significant at a 1% level. Similarly, in DU, age is statistically significant, but positive for minimum boundary (0.007%) and negative with the maximum (-0.01%), implying a preference for acceptance within younger consumers.

We also checked the robustness of our results by alternative estimations and econometric tests. Firstly, we tested the goodness of fitness of the estimated model for each index, by *Link Test*. Regarding the specification tests for the DU model, the *Link Test* reveals no problem with our specification. On the other hand, for the EU model, this test reveals problems with specification (see Appendix III). Although, we decided not to insert more variables into models for some reasons: i) since DU reached a good quality, this means that the amount of explanatory variables, in such a way, is suitable; ii) adding more environmental or socio-economic data only in EU is unnecessary (with aiming to increase its quality) since our main goal in this paper is to compare the performance of each index regarding its capacity to explain the behavior of consumers through their capacity of adapting due to climate changes; iii) usually, *Link Test* is

[38] The full list of marginal effects is in Appendix II. For DU Model, the dependent variable doesn't have the outcome 1.

expounded as a tool for testing if the independent variables are specified incorrectly, but, formally it is a test of the specification of the dependent variable (Stata Corp, 2015).

Following Ferrer-i-Carbonell and Fritjers (2004), we also estimated the Equation (3) by Ordinary Least Squares (OLS)[39]. However, the results showed a slight difference in DU, with a reduction in the level of significance in children and age, which in OLS become significant only at 10%. For the EU, none distinction was found. Lastly, similar to Cuñado and Gracia (2013), we tested again the Ordered Probit Model, but separately for each group of variables (socio-economic and environmental), to verify whether there is more significance within the models. Here, this estimation demonstrated some additional changes. About the signs of coefficients, only the variable last degree in the EU changed, becoming positive. Regarding significance in both indexes, three coefficients (children, age, and years of study) moved out from being significant at a 1% level to a lack of it. Overall, these estimations don't change considerably our results and not offering any extra contribution to the study.

## 5. Conclusion

In this paper, we expand the understanding regarding the relationship between satisfaction, well-being, and adaptation due to climate changes. Based on this link, we asked what concept better explains this decision: Decision Utility or Experienced Utility. Our goal was to assess the propensity to adaptation due to climate changes, based on that aforementioned link, by using environmental and socio-economic as explanatory variables. In doing so, we detailed the assumptions of the choice-oriented framework applied here, as well as some relevant studies of the related literature to SWB, individual characteristics, and environmental data.

Our findings show that both groups of explanatory variables have significance for explaining this process in the DU, whereas in EU, it is happened only partially. In other words, this result gives us a sign of how relevant the rational behavior is in this context, since the lack of full information about the future development of climate changes may become the subjects more insecure, then, more prone to adapt themselves. However, the strength of the thought *ex-ante* takes some choice, not rules out the importance of *ex-post* one. On the contrary, it adds more urgency in discussing how each concept relates to the human behavior, due to the current

[39] Despite our dependent variable to be naturally ordered, we did the OLS estimates to follow the same track of the current literature.

degradation of the environment. In comparison to Decision Utility, the concept of Experienced Utility may have had an opposite performance due to its nature, which is usually pictured as a complex concept in Behavioral Economy (hedonic sensation stressed by feelings, personal experiences, and psychological features) or some possible link related to the contemporaneity of the independent variables.

Our paper also offers relevant contributions to public policy, since it highlights how the explanatory variables are capable of interacting with the subjects in this scenario of climate change. For instance, as we hypothesized, if more welfare leads to more propensity to adaptation, more units in variables like precipitation let the individuals more comfortable today, at the same time that decreases their tendency in changing habits; whereas old people have less patience in adapting themselves. The results also highlight one main concept present in the households' behavior: a great part of the well-being is driven by a rational posture. This finding might be related to the great uncertainty on part of the population in general when the subject "climate changes" is the main topic. We observe that this behavior happens because of the high amplitude of subtopics (rainfall, sea level arises, pollution, carbon intensity, so forth) covered by it, the huge complexity in understanding the dynamics of each subtopic, and the extension in which its future changes may occur (some cases in one century or more).

Following the track of Tol et al. (1998), our study also contributes to analyses of the impacts due to climate changes by a microeconomic view. Even though we take into account data at the individual level partially for each country, those opinions about a handful of factors related to environmental features still allow us to build a suitable microeconometric model (Ordered Probit Model). Consequently, we found out some insights regarding the behavior of consumers and their relationship with environmental and socio-economic variables, which represents a good contribution to the literature of climate change economy. At last, our inferences just give some cues of how this path needs more assessments since the interaction of important institutions creates more complexity due to dimensions of time and space (Sahakian and Wilhite, 2014). Beyond this challenging arena, understanding how the individuals will behave due to several restrictions caused by climate change has demanded long and constant monitoring, either by Decision Utility or Experienced Utility, which implies a continuous process (Adger et al., 2005).

For increasing the knowledge around this theme, extra analysis needs to be extended in several ways. First, it is suggested to analyze the EU model through lagged values of the explanatory variables, aiming to find a relevant timing able to offer evidence of changes. Second, our analysis is restricted only to those covered countries by ESS in 2016. It may be useful for some expansion in regions or counties with aiming to control more by individual information. Third, we have not explored any type of feelings into the EU, i.e., selfishness, altruism, or cooperation. Maybe this discussion could offer some additional inferences, mainly for the EU, due to the impact of psychological features. Fourth, we also didn't discuss the interactions between the explanatory variables, like emissions and precipitation. Nonetheless, we leave the opportunity for future research to explore these issues.

# Appendix I – Adjustments on the chosen questions of ESS survey for reaching the individual level of satisfaction – Part One

| ESS' Code | Question | Tag | Reasoning | Scales | | | | | | | | | | | | Exclusions by mistake |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | If you were to buy a large electrical appliance for your home, how likely is it that you would buy one of the most energy efficient ones? | Decision Utility | Most products generate an expectation based on the information provided by the producer. They do not require prior use. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| D2 | There are some things that can be done to reduce energy use, such as switching off appliances that are not being used, walking for short journeys, or only using the heating or air conditioning when really needed. In your daily life, how often do you do things to reduce your energy use? | Experienced Utility | The answer is based on experience already lived by the individual, therefore, his ability to adapt is derived from something known. | Original scale | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 1 | 1 | 2 | 3 | 4 | 5 | | | | | | |
| D3 | Overall, how confident are you that you could use less energy than you do now? | Experienced Utility | The answer is based on experience already lived by the individual, therefore, his ability to adapt is derived from something known. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| | *How much of the electricity used in [country] should be generated from each energy source? Please choose your answer from the options at the bottom of this card.* | | | | | | | | | | | | | | | |
| D4 | First, how much of the electricity used in [country] should be generated from coal? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D5 | And how about natural gas? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). Also, its dual effect in the transport sector give us a more complex cost benefit analysis (T&E, 2018). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D6 | And how about hydroelectric power generated by flowing water from rivers, dams and seas? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | | |
| D7 | How much of the electricity used in [country] should be generated by nuclear power? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D8 | And how about sun or solar power? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | | |
| D9 | And how about wind power? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | | |
| D10 | And how about biomass energy generated from materials like wood, plants and animal excrement? | Decision Utility | The answer here is based on the expectation of contribution from each source. For this, natural availability and possible side effects arising from this source are considered (probabilistic judgment). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | | |
| D11 | How worried are you that there may be power cuts in [country]? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D12 | How worried are you that energy may be too expensive for many people in [country]? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D13 | How worried are you about [country] being too dependent on energy imports from other countries? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D14 | How worried are you about [country] being too dependent on using energy generated by fossil fuels such as oil, gas and coal? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |
| D15 | How worried are you that energy supplies could be interrupted... by natural disasters or extreme weather? | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | | |

# Appendix I – Adjustments on the chosen questions of ESS survey for reaching the individual level of satisfaction – Part Two

| ESS' Code | Question | Tag | Reasoning | Scales | | | | | | | | | | | Exclusions by mistake |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D16 | How worried are you that energy supplies could be interrupted... and by insufficient power being generated? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | |
| D17 | How worried are you that energy supplies could be interrupted... and by technical failures? | Experienced Utility | The answer is based on experience already lived by the individual, such as the history of electrical management in his country, the ability to deal with limitations of sources, etc. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | |
| D18 | And how worried are you that energy supplies could be interrupted by terrorist attacks? | Excluded | | | | | | | | | | | | | |
| D19 | You may have heard the idea that the world's climate is changing due to increases in temperature over the past 100 years. What is your personal opinion on this? Do you think the world's climate is changing? Choose your answer from this card. | Experienced Utility | The large mass of available information in the media allows the individual, at least to think as if he had experienced some of these changes (Moser and Ekstrom, 2011). | Original scale | 1 | 2 | 3 | 4 | 4 | | | | | | 55, 77, 88 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | |
| D20 | How much have you thought about climate change before today? | Excluded | | | | | | | | | | | | | |
| D21 | How much have you thought about climate change before today? | Experienced Utility | The large mass of available information in the media allows the individual, at least to think as if he had experienced some of these changes (Moser and Ekstrom, 2011). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | |
| D22 | Do you think that climate change is caused by natural processes, human activity, or both? | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. | Original scale | 1 | 2 | 3 | 4 | 5 | 55 | | | | | 77, 88 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | 1 | | | | | |
| D23 | To what extent do you feel a personal responsibility to try to reduce climate change? | Decision Utility | Given the complexity of the issue, there are several studies that prove effects due to practices considered "green" (Adger et al, 2004). So, a macro view of how each individual acts is susceptible to many criticisms. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| D24 | How worried are you about climate change? | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. The lived experiences do not fully impact the degree of concern, as there are other feelings acting simultaneously (Diener et al, 1996). | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 1 | 2 | 3 | 4 | 5 | | | | | | |
| D25 | How good or bad do you think the impact of climate change will be on people across the world? Please choose a number from 0 to 10, where 0 is extremely bad and 10 is extremely good. | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. The lived experiences do not fully impact the degree of concern, as there are other feelings acting simultaneously (Diener et al, 1996). | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *5* | *5* | *5* | *4* | *4* | *3* | *3* | *2* | *2* | *1* | *1* | |
| D26 | Now imagine that large numbers of people limited their energy use. How likely do you think it is that this would reduce climate change? | Experienced Utility | Even though the reduction of energy use in an isolated way does not directly affect climate change (since the latter is multifactorial and is related to a process of historical degradation), if everyone reduces their energy use, the final result could be relevant. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| D27 | How likely do you think it is that large numbers of people will actually limit their energy use to try to reduce climate change? | Experienced Utility | Even though the reduction of energy use in an isolated way does not directly affect climate change (since the latter is multifactorial and is related to a process of historical degradation), if everyone reduces their energy use, the final result could be relevant. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| D28 | And how likely do you think it is that governments in enough countries will take action that reduces climate change? | Experienced Utility | There is a great variety of attitudes coming from the national authorities around public policies aimed at controlling climate change. Then, the choice relies on each personal experience. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |
| D29 | How likely do you think it is that limiting your own energy use would help reduce climate change? | Experienced Utility | Even though the reduction of energy use in an isolated way does not directly affect climate change (since the latter is multifactorial and is related to a process of historical degradation), if everyone reduces their energy use, the final result could be relevant. | Original scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 77, 88 |
| | | | | New scale (adapted) | *1* | *1* | *1* | *2* | *2* | *3* | *3* | *4* | *4* | *5* | *5* | |

# Appendix I – Adjustments on the chosen questions of ESS survey for reaching the individual level of satisfaction – Part Three

| ESS' Code | Question | Tag | Reasoning | Scales | | | | | | | | | | | Exclusions by mistake |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *To what extent are you in favour or against the following policies in [country] to reduce climate change?* | | | | | | | | | | | | | | |
| D30 | Increasing taxes on fossil fuels, such as oil, gas and coal. | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. In addition, this type of public policy requires a great knowledge about it. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | |
| D31 | Using public money to subsidise renewable energy such as wind and solar power. | Decision Utility | Due to the cognitive limitation, the considered conditions obliges the interviewee to perform probabilistic calculations. In addition, this type of public policy requires a great knowledge about it. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | |
| D32 | A law banning the sale of the least energy efficient household appliances. | Experienced Utility | Even though the reduction of electrical energy in an isolated way does not directly affect climate change (since the latter is multifactorial and is related to a process of historical degradation), if everyone has the most efficient household appliances, the final result could be relevant. | Original scale | 1 | 2 | 3 | 4 | 5 | | | | | | 7 , 8 |
| | | | | New scale (adapted) | 5 | 4 | 3 | 2 | 1 | | | | | | |

## Appendix II – Ordered Probit Model – Marginal Effects (%)

| Type | Variable | Marginal Effects (standard error) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | DU Model | | | | EU Model | | | | |
| | | Outcome 2 | Outcome 3 | Outcome 4 | Outcome 5 | Outcome 1 | Outcome 2 | Outcome 3 | Outcome 4 | Outcome 5 |
| Environmental | Waste | -0.02%** (0.00008) | -0.54%*** (0.0019) | 0.54%*** (0.0019) | 0.02%*** (0.00009) | -0.001% (0.00004) | -0.05% (0.0027) | 0.03% (0.0017) | 0.01% (0.0010) | 0.0003% (0.0000) |
| | Emissions | -0.02%** (0.00006) | -0.44%*** (0.0015) | 0.43%*** (0.0015) | 0.03%*** (0.00007) | 0.003% (0.00006) | 0.23% (0.0029) | -0.14% (0.0019) | -0.08% (0.0011) | -0.00001% (0.0000) |
| | Energy Production | -0.02%** (0.00008) | -0.46%** (0.0020) | 0.45%** (0.0020) | 0.02%** (0.0001) | -0.004% (0.00003) | -0.31%* (0.0016) | 0.19%* (0.0010) | 0.12% (0.0007) | 0.0002% (0.0000) |
| | Precipitation | 0.0000%*** (0.0000) | 0.0000%*** (0.0000) | 0.0000%*** (0.0000) | 0.0000%*** (0.0000) | 0.0000% (0.0000) | -0.0001% (0.0000) | 0.0000% (0.0000) | 0.0000% (0.0000) | 0.0000% (0.0000) |
| | Energy Consumption | 0.001%* (0.00006) | 0.27%** (0.0013) | -0.27%** (0.0013) | -0.01%** (0.00006) | 0.001% (0.00003) | 0.04% (0.0017) | -0.02% (0.0011) | -0.01% (0.0006) | 0.0000% (0.0000) |
| | Burnt Area | -0.02%* (0.0001) | -0.59%* (0.0030) | 0.59%** (0.0030) | 0.03%* (0.0001) | -0.004% (0.00004) | -0.24% (0.0020) | 0.15% (0.0013) | 0.09% (0.0008) | 0.0001% (0.0000) |
| | Carbon Intensity | 0.001%*** (0.0000) | 0.04%*** (0.00007) | -0.04%*** (0.00007) | -0.002%*** (0.0000) | 0.0002%** (0.0000) | 0.01%** (0.00004) | -0.006% (0.00003) | -0.003%** (0.0002) | 0.0000% (0.0000) |
| Socio-economic | Gender | -0.27%*** (0.007) | -7.46%*** (0.0124) | 7.38%*** (0.0126) | 0.35%*** (0.0006) | -0.07%*** (0.0002) | -4.66%*** (0.0079) | 2,96%*** (0.0061) | 1.76% *** (0.0037) | 0.01% (0.00003) |
| | Children | -0.15%*** (0.0003) | -4.24%*** (0.0099) | 4.19%*** (0.0097) | 0.19%*** (0.0005) | -0.02%* (0.0001) | -1.72%** (0.0087) | 1.09%** (0.0055) | 0.65%* (0.0034) | 0.001% (0.0001) |
| | Age | 0.007%*** (0.00002) | 0.21%*** (0.0003) | -0.21%*** (0.0004) | -0.01%*** (0.00002) | -0.001% (0.00001) | -0.03% (0.0002) | 0.02% (0.0001) | 0.012% (0.0001) | 0.0000% (0.0000) |
| | Last Degree | -0.03%*** (0.00006) | -0.85%*** (0.0015) | 0.84%*** (0.0014) | 0.04%*** (0.0001) | 0.001% (0.0000) | 0.03% (0.0019) | -0.02% (0.0012) | -0.01% (0.0007) | 0.0000% (0.0000) |
| | Years of Study | -0.004%*** (0.00001) | -0.11%*** (0.0003) | 0.11%*** (0.0003) | 0.001%*** (0.00002) | -0.001% (0.00001) | -0.04% (0.0003) | 0.02% (0.0002) | 0.01% (0.0001) | 0.0000% (0.0000) |

Source: Self elaboration

* Significant at the 10% level; ** Significant at the 5% level; ***Significant at the 1% level;

## Appendix III – Link Test's results

Parte I – Link Test for DU Model

Ordered probit regression — Number of obs = 19,037
LR chi2(2) = 1878.68
Prob > chi2 = 0.0000
Log likelihood = -13409.144 — Pseudo R2 = 0.0655

| du | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| _hat | 1.023447 | .0597411 | 17.13 | 0.000 | .9063568 | 1.140538 |
| _hatsq | -.019942 | .046663 | -0.43 | 0.669 | -.1113997 | .0715157 |
| /cut1 | -1.937985 | .0336756 | | | -2.003988 | -1.871982 |
| /cut2 | .3654109 | .0200187 | | | .326175 | .4046468 |
| /cut3 | 3.172754 | .0361252 | | | 3.10195 | 3.243558 |

Parte II – Link Test for EU Model

Ordered probit regression — Number of obs = 20,626
LR chi2(2) = 531.84
Prob > chi2 = 0.0000
Log likelihood = -14643.111 — Pseudo R2 = 0.0178

| eu | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| _hat | 2.370414 | .2089319 | 11.35 | 0.000 | 1.960915 | 2.779913 |
| _hatsq | -1.278852 | .190199 | -6.72 | 0.000 | -1.651636 | -.9060691 |
| /cut1 | -2.17712 | .0741486 | | | -2.322449 | -2.031792 |
| /cut2 | .0046974 | .0533002 | | | -.099769 | .1091638 |
| /cut3 | 2.455553 | .0559097 | | | 2.345972 | 2.565134 |
| /cut4 | 4.788032 | .2519996 | | | 4.294122 | 5.281942 |

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