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The effect of relative concern on life satisfaction: Relative deprivation and loss aversion*

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Abstract

Income comparisons are important for individual well-being. We examine the shape of the relationship between relative income and life satisfaction, and test empirically if the features of the value function of prospect theory carry on to experienced utility. We draw on a unique dataset for a middle-income country, that allows us to work with an endogenous reference income, which differs for individuals with the same observable characteristics, depending on the perception error about their relative position in the distribution. We find the value function for experienced utility to be concave for both positive and, at odds with prospect theory, also negative relative income. Loss aversion is only satisfied for incomes that are sufficiently distant from the reference income. Our heterogeneity analysis shows that the slope of the value function differs across individuals who care differently about income comparisons, people with different personality traits, or social beliefs.

Keywords: Life satisfaction, relative income, loss aversion, prospect theory.

JEL Classification: D6, I31.

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1 Introduction

We know from happiness economics that relative income matters. As convincingly argued by an increasing number of economists, this influences individual behaviour (Frank, 1985), causes welfare losses (Frank, 2005), and it is also relevant for public policy, such as optimal taxation (Boskin and Sheshinski, 1978; Oswald, 1983; Kanbur and Tuomala, 2013). Own income relative to the average income of a social reference group has been found to have a sizable effect on individual well-being: Ferrer-i-Carbonell (2005), for instance, finds relative income to be as important as absolute income. Furthermore, as suggested by Duesenberry's (1949) relative income hypothesis, relative income matters more for people with relative deprivation (lower income than the group's average) than for those with relative affluence. With very few notable exceptions, pioneered by Vendrik and Woltjer (2007), the relationship between relative income and subjective well-being has been assumed to be linear. Despite this usual (but unfounded) practice in empirical work, this functional form may not be the best choice to capture the salient features of the relationship between relative income and experienced utility.

In widening the possible applications of Prospect Theory to riskless choices, Tversky and Kahneman (1991) argue that the average income of the reference group represents the natural comparison point for each person to value their income. In doing so, they establish a bridge between their original contributions in decision making under uncertainty and the research in economics (and other social sciences) that assumes or accepts interdependence of preferences and incorporates relative concerns into individuals' objective function.

The prospect theory developed by Kahneman and Tversky (1979) contends that when agents make decisions based on a value function that reflects their expected utility, they value the options with respect to a reference point. This function has several features, which distinguish it from conventional decision making models: (a) reference dependence, which postulates that the well-being depends more on income relative to a reference point than on its level in absolute terms; (b) the asymmetric valuation between gains and losses, which states that the intensity of the valuation of a loss is greater than that of a gain of equal magnitude; (c) the principle of diminishing sensitivity, which implies that the value function may be convex in the area of losses and concave in gains; (d) reflection effect, which postulates equal degree of concavity and convexity; (e) loss aversion, which implies that the value function is stepper in losses than in gains; and (f) subjective probability assessments, that states that under uncertainty people weight their options based on subjective distribution functions (Kahneman and Tversky, 1979 and 2000).

These fundamental characteristics of the utility function of prospect theory have been extensively examined in the lab using expected utility, the utility concept for which prospect theory was originally conceived. As outlined above, the empirical literature that uses self-reported life satisfaction as an empirical measure of experienced utility has long corroborated Tversky and Kahneman's (1991) argument about the pertinence of relative income as a benchmark to assess the value of own income. The question that arises, then, is

whether the features that characterize the value function of expected utility are also useful to characterize the utility function with experienced utility.

This paper addresses this question using a new and unique panel dataset for a middle-income country (Uruguay), which includes information on personality traits and individual beliefs. We examine whether the basic properties of the value function of prospect theory carry over to experienced utility by allowing the value function to be non-linear. In the only paper that estimates a non-linear relationship between experienced utility and relative income, Vendrik and Woltjer (2007) confirm, using data for Germany, asymmetric effects for positive and negative relative income. They also find life satisfaction to be concave in positive relative income, but in contrast to prospect theory, also in negative relative income, which in turn implies loss aversion, in a wide sense.

Vendrik and Woltjer (2007) suggest that the contradiction between their findings and prospect theory could be due to their exogenous definition of reference income, which assume that individuals with similar observable characteristics have the same reference group. We improve the definition of reference income in two ways. First, in line with Van Praag and Ferrer-i-Carbonell (2008), which suggest that individuals assign much weight to individuals from their reference group who are nearby socially speaking, and related to feature (f) above, we use neighbourhoods, that is, very small geographical areas, to define reference groups. Second, we also take into account that reference group selection may be a source of bias in the individual assessment of their own income (Kapteyn et al., 1978; Cruces et al., 2013), and assume that those biases are related to the difference between the reference income of an exogenously defined group and the true reference income of the individual. This introduces heterogeneity in the reference income among individuals with similar observable characteristics.

Our estimates corroborate that income comparisons are not symmetric. They are more important for relative deprivation than for relative affluence. In line with the findings of Vendrik and Woltjer (2007) for Germany, we also find the relationship between relative income and life satisfaction in Uruguay to be concave both for relative affluence and relative deprivation, which is at odds with the principle of diminishing sensitivity (c) of prospect theory. Finally, loss aversion is only satisfied for incomes that are sufficiently distant from the reference income.

These findings apply on average to the whole sample. However, there are many reasons to believe that different population subgroups may have different value functions. We shall explore three factors: (i) intensity of comparisons, as not everyone gives the same importance to income comparisons (Clark and Senik, 2010); (ii) personality traits, as they have been found to mediate in the relationship between relative income and life satisfaction (Proto and Rustichini, 2015; Budria and Ferrer-i-Carbonell, 2017)); and (iii) social beliefs, as people's beliefs about how society works are important drivers of individuals' preferences and behaviour (Bénabou and Tirole, 2006). Heterogeneity does not change the shape of the value function, which is always found concave for the full support of relative incomes,

but affects the slopes of the value function of the different groups.

Our paper contributes to the literature in several ways. It is the first study to provide evidence on the prospect theory hypotheses with experience utility for a middle-income country, and one of the few studies addressing the relevance of relative income for life satisfaction. Our finding of a concave value function for negative relative incomes suggests that the costs of social participation are increasing with relative deprivation in Uruguay (Vendrik and Woltjer, 2007). We also improve the definition of reference income in two ways: we endogenize reference income and reference groups are comprised by individuals who are socially nearby the individual. Finally, we examine heterogeneous effects for the first time.

The rest of the paper is organized as follows. Section 2 motivates and describes the hypotheses we are taking to the data. Section 3 presents the empirical strategy: introduces the power-function specification we use, describes the empirical test of our hypotheses, and puts forth a new reference income variable that takes into account individual's perception about her own position in the income distribution. Section 3 presents our empirical strategy to take the prospect theory hypotheses to the data, describes the endogenous reference groups, and discusses the salient features of our data, the "Multidimensional Well-being Trajectories in Childhood" survey. Section 4 presents our main results for the whole sample and provides heterogeneity analysis by comparison intensity, personality traits, and social beliefs. Finally, Section 5 provides arguments to explain the estimated concavity of the value function, discusses the implications of such concavity, and concludes.

2 Hypotheses

We test four basic assumptions about the functional form of relative concern used in the value function proposed by prospect theory.

Hypothesis HI: (*Asymmetry of comparisons*). The valuations with respect to relative income are asymmetric.

This first hypothesis presupposes reference dependence –i.e. that relative income and hence reference groups are relevant– and suggests that the same relative distance to the reference income has a differential effect on satisfaction depending on what side of the reference income individuals are located, that is, on whether relative income is positive or negative. The hypothesis is thus related to the asymmetric valuation between gains and losses hypothesis (b) from prospect theory. Empirical evidence in support for this hypothesis was first provided by Ferrer-i-Carbonell (2005), drawing on data from the German SOEP and using a linear specification for relative income. Vendrik and Woltjer (2007) corroborate such asymmetry of comparisons with a power-function specification and the same data for Germany.

Hypothesis HII: (*Diminishing sensitivity*). The marginal sensitivity of the utility function to relative income has an asymmetric shape, being convex for individuals with relative

deprivation and concave for those with a positive relative income.

The second hypothesis is the equivalent to the diminishing sensitivity hypothesis in prospect theory, which postulates convexity in losses and concavity in gains –that is, that people are more sensitive to changes near their status quo than to changes far from their status quo. To the best of our knowledge, there is no evidence in support of diminishing sensitivity with respect to the reference income of a relevant reference group. Vendrik and Woltjer (2007) is the only paper we know of that tests this hypothesis in the context of experienced utility and social comparisons and find concavity both in positive as well as negative relative incomes.

Hypothesis HIII: (*Equal degree of convexity and concavity*). The degree of convexity for individuals with relative deprivation is the same as the degree of concavity for individuals with positive relative income.

The third hypothesis is equivalent to the reflection effect in prospect theory, which postulates equal degree of convexity in losses and concavity in gains. Such symmetry results from assuming that "people focus on the numbers indicating a scale's value without concern for the unit or physical meaning of the scale" (Wakker et al., 2007), that is, from the so-called numerosity effect. Studies on decision utility find evidence in support of the reflection effect (Kahneman, 2003).

Economists assume decreasing marginal utility of income, which reinforces the concavity in gains but reduces the convexity in losses, making it closer to linearity. Put together, the general psychological perceptions determined by the nominal value of money and the economic assumption determined by the intrinsic value of money, predict a larger degree of concavity in gains than convexity in losses. Wakker et al. (2010) call it partial reflection. As noted above, there is no evidence for experienced utility consistent with diminishing sensitivity. Notwithstanding this, Vendrik and Woltjer (2007) find larger degrees of concavity for positive relative income than for negative relative income. This could be interpreted as the economic intrinsic effect of money outweighing the psychological numerosity effect.

Hypothesis HIV: (*Loss aversion*). Changes in relative income have a greater impact for those who face relative deprivation than for those who have a positive relative income.

The fourth hypothesis informs about the relative size of the effect of comparisons. In particular, it postulates that the negative effect on satisfaction of negative relative income for poorer individuals is larger than the effect of positive relative income of richer individuals. In the context of prospect theory, it is similar to loss aversion. Again, Ferrer-i-Carbonell (2005) and Vendrik and Woltjer (2007), among others, find evidence consistent with this hypothesis. Furthermore, they also find downward comparisons of richer individuals with positive relative income not to influence their satisfaction.[1]

[1]Some papers test this hypothesis with respect to own income gains and losses over time, finding mixed evidence. For instance, while Di Tella et al. (2010) and Boyce et al. (2016) for find evidence in support for loss aversion for Germany and the UK, Fang and Niimi's (2015) findings for Japan do not support loss aversion for own income gains and losses over time. Notwithstanding this, the latter reports evidence in line with loss aversion with respect to a reference income.

3 Empirical Strategy

3.1 Empirical Model

We use a satisfaction variable, S, as a proxy measure of utility. The validity of satisfaction variables has been discussed in Kahneman and Krueger (2006), Clark et al. (2008), and Ferrer-i-Carbonell (2011). Since we want to test the importance and shape of relative income effects at either side of a reference income level, our baseline model relaxes the logarithmic functional form of both absolute and relative income, which is the standard specification with satisfaction equations, and uses instead a more flexible parametric power-functions, $h(\cdot)$, to capture the absolute and relative income effects on satisfaction:

$$S = \alpha + \beta h(y) + \gamma_{+} h(G^{+})(\mathrm{I}) + \gamma_{-} h(G^{-})(1 - \mathrm{I}) + \delta X + e \tag{1}$$

where y is household income, the vector X includes relevant controls and the Greek letters are parameters to be estimated. I is an indicator function, which equals 1 when $(y - y^{rg}) \geq 0$ and 0 when $(y - y^{rg}) < 0$. This specification falls within the models that Hopkins (2008) classifies as "mean dependence", which assume that utility increases with income in absolute terms, but also with respect to income relative to a reference point. Some studies employ income ranks to model relative concern –see, for instance, Clark et al. (2009). This is however not a good option for us, as we want to study how satisfaction responds to variations in the size of the relative income gap.

We define income relative to the reference's group average income level, y^{rg} in percentage terms, and thus define $G^{+} = (y - y^{rg}/y^{rg}) > 0$ and $G^{-} = (y^{rg} - y/y^{rg}) > 0$. Gains and losses are defined in absolute terms in prospect theory, i.e. $(y - y^{rg})$ (Tversky and Kanheman, 1991). However, as Vendrik and Woltjer (2007) argue, relative distances to the reference value seem more relevant determinants of satisfaction than absolute gains and losses.

Previous empirical studies typically find a positive relationship between relative income and life satisfaction. Since we define both G^{+} and G^{-} as non-negative, we expect $\gamma_{+} \geq 0$ and $\gamma_{-} < 0$.

The power-functions of absolute and relative incomes, $h(y)$, $h(G^{+})$, and $h(G^{-})$ take the following form:

$$h(y) = \frac{\left(1 + y\right)^{1-\rho} - 1\right)}{1 - \rho}, \tag{2}$$

$$h(G^{+}) = \frac{\left(1 + G^{+}\right)^{1-\rho^{+}} - 1\right)}{1 - \rho^{+}}, \tag{3}$$

$$h(G^-) = \frac{\left(1+G^-)^{1-\rho^-}-1\right)}{1-\rho^-}. \tag{4}$$

3.2 Specification tests for our hypotheses

The four hypotheses outlined in section 2 have implications on the parameters of interest in equations (1)-(4), which can be tested. The asymmetry of comparisons hypothesis (HI) implies the absolute values of parameters γ_+ and γ_- in equation 1 to differ: ($|\gamma_+| \neq |\gamma_-|$).

The following two hypotheses address the possible non-linearity of relative income effects and also involve parameters ρ_+ and ρ_-. Diminishing sensitivity (HII) implies convexity for individuals facing relative deprivation and concavity for individuals with positive relative income. Convexity requires a positive second derivative of S with respect to G^-, which is obtained with parameters γ_- and ρ_- of opposite sign, i.e. either $\gamma_- > 0$ and $\rho_- < 0$ or $\gamma_- < 0$ and $\rho_- > 0$. Concavity requires a negative second derivative of S with respect to G^+, which is obtained with parameters γ_+ and ρ_+ of the same sign, i.e. either $\gamma_+ > 0$ and $\rho_+ > 0$ or $\gamma_+ < 0$ and $\rho_+ < 0$.

Hypothesis HIII requires measuring the degree of concavity and convexity. Given our power function specification, we use ρ_+ and ρ_- for that purpose, which resembles Pratt's measure of relative risk aversion. Then equal degree of concavity for relative deprivation and convexity for relative advantage implies $|\rho_+| = |\rho_-|$.

Finally, loss aversion (HIV) may be tested in two different ways. One first (and more global) strategy is to check whether the slope is steeper for relative deprivation than for relative advantage, for the same gap, i.e. $G^+ = G^-$. A second, more local, strategy is to check whether there is a kink in the slope of the value function at the reference level, i.e. $G^+ = G^- = 0$, with a steeper slope for relative deprivation (Kahneman et al., 1991; Köbberling and Wakker, 2005).

The first strategy concerns parameters γ_+ and γ_-, but also ρ_+ and ρ_-, since $\partial S/\partial G^+ = \gamma_+ (1+G^+)^{-\rho_+}$ and $\partial S/\partial G^- = \gamma_- (1+G^-)^{-\rho_-}$. Loss aversion is fulfilled if the value function is concave and smooth in both G^- and G^+, as in Vendrik and Woltjer (2007). This, of course, means that hypothesis HII does not hold. If hypothesis HII holds, however, and the value function is convex for relative deprivation, loss aversion depends on the particular values of γ_+ and ρ_+ relative to γ_- and ρ_-, and of $G^+ = G^-$ in a complex way. Since the second strategy evaluates the slope of the value function at $G^+ = G^- = 0$, it simply implies ($|\gamma_+| < |\gamma_-|$). Previous evidence suggest relative income is not relevant for individuals with a relative advantage (Ferrer-i-Carbonell, 2005). Thus, we will also test whether $\gamma_+ = 0$.

3.3 Endogenous Reference Groups

The above model assumes that the researcher knows the income of the reference group Y^{rg}. However, determining the reference income is the most problematic aspect of prospect theory (de Meza and Webb, 2007). The literature is inconclusive about how reference groups are formed and generally assume that individuals compare themselves with other individuals who share observable characteristics (Ferrer-i-Carbonell, 2011; Vendrik and Woltjer, 2007), thus assuming that individuals with similar observable characteristics have the same reference group. However, aspects such as individual social mobility, social interactions, the presence of information problems, copying strategies, or misperceptions about one's relative position may also explain individual's choice of reference group and thus of reference point (Falk and Knell, 2004; Stutzer, 2004; Clark and D'Angelo, 2013). If so, the standard practice of using basic socio-economic observable characteristics to define reference groups would not provide an accurate estimate of each individual's reference income, casting thus doubt on our findings about the validity of the assumptions of prospect theory.

We address this issue by using a definition of reference income that depends on individuals' own perception of outcomes. This introduces heterogeneity in the reference income among individuals with similar observable characteristics. We explore the idea that individuals assess their own situation by comparing it with the perceived distribution of outcomes (Kapteyn et al., 1978). To this end, we first assume that the reference group based on observable characteristics ($y_i^{rg-observed}$) provides relevant, but insufficient information, as it may differ from what each individual really considers when making their valuations ($y_i^{rg-true}$). We also assume that the difference between $y_i^{rg-observed}$ and $y_i^{rg-true}$ is related to the biases in individuals' evaluations of their own relative position in the overall income distribution.

Let the perception error of an individual's i own relative position in the income distribution, (e_i), be the difference between her perceived position ($P_i{}^P$) and the true position ($P_i{}^T$) in the income distribution, $e_i^p = P_i{}^P - P_i{}^T$. Following the evidence provided in Kapteyn et al. (1978) and Cruces et al. (2013), we assume that biased perceptions of own relative position depend on the reference group and the resulting threshold taken as a reference. The richer the reference group, and thus the higher the reference income, the more individuals underestimate their relative position in the overall income distribution. Table Appendix I.2 provides empirical support to this assumption for the MWTC data.

We then use an increasing function of e_i, $\psi_i(e_i)$, to adjust the observed reference group income, as follows:

$$y_i^{rg-true} \simeq y_i^{rg-adj} = \frac{y_i^{rg-observed}}{\psi_i(e_i)} \tag{5}$$

The function $\psi(e_i)$, which solely depends on the individual's perception error, can be generally defined as

$$\psi(e_i) = \begin{cases} 1 & if\ P_i^P = P_i^T \\ > 1 & if\ P_i^P > P_i^T \\ < 1 & if\ P_i^P < P_i^T \end{cases} \tag{6}$$

where $\psi(e_i) > 0$, $\psi(0) = 1$, and $\psi'(e_i) > 0$. That is, individuals' reference income is adjusted only if their perceptions about their own position in the income distribution are not correct. Overestimating one's position, i.e. $(P_i^P > P_i^T)$, leads to a downward adjustment in own reference income, while the opposite happens when one's position is underestimated. For the empirical analysis we use the following functional form of $\psi(e_i)$:

$$\psi(e_i) = \begin{cases} 1 & if\ P_i^P = P_i^T \\ 1 + e_i^P & if\ P_i^P \neq P_i^T \end{cases}$$

where both perceived and true positions, $\mathrm{P}_i{}^P$ and $\mathrm{P}_i{}^T$, are measured in deciles and take values from 0.1 to 1.[2]

However, results are robust to other functional forms of $\psi(e_i)$, such as the square root of the error, which gives less importance to greater perception errors, or to different definitions of the perception error, such as the ratio between true income and that of the decile where individuals perceive themselves to be.

Using subjective perception errors to adjust reference incomes may raise endogeneity concerns, as we are introducing subjective aspects among the regressors. However, since subjective perceptions only enter the righ-hand side variables indirectly and we are also using fixed effects, which controls for time-invariant unobserved heterogeneity, we believe such concerns should not be serious.

3.4 Data

Our data comes from the "Multidimensional Well-being Trajectories in Childhood" (MWTC), a unique panel data set, which includes a wide set of individual socioeconomic characteristics, as well as individual perceptions and opinions, which are important for our analysis and are not usually found in surveys that are representative of large populations. The MWTC is representative of the households residing in the metropolitan area with children attending the first year at a public primary school in 2004.[3] Public school coverage is close to 90% among first-year school children in Uruguay.[4]

[2] As the variable of the perception of own position in the distribution is only available in the third wave, we assume that the error is constant between 2006 and 2011.

[3] The metropolitan area includes Montevideo and Canelones, and accounts for 54% of the entire population.

[4] Original sample sizes are 1800 households in 2004, 1327 in 2006, and 1084 in 2011. It is worth noting that top income households are underrepresented in the MWTC sample. See Burstin et al. (2010) for further details about the MWTC data.

We use data from the last two waves of the survey, corresponding to the years 2006 and 2011, as the first wave does not include information on life satisfaction, our dependent variable. Our sample includes 1629 individuals, of which 1278 are respondents of the 2006 wave and 1070 come from the 2011 wave. The panel component includes 722 individuals who provided answers in both waves. This is the sample we use for the panel data analysis. It is worth noting that our longitudinal sample does not seem to be a self-selected sample, since the mean values of the main variables are not statistically different for the different samples at conventional significant levels (see summary statistics and difference-in-means tests in Table Appendix I.3 in Appendix A.I).[5] The description and source of each variable is provided in Table Appendix I.1 in Appendix A.I.

Our dependent variable is reported individual life satisfaction, S, which following Vendrik and Woltjer (2007) we interpret as a measure of experienced utility.[6] The income variable measures real annual disposable household income, which includes labour and capital income net of taxes and transfers.[7]

As explained in section 3.3, reference income is the income of a relevant reference group, adjusted by individual's own perception error about their position in the income distribution. Unlike previous studies, instead of using broad regions to define reference groups, we use much finer geographical areas, namely neighbourhood of residency, which we believe define more relevant reference groups.[8]

To estimate the reference income of the groups we use the whole cross-section sample of the MWTC, which is larger than the panel sample. Our set of controls is standard and includes age, hours worked, and number of adults in the household, all in logarithms, and marital status, number of children, labour market status, number of active household members, as categorical variables, a dummy for the capital city Montevideo, and year fixed effects. Time-invariant variables such as education, cognitive, and non-cognitive skills are subsumed in the individual fixed effect. Table Appendix I.1 shows the precise definition of all variables.

3.5 Estimation procedure

In accordance to a substantial part of the empirical literature, we do not use ordinal models (Ferrer-i-Carbonell and Frijters, 2004), but non-linear least squares with fixed individual

[5] The only exceptions are sex and hours worked for the first wave and years of education, age and sex for the second wave.

[6] Life satisfaction questions have also been considered a measure of remembered utility by Kahneman and Krueger (2006). In agreement with Vendrik and Woltjer (2007), we prefer to interpret it as experience utility since it is an assessment about how people experience their life.

[7] The average of our income variable is consistent with the larger and representative Continuous Household Survey, which is run by the National Institute of Statistics of Uruguay.

[8] People tend to compare themselves to similar others (Falk and Knell, 2004), and we argue that residential choice also captures unobserved individual characteristics that are relevant to define the group of similar others. Moreover, the behaviour, haves, and have-nots of neighbours is more readily observed and thus more likely to exert a larger influence than that of individuals that one never comes across but are nevertheless living in the same administrative region.

effects. This assumes interpersonal comparability and cardinality,[9] but provides a simpler interpretation of the coefficients of interest –i.e. those associated with relative concern. Since fixed effect models use only within-individual variation to estimate the regression coefficients and do not use information about interpersonal variation, our estimates do not require the assumption of interpersonal comparability of economic satisfaction scales, but only require the intertemporal cardinal comparability of the responses (Vendrik and Woltjer, 2007). Furthermore, fixed effects control for unobserved time-invariant heterogeneity, which is key when modelling self-reported satisfaction levels (Ferrer-i-Carbonell and Frijters, 2004)

As outlined above, a source of simultaneity and bias lies in the choice of the reference group (Falk and Knell, 2004; Heffetz and Frank, 2011). On the one hand, the reference group may be relevant in deciding how much income is necessary to obtain a certain level of economic satisfaction, but on the other hand, individuals may choose the reference group endogenously in order to maximize economic satisfaction –see Falk and Knell (2004), Senik (2009), and Clark and Senik (2010) for evidence on the endogenous determination of reference groups. Notwithstanding this, reference groups are usually assumed exogenous in the empirical literature (Clark et al., 2008). As explained in sections 3.3 and 3.4, to address this issue, we introduce two novelties: we use neighbourhood of residency to define the reference groups and use individual perceptions about own relative position in the income distribution to correct the reference income from endogeneity biases (Kapteyn et al., 1978; Cruces et al., 2013)

4 Testing the assumptions of prospect theory

Section 4.1 reports and discusses our main findings on the four basic assumptions about the functional form of relative concern used in the value function proposed by prospect theory presented in Section 2, while Section 4.2 explores to what extent individual attributes and characteristics introduce heterogeneity in the functional form of relative concern.

4.1 Main Results

Table 1 reports estimates of the main parameter of interest from our flexible model outlined in equations (1)-(4), which allow us to test empirically hypothesis HI to HIV. The full set of estimates of model (1)-(4) is reported in Appendix Table Appendix I.5. The estimates of γ_+ and γ_- indicate that income comparisons are not symmetric, as ($|\hat{\gamma}_+| \neq |\hat{\gamma}_-|$).[10] The negative estimate of γ_- corroborates previous findings about upward comparisons reducing individuals' satisfaction, consistent with envy effects. The positive estimate of γ_+ suggests a satisfaction-enhancing impact of downward comparisons, consistent with pride

[9] See Ferrer-i-Carbonell and Frijters (2004) for the implications of these assumptions.

[10] The difference is statistically significant with a p-value<0.0001. Hereafter we will only report difference-of-means tests with large enough p-values (>0.001).

or status effects (Fehr and Schmidt, 1999). It is worth noting that $\hat{\gamma}_+$ is usually found to be zero in linear specifications (Ferrer-i-Carbonell (2005)). The estimated nil effect of downward comparisons, however, could be induced by imposing a linear G^+ function. Indeed, when we fit a linear specification to our data, as in Ferrer-i-Carbonell (2005), we also find a positive but statistically insignificant $\hat{\gamma}_+$ –while $\hat{\gamma}_-$ is negative and statistically significant.[11] Our results are in line with Vendrik and Woltjers (2007), who also allow for non-linearity in G^+ (and G^-) and find a positive estimate of γ_+.

Table 1: Effect of Relative and Absolute Income on Life Satisfaction

	Coefficient		t-stat
γ_-	-0.13	***	-3.22
γ_+	1.75	***	3.69
ρ_-	-5.09	***	-5.09
ρ_+	2.81	***	4.08
β	-0.03	***	-2.77
ρ	0.71	***	8.70
N	1444		
R^2	0.08		

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fixed effect estimates of equation 1. Standard errors of parameters ρ, ρ_-, and ρ_+ are estimated from bootstrapping equation 1 with 100 iterations. Controls include: Inactive dummy, unemployed dummy, ln(1+working hours), ln(age), active individuals over household members, ln(houeshold members), widower dummy, separated or divorced dummy, two children (<18) dummy, three children dummy, more than three children dummy, year dummy, Montevideo dummy, constant.

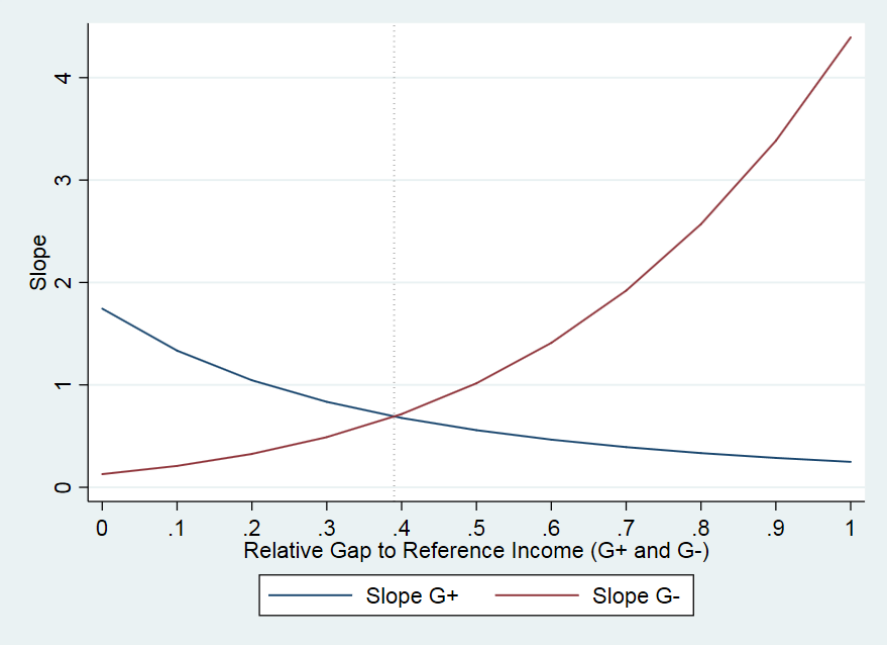
Our findings do not give support to the diminishing sensitivity hypothesis (HII). This hypothesis postulates a convex relationship between relative income and satisfaction for individuals with relative deprivation but a concave relationship for individuals with positive relative income. Convexity requires parameters γ and ρ of opposite sign while concavity is satisfied when parameters γ and ρ have the same sign. Our parameter estimates of γ and ρ have the same sign at either side of the reference income (i.e. $\hat{\gamma}_+ > 0$, $\hat{\rho}_+ > 0$ and $\hat{\gamma}_- < 0$, $\hat{\rho}_- < 0$), implying concavity both for positive relative income, as suggested by HII, but, contrary to HII, also for relative deprivation.

[11] $\hat{\gamma}_+$=0.207, t-statistic=1.38

The equal degree of convexity and concavity hypothesis (HIII) is clearly rejected, as we find no support for the hypothesis of diminishing sensitivity. Nonetheless, we can check whether the degree of concavity differs at both sides of the reference income level. The larger estimate of $|\rho_-| = 5.09 > 2.81 = |\rho_+|$ suggests concavity to be larger for relative deprivation than relative affluence. A Wald test on $H_0 : |\rho_-| > |\rho_+|$ cannot reject the hypothesis at 1% level.

Loss aversion is only satisfied for incomes that are sufficiently distant from the reference income. Loss aversion required steeper slope for losses than for gains. As Figure 1 shows, however, the slope of G^- is only larger than that G^+ for incomes at least 39% higher or lower than reference income (i.e. $G^- = G^+ > 0.39$).[12] In our sample, this means that loss aversion holds for about 53% of individuals. The more local strategy to test for loss aversion, consisting of evaluating the slope of the value function at $G^- = G^+ = 0$, indicates that there is a jump at this point and corroborates the lack of loss aversion for incomes close to the reference income, as $(1.75 = |\hat{\gamma}_+| > |\hat{\gamma}_-| = 0.13)$.

Figure 1: Loss Aversion: Slope of value function for positive and negative relative incomes



Notes: The figure shows the slope of the value function for G^+ and G^-. $\partial S/\partial G^- > \partial S/\partial G^+$ for $G^- = G^+ > 0.39$. Thus, loss aversion holds for incomes at least 30.1% higher or lower than reference income.

In sum, our findings for Uruguay, a middle-income country, are in line with those of Vendrik and Woltjers (2007) for Germany, a high-income country: Satisfaction is concave in positive as well as negative relative income –thus rejecting the diminishing sensitivity as well as the equal degree of convexity and concavity hypotheses–, concavity being larger for positive relative income, and loss aversion is only satisfied for incomes that are sufficiently distant from the reference income. We find this relative income gap of 39% to be about three times

[12] 0.39 is the solution for G of equalizing the slopes for positive and negative relative incomes, i.e. $\partial S/\partial G^- = \partial S/\partial G^+$

larger for Uruguay than the gap for Germany, reported by Vendrik and Woltjers (2007) to be 12%.

We finally turn to the effect of absolute income. Before discussing the size of the effect, it is worth noting that the power function parameter $\rho = 0.71$, which means that the data supports our power function specification, a more flexible specification than the usual log function commonly used in previous empirical literature. The size of the marginal effect of absolute income is negligible. Since the partial derivative of equation 1 depends on the relative income gaps G^- and G^+[13], Appendix Figure 2 plots the average predicted marginal effect of absolute income for various income levels, when they are above or below the reference group income. The marginal effect of absolute income is always very close to zero, being smaller for relative deprivation, $G^- > 0$, than for positive relative incomes, $G^+ > 0$.

4.2 Heterogeneity

Do the above conclusions, which apply on average to the whole sample, also characterize the value function of relevant population subgroups? The literature has not devoted much work to examine the heterogeneous effects of relative income on life satisfaction. The existing limited evidence suggests that non-cognitive traits have a relevant influence on the relative income (comparisons) effect on life satisfaction (Budria and Ferrer-i-Carbonell, 2017).[14] This section provides further and novel evidence on how individual heterogeneity shapes the value function. We will explore differences that arise from the importance given by individuals to income comparisons, from personality or non-cognitive traits, and from fairness beliefs.

A common finding arises from all the heterogeneity analyses we undertake: the value function is always found to be concave, as we have documented for the sample as a whole. Thus, in what follows we are discussing mainly the differences in slopes of the various heterogeneous groups.

4.2.1 Importance of Income Comparisons

Comparing one's income with that of relevant others has been proven to be important. Using data for European countries, Clark and Senik (2010) show that self-reported intensity on the relevance of comparisons matter for individuals' life satisfaction. In particular, they find a negative relationship between own happiness and intensity of comparisons. That is, those who deem relevant comparing their income are less happy.

[13]

$$\frac{\partial S}{\partial y} = \begin{cases} \beta(y)^{-\rho} + (\gamma)^{+} \frac{(1+G^{+})^{-\rho^{+}}}{y^{rg}} & if\ y > y^{rg} \\ \beta(y)^{-\rho} - (\gamma)^{-} \frac{(1+G^{-})^{-\rho^{-}}}{y^{rg}} & if\ y < y^{rg} \end{cases} \tag{7}$$

[14] Much the same has been found for loss aversion (Boyce et al., 2016).

On average, the results reported in Section 4.1 suggest that life satisfaction decreases at an increasing rate as individuals income is increasingly lower than reference income, while it increases at a decreasing rate as individuals income is increasingly higher than reference income. Does the value function of individuals who report that income comparisons are important to them differ from those who feel that income comparisons are not important? And if so, do individuals who report income comparisons to be important experience larger or smaller changes in life satisfaction as their income moves away from the reference income?

To examine whether the value function differs for individuals who care about income comparisons, we use the answers to the following question: "How important is it for you to compare your income with other people's incomes?" Individuals answered using a showcard, where 1 corresponds to "Not at all important", and 5 is labeled "Very important". Since only one fourth of the mass reports values greater than one, we collapse the five-point scale original variable into a dichotomous variable indicating high intensity, which takes value 1 if individuals answer 2 to 5 in the original five-point scale, and zero otherwise. Table Appendix I.4 shows the distribution of answers to the original question.

To allow individuals with different income comparison intensity to have different value functions, we interact the power functions of relative incomes $h(G^+)(\mathrm{I})$ and $h(G^-)(1-\mathrm{I})$ with the indicator variable H, and estimate the following specification[15]:

$$S = \alpha + \beta h(y) + \gamma_+ h(G^+)(\mathrm{I}) + \gamma_- h(G^-)(1-\mathrm{I}) + \mathrm{H}[\gamma_+^H h(G^+)(\mathrm{I}) + \gamma_-^H h(G^-)(1-\mathrm{I})] + \delta X + e \tag{8}$$

where now, with a slight abuse of notation, parameters γ_+ and γ_- capture the effect of individuals for whom comparisons are not important, while parameters γ_+^H and γ_-^H indicate the differential effect of individuals for whom comparisons are important. The overall effect for the latter individuals is obtained from adding both parameters γ_+ and γ_+^H (or γ_- and γ_-^H), as usual.[16]

Table 2 shows that the value function of individuals who care for income comparisons differs from those who do not, as both γ_+^H and γ_-^H are significantly different from zero. The estimates show a flatter value function in income losses and a steeper function in income gains for individuals who deem income comparisons important. The value function for relative negative income is actually entirely flat, as a Wald test on H_0 :$\gamma_- = \gamma_-^H$ cannot reject the null (F(1,704)=0.30; p-value=0.58). This means that negative relative income does not affect life satisfaction of individuals who care for income comparisons. One interpretation of this result is that envy and information effects are of similar size.

[15] Because of our limited sample size, in our estimations we restrict the curvature, captured by ρ_+ and ρ_-, to be homogeneous across different groups. Our attempts to estimate a different ρ parameter per group yield unstable and unreliable estimates.

[16] Note that the hypothesis $H_0 = \gamma_+ = \gamma_+^H = \gamma_- = \gamma_-^H = 0$ is rejected for all models in Section 4.2. Likewise, hypotheses $H_0 = \rho_+ = \rho_- = 0$ and $H_0 = \rho_+ = \rho_- = 1$ are also rejected by the data.

A related interpretation is that these individuals choose reference groups to balance self-enhancement –which leads to choosing reference groups that make themselves feel better– and self-improvement –which entails choosing reference groups that help them improve their performance.[17] Why does then relative negative income depresses life satisfaction of those reporting income comparisons not to be important? The explanation that derives from the first interpretation is that the envy effect dominates the information effect. For some reason these individuals believe there is little to be learned from others' good fortune. The negative effect of relative negative income for those who report that comparisons are not important is also consistent with self-improvement motives dominating self-enhancing aspects, which could result from these individuals being more ambitious or less complacent.

Table 2: Effect of Relative and Absolute Income on Life Satisfaction, by Intensity of Comparisons

	Coefficient		t-stat
γ_-	-0.26	***	-4.02
γ_-^H	0.23	***	3.66
γ_+	1.21	***	2.82
γ_+^H	1.26	***	2.88
ρ_-	-4.29	***	-3.36
ρ_+	2.21	***	4.24
β	-0.03	***	-2.75
ρ	0.71	**	2.51
N	1444		
R^2	0.10		

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fixed effect estimates of equation 1. Standard errors of parameters ρ, ρ_-, and ρ_+ are estimated from bootstrapping equation 1 with 100 iterations. Controls include: Inactive dummy, unemployed dummy, ln(1+working hours), ln(age), active individuals over household members, ln(houeshold members), widower dummy, separated or divorced dummy, two children (<18) dummy, three children dummy, more than three children dummy, year dummy, Montevideo dummy, constant.

The larger (positive) effect of positive relative income of individuals who find income com-

[17] Yet another possibility is that the reference group we have chosen, i.e. neighbours, is not the relevant one for them. However, residential choice is endogenous, we are confident to discard this possibility.

parisons important, relative to those who do not find them important can be interpreted as status or self-enhancing effects being larger for individuals who compare.

The different slope of the value function between those who compare and those who do not implies that the difference in life satisfaction between these two types of individuals increases as relative income increases. This is to the best of our knowledge novel evidence.[18]

4.2.2 Personality Traits

In this section we report heterogeneity by three personality traits, locus of control, self-efficacy, and self-esteem, which are indicators of a common construct termed 'core self-evaluations' (Judge et al., 2002).[19] Almlund et al. (2011) define positive self-evaluation as indicating "a generally positive and proactive view of oneself and one's relationship to the world".

Locus of control measures the extent to which individuals perceive that the control of their life is external (depends on others, luck, etc.) or internal (the course of own life depends on own decisions and effort); self-esteem is usually conceived of as the perception that individuals have about their own ability; while self-efficacy captures the belief that one can act effectively to bring about desired results.

Out of these three personality traits, locus of control is the non-cognitive skill which has captured most attention amongst economist. A rapidly increasing stock of literature examines the extent to which locus of control, which is rather stable for adults (Cobb-Clark and Schurer, 2013), provides helpful insights in our understanding of relevant economic outcomes and behaviours, such as education attainment (Almlund et al., 2011), labour market outcomes (Cobb-Clark, 2015), health status (Cobb-Clark et al., 2014), savings behaviour (Cobb-Clark et al., 2016), individual's well-being (Verme, 2009), poverty (Bernheim et al., 2015), social behaviour (Heckman et al., 2006), and economic preferences (Becker et al., 2012). There is more paucity of studies using either self-esteem or self-efficacy. Still, self-esteem has been also found to be relevant for labour market outcomes, notably earnings (Drago, 2011), education (de Araujo and Lagos, 2013), and health (Trzesniewski et al., 2006), while self-efficacy correlates positively with educational attainment (Behncke, 2009), risk attitudes (Krueger and Dickson, 1994), and pro-social behaviour (Caprara et al., 2010)

We measure locus of control with the Internality, Powerful Others, and Chance (IPC) scale (Levenson, 1981).[20]. Our external locus of control indicator combines the answers to two

[18] Clark and Senik (2010), for instance, use an empirical strategy that only allows them to identify the effect of relative income at the average relative income level.

[19] The direct effect of these time-invariant personality traits on life satisfaction is subsumed in the fixed effect.

[20] Levenson's scale has been previously used in economics, e.g. Tanguy et al. (2014), and builds on earlier work by Rotter et al. (1966), which is the scale many economists have employed and which can be found in large data sets, such as the German SOEP or the Australian HILDA. Unlike Rotter's, however, Levenson's scale considers more than one dimension, which has been argued to better capture beliefs about control (Lefcourt, 1991)

questions. In the first one respondents choose their position in a 5-point scale, where 1 is "everything is determined by destiny or external forces" and 5 "we make our own destiny", while in the second one individuals report about their perceived power today, five years ago, and bout the power of their neighbours, in a 9-point scale.[21]

The indicator variable for high self-efficacy takes value 1 if individuals answer that they are responsible for changes in their live when asked "who will contribute more to a change in your live?", while takes value 0 when answering either of the other six options, including their family, the State, God, local government, other groups of people or another person.

We use two different indicator variables for self-esteem that measure low self-esteem. The first one takes value 1 if individuals report having very often at least one of the following feelings: stupid, ridicule, ashamed, or humiliated, while it takes value 0 otherwise, while the second one takes value 1 if individuals report having very often at least one of the following feelings: was treated unfairly, was humiliated, was treated disrespectfully, being sickening, while it takes value 0 otherwise –Table Appendix I.1 shows the exact wording of the questions and the possible answers.

As Table 3 shows, the value function is flatter for external individuals, in the range of relative deprivation, but steeper in the range of relative advantage. In other words, income losses affect externals less than internals, but the former derive higher satisfaction from income gains.

Table 3: Effect of Relative and Absolute Income on Life Satisfaction, by Core Self-Evaluation Personality Traits

	External LOC			High Self-Efficacy			Low Self-esteem (1)			Low Self-esteem (2)		
	Coefficient		t-stat	Coefficient		t-stat	Coefficient		t-stat	Coefficient		t-stat
γ_-	-0.08	***	-3.40	-0.06		-1.43	-0.12	***	-3.63	-0.20	***	-4.15
γ_-^H	0.06	**	2.01	-0.08	**	-2.06	0.08	**	2.46	0.14	***	3.20
γ_+	1.34	***	2.22	1.91	***	3.10	1.40	***	2.77	1.33	***	2.66
γ_+^H	2.38	***	2.86	-0.17		-0.33	1.05	**	2.09	1.17	**	2.48
ρ_-	-6.09	***	-7.01	-5.29	***	10.23	-5.49	***	-6.98	-4.89	**	-2.25
ρ_+	3.41	***	3.45	2.81	***	4.00	2.81	***	2.93	2.81		1.36
β	-0.02	***	-2.51	-0.03	***	-2.81	-0.02	**	-2.58	-0.03	***	-2.80
ρ	0.71	***	8.70	0.71	***	4.35	0.71	***	4.35	0.71	**	2.17
N	1444			1444			1444			1444		
R^2	0.10			0.09			0.09			0.08		

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fixed effect estimates of equation 1. Standard errors of parameters ρ, ρ_-, and ρ_+ are estimated from bootstrapping equation 1 with 100 iterations. Controls include: Inactive dummy, unemployed dummy, ln(1+working hours), ln(age), active individuals over household members, ln(household members), widower dummy, separated or divorced dummy, two children (<18) dummy, three children dummy, more than three children dummy, year dummy, Montevideo dummy, constant.

The results for the other two core self-evaluation variables, shown in columns 2 to 4 of Table 3, are very consistent with those of locus of control. The results from columns 3 and

[21] The variable we use in the analysis is the union of two indicator variables, which capture externality/chance and low power, respectively. Externality/chance takes value 1 if the average answer of individuals over the two waves is less than four, while low power takes value 1 if if the average answer of individuals over the three questions (own power today, own power five years ago, and neighbour's power) is less than five.

4 also suggest that individuals with high self-esteem obtain larger satisfaction gains from increasing relative negative income. As for locus of control, self-esteem is also relevant for individuals with positive relative income. Now, high self-esteem individuals show a flatter value function. Our findings, thus suggest that internality and high self-esteem have asymmetric effects on both sides of the reference income: The fall in satisfaction from an income decrease when the individual is relatively deprived is larger than the increase in satisfaction from an income increase of the same size when her relative income is positive. Finally, self-efficacy is only relevant for relative negative income, and individuals with high self-efficacy obtain a satisfaction premium from increments in relative income, relative to low-self efficacy individuals.

4.2.3 Social Beliefs

People's beliefs about how society works are important drivers of individuals' preferences and behaviour. In this section we focus on fairness beliefs and exploit answers to two questions on beliefs about there being discrimination in society. To interpret the role of fairness beliefs we draw on the concept of "Belief in a just world" (BJW), where people generally get what they deserve, introduced by Lerner (1965, 1980) in psychology.[22] Believing in a just world serves to combat the idea that one's fate is largely random and provides a feeling of self-determination and control over one's destiny. It is then no surprise that BJW has been shown to correlate with locus of control (Furnham, 2003), and to enhance mental health and self-esteem (Dalbert, 1999). The belief in self-reliance or self-sufficiency that is related to BJW may imply that those individuals who perceive less or no discrimination have a steeper value function than those who do. In other words, people who see their relative income improve get a satisfaction premium that may result from believing that they are mostly responsible for such improvement. Analogously, the extra depression in satisfaction experienced by those who see their relative income decrease may be due to their belief that the income reduction is mostly due to their actions.

To examine the extent to which fairness beliefs affect individuals' value function, we use two dummy variables that measure whether individuals perceive that society discriminates either by social origin or by ethnic origin. Social discrimination by social (ethnic) origin takes value one if respondents agree that social (ethnic) origin hinders at least one of the following: the chance of getting a job, access to services, access to education, getting a contract with the government, and it takes value 0 otherwise.

Consistent with the concept of BJW and the ensuing self-determination beliefs, the estimates of Table 4 show a flatter value function in negative relative income for individuals who perceive social discrimination either by social or ethnic origin. As expected, these results are in line with our previous findings by locus of control. For positive relative in-

[22] The economics literature has embedded BJW and fairness perceptions in political economy models to explain redistributive politics, tax policy, and economic growth (Alesina et al., 2012; Bénabou and Tirole, 2006; Alesina and Angeletos, 2005).

comes, however, the value function of those who perceive no or little discrimination is only steeper for one of the indicator variables used.

Table 4: Effect of Relative and Absolute Income on Life Satisfaction, by Social Beliefs

	Social Origin Discrimination			Ethnic Origin Discrimination		
	Coefficient		t-stat	Coefficient		t-stat
γ_-	-0.34	***	-4.08	-0.37	***	-4.83
γ_-^H	0.14	**	2.05	0.24	***	4.00
γ_+	2.00	***	3.71	0.90	*	1.80
γ_+^H	-0.56		-1.34	1.10	***	2.73
ρ_-	-4.89	***	-3.64	-4.09	***	-10.04
ρ_+	2.61	***	3.13	2.41	***	4.00
β	-0.03	***	-3.01	-0.03	***	-2.83
ρ	0.71	***	4.72	0.71	***	8.70
N	1444			1444		
R^2	0.10			0.11		

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fixed effect estimates of equation 1. Standard errors of parameters ρ, ρ_-, and ρ_+ are estimated from bootstrapping equation 1 with 100 iterations. Controls include: Inactive dummy, unemployed dummy, ln(1+working hours), ln(age), active individuals over household members, ln(household members), widower dummy, separated or divorced dummy, two children (<18) dummy, three children dummy, more than three children dummy, year dummy, Montevideo dummy, constant.

5 Discussion and Conclusions

This paper contributes new evidence to the literature on how individuals value their situation in relation to a reference group, evaluating the validity of the basic assumptions of prospect theory, for a middle-income country. In line with previous evidence, our findings suggest that income comparisons within a relevant social group matter and are more important for people with negative relative income than for individuals whose income is larger than the reference income. A substantial body of evidence imposes a linear function for relative incomes and finds a nil effect of relative income for downward comparisons (e.g. Ferrer-i-Carbonell, 2005). Contrary to this evidence, when we allow for non-linearities by means of a power function, the effect of downward comparisons turns to be positive, suggesting that the nil effect may be induced by the linear specification of previous studies.

The value function describing the relationship between relative income and life satisfaction is found to be concave for positive relative incomes, and contrary to the principle of diminishing sensitivity of prospect theory, as well for negative relative incomes. Loss aversion, which requires steeper slope of the value function for negative relative incomes than for

positive ones, is only satisfied for incomes that are sufficiently distant from the reference income (i.e. at least 30.1% higher or lower).

The importance given by individuals to income comparisons, their personality traits and social beliefs affect the slope of the value function, mostly for negative relative incomes. Individuals reporting income comparisons not to be important show a steeper value function. Different arguments may explain this finding: the envy effect dominates the information effect, or self-improvement motives dominate self-enhancing aspects. Internal locus of control, high self-efficacy, and high self-esteem –traits that indicate a positive and proactive view of oneself and one's relationship to the world– also show steeper value functions. This satisfaction premium to income increases may result from their believe in them being responsible for their economic success. Moreover, these three personality traits have asymmetric effects on both sides of the reference income: The fall in satisfaction from an income decrease when the individual is relatively deprived is larger than the increase in satisfaction from an income increase of the same size when her relative income is positive. Finally, and consistent with the concept of "Belief in a just world" (Lerner, 1965 and 1980), individuals who do not perceive social discrimination also show a steeper value function.

The value function for experienced utility in Uruguay shares basic characteristics with that in Germany: Comparisons are asymmetric, the value function is concave, and loss aversion holds for incomes not too close to the reference income. However, the incidence of loss aversion and the degree of concavity in negative and positive relative income differ in the two countries. Loss aversion holds for incomes that are two and a half times further away from relative income in Uruguay than in Germany. Concavity of the value function is also larger in Uruguay, both for negative and positive relative incomes. As outlined below, this has implications for effort decisions and aggregate economic mobility.

The concave value function for relative deprivation, which conforms with standard economic theory, can be explained by increasing costs of social participation as the relative gap between own income and reference income widens up (Vendrik and Woltjer, 2007). According to this interpretation, then, the more concave value function in Uruguay implies that the costs of social participation increase more rapidly in Uruguay than in Germany. Our heterogeneity analysis also shows that such costs are not homogeneous across the board, but are higher for internal individuals, those with high self-efficacy and high self-esteem.

Our finding of a concave, as opposed to convex, value function for relative deprivation, may also be explain by our mistaken choice of reference group for each individual. Reference groups are endogenously chosen by individuals in a non-trivial way, for self-enhancing or self-improvement purposes, for instance. We have tried to minimize the error when estimating reference incomes by exploiting endogenous residential choices and the perception error of an individual's own relative position in the income distribution, which introduces heterogeneity within groups of individuals who share the same observable characteristics. Notwithstanding this, if we still were estimating upwardly biased reference incomes, we

would obtain a concave relationship between life satisfaction and relative income, even when the true relationship were convex, as predicted by prospect theory. Substantial further work in defining the correct reference group and estimating the correct reference income is clearly needed if we want to be entirely certain that these issues do not affect the estimated shape of the value function.

The concavity or convexity of life satisfaction in relative concern has important economic implications, as it influences individuals' behaviour (Clark and Oswald, 1998) and effort decisions (Leites and Ramos, 2015; Goette et al., 2004). In order to understand the importance of reference groups on intergenerational mobility, Leites and Ramos (2017) model effort decisions of rational agents from different social origins, who choose the level of effort that maximizes their expected utility. They show that when facing sufficiently large relative deprivation people get discouraged and respond by reducing their effort, if relative concern is convex. However, if the value function is concave, sufficiently large relative deprivation encourage individuals to increase their effort. The former reaction enhances intergenerational persistence, while the latter reduces intergenerational poverty traps and contributes to increased mobility. In an earlier modelling of individual behaviour when relative concerns matter, Clark and Oswald (1998) show that the concavity or convexity of the utility function in relative concern is key to understand people's following or deviant behaviour. Applied to relative deprivation and effort decisions, the concavity of the life satisfaction function found for Uruguay implies that reference groups will induce people to increase their effort. Once again this effect proofs to be heterogeneous, being larger for individuals perceiving discrimination or with low self-esteem, and lower for high self-efficacy individuals.

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A.I Appendix

Table Appendix I.1: **Definition of the variables**

Variable	**Variable definition**	**Source/years**
Life satisfaction	Categorical variable, 1 very dissatisfied, 5 very satisfied	MWTC 2006/11
Household income	Log(1+real household income); July 2012 prices	MWTC 2006/11
Age	Age of the respondent	
Sex	Male = 1; Female = 0	
Inactive	Inactive = 1; Otherwise = 0	
Unemployed	Unemployed = 1; Otherwise = 0	
Household members	Log(number of members in the household)	
Active household members	Log(Number of labor active members in the household)/Log(number of members in the household)	
Widow	Widow = 1; Otherwise = 0	
Separated/Divorced	Separated/Divorced = 1; Otherwise = 0	
Working hours	Log(1+respondent's working hours)	
Two children	(Household has 2 children or less) = 1; Otherwise = 0; Children <18 year old	
Three children	(Household has 3 children) = 1; Otherwise = 0; Children <18 year old	
Four+ children	(Household has 4 children or more) = 1; Otherwise = 0; Children <18 year old	
Y_i^{rg}	Mean reference group income. Reference group defined by neighbourhood of residence	
PP_i	Perceived income decile of respondent	
PT_i	Objective (estimated) income decile of respondent	CHS 2006/11

Definitions of the variables (cont)

Variable	Variable definition	Source/years
High Intensity of Comparisons	Equals 1 if individual answers 2 to 5 to the following question: "How important is it for you to compare your income with other people's incomes?", where 1 is "Not at all important" and 5 is "Very important"; and equals 0 otherwise	MWTC 2006/11
External LOC	Equals 1 if the following two indicator variables take value 1. First, externality/chance takes value 1 if the average answer of individuals to the following question over the two waves is less than four: Some believe that people can build their own future, while others believe it is not possible to escape one's luck. Other people believe in both. Please tell me which of the following options captures better your own beliefs about this: (1) "Everything is determined by destiny or external forces" (2) "Mostly by destiny" (3) "Half by destiny and half by own decisions" (4) "Mostly by myself" (5) "We make our own destiny". Second, powerful others takes value 1 if the average answer of individuals over the following three questions is less than five: Suppose a ladder of nine steps: the powerless are on the lower step, while those with a lot of power are on the highest step. According to you, (a) On what step are you located now?, (b) On what step are your neighbours located?, (c) On what step were you located five years ago?	
High Self-Efficacy	Equals 1 if individuals answer that they are responsible for changes in their live when asked "Who will contribute more to a change in your live?", and equals 0 when answering either of the other six options, including their family, the State, God, local government, other groups of people or another person	
High Self-Esteem (1)	Equals 1 if individuals report having very often at least one of the following feelings: stupid, ridicule, ashamed, or humiliated, and equals 0 otherwise	
High Self-Esteem (2)	Equals 1 if individuals report having very often at least one of the following feelings: was treated unfairly, was humiliated, was treated disrespectfully, being sickening, and equals 0 otherwise	
Social Origin Discrimination	Equals 1 if respondents agree that social origin hinders at least one of the following: the chance of getting a job, access to services, access to education, getting a contract with the government, and equals 0 otherwise	
Ethnic Origin Discrimination	Equals 1 if respondents agree that ethnic origin hinders at least one of the following: the chance of getting a job, access to services, access to education, getting a contract with the government, and equals 0 otherwise	

Table Appendix I.2: Distribution of Error Perceptions by Average Income of the Reference Group

Reference group	Average income (pesos)	Understate (%)	Get it right (%)	Overstate (%)
Poorest	20,066	10%	5%	85%
	20,433	6%	8%	87%
	22,032	8%	12%	80%
	22,335	0%	17%	83%
	22,774	13%	19%	69%
	23,644	4%	14%	82%
	23,849	10%	8%	82%
	32,023	15%	13%	72%
	35,354	23%	10%	67%
	38,548	25%	18%	57%
	39,404	43%	10%	48%
Richest	53,489	40%	18%	42%

Notes: Reference groups are neighbourhoods of residency. The column entitled "Understate" shows the percentage of individuals from a given reference group who reported having a lower social position than her actual one. The other two columns can be interpreted in an analogous manner. That is, rows add up to 100%

Table Appendix I.3: Descriptive Statistics and Differences of Means Tests

	Cross-section sample		Panel sample		t-test	(Cross-section sample)		(Panel sample)		t-test
	Mean	Std. Dev.	Mean	Std. Dev.	p-value	Mean	Std. Dev.	Mean	Std. Dev.	p-value
Life satisfaction	3.84	0.79	3.77	1.03	0.97	3.84	0.83	3.74	1.04	0.67
log(1+household income)	9.82	0.99	9.91	0.83	0.41	9.86	0.93	9.97	0.77	0.25
Years of education	8.89	3.72	8.94	3.77	0.12	9.23	3.92	9.45	3.60	0.03
Unemployment	0.11	0.31	0.08	0.27	0.88	0.11	0.31	0.07	0.25	0.36
log(Active household members)	1.78	0.91	1.84	0.95	0.68	1.76	0.88	1.86	0.93	0.75
log(Household members)	1.54	0.35	1.51	0.42	0.87	1.53	0.34	1.51	0.35	0.82
Log age	3.59	0.22	3.74	0.20	0.67	3.58	0.21	3.71	0.19	0.00
Male	0.21	0.41	0.24	0.43	0.00	0.06	0.23	0.04	0.21	0.00
log (1+working hours)	2.40	1.76	2.69	1.69	0.00	2.07	1.77	2.63	1.61	0.57
Marital status	0.15	0.35	0.18	0.38	0.74	0.15	0.36	0.19	0.39	0.77
Log (number of children)	1.09	0.34	0.50	0.55	0.70	1.08	0.34	0.49	0.50	0.83
Neighborhood income	28334	11557	27893	9781	0.07	27187	10882	27737	9351	0.80
N	556		722			348		722		

Notes: The null hypothesis of the t-tests is that sample means of the panel sample and the cross-section sample are equal.

Table Appendix I.4: How important is it for you to compare your income with other people's income?

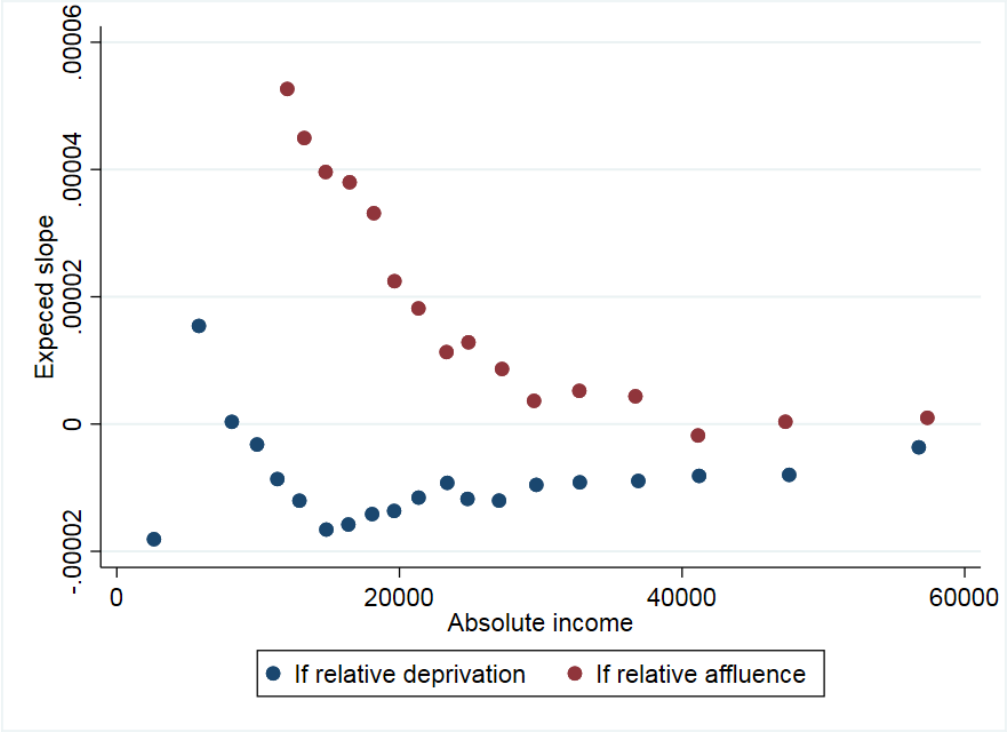
Answer		N	%
Not at all	1	530	73.41
	2	58	8.03
	3	59	8.17
	4	22	3.05
Very important	5	53	7.34
N		722	100

Table Appendix I.5: Effect of Relative and Absolute Income on Life Satisfaction. Full estimates.

	Coefficient		t-stat
γ_-	-0.13	***	-3.22
γ_+	1.75	***	3.69
ρ_-	-5.09	***	-5.09
ρ_+	2.81	***	4.08
β	-0.03	***	-2.77
ρ	0.71	***	8.70
Inactive	-0.02		-0.17
Unemployed	-0.29	*	-1.70
Ln(1+working hours)	-0.06		-1.60
Ln(age)	-0.27		-0.67
Active household members	0.97	***	3.38
Ln(Household members)	0.01		0.28
Widower	-0.51		-1.61
Separated/divorced	-0.21	**	-1.97
Two children (<18 yrs.)	0.14		1.14
Three children (<18 yrs.)	0.13		0.78
Four+ children (<18 yrs.)	0.23		0.93
Year	-0.04		-0.63
Montevideo	0.85	**	2.47
Constant	5.28	***	3.55
N		1444	
R^2		0.08	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fixed effect estimates of equation 1. This table reports the full set of estimates of our baseline model. The key parameters are also shown in Table 1. Standard errors of parameters ρ, ρ_-, and ρ_+ are estimated from bootstrapping equation 1 with 100 iterations. The variable "Active household members" is defined relative to the overall household members.

Figure 2: Marginal effect of absolute income for positive and negative relative incomes



Notes: Relative deprivation if $y < y^{rg}$ and relative affluence if $y > y^{rg}$. The derivatives are shown in equation 7.