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TESTING CONSUMERS' ASYMMETRIC PERCEPTION OF CHANGES IN HOUSEHOLD FINANCIAL SITUATION

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Using empirical analysis, this study shows that individuals perceive negative changes in their financial situation as larger relative to positive changes. Evidence of this asymmetry is provided using survey data on individual expectations, perceptions, income, and wealth. The study's results are in line with results in the psychological-economic literature but, contrary to that literature, are obtained by analyzing panel survey data, rather than experimental evidence. These results cast some doubts on the tendency of economists to treat symmetrically the relation between economic variables and income or wealth in their models.

1. Introduction

Many models, designed for policy advice or used in forecasting, make use of marginal propensities to consume or save out of different forms of wealth, and include relations between wealth and labor-market participation or labor supply. If implemented asymmetrically, these elasticities are an easy way to integrate behavioral responses into forecasting models, easier than alternative options like imputing changes in the preference structure. However only a few models use elasticities that depend on the direction of the change in the underlying variable. In this study we suggest that some puzzling results recently delivered by forecasting models could be due to wealth effects and the underlying asymmetric perceptions of wealth changes.

Take for instance the case of consumption forecasts in several European countries like Germany, Switzerland, Italy, and the Netherlands. Following the downturn in 2001 the residual of these forecasts has become larger and larger. The forecast models in these countries have a common feature: a unique elasticity between private consumption and passive returns to financial wealth. For the Netherlands this elasticity was calibrated on data from the previous 15 years, all years with positive growth. For time series with periods of downturn, one needed to go back to the 1970s. This makes the results derived from these data less useful to study behavioral responses nowadays, as direct stock market participation of

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households is now more common. Did this induce a different perception of market conditions by, for instance, increasing the elasticity of consumption to those returns? Is it possible to correct the elasticity of consumption to wealth, currently in these models, by a correction factor (we will call it a symmetry ratio later on) to be estimated? While a study about the perception of wealth changes obviously cannot resolve these puzzles completely, it may indicate an avenue for further research on the underlying variables. This study indicates a factor of proportionality that could be used when the development of the underlying wealth variable changes direction and the reactions of consumers cannot yet be estimated.

A number of studies have looked at the asymmetric reaction of individuals to wealth variables. In these studies, the asymmetry depends on the direction of the change of the underlying wealth component. Poterba (2000) suggests that the aggregate consumption reaction to capital gains or losses could be asymmetric. This is tested directly by Shirvani and Wilbratte (2000), who find that private-consumption responses are more rapid in the presence of capital losses. Also the development of house prices has an asymmetric effect on consumption and savings—although not all studies agree on the magnitude and the significance of the effect (Engelhardt, 1995; Alessie and Kapteyn, 2003). Pension wealth also has an asymmetric effect on consumption and the labor participation of older workers (Blake, 2004). These examples are drawn from rather diverse sectors of the economic literature, and show that, in general, the way that individuals react (in terms of consumption, saving, or labor participation) to changes in wealth components (capital gains, housing wealth, or pension wealth) is asymmetric, depending on whether this change is positive or negative. In general, this asymmetry points in a specific direction. The reaction is larger when the wealth component decreases. Capital losses generate larger increases in savings of individuals relative to their gains (Berben *et al.*, 2006). Decreases in housing wealth matter more to the consumption or saving decision (Disney *et al.*, 2002), and labor participation reacts more strongly to lower than to higher pension wealth (Blake, 2004) or residual lifetime resources (Mastrogiacomo and Bosch, 2006).[1] The question is therefore whether an underlying asymmetric perception of wealth changes exists, and whether we can provide empirical evidence of it. This could help in identifying the preliminary step that lies behind these asymmetric reactions.

Economic theory has found several justifications for these asymmetries. The most common has to do with the form of the utility function and the risk attitude. The fundamental reason is the assumption of diminishing marginal utility of wealth, which implies that agents have concave utility functions, reflecting risk aversion. Under this assumption, consumers would value increases in wealth less highly than they would value equivalent decreases in wealth. This explanation has a long tradition (Friedman and Savage, 1948).

Furthermore, Prospect Theory (Kahneman and Tversky, 1979) and different fields in the psychological economic literature look at evaluations of gains and losses starting from a reference point. This is done with reference to a number of

[1]These studies define the direction of the change on the basis of its sign. Any increment of wealth is considered as a gain, while individuals may consider only those changes that are above their expectations to be gains.

competing explanations. First, given the same variation in absolute value, losses have a greater impact than gains (loss aversion). This may be due to a framing problem. Within prospect theory, a second justification has been put forward. Individuals value an item more when it is a component of their wealth, relative to the value they were willing to pay to acquire it beforehand. The literature has named this asymmetric perception the "endowment effect" (Knetsch, 1989). It indicates that individuals have a "mental registration" of a negative change (a willingness to accept) that is different from the registration of the positive change. The existence of this effect has been questioned, as the experimental settings that have been chosen are perceived by some as being "artificial" (Shogren *et al.*, 1994), and the consumers being observed as "inexperienced" (List, 2004). With reference to the directional changes in household finances, a third explanation is concerned with idiosyncratic perceptions. This involves studies on positional utility (Frank, 1985) or habit formation, which call for the consideration of the reference point that individuals have in mind when expressing their perception.

This paper does not support any particular of these competing theories and explanations. The concern here is rather with the identification of the phenomenon, which involves searching for evidence of asymmetric wealth perceptions within survey data. We will supply evidence that allows us to abandon one aspect criticized in several studies: the experimental setting. Such a shift, however, is possible only if one is willing to make some assumptions, as will be clear later on.

One simplification that needs to be made from the outset is that we abstract initially from the reference point of each household, and rely on a positional benchmark, which is the average outcome of those who experience no change in their finances. The relevance of this literature was introduced above, but we do not dispose of data that directly quantify households' expected wealth changes (which may directly reveal, through stated preferences, the most obvious candidate for a reference point). This issue will be treated in a separate section, in which data on categorized wealth expectations of financial situation and income will be used as a reference point.

To summarize, this study contributes to the literature on two main points. First, we test whether an individual's perception of the change in his or her household's financial situation is asymmetric in a non-experimental setting; in so doing, we provide empirical evidence of this asymmetry without using experimental data. This means that we partly abstract from the reference point issue and use as a reference the ordinal sequence of these perceptions. Second, to account for this problem, we also show some computations that relate the individual's perception of change in his or her financial situation to the previously stated expectation, which is a most plausible reference point.[2] This second part is a separate piece of analysis, which is added merely to demonstrate that, also in the case of stated expectations, the relationship to perceptions is asymmetric.

The remainder of this study is organized as follows. The next section describes the set-up of the analysis and the data. Section 3 shows how asymmetric the (stated) perception of the change in financial situation is when this perception is

[2]We also look separately at the perceptions of those who fulfill their expectations, and find also that this group is "asymmetric" in perceptions.

related to the outcome of some underlying variables that elicit household finances. Here, the concern is simply the ordering—where a more positive increase in wealth should be perceived as an improvement. The Appendix examines the relation between the perception of wealth outcomes and the previously reported expectation; these also appear to be non-symmetric.

Our results also indicate that survey data contain evidence that negative changes in an individual's financial situation are perceived to be about twice as large as the positive changes.

2. Set-Up and Data

This study investigates several definitions of wealth and their development over time. We look at these variables because we also have data on the perceptions and expectations of the head of the household[3] concerning the financial situation of the household and its development. It is unclear, however, what is actually meant by "financial situation" and we therefore attempt to proxy this concept using several variables:[4] net financial wealth, net liquid wealth, total household income, and total wealth. Net financial wealth sums up all financial assets (accounts, stocks, bonds, mutual funds) and deducts liabilities (overdrafts, debts, negative accounts). Liquid wealth includes only the net amounts in disposable accounts (checking, saving, and employers accounts); this variable is therefore a component of financial wealth, to which it is indeed strongly related. Total household income includes all net income earned out of labor, pension, or welfare. Total wealth is equal to net financial wealth plus the value of real estate (this is set to zero for those who own no real estate). All of these definitions will obviously only provide an imperfect proxy of "household financial situation"; however, looking at several definitions will allow for robustness checks. These definitions are therefore the first (necessary) assumption that one needs to make in order to carry out a comparison between perceptions of financial situation and household finances.

This information has been extracted from the Dutch Social Economic Panel (SEP). It is administered by Statistics Netherlands (CBS), and contains approximately 5,000 households per year in the period 1990 to 2002 (where each year contributes about 7–8 percent of the total sample). The waves 1984 to 1989 are dropped due to inconsistent definition of household income, and to the lack of wealth expectations data. In structure and content, this panel survey is similar to the German Social Economic Panel (GSOEP) and the American PSID.[5]

In the SEP, the question eliciting subjective perceptions of realized finances (answered by the head of the household) refers to "household financial situation." Since we observe all financial items owned by each household, we can try to quantify it. The question about perceptions is formulated as follows: "How did the

[3]The head of the household is, according to Statistics Netherlands, the man in the household, if present. This definition is therefore not linked to age, income, or marital status. It is not possible to use a different definition of head, as the identification number of the head is the only time-consistent key that allows a household to be followed over time.

[4]It also appears that the way consumer look at different accounts may be very heterogeneous (Thaler, 1990).

[5]The sample includes non-self-employed respondents (derivation of self-employed financial wealth requires manipulations that we found unreliable). We are therefore left with about 50,000 observations.

TABLE 1

Sample Selection and Summary Statistics

Original panel		Observations 51,622
Reason for removal		
Missing perception of development of household financial situation	–113	
Missing net financial wealth or income	–10,394	
Missing other relevant characteristics (labor market, background characteristics, etc.)	–919	
Dimension sample for multivariate analysis (Table 6)		40,196
Summary statistics main variables in multivariate analysis	Mean	S.D.
Perception of change in financial situation	3.078	0.894
Relative change in financial wealth (% point)	0.829	4.215
Relative change in income (% point)	0.096	0.774
Relative change in total wealth (% point)	1.189	17.12
Relative change in liquid wealth (% point)	0.954	56.23
Age head	49.10	16.34
Male head	0.789	0.408
Family size	2.514	1.314
Intermediate education head	0.378	0.485
Higher education head	0.356	0.479
Head employed	0.601	0.490
Head self-employed	0.029	0.169
Head civil servant	0.144	0.351
Experience head	27.73	11.59
ln(Social security and pension wealth head)	13.73	0.565
Household net financial wealth * 10^6	0.013	0.017
Net household income * 10^6	0.028	0.018
Income shock	0.043	0.203
Health shock	0.162	0.368
Family member becomes not self-sufficient in t	0.067	0.250
Head becomes divorced or widow in t	0.004	0.060
Head receives inheritance	0.042	0.200

Notes: The upper panel of the table shows the sample selection. The original panel is cleaned of time inconsistencies in calendar year, year of birth, and age, where only heads of household above age 18 are allowed. The relative changes are measured in percentage points relative to period $t-1$. Perception of change in financial situation is expressed by the head. Also related to the head are all individual variables, such as age or education. Wealth and income are instead of the entire household, and are self-reported by each individual household member. The income shock is defined as a realization (small decrease, for instance) that is lower than the expectation in $t-1$ (no change, for instance). Year dummies are not included, each year has a share of 7–9% of the whole sample.

Source: SEP, own computations.

financial situation of your household develop in the last 12 months?" The respondent answers by choosing one of the five ordered categories listed from 1 to 5: "large decrease," "small decrease," "equal," "small increase," "large increase."

The steps of the sample selection and the descriptive statistics of the main variables are recorded in Table 1. Most of the observations that are lost are due to missing item non-responses. Sample statistics show an average perception of 3 (the value indicating "equality"), and also small relative percentage increments in all financial variables. Particularly interesting is the number of respondents reporting the occurrence of a health condition (Health shock, 16 percent) and the lower share of those who report an unexpected drop in income (Income shock, 4 percent) or who receive a bequest (4 percent).

In Table 2 we use the sample selected by dropping only missing responses or outliers on financial wealth or income. The table is divided into an upper panel

TABLE 2

HOUSEHOLD FINANCES (EURO), LEVEL, AND FIRST DIFFERENCES, IN THE LAST 12 MONTHS AND SUBJECTIVE PERCEPTIONS

		Net Fin. Wealth		Net Total Wealth		Liquid Wealth		Household Income		
Age	Perception	Med	S.D.	Med	S.D.	Med	S.D.	Med	S.D.	N
						(levels)				
Younger than 50	Large decrease	2,495	14,361	11,651	60,425	1,997	10,972	25,318	20,024	1,253
	Small decrease	3,672	15,117	25,704	64,540	2,922	12,582	26,675	18,446	3,617
	Equal	4,877	15,580	36,190	66,897	3,801	12,661	27,836	18,836	10,451
	Small increase	6,481	16,956	40,674	66,577	5,155	13,174	30,084	18,266	6,728
	Large increase	6,796	18,461	32,702	65,815	5,464	15,018	30,509	20,751	2,043
Older than 50	Large decrease	3,133	17,392	6,690	73,605	2,437	12,746	19,192	14,271	793
	Small decrease	5,249	18,258	10,265	78,564	4,270	14,719	18,887	14,515	3,080
	Equal	7,620	18,744	21,168	81,290	6,341	14,993	20,988	18,992	10,450
	Small increase	8,808	19,412	36,310	82,123	6,775	15,651	26,384	21,976	2,416
	Large increase	11,940	19,481	67,554	82,275	8,347	15,400	28,937	18,153	320
						(first difference)				
Younger than 50	Large decrease	–214	11,419	124	32,645	–237	9,223	–155	17,204	1,253
	Small decrease	–156	11,605	750	34,531	–193	10,364	77	16,464	3,617
	Equal	273	11,310	1,367	35,244	159	10,020	203	18,651	10,451
	Small increase	853	12,181	2,913	36,989	645	10,826	808	17,773	6,728
	Large increase	1,444	13,882	3,358	39,534	1,161	12,800	1,644	19,993	2,043
Older than 50	Large decrease	–176	11,973	–87	33,399	–220	10,746	–173	18,582	793
	Small decrease	16	11,769	170	31,475	21	10,338	–48	13,949	3,080
	Equal	171	12,495	421	33,740	142	10,939	42	16,133	10,450
	Small increase	400	13,185	1,004	34,590	422	11,810	112	21,722	2,416
	Large increase	2,220	16,644	2,670	42,606	1,504	13,749	524	27,215	320

Notes: The table reports median (med) levels and time differences in values between two adjacent years of four financial variables. Standard deviations are also reported. The first and last 5% of the wealth distribution are dropped in order to remove outliers. Figures are corrected for inflation, base year 2005. Household income is net of taxes.

Source: SEP, own computations.

(containing median levels) and a lower panel (containing first differences). Both panels show the five possible perceptions of younger and older respondents. We relate the perception of wealth changes to the median financial outcomes. We opted for median outcomes (dropping the tails of the wealth distribution), as these were found more reliable for SEP data (Alessie *et al.*, 1997). The table shows that to qualify a decrease as "large," respondents need a larger absolute wealth change, relative to an increase when both are compared to "equality." This must be about two to four times larger. This simple piece of descriptive analysis already suggests that respondents have asymmetric perceptions of their income or wealth changes.

The table also shows that wealth changes are ordered consistently with their perceptions, for both older and younger respondents. We split the sample into these two groups to show that observable characteristics (age, in this case) may affect outcomes. Older respondents, who have higher levels of wealth, evaluate these changes differently—though these evaluations appear also to be "asymmetric." The ratio between the relative distance of experienced changes (small or large) compared to equality, is typically above 1.[6] Before discussing the relationship between perceptions and observable characteristics, we will explore three more considerations concerning Table 2.

First, notice that for all wealth items the standard deviation of the level is high. Any consideration regarding the ordering of perceptions and financial outcomes may therefore seem rather optimistic. However, we also included total net household income as a variable. This figure has a lower standard deviation, and is also properly ordered relative to the subjective perceptions. If we compare the figures pertaining to wealth and income (upper panel of Table 2), we see that although the median levels are sometimes very close (as for total wealth and income), the standard deviation of income is about half as high. So while we cannot do anything to reduce the deviation of wealth figures, we observe that income behaves similarly to wealth in the perception of respondents, but with a much smaller deviation. This is not exactly a sensitivity analysis, but suggests that the discovery of an asymmetric wealth perception is not to be ignored only on the basis of the high deviation of wealth variables in the SEP. Median analysis on these data was found to be reliable (Alessie and Kapteyn, 2002).

The second issue concerns discounting. Although we have deflated all figures using the price index (CPI), individuals (the head of the household in this case) may have their own discount rate that not necessarily is picked up by the CPI. Sensitivity analysis, using different discount factors for the computations in Table 2, shows that we still find asymmetric outcomes of the same nature as in Table 2. Therefore when we relax the assumption that discounting is based only on standard deflating, we find that these results are robust (computations available from the author).

The third and final issue concerning Table 2 is that it does not show relative changes. One may think that the relative picture is a more correct approach, as a change of 300 Euro may be of little consequence to rich respondents. We have therefore added Table 3 which shows the percentage change between $t - 1$ and t of

[6]Take, for instance, the first differences in financial wealth. The relative (to equality) distance upward (853 – 273 = 580) divided by the relative distance downward (273 – (–156) = 429) returns an asymmetry of 1.4 for the younger respondents. The elderly, instead, have an asymmetry of (400 – 171)/(171 – 16) = 1.5.

TABLE 3

HOUSEHOLD FINANCIAL VARIABLES IN THE LAST 12 MONTHS AND PERCEPTIONS, MEDIAN PERCENTAGE CHANGE

		Net Financial Wealth		Net Total Wealth		Liquid Wealth		Household Income		
Age	Perception	Med	S.D.	Med	S.D.	Med	S.D.	Med	S.D.	N
Younger than 50	Large decrease	–8%	35	2%	35	–12%	62	–0.8%	3	1,253
	Small decrease	–4%	77	8%	30	–6%	78	0.3%	12	3,617
	Equal	7%	81	11%	31	5%	77	0.8%	97	10,451
	Small increase	16%	141	17%	52	14%	279	2.9%	368	6,728
	Large increase	29%	249	25%	112	28%	249	6.0%	5	2,043
Older than 50	Large decrease	–7%	108	–3%	18	–10%	116	–1.1%	6	793
	Small decrease	0%	66	3%	49	1%	51	–0.3%	35	3,080
	Equal	4%	258	5%	97	4%	185	0.2%	16	10,450
	Small increase	8%	15	9%	6	9%	657	0.5%	110	2,416
	Large increase	32%	29	14%	19	29%	35	1.9%	13	320

Notes: The table reports the relative difference in value over two adjacent years. The first and last 5% of the wealth distribution are dropped in order to remove outliers.

Source: SEP, own computations.

each indicator. This second table confirms in general the results above—although the asymmetry described above does not seem to be as strong for small wealth variations of the youth.

In the descriptive analysis we could not address two fundamental issues. The first concerns the thresholds that separate equality from small and large changes in financial situation. What is the amount needed above (below) which one starts to perceive a small increase (decrease) of the financial situation?

The second issue has to do with the reliability of stated perceptions. One way to examine the reliability or plausibility of these data is to look at their covariance relative to observable characteristics. Other covariates may also affect the perception of wealth outcomes. Typically, in these types of analysis, one may want to correct for demographics or the business cycle. Over time, radical changes may occur to the individual such as income shocks or health-related shocks. Household income or pension wealth should also affect the perception of changes in financial situation, as richer households may perceive a wealth decrease of a given size as smaller, relative to a poor household. However, as observationally similar households may still perceive their financial changes quite differently, we also want to account for unobserved heterogeneity. Such a multivariate analysis is difficult to carry out non-parametrically, and can be better implemented in an ordered model.

3. Model

This section addresses the two issues mentioned above. The first is the measurement of the thresholds that separate perceptions of financial outcomes. The second is the relation between perceptions and (non)observable characteristics. The analysis of the thresholds will then be employed to test whether we find any asymmetry between perceptions and outcomes in terms of our income and wealth variables. In the models, $y_{i,t}$ denotes the categorized answer to the question about perceptions. As in a standard ordered-response model, the dependent variable is related to the underlying latent variable $y^*_{i,t}$ in the following way:

$$y_{i,t} = j \quad if \quad (m_{j-1} < y^*_{i,t} \leq m_j) \quad j = 1, \ldots, 4. \tag{1}$$

The boundaries $-\infty = m_0 < m_1 < \ldots < m_4 < m_5 = \infty$ are constant across individuals and will be estimated. Although one could opt for a different strategy and estimate variable thresholds, our desired output is an average figure that could serve policymaking, rather than a description of such a detailed individual process.[7] Further, this approach is quite standard and will allow comparison of our results to those in other studies (see Das *et al.*, 1999; Mastrogiacomo, 2005). The underlying latent variable is modeled by the equation

$$y^*_{i,t} = \beta_0' x_{i,t} + \beta_1 z_{i,t} + \beta_2' \lambda_t + \tilde{\alpha}_i + u_{i,t} \quad i = 1, \ldots, N, t = 1, \ldots, T, \tag{2}$$

[7]Forecasting models for consumption or labor participation take wealth effects into account and are calibrated using elasticities estimated on wealth data. In recent decades wealth has in most countries followed an increasing pattern. At the household level, this is not necessarily the case. Our output gives policy makers an indication of the relation that they could expect between the elasticities currently present in their models, and those that could be estimated if time series with decreasing wealth were available for the last decades.

where $x_{i,t}$ is a vector of variables (excluding the constant) reflecting, for example, education, gender, and family composition. $z_{i,t}$ is a variable depicting a wealth outcome (relative variation in wealth outcomes, of the type reported in Table 3). This is, in turn, one of the four wealth or income variables listed above. Time effects λ_t are included to allow for macro-shocks, common to all respondents and not varying with $x_{i,t}$. The parameter $\tilde{\alpha}_i$ is an individual-specific (random) effect indicating unobserved heterogeneity across individuals.

The white noise, which is the individual time-specific error term $u_{i,t}$, is normally distributed and independent of the regressors $x_{i,t}$ and of the individual effect $\tilde{\alpha}_i$. The latter is treated as a random effect.[8] Exploiting the panel features of the data, we allow for an underlying correlation in the same spirit as Mundlak's (1978) extension of the random-effect model where the relation between $\tilde{\alpha}_i$ and $x_{i,t}$ is specified as $\tilde{\alpha}_i = \alpha_i + \gamma_1' \bar{x}_i$. In $\bar{x}_i$ only those variables expected to be correlated with $\tilde{\alpha}_i$ are included. Therefore, we also add the means of several time-varying controls.

3.1. *Results*

First we report the results when we assume $\beta_0 = 0$ and $\beta_2 = 0$. This allows us to analyze the exclusive relation between perceptions and outcomes without having to take account of possible endogeneities among the set of regressors. Next we show the results of a broader specification and by different age subgroups. This results in the estimation (see Table 4) of four different models, one for each of the income and wealth variables. In order to make results comparable to those of the broader model later on, we use the same estimating sample as in Table 6. In all cases there is a positive and generally significant relation, which indicates that higher increases in the outcome variables are associated with higher perceptions. As we have omitted all other observable characteristics, we do not interpret these results yet. For the moment we only want to look at the estimated thresholds.

These are ancillary parameters with no direct economic interpretation. These estimates could be used to translate the thresholds into figures with a more familiar economic meaning. We would like to know what the value of the financial outcome associated with each threshold (z_j) is, and how these values relate to each other. In order to do that, we need to rewrite equation (2) in such a way that we can derive the value of z_j that corresponds to m_j. This approach, which is unusual in the microeconomic literature on subjective evaluations quoted above, is more popular in studies of competition and market entry thresholds (Bresnahan and Reiss, 1991). Notice that normality of the residuals is not a prerequisite to the following transformations (i.i.d. is enough). As we estimate the model in the form of an order probit on the vector z, we can rewrite the model (simplifying the notation) as:

$$P(y_{i,t} = j) = \Phi(m_{j-1} < \beta_1 z_{i,t} \leq m_j) \tag{3}$$

$$= \Phi(m_j - \beta_1 z_{i,t}) - \Phi(m_{j-1} - \beta_1 z_{i,t}), \tag{4}$$

[8]For the random-effect estimator, see Butler and Moffit (1982), which is also implemented by the Stata program reoprob.ado. Our maximum simulated likelihood is estimated using Ox, with 150 random draws, it delivers the same results as Stata.

TABLE 4

ESTIMATES OF PERCEPTION OF FINANCIAL WEALTH WITH DIFFERENT VARIABLES

	Model 1		Model 2		Model 3		Model 4	
Dependent variable: stated perception	Estim	S.E.	Estim	S.E.	Estim	S.E.	Estim	S.E.
Relative change in financial wealth (%)	0.015	0.001						
Relative change in liquid wealth (%)			3.9E–05	1.04E–04				
Relative change in total wealth (%)					1.4E–03	3.4E–04		
Relative change in household income (%)							0.05	0.01
m_1	–1.86	0.01	–1.88	0.01	–1.87	0.01	–1.87	0.01
m_2	–0.91	0.01	–0.92	0.01	–0.92	0.01	–0.92	0.01
m_3	0.66	0.01	0.64	0.01	0.65	0.01	0.65	0.01
m_4	1.80	0.01	1.78	0.01	1.78	0.01	1.79	0.01
σ^2_α	0.22	0.01	0.22	0.01	0.22	0.01	0.22	0.01
s	1.59	0.03	1.23	0.01	3.38	0.78	1.64	0.04
N				40,196				

Notes: The four models are estimated separately on the same sample of approximately 7,800 households observed on average 5 to 6 years, therefore 39,939 observations. Standard errors allow for intragroup correlation.

Source: SEP, own computations.

where the m_j thresholds are estimated and Φ stands for the cumulative normal distribution. We are interested in the average value of z corresponding to the m_j ($j = 1, \ldots, 4 = J$) thresholds (that is, what we called z_j). We can compute it, as we observe j and can invert equation (4) once $P(y_{i,t} = j)$ is estimated. For each observation, we replace then the corresponding $z_{i,t}$. The thresholds z_j follow from solving the equations:

$$P(y_{i,t} = 1) = \Phi(m_1 - \beta_1 z_{i,t}) \tag{5}$$

$$P(y_{i,t} = 2) = \Phi(m_2 - \beta_1 z_{i,t}) - \Phi(m_1 - \beta_1 z_{i,t}) \tag{6}$$

$$P(y_{i,t} = 3) = \Phi(m_3 - \beta_1 z_{i,t}) - \Phi(m_2 - \beta_1 z_{i,t})$$

$$P(y_{i,t} = 4) = \Phi(m_4 - \beta_1 z_{i,t}) - \Phi(m_3 - \beta_1 z_{i,t}) \tag{7}$$

$$P(y_{i,t} = 5) = 1 - \Phi(m_4 - \beta_1 z_{i,t}).$$

We can rewrite equation (5) as

$$\Phi^{-1}(P(y_{i,t} = 1)) = m_1 - \beta_1 z_{i,t} \tag{8}$$

in order to derive $z_{j=1}$. As β_1, m_1 and $P(y_{i,t} = 1)$ are estimated and therefore known, we can compute $z_{j=1}$, which is the average value of $z_{i,t}$ corresponding to alternative $j = 1$. We can do the same for all other thresholds[9] until the last (that is equation (7) in this case):

$$\Phi^{-1}(1 - P(y_{i,t} = 5)) = m_4 - \beta_1' z_{i,t}$$

and derive $z_{j=4}$.

The great advantage of this approach is that we can interpret the thresholds as the amount needed to report a certain perception, without the need of additional identification assumptions, by only rewriting the estimated ordered model. We are not interested in the thresholds themselves, however, but in the relation between thresholds separating positive and negative changes in the underlying outcome (income and wealth). We define the ratio $s = \frac{z_3}{-z_2}$, which we call the *symmetry ratio*.[10] Although this is a new concept, it is intuitive that if individuals were symmetrically evaluating decreases and increases in their financial outcomes (relative to equality), then s would be 1. This would, for instance, mean that a small negative variation and a small positive variation would have the same distance from equality. If the symmetry ratio is larger (say, $s = 2$) then the amount of wealth necessary to identify a small increase would be twice as large as the sum needed to report a small decrease. Table 4 also shows the value of the symmetry ratio for all households and all financial variables. Make 1 the amount qualifying a small decrease; an average individual then needs 1.6 the same amount of net financial wealth in order to report a small increase in net financial wealth. This is in line with

[9]Computing $z_{j=2}$ needs inverting equation (6) and substituting for equation (8), such that $\Phi^{-1}[P(y_{i,t} = 2) + P(y_{i,t} = 1)] = m_2 - \beta_1' z_{i,t}$.

[10]The second threshold separates the perception "no change in financial situation" from the perception "small decrease." The third threshold instead separates "no change" and "small increase."

other findings in the endowment-effect literature (see Kahneman *et al.*, 1990; Tversky and Kahneman, 1991) which established a relation between gains and losses approximately equal to 2. Income and liquid wealth return similar values, while for total wealth it is somewhat higher.

We conclude this part with the remark that the other interesting symmetry ratio would be $\frac{z_4}{-z_1}$. However, the amount of respondents reporting "large increases" of their financial situation is unfortunately too small to yield reliable estimates.

3.2. *Measurement Error*

We have already seen that the information contained in wealth data can have high standard deviations. This is often the case in studies that look at wealth data in most European countries (Haliassos *et al.*, 2002). Wealth data may also be affected by measurement error, both unsystematic and systematic. The latter can be particularly troublesome with wealth data. There is a special kind of reporting error that can be easily addressed here. Self-reported wealth is likely to be subject to bias, as individuals that are not constantly updating their information set tend to under-report true values during periods of rapid appreciation and over-report them during periods of depreciation. In the presence of this type of measurement error, the estimated coefficients are biased toward zero (Wooldridge, 2001); also the transformation in the previous section may therefore return biased thresholds. One way to deal with measurement error of this type is to transform the continuous financial variables (wealth or income) into dummy variables expressing the position in the wealth or income distribution of each individual. There are also more parametric ways to deal with this issue (Brownstone and Valletta, 1996), although these are typically applied to earnings and not to wealth.

We select here a homogeneous sub-sample of individuals with similar characteristics: age in our case. If measurement error leads to over-reporting or under-reporting (of the type described above) in this sub-population it will affect the wealth or income level but not necessarily the position within the wealth or income distribution. Of course, whether one belongs to the first or last decile of the income or wealth distribution represents a loss of information relative to using the row data. Nonetheless, it helps in dealing with this special measurement error issue that often applies to self-reported wealth. We have therefore transformed all four financial variables into quantile indicators, and re-estimated Models 1 to 4 augmented by some background characteristics (results available from the author) on the entire sample and on the sub-sample of individuals aged 30 to 40, 40 to 50, and 50 to 60 (while our sample also includes younger and older respondents). The symmetry ratios that we derived from this second set of estimations are reported in Table 5. Due to the high correlation between the wealth variables, we show results only for net financial wealth and household income, both expressed as percentage changes with respect to year $t - 1$.

We see that most mean estimates in Table 5 are between the values of 3 and 6.8, while medians are between 1 and 2.5, which is not far away from what we estimated already above. This also seems to be robust to the age sub-samples that we selected.

TABLE 5

Symmetry Ratio Based on Model that Uses the Position of Each Household in the Distribution of the Relative Change in Net Financial Wealth and Household Income, Different Age-Related Sub-Samples

	Percentage Difference in Net Financial Wealth			Percentage Difference in Total Household Income		
	Mean	Median	S.D.	Mean	Median	S.D.
Whole sample	3.7	1.1	47.1	4.0	1.1	54.1
30–40 years old	3.0	1.2	23.9	4.3	1.2	101.2
40–50 years old	6.8	1.5	118.6	3.3	1.3	16.5
50–60 years old	3.8	1.3	20.6	6.1	2.5	85.4

Notes: We define the symmetry ratio as the ratio between the threshold separating no change in financial wealth from a small increase, over the threshold separating no change in financial wealth from a small decrease. The thresholds are now computed on the base of models that include transformed financial indicators in order to account for possible errors in measurement, like a common over- or under-estimation. The transformation expresses the position of the household in the distribution of the financial variable (in which decile of the distribution a household is located) rather than expressing levels of income or net financial wealth.

Source: SEP, own computations.

3.3. *Multivariate Analysis*

We now turn to the interaction between financial wealth perceptions and other observable characteristics. Table 6 shows the model results when we augment the models, up to including also time effects, taste shifters, shocks, financial variables, mean variables, and unobserved heterogeneity. As we drop observations where this information is missing, the sample reduces to about 40,000 observations as explained in Table 1. In order to simplify the exposition, the table includes only those estimates concerning the relative change (in percentage points) of net financial wealth. Thus far, we have seen that results are robust through the different financial variables and age sub-samples. Results for the other three variables, highly correlated to each other and therefore not jointly included, are qualitatively similar and are available from the author. The table shows ordered probit coefficients and not marginal effects. The table contains results for the model in which the perception of the development of household finances in the last 12 months, reported in t, is the dependent variable (Models 5 and 6). In the second model we drop the shock indicators, as one may doubt that some family-related events occurred as completely unexpected. The results of Models 5 and 6 are described together.

The indicators for the current year are introduced in order to correct for business-cycle effects that may be common to all respondents. Recall that in periods of economic downturn perceptions may tend to overestimate real outcomes, which shows the importance of adding such controls. These are significant and indicate that individuals perceived a decline in their financial situation after 1991. This follows the business cycle as, beginning with 1998 (notice that in 1998 individuals reported the development of their wealth in 1997), individuals perceived qualitative improvements in their net financial situation, which again stopped after 2001. We include also a number of taste shifters that are present in most of the studies to which we refer. Education is often associated with cognitive

TABLE 6

MULTIVARIATE ANALYSIS

Dep. Variable: Perception of Change in Financial Situation	Model 5		Model 6	
	Coeff	t-value	Coeff	t-value
Relative change in financial wealth (%)	0.01	8.17	0.01	8.29
Time effects				
Year 1992	–0.12	–4.44	–0.14	–5.20
Year 1993	–0.18	–6.52	–0.17	–6.33
Year 1994	–0.20	–6.91	–0.23	–8.29
Year 1995	–0.16	–5.72	–0.17	–6.17
Year 1996	–0.21	–7.70	–0.19	–6.94
Year 1997	–0.11	–3.81	–0.08	–3.05
Year 1998	0.12	4.10	0.12	4.10
Year 1999	0.07	2.35	0.08	2.99
Year 2000	0.24	8.19	0.26	8.87
Year 2001	0.28	9.25	0.29	9.80
Year 2002	–0.18	–5.93	–0.17	–5.72
Taste shifters				
Age head	0.00	–0.54	0.01	4.12
Male head	–0.12	–5.47	–0.13	–5.63
Family size	–0.05	–7.38	–0.05	–7.40
Intermediate education head	–0.04	–2.13	–0.04	–1.84
Higher education head	–0.06	–2.75	–0.06	–3.06
Labor market characteristics				
Head employed	0.39	17.63	0.52	23.81
Head self-employed	–0.12	–2.92	–0.20	–5.15
Head civil servant	–0.03	–1.39	–0.03	–1.26
Experience head	–0.01	–6.75	–0.01	–8.69
Other financial controls				
ln(Social security and pension wealth head)	–0.02	–3.08	–0.02	–4.00
Household net financial wealth*10^6	2.82	4.64	2.41	4.00
Net household income	1.16	2.28	0.91	1.81
Houshold means over time				
Mean SSW	0.02	2.39	0.03	2.90
Mean net financial wealth	–0.57	–0.66	0.20	0.23
Mean household income	2.41	2.75	1.77	2.02
Mean active savings	0.01	5.17	0.01	5.37
Observed micro-shocks				
Income shock	–2.24	–67.83		
Health shock	0.03	1.93		
Family member becomes not self-sufficient in t	–0.12	–4.99		
Head becomes divorced or widow in t	–0.65	–6.58		
Head receives inheritance	0.08	2.69		
Other statistics				
m_1	–2.49	–17.91	–1.91	–13.64
m_2	–1.33	–9.58	–0.95	–6.79
m_3	0.35	2.51	0.66	4.72
m_4	1.53	11.04	1.83	13.08
σ_α^2	0.16	28.78	0.17	30.27
s	2.73	42.95	2.41	15.4
Log likelihood	–46,177		–48,788	
N	40,196			

Notes: The variables excluded are Year 1991, Lower education, Female head. The shock indicators are defined as a transition between year $t-1$ and t. s is the mean symmetry ratio. Standard errors allow for intragroup correlation.

Source: SEP, own computations.

capacities that may be related to one's perceptions, while family size may signal the quality of household finances (due, for instance, to the number of income earners). These taste shifters are also generally significant although the effect of age is extremely close to zero and surprisingly switches signs across the two specifications (although always very close to zero in both). Male heads report having experienced a lower financial situation in the last year, as lower educated heads do, or heads of larger households.

Sudden changes in the household environment could also affect financial outcomes and therefore one's perception of these outcomes. Consider, for instance, an unanticipated drop in income, the onset of a health condition (likely to be correlated to the earning capacity), or the loss of a household member. These events could be negatively correlated to household finances. Positive events could also occur, like receiving a bequest. The unanticipated income shock is derived by the questions eliciting expectations in $t-1$ and realizations in t of household income. The variable captures those who expected a higher change ("small increase," for instance) and obtained a lower realization ("small decrease," for instance). The related coefficient is, as expected, negative and significant. The perception of financial situation development also lowers when a member of the family gets into health problems or exits the households, whereas it improves when someone in the household receives a bequest.[11] Dropping these indicators (Model 6) did not affect the results significantly. We also include financial variables, since the perception of the change in financial situation may well depend on the outcome of other financial variables rather than only on the relative change listed at the top of the table. Consider, for instance, those who may evaluate their change in financial situation as small, relative to the change in their absolute level of income or pension wealth. Among the financial variables, income and the variation (delta) of net financial wealth over time are significant. They show a positive effect in line with our expectations and the results of the previously estimated models. Individuals with higher pension wealth, which we impute on the basis of income profiles and institutional rules, have a lower perception of changes in household finances. While this may seem counterintuitive, it may also simply indicate that individuals do not include pension wealth (which is compulsory savings in the Netherlands) in their perception of the household financial situation. Most individuals are found to be relatively uninformed about their pension wealth (Japelli *et al.*, 2006) and are not able to perform the computations (Lusardi and Mitchell, 2007) that we have performed here. The household mean variables, which are those variables correlated to the unobservable individual effects, are all significant and positively related to the dependent variable, with exception of mean financial wealth. This means that those unobservables that are correlated to these characteristics are also positively correlated to the perceived realizations of financial situation.

The table also reports the estimated thresholds and the variance of the simulated individual effect. Finally, the symmetry ratios are also reported. These vary

[11]Rather than bequests received, we might better have used expected bequests. It would be interesting to disentangle the effect of exogenous events, like receiving a bequest or capital gains from stocks in the future, from the effect of exogenous patterns in spending on the perception of current outcomes. This should be an avenue for future research on a richer dataset.

between 2 and 3—again differing little from all of the statistics that we have shown so far.

3.4. *Subjective Expectations as Reference Points*

This far, we have applied the definition of perceived increases to the financial situation as positive variation of financial wealth relative to equality (see footnote 7 for a numeric example). Our definition of asymmetry is therefore centered around the (average) perception of equality expressed by individuals. One may define as a gain everything above a value that differs from this average equality. If this is the case, then the descriptive results in Table 2, showing asymmetry, may actually be misleading. If we pursue the numeric example on financial wealth in Table 2 further, and (for instance) assume that the reference point is not equality (273 Euro) but, say, closer to zero, then the asymmetry increases substantially.

Stated expectations are found to be extremely informative to test this (BenitezSilva *et al.*, 2008; Manski, 2004), as stated expectations could qualify as a reference point alternative to equality in realizations (there are, in principle, also other candidates, such as positional variables relative to peers, or vignettes relative to individuals in similar conditions as the respondent (van Soest *et al.*, 2007)). Other alternative ways to approach the reference point issue in the experimental papers on prospect theory use flexible threshold models (Tsay, 1998). These approaches are beyond the scope of the present study.

As it seems reasonable to relate the perception of the financial situation change to the *a priori* expectation of it, we decided to apply the methodology of Das *et al.* (1999). We make use of the information derived from the question "How will the financial situation of your household develop in the next 12 months?" that is asked 12 months before enquiries are made into perceptions. This allows us to test how stated expectations relate to the individual distribution of anticipations of financial situation. If these also appear to relate asymmetrically to perceptions, then it is not the "equality" reference point that induces the results that we have shown.

The intuition behind this methodology is that when individuals answer the question about their expectations concerning their future financial situation, they report a location of their individual subjective distribution relative to a prospective event. As in Das and van Soest (2000) and Das *et al.* (1999), and other contributions of these authors, individuals who experience no shocks should report a location of their individual subjective distribution that coincides with the one relative to the distribution of the realization. This simple reasoning offers the possibility of checking whether individuals think "symmetrically" about their future financial situation. If so, respondents should report a location of their individual subjective distribution such as the mean, the median, or the mode (if we assume normality then any of them would qualify).

We tested this and conclude that none of these statistics summarizes the distribution of stated expectations relative to perceptions. We observe that individuals tend to report lower perceptions relative to stated expectations. This "pessimistic" perception (see Das *et al.*, 1999) suggests that the reference point should be below realizations. We also find that financial outcomes relate asym-

TABLE 7

Symmetry Ratios for Percentage Difference in Net Financial Wealth of Individuals with Fulfilled Income Anticipations of No Income Change

Individuals that Fulfill their Income Expectations			
	Mean	Median	S.D.
Whole sample	3.3	1.2	27.2
30–40 years old	2.5	1.4	14.8
40–50 years old	2.5	1.5	17.2
50–60 years old	2.7	1.2	12.3

Notes: We define the symmetry ratio as the ratio between the threshold separating no change in financial wealth from a small increase, over the threshold separating no change in financial wealth from a small decrease. The thresholds are now computed for the sub-sample of those who expect and realize no income change.

Source: SEP, own computations.

metrically to perceptions. This suggests that moving from a reference point of equality (in realizations) toward individual expectations (which are lower than realizations according to the literature that has studied these same data) can only serve to magnify the asymmetric effect, as in the numeric example above, rather than call into question its existence. We report the results of these tests in the Appendix; a more extensive discussion on the issue is contained in a companion study to this paper (Mastrogiacomo, 2006).

Finally we compute symmetry ratios for a specific sub-sample. We take into account only those individuals whose income expectations are fulfilled (in the sense that they expect and realize equality in income; notice that we select the sample on income expectations rather than on financial expectations and realizations, as we need variation in financial realizations to determine whether there is an asymmetry). This sub-sample was neither jolted by income shocks nor subject to any unexpected income change. When we look at the financial outcomes and perceptions of this group, we also find evidence of asymmetry (see Table 7) that is comparable to the rest of the sample.

To conclude this section, we note that one would ideally prefer to have information on the reference point of each individual in order to be conclusive on the issue of asymmetric perceptions. In the absence of this information, we propose three different approaches. First, we related perceptions of small variations to average perceived equality and computed symmetry ratios. Second, we related realizations of household finances to (prior) expectations using the methodology of Das *et al.*; third, we looked at the symmetry ratio of those individuals who expected and experienced no shocks nor a relevant change in income. All of these approaches returned comparable asymmetries.

4. Summary

The relationship between changes in wealth and economic variables such as consumption, savings, or labor participation, is often found to be asymmetric with

regard to the direction of the wealth change. This study aimed to produce empirical evidence that shows that the perception of changes in household finances is also asymmetric. This is in line with findings in several sectors of the literature (loss aversion and prospect theory, for example). Many studies have been criticized on the basis of the artificial setting in which the experimental evidence of asymmetry is derived. In this study we returned to this issue by also showing that if we abandon the experimental setting and use survey panel data, individuals perceive asymmetrically the direction of the change in their financial situation.

This study tested whether idiosyncratic relations are found when positive wealth changes were separated from negative ones, within a given definition of financial situation. We accomplished this by proxying "financial situation" with four different wealth or income measures. Using perceptions of financial situation, we related these to income and wealth outcomes, and found that individuals need a larger absolute variation in income or wealth to perceive it as an increase relative to the change needed to perceive a decrease. This is computed relating these differences to the (average) sense of equality in financial outcomes reported in the sample. This benchmark could however be perceived as being somewhat arbitrary. The asymmetry is then confirmed when we related the perception not to the equality but to the *a priori* reported expectation of the change in financial situation. We did that in order to take into consideration the possibility that a common reference point (equality normalized to zero, in this case) might be inappropriate. As a last check we isolated those who report expecting and realizing no income change. These individuals have anticipated income changes correctly, and their financial environment is likely to be stable. Also for those who fulfill their income expectations, wealth perceptions are found to be asymmetric. Our results show that mean asymmetries are somewhat higher than those found in the literature, while medians tend to be somewhat lower.

The high standard deviation of the available wealth data could partly drive our results. A simple correction that takes care of a special type of measurement error often pertinent to reported wealth measures, indicated that our estimates replicate closely the loss-aversion coefficients found in the literature, or the endowment effects outcomes. These computations show that individuals qualify as "small" a particular decrease in their finances and also call an increase "small" when it is about twice as large as the decrease.

We can put our findings in a broader perspective for further research. As economists make use of the relation between wealth and economic variables in their models, we suggest that the direction of the wealth change should be taken into account in order to determine the size of the reaction, as perceptions could be asymmetric. We suggest that the relation between the perceptions of individuals with regard to negative and positive changes in their financial situation derived from survey data is about two, in accordance with most findings in the economic literature.

Further research should investigate whether the asymmetry in perceptions might be due to a real asymmetry in the information content of up-movements and down-movements in wealth. This is interesting mostly for financial wealth, as downward fluctuations of stocks are related to negative developments in income and employment. No consumption data were available for this research, but the

question arises about whether an asymmetry in the consumption response could be due to perceptions rather than information, which is contained, for instance, in the development of other macro variables.

Appendix: Non-Parametric Tests

The data contain questions eliciting expectations of outcome y = financial situation; where respondents may choose among ordered categories. Let $f(y|s)$ be the subjective probability density of outcome y given information s. Respondents choose one of the K categories $C_1, \ldots, C_K$ of the form $C_k = (m_{k-1}, m_k]$, with $-\infty = m_0 < m_1 < \ldots < m_{k-1} < m_K = \infty$. The threshold values m_k are subjectively determined, and ordered models may be used to estimate their values. The answer to the expectation question is denoted by p. The minimization of some loss function will return p (see equation (10)). If the respondents answer the question having in mind the most likely outcome, they will report the mode of their subjective distribution. This means that they report the category

$$p = \arg\max_k P\{y \in C_k | s\}. \tag{9}$$

This corresponds to minimizing, with respect to k, the expected loss function: $E1(y \notin C_k)|s$. Here we are dealing with the behavior of an individual forming some point expectations p^* and choosing the category p that contains p^*. The general form of the problem is minimizing the expected loss for some loss function L:

$$\begin{aligned} p^* &= \arg\min_{\pi} \int_{-\infty}^{\infty} L(y-\pi) f(y|s) dy \\ p = k \quad &\text{iff} \quad p^* \in C_k. \end{aligned} \tag{10}$$

If respondents interpret the question as eliciting the median of $f(y|s)$. then the relative loss function will be $L(u) = |u|$ while, for the category containing the mean, the loss function will be $L(u) = u^2$ (Das *et al.*, 1999).

If individuals are good predictors, then the categorized answer to the question about expectations and to the question about realizations should mirror a location from the same distribution. Assuming these distributions are normal,[12] and if individuals are "symmetrical," this location should be either the mode, the median or the mean of such individual distribution. By comparing expectations and outcomes, we perform the following tests to show that what individuals report may not be found at any of those locations.

A.1. *Modal Category*

Following Das *et al.* (1999), we formalize the modal category assumption for individual i, given the available information x_i, as

$$P\{c_i = k | x_i, p_i = k\} \geq P\{c_i = j | x_i, p_i = k\}, \quad j = 1, \ldots, K, \tag{11}$$

[12]Or, more in general, symmetrical and unimodal.

where c_i is the realized category and k is the predicted category. For those individuals with $p_i = k$, most outcomes will be located in category k. Realizations, in the best-case scenario, are based upon drawings from the same distribution leading to probabilities (11). We can use observations of c_i to see whether equation (11) holds. Define, for notational convenience, $P_j \equiv P\ c_i = j|x_i,\ p_i = k$. Let $\hat{P}_j$ be the sample equivalent of P_j.[13] Under the hypothesis of the independence of realizations, frequencies of financial situation can be used to estimate the probabilities in (11). Assuming x_i = gender, Table 8 reports the frequencies. Table 8 shows that only for the case $k = 3$ can the modal category assumption be used as a model generating expectations for both males and females. For $k = 2$, for instance, this is never true.[14]

A.2. *Median Category*

It is natural to interpret p_i as containing the α-quantile of the respondent's subjective distribution of y_i. For $\alpha = 0.5$, the category is the one containing the median. If p_i^* is the α-quantile (corresponding, for convenience, to the cumulative probability α), then in the best case scenario it must be

$$P\{y_i - p_i^* \leq 0|x_i\} = \alpha. \tag{12}$$

Since we observe the category c_i, we focus on the case with $c_i = k$. Then

$$P\{c_i \leq k-1|s_i,\ p_i = k\} < \alpha \leq P\{c_i \leq k|s_i,\ p_i = k\},$$

which implies the following inequalities:

$$P\{c_i > k|x_i,\ p_i = k\} \leq 1-\alpha \tag{13}$$

$$P\{c_i < k|x_i,\ p_i = k\} < \alpha. \tag{14}$$

To fit in the best-case scenario, the α-quantile of c_i must fall in category k, given that $p_i = k$; with no more than 100 α percent of realized values in lower categories and no more than 100 $(1 - \alpha)$ percent in higher categories. A test for (13) and (14) is reported in the right-hand panel of Table 8 using the data of the left-hand panel of the same table:

$$\sqrt{n}\left(\sum_{j=k+1}^{K}\hat{P}_j - \sum_{j=k+1}^{K}P_j\right) \xrightarrow{d} N\left(0, \left(1-\sum_{j=k+1}^{K}P_j\right) * \sum_{j=k+1}^{K}P_j\right)$$

where n is the number of observations and x_i includes only gender. In Table 8 the value of $\alpha = 0.5$ should be included in the reported intervals in order to conclude that individuals are reporting the median as a point expectation.

[13]That is, the number of observations with $c = j$ and $p_i = k$ and the given value of x_i.

[14]We also estimated Table 8 conditional on several covariates of x_i, such as year and education. The results are confirmed.

TABLE 8

TESTS FOR MODAL CATEGORY AND MEDIAN CATEGORY ASSUMPTION

	Modal Category Assumption						Median Category Assumption				
	$P\{c_i = k \mid x_i, p_i = k\} \geq P\{c_i = j \mid x_i, p_i = k\}$						$P\{c_i < k \mid p_i = k\}$		$P\{c_i > k \mid p_i = k\}$		
	Gender	*c = 1*	*c = 2*	*c = 3*	*c = 4*	*c = 5*	Lower	Upper	Lower	Upper	
											k = 1
k = 1	1	0.3	0.3	0.3	0.1	0.0	.	.	0.67	0.72	
large	2	0.3	0.3	0.3	0.1	0.1	.	.	0.64	0.73	
decrease											k = 2
k = 2	1	0.1	0.3	0.4	0.1	0.0	0.09	0.11	0.59	0.61	
small	2	0.1	0.3	0.4	0.2	0.0	0.09	0.12	0.54	0.58	
decrease											k = 3
k = 3	1	0.0	0.2	0.6	0.2	0.0	0.16	0.17	0.23	0.24	
equal	2	0.0	0.1	0.6	0.2	0.0	0.19	0.21	0.17	0.19	
											k = 4
k = 4	1	0.0	0.1	0.4	0.3	0.1	0.47	0.49	0.12	0.13	
small	2	0.0	0.1	0.3	0.4	0.1	0.50	0.55	0.08	0.11	
increase											k = 5
k = 5	1	0.1	0.1	0.3	0.3	0.3	0.64	0.68	.	.	
large	2	0.0	0.1	0.2	0.3	0.4	0.67	0.77	.	.	
increase											

Notes: k = predicted category, c = realized category. Gender = 1 stands for male.
Source: SEP; own computations.

This test uses the ordering of the categories. This suggests that the assumptions required for the modal category case were less stringent.[15] In this sense, the median category assumption is more restrictive, and it comes as no surprise that this symmetric moment also does not seem to summarize the distribution of anticipations of financial situation.

A.3. *Mean Category*

When the loss function is $L(u) = u^2$, then p_i reflects the category containing the mean. To test this implication we need the data that in the SEP approximate the concept of y_i rather than the ordered category c_i. We use, among the other variables, net financial wealth as a proxy of household financial condition, as reported in the question eliciting c_i.

In this case the answer p_i is the category containing $E\{y_i|x_i\}$. When $p_i = k$, then p^* will fall within two adjacent thresholds (m_{k-1} and m_{k1}). That is

$$E\{y_i|x_i,\ p_i = k\} \in \left(m_{k-1,i},\ m_{k,i}\right].$$

In Table 2, for instance, we already defined x_i as a dummy that identifies older respondents. In Table 2 the medians increase with k; the means do so as well, although we do not show that in the table. The means (available from the author) show that equality is far from zero. This could depend on the definition of y that we adopt (which, for instance, does not include pension wealth). More likely, it also suggests that other covariates—and not only age—may be related to financial wealth and thus affect m. Overall, none of the three hypotheses tested produced convincing results in terms of respondents' symmetry relative to reported expectations. This probably indicates that individuals may actually be minimizing asymmetric loss functions that attach more weight to lower reported categories.

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[15]For the case of $\alpha = 0.5$ we see that (13) and (14) for all k do not imply that (12) holds for all k and j, and vice versa. It is, however, true that for the extreme values of the k categories the inequalities (13) and (14) will hold (for $k = 1$, which is the first category, (13) implies (12), while for the last category $k = K = 5$, (14) implies (12)). Such a test imposes that an absolute majority should fall into a certain category, rather than a relative majority (as in the modal case).

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