Who Is (More) Rational?

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Online Appendix

Appendix I: Experimental design

I. Experimental procedures

The experiment consisted of 25 independent decision rounds. In each round, a subject was asked to allocate tokens between two accounts, labeled blue and red. The blue account corresponds to the x-axis and the red account corresponds to the y-axis in a two-dimensional graph. Each decision involved choosing a point on a budget line of possible token allocations. Each round started by having the computer select a budget line randomly from the set of lines that intersect at least one axis at or above the 50 points and intersect both axes at or below the 100 points. The budget lines selected for each subject in his decision problems were independent of each other and of the budget lines selected for other subjects in their decision problems.

The x-axis and y-axis were scaled from 0 to 100 points. The resolution compatibility of the budget lines was 0.2 points. At the beginning of each decision round, the experimental program dialog window went blank and the entire setup reappeared. The appearance and behavior of the pointer were set to the Windows mouse default and the pointer was automatically repositioned randomly on the budget line at the beginning of each round. To choose an allocation, subjects used the mouse to move the pointer on the computer screen to the desired allocation. Subjects could either left-click or press the Enter key to record their allocations. The computer program dialog window is shown at the end of the experimental instructions which are reproduced below.

At the end of the round, the computer randomly selected one of the accounts. The two accounts were equally likely to be selected. Subjects were not informed of the account that was actually selected at the end of each round. At the end of the experiment, the computer selected one decision round for each participant, where each round had an equal probability of being chosen, and the subject was paid the amount he had earned in that round.

II. Experimental instructions (Dutch / *English*)

Screen 1

Deze vragenlijst bestaat uit een experiment op het gebied van individuele besluitvorming. Onderzoeksinstellingen in Groot-Brittannië en Nederland hebben geld beschikbaar gesteld om dit onderzoek uit te voeren. In dit experiment kunt u echt geld verdienen dat zal worden betaald in de vorm van CentERpunten. Wat u verdient is voor een deel afhankelijk van uw beslissingen en voor een deel van toeval. Leest u alstublieft de instructies zorgvuldig door omdat het om een aanzienlijk geldbedrag gaat. Gedurende het experiment spreken we over punten in plaats van euro's. Uw verdiensten worden berekend in punten en later aan u in geld uitbetaald. LET OP: U zult pas over een aantal weken het aantal punten aan uw tegoed toegevoegd zien. U zult dit niet meteen zien.

4 punten = 1 euro

This questionnaire consists of an experiment in the field of individual decision making. Research institutes in the United Kingdom and the Netherlands have made funding available to conduct this research. In this experiment you can earn real money, which shall be paid out in CentERpoints. The amount you earn depends partly on your decisions and partly on chance. Please read the instructions carefully, because a considerable amount of money is involved. During the experiment, we will refer to points instead of Euros. Your earnings will be calculated in points and later paid to you in money.

4 points = 1 Euro

Screen 2

Dit experiment bestaat uit 25 ronden. Iedere ronde staat op zichzelf, maar de taak die u hebt, is steeds dezelfde. In iedere ronde hebt u de taak om punten te verdelen tussen twee rekeningen, die BLAUW en ROOD heten. Bij het begin van iedere ronde krijgt u een aantal mogelijke puntenverdelingen, waaruit u er één mag kiezen. Nadat u uw beslissing hebt gemaakt, kiest de computer op basis van toeval een rekening; elk van de rekeningen BLAUW en ROOD hebben een gelijke kans om gekozen te worden. Uw verdiensten in een ronde zijn de punten die u op de rekening hebt gezet die door de computer is gekozen, de punten die u op de andere rekening hebt gezet tellen niet mee.

This experiment consists of 25 rounds. Every round is independent, but your task will be the same in every round. In each round, your task is to distribute points between two accounts, called BLUE and RED. At the start of each round, you will receive a set of possible distributions of points, out of which you are allowed to choose one. After you have made your decision, the computer will randomly select one of the accounts; both of the accounts BLUE and RED have the same probability of being selected. Your earnings in a particular round are the points that you allocated to the account that has been selected by the computer, the points that you distributed to the other account do not count.

Screen 3

Om uw beslissing in iedere ronde te maken, maakt u gebruik van een grafiek. Hieronder ziet u hoe dat er uit ziet. De BLAUWE rekening komt overeen met de horizontale as en de RODE rekening komt overeen met de verticale as. Ieder punt in de grafiek stelt een verdeling voor tussen de BLAUWE en de RODE rekening. Bij het begin van iedere beslissingsronde ziet u een lijn die de mogelijke puntenverdelingen tussen de BLAUWE en RODE rekening voorstelt. In iedere beslissingsronde kunt u alleen een punt kiezen, dat op de lijn ligt. Voorbeelden van lijnen die u te zien kunt krijgen ziet u hieronder. In elke ronde selecteert de computer een lijn die de beide assen snijdt tussen de 10 en 100 punten en ten minste één van de assen op 50 of meer punten. De lijnen die voor u in de verschillende beslisronden worden geselecteerd zijn onafhankelijk van elkaar.

To make your decision in each of the rounds, you will use a chart. Below you can see what this looks like. The BLUE account corresponds to the horizontal axis, and the RED account corresponds to the vertical axis. Every point on the chart resembles a distribution between the BLUE and RED account. At the start of each decision round, you will see a line which shows the possible distributions of points between the BLUE and RED account. In each decision round you can only choose a point, which lies on the line. Examples of lines that you will see are shown below. In each round the computer selects one line which crosses both axes between 10 and 100 points, and at least one of the axes at 50 or more points. The lines that will be selected for you in the other decision rounds are independent of each other.

Screen 4

In iedere ronde krijgt u van de computer een nieuwe lijn. Bij iedere keuze, mag u elke toewijzing van punten kiezen tussen de BLAUWE en de RODE rekening die op de lijn ligt. U mag er één punt kiezen. Hieronder ziet u een voorbeeld van zo'n lijn. Een mogelijke keuze is A, waarbij u 20.0 punten toewijst aan de BLAUWE rekening en 41.0 punten aan de RODE rekening. Een andere mogelijke keuze is B, waarbij u 55.4 punten toewijst aan de BLAUWE rekening en 17.6 punten aan de RODE rekening. Er zijn nog veel meer punten op deze lijn die u kunt kiezen dan alleen punt A of B. U mag ieder punt op de lijn kiezen. Alleen, u kunt maar één punt kiezen in iedere ronde.

In every round the computer will provide you with a new line. With every choice, you are allowed to choose any allocation of points between the BLUE and RED account that is located on the line. You are allowed to choose one point. An example of one of those lines is shown below. A possible choice is A, where you allocate 20.0 points to the BLUE account and 41.0 points to the RED account. Another possible choice is B, where you allocate 55.4 points to the BLUE account and 17.6 points to the RED account. There are many more points on this line that you can choose, other than point A and B alone. You are allowed to choose any point on the line. The only condition is that you can only choose one point in each round.

Screen 5

Op dit scherm kunt u even twee ronden oefenen. Om te beginnen klikt u op START. Dan krijgt u een lijn te zien met mogelijke puntenverdelingen in deze oefenronde. Om een toewijzing te kiezen gebruikt u de muis om de cursor op het computerscherm langs de lijn te bewegen naar de toewijzing die u wenst. (Om dit de doen, breng de cursor eerst in de buurt van het punt op de lijn.) U ziet dat u alleen toewijzingen kunt kiezen die op de lijn liggen. Als u weet welke beslissing u wilt nemen, klikt u op de linker muisknop om uw keuze te maken. Om de beslissing te bevestigen, klikt u op de OK knop. U wordt dan automatisch doorgestuurd naar de volgende ronde. Om een ander punt op deze lijn te kiezen, moet u op annuleren klikken. Nadat u twee keer een oefenronde hebt gedaan, zal de 'verder' knop verschijnen waarmee u naar de volgende informatiepagina kunt gaan. Dit is een oefenscherm. De keuze die u maakt, wordt niet opgeslagen.

In this screen you can practise two rounds. Click the START button to begin. Then, you'll see a line with the possible distributions in this practice round. To choose a distribution, use the mouse to move the cursor on the screen along the line towards the distribution of your choice. (To do this, first move the cursor in the neighborhood of the point on the line.) You can see that you can only choose distributions that are located on the line. When you know which decision you would like to make, click on the left button on your mouse, to select your choice. To confirm your decision, click the OK button. You will then be automatically transferred to the next round. To choose another point on this line, click the Cancel button. After you have practised two rounds, click 'continue' to proceed to the next information page. This is a practice screen. The decision you make, will not be recorded.

Screen 6

Nadat u uw keuze hebt bevestigd, kiest de computer op basis van toeval één rekening; elk van de rekeningen BLAUW en ROOD hebben een gelijke kans om gekozen te worden. Als de BLAUWE rekening is gekozen, zijn uw verdiensten in de ronde het aantal punten op de BLAUWE rekening. De punten op de andere rekening worden niet meegerekend. Als de RODE rekening is gekozen, zijn uw verdiensten in de ronde het aantal punten op de RODE rekening. De punten op de andere rekening worden niet meegerekend. Vervolgens begint een nieuwe beslissingsronde. U krijgt van de computer een grafiek met een nieuwe lijn. U maakt dan weer een nieuwe keuze voor het aantal punten dat u op de BLAUWE en op de RODE rekening zet. De computer kiest dan weer tussen de BLAUWE en de RODE rekening. Dit proces herhaalt zich, totdat er 25 ronden geweest zijn. Na de laatste ronde krijgt u een scherm met de mededeling dat het experiment beëindigd is.

After confirming your decision, the computer will randomly select one account; each of the two accounts, BLUE and RED, have the same probability of being selected. If the BLUE account is selected, then your earnings in this round equal the amount of points on the BLUE account. The points on the other account are not used. If the RED account is selected, then your earnings in this round equal the amount of points on the RED account. The points on the other account are not used. Next, a new decision round starts. You will receive a graph with a new line from the computer. You will then make a

new decision about the number of points to allocate to the BLUE and the RED account. The computer will again choose between the BLUE and RED account. This process repeats itself, until 25 rounds have passed. After the last round, you will see a screen showing a message that the experiment has ended.

Screen 7

Dit is de manier waarop bepaald wordt hoeveel u verdient in dit experiment. Na afloop van het experiment (na de 25e ronde), kiest de computer op basis van toeval één ronde uit de 25 ronden. Om dat te doen trekt de computer een getal van 1 tot en met 25. Dus de geselecteerde ronde is uitsluitend afhankelijk van toeval: alle ronden hebben een gelijke kans om gekozen te worden. Omdat slechts één ronde (van de 25 ronden totaal) op basis van toeval wordt geselecteerd en uitbetaald, is er geen terugkoppeling bij iedere ronde over de uitkomst (welke ronde is geselecteerd door de computer en de verdienste in die ronde). De geselecteerde ronde, uw eigen keuze in die ronde en het bedrag dat u krijgt uitbetaald worden op het scherm getoond. De punten worden omgerekend naar geld. Vier punten zijn 1 euro waard. U krijgt de punten bijgeschreven bij uw CentERpunten, waarbij 1 punt in dit experiment dus 25 CentERpunten waard is.

This is the method that is used to determine how much you earn in this experiment. At the end of the experiment (after round number 25), the computer randomly chooses one round from the 25 rounds. To do that, the computer draws a number between 1 and 25. So the selected round only depends on chance: all rounds have the same probability of being chosen. Because only one round (out of the 25 rounds in total) is randomly selected and paid out, there is no feedback after each round about the result (which round has been selected by the computer and the earnings in that round). The selected round, your own choice in that round and the amount that will be paid, are shown on the screen. The points will be exchanged to money. Four points are worth 1 Euro. The points will be added to your CentERpoints, where 1 point in this experiment is worth 25 CentERpoints.

Screen 8

Het experiment gaat nu beginnen. U krijgt vanaf nu 25 schermen te zien met de grafiek en 25 verschillende lijnen. De computer kiest de lijnen op basis van toeval. Zoals uitgelegd in de eerdere instructies, is het uw taak om een punt te selecteren uit de mogelijke puntenverdelingen. Om de punt op de lijn te kunnen bewegen, breng de cursor eerst in de buurt van het punt op de lijn. Het kan even duren voordat het volgende scherm verschijnt. Om te beginnen klikt u op het volgende scherm op START.

The experiment starts now. From now, you will see 25 screens with the chart and 25 different lines. The computer chooses the lines based on chance. As explained earlier in the instructions, your task is to select a point from the possible point distributions. To move a point along the line, first move the cursor in the neighborhood of the point on the line. It could take a moment before the next screen shows up. To begin, you'll have to click the START button on the next screen.

Online Appendix II
Testing for consistency

I. Afriat's (1967) Theorem

Let $\left\{(p^i, x^i)\right\}_{i=1}^{25}$ be the data generated by some individual's choices, where p^i denotes the i-th observation of the price vector and x^i denotes the associated allocation. More precisely, the data generated by an individual's choices are $\left\{\left(\bar{x}_1^i, \bar{x}_2^i, x_1^i, x_2^i\right)\right\}_{i=1}^{25}$, where $\left(x_1^i, x_2^i\right)$ are the coordinates of the choice made by the subject and $\left(\bar{x}_1^i, \bar{x}_2^i\right)$ are the end-points of the budget line, so we can calculate the budget line $x_1^i/\bar{x}_1^i + x_2^i/\bar{x}_2^i = 1$ for each observation i.

An allocation x^i is *directly revealed preferred* to an allocation x^j, denoted $x^i R^D x^j$, if $p^i \cdot x^i \geq p^i \cdot x^j$. An allocation x^i is *revealed preferred* to x^j, denoted $x^i R x^j$, if there exists a sequence of allocations $\left\{x^k\right\}_{k=1}^{K}$ with $x^1 = x^i$ and $x^K = x^j$, such that $x^k R^D x^{k+1}$ for every $k = 1, ..., K-1$.

The Generalized Axiom of Revealed Preference (GARP) requires that if $x^i R x^j$ then $p^j \cdot x^j \leq p^j \cdot x^i$; that is, if x^i is revealed preferred to x^j, then x^i must cost at least as much as x^j at the prices prevailing when x^j is chosen. It is clear that if the data are generated by a non-satiated utility function, then they must satisfy GARP. Conversely, the following result due to Afriat (1967) tells us that if a *finite* data set generated by an individual's choices satisfies GARP, then the data can be rationalized by a well-behaved utility function.

THEOREM 1 (Afriat (1967)): *If the data set $\left\{(p^i, x^i)\right\}$ satisfies GARP, then there exists a piecewise linear, continuous, increasing, concave utility function $u(x)$ such that for each observation (p^i, x^i) $u(x) \leq u(x^i)$ for any x such that $p^i \cdot x \leq p^i \cdot x^i$.*

This statement of the theorem follows Varian (1982, 1983), who replaced the condition Afriat called *cyclical consistency* with GARP. Note that satisfying GARP entails only that choices are consistent with the utility maximization model. The further implication, that the choices may be rationalized by a well-behaved utility function, is a consequence of linear budget lines. Given that the budget constraints are linear, if a rationalizing utility function exists then we cannot reject the hypothesis that it is well-behaved.

II. Goodness-of-fit

In order to show that the data are consistent with utility-maximizing behavior we must check whether it satisfies GARP. Since GARP offers an exact test, it is desirable to measure the *extent* of GARP violations. We report measures of GARP violations based on three indices: Afriat's (1972) critical cost efficiency index (CCEI), Varian (1990, 1991), and Houtman and Maks (1985).

Afriat (1972) The CCEI measures the amount by which each budget constraint must be adjusted in order to remove all violations of GARP. For any number $0 \leq e \leq 1$, define the direct revealed preference relation $R^D(e)$ as

$$x^i R^D(e) x^j \Longleftrightarrow e p^i \cdot x^i \geq p^i \cdot x^j,$$

and define $R(e)$ to be the transitive closure of $R^D(e)$. Let e^* be the largest value of e such that the relation $R(e)$ satisfies GARP. Afriat's CCEI is the value of e^* associated with the data set $\{(p^i, x^i)\}$. Figure 1 illustrates the construction of the CCEI for a simple violation of GARP involving two allocations, x^1 and x^2. It is clear that x^1 is revealed preferred to x^2 because $p^1 \cdot x^1 > p^1 \cdot x^2$, yet x^1 is cheaper than x^2 at the prices at which x^2 is purchased, $p^2 \cdot x^1 < p^2 \cdot x^2$. Here we have a violation of the Weak Axiom of Revealed Preference (WARP) since $x^1 R^D x^2$ and $x^2 R^D x^1$. If we shifted the budget line through x^2 as shown ($A/B < C/D$) the violation would be removed so the CCEI score associated with this violation of GARP is A/B.

[Figure 1 here]

The CCEI is bounded between zero and one and the closer it is to one, the smaller the perturbation of the budget lines required to remove all violations and thus the closer the data are to satisfying GARP. Although the CCEI provides a summary statistic of the overall consistency of the data with GARP, it does not give any information about which of the observations (p^i, x^i) are causing the most severe violations. A single large violation may lead to a small value of the index while a large number of small violations may result in a much larger efficiency index.

Varian (1990, 1991) Varian refined Afriat's CCEI to provide a measure that reflects the minimum adjustment required to eliminate the violations of GARP associated with each observation (p^i, x^i). In particular, fix an observation (p^i, x^i) and let e^i be the largest value of e such that $R(e)$ has no violations of GARP within the set of allocations x^j such that $x^i R(e) x^j$. The value e^i measures the efficiency of the choices when compared to the allocation x^i. Knowing the efficiencies $\{e^i\}$ for the entire set of observations $\{(p^i, x^i)\}$ allows us to say where the inefficiency is greatest or least. When a single number is desired, as here, Varian (1990, 1991) uses $e^* = \min\{e^i\}$. Thus, the Varian (1990, 1991) score associated with the violation of GARP depicted in Figure 1 above is also A/B. More generally, the Varian (1990, 1991) index is a lower bound on the CCEI.

Echenique, Lee, and Shum (2011) also provide a disaggregated measure that indicates the amount of money one can extract from an individual for each violation of GARP. Their measure is based on the idea that an individual who violates GARP can be exploited as a "money pump." The construction of their money pump index for a simple violation of GARP is also illustrated in Figure 1 above. An "arbitrager" who chooses allocation x^1 at prices p^2 and allocation x^2 at prices p^1 could profitably trade x^1 with the individual at prices p^1 and x^2 at prices p^2, yielding a profit

$$mp = p^1(x^1 - x^2) + p^2(x^2 - x^1) = C/D + A/B.$$

Echenique et al. (2011) use money pump index to measure the extent of each GARP violation. To summarize consistency, they use the mean and median money pump scores across all violations of GARP (cyclic sequences of allocations). The reasons for the

discrepancies between the CCEI and the Varian (1990, 1991) index and the money pump index are discussed in Echenique et al. (2011).

Houtman and Maks (1985) Houtman and Maks find the largest subset of choices that is consistent with GARP. This method has a couple of drawbacks. First, some observations may be discarded even if the associated GARP violations could be removed by small perturbations of the budget line. Second, since the algorithm is computationally very intensive, for a small number of subjects we report upper bounds on the consistent set. We compute the Houtman and Maks (1985) scores using the algorithm developed by Dean and Martin (2010).

In reporting our results, we focus on the CCEI, which offers a straightforward interpretation. The econometric results based on the indices proposed by Varian (1990, 1991) and Houtman and Maks (1985) are presented in Appendix III.[1] In practice, these measures yield qualitatively very similar results. We therefore do not repeat the econometric analysis with the "money pump" measure of Echenique et al. (2011). Figure 2 summarizes the mean Varian (1990, 1991) and Houtman and Maks (1985) scores and 95 percent confidence intervals across selected socioeconomic categories. Table 1 below provides a summary of each consistency score. There is considerable heterogeneity within and across categories for all measures.

[Figure 2 here]
[Table 1 here]

III. The power of the GARP tests

Revealed preference tests have a drawback: there is no natural threshold for determining whether subjects are so close to satisfying GARP that they can be considered utility maximizers. Varian (1991) suggests a threshold of 0.95 for the CCEI. If we follow Varian, we find that out of the 1,182 subjects, 534 subjects (45.2 percent) have CCEI scores above this threshold and of those 269 subjects (22.8 percent) have no violations of GARP.

To generate a benchmark against which to compare these CCEI scores, we use the test designed by Bronars (1987), which builds on Becker (1962) and employs the choices of a hypothetical subject who chooses randomly among all allocations on each budget line as a point of comparison. The mean CCEI score across all subjects in our experiment is 0.881 whereas the mean CCEI score for a random sample of 25,000 simulated subjects is 0.659. More than half of actual subjects have CCEI's above 0.925, while only about five percent of simulated subjects have CCEI's that high.

The Bronars' (1987) test has often been applied to experimental data, so using it situates our results in a literature. The setup used in this study has the highest Bronars power of one (all random subjects had violations). Our results show that the experiment is sufficiently powerful to exclude the possibility that consistency is the accidental result

[1] Appendix III: http://emlab.berkeley.edu/~kariv/CKMS_I_A3.pdf.

of random behavior. To provide a more informative metric of the consistency of choices, we follow Choi et al. (2007a) who extend and generalize the Bronars (1987) test by employing a random sample of simulated subjects who maximize a utility function $U(\cdot)$ with error where the likelihood of error is assumed to be a decreasing function of its cost. In particular, we assume an idiosyncratic preference shock that has a logistic distribution. This implies the probability of choosing the allocation x^* satisfies

$$\Pr(x^*) = \frac{e^{\gamma \cdot U(x^*)}}{\int\limits_{x:p\cdot x=1} e^{\gamma \cdot U(x)}},$$

where the parameter γ reflects sensitivity to differences in utility. The choice of allocation becomes purely random as γ goes to zero (Bronars test), whereas the probability of the allocation yielding the highest utility increases as γ increases.

The histograms in Figure 3 below summarize the distributions of CCEI scores generated by samples of 25,000 simulated subjects who implement the logarithmic von Neumann-Morgenstern utility function $\log x_1 + \log x_2$ with various levels of precision γ. The horizontal axis measures the fractions for different intervals of CCEI scores and the vertical axis measures the percentage of subjects corresponding to each interval. Each of the simulated subjects makes 25 choices from randomly generated budget lines in the same way as the human subjects do. The number above each bar of the histogram represents the percentage of actual subjects corresponding to each interval. The histograms show the extent to which subjects did worse than choosing consistently and the extent to which they did better than choosing randomly. The histograms thus demonstrate that if utility maximization is not in fact the correct model, then our experiment is sufficiently powerful to detect it.

[Figure 3 here]

IV. Additional references

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Table 1. Consistency scores

A. CCEI

			Percentiles					
	Mean	Std. Dev.	10	25	50	75	90	# of obs.
All	0.881	0.141	0.676	0.808	0.930	0.998	1.000	1182
Female	0.874	0.147	0.666	0.796	0.928	0.998	1.000	537
Age								
16-34	0.920	0.119	0.734	0.881	0.979	1.000	1.000	219
35-49	0.906	0.123	0.708	0.853	0.966	1.000	1.000	309
50-64	0.863	0.142	0.666	0.784	0.901	0.985	1.000	421
65+	0.843	0.164	0.595	0.770	0.882	0.981	1.000	233
Education								
Low	0.863	0.143	0.665	0.782	0.906	0.987	1.000	397
Medium	0.881	0.140	0.689	0.814	0.926	0.998	1.000	351
High	0.899	0.137	0.686	0.842	0.963	1.000	1.000	430
Household monthly income								
€0-2499	0.856	0.154	0.617	0.769	0.911	0.983	1.000	269
€2500-3499	0.885	0.133	0.705	0.809	0.925	0.999	1.000	302
€3500-4999	0.882	0.141	0.649	0.817	0.932	0.999	1.000	345
€5000+	0.901	0.131	0.729	0.836	0.968	1.000	1.000	266
Occupation								
Paid work	0.896	0.131	0.705	0.833	0.950	1.000	1.000	628
House work	0.873	0.151	0.649	0.795	0.937	0.999	1.000	137
Retired	0.839	0.158	0.597	0.767	0.876	0.971	1.000	247
Others	0.891	0.129	0.712	0.809	0.936	0.998	1.000	170
Household composition								
Partnered	0.878	0.142	0.673	0.802	0.927	0.998	1.000	956
Children	0.899	0.128	0.704	0.835	0.959	1.000	1.000	490

B. Varian (1990, 1991)

			Percentiles					
	Mean	Std. Dev.	10	25	50	75	90	# of obs.
All	0.736	0.262	0.330	0.515	0.820	0.991	1.000	1182
Female	0.724	0.268	0.325	0.484	0.804	0.989	1.000	537
Age								
16-34	0.818	0.236	0.418	0.670	0.945	1.000	1.000	219
35-49	0.782	0.246	0.398	0.590	0.882	1.000	1.000	309
50-64	0.699	0.263	0.296	0.479	0.764	0.949	1.000	421
65+	0.664	0.272	0.293	0.427	0.687	0.941	1.000	233
Education								
Low	0.696	0.268	0.301	0.452	0.760	0.961	1.000	397
Medium	0.734	0.253	0.380	0.515	0.787	0.990	1.000	351
High	0.776	0.256	0.341	0.600	0.891	1.000	1.000	430
Household monthly income								
€0-2499	0.687	0.263	0.302	0.452	0.726	0.949	1.000	269
€2500-3499	0.739	0.255	0.380	0.520	0.801	0.994	1.000	302
€3500-4999	0.739	0.269	0.315	0.479	0.838	0.993	1.000	345
€5000+	0.778	0.252	0.370	0.583	0.899	1.000	1.000	266
Occupation								
Paid work	0.761	0.255	0.350	0.553	0.863	1.000	1.000	628
House work	0.719	0.281	0.277	0.439	0.821	0.989	1.000	137
Retired	0.663	0.262	0.293	0.437	0.686	0.920	1.000	247
Others	0.760	0.252	0.373	0.536	0.853	0.991	1.000	170
Household composition								
Partnered	0.732	0.263	0.330	0.512	0.818	0.989	1.000	956
Children	0.773	0.252	0.372	0.558	0.883	1.000	1.000	490

C. Houtman and Maks (1985)

			Percentiles					
	Mean	Std. Dev.	10	25	50	75	90	# of obs.
All	22.361	2.259	19	21	23	24	25	1182
Female	22.289	2.306	19	21	23	24	25	537
Age								
16-34	22.950	2.147	19	22	24	25	25	219
35-49	22.773	2.176	19	21	23	25	25	309
50-64	22.057	2.185	19	21	22	24	25	421
65+	21.811	2.387	19	20	22	24	25	233
Education								
Low	21.990	2.360	19	20	22	24	25	397
Medium	22.342	2.249	19	21	23	24	25	351
High	22.737	2.113	19	21	23	25	25	430
Household monthly income								
€0-2499	22.086	2.263	19	20	22	24	25	269
€2500-3499	22.421	2.187	19	21	23	24	25	302
€3500-4999	22.330	2.384	19	21	23	24	25	345
€5000+	22.613	2.147	19	21	23	24	25	266
Occupation								
Paid work	22.584	2.191	19	21	23	24	25	628
House work	22.307	2.451	19	21	23	24	25	137
Retired	21.672	2.320	18	20	22	24	25	247
Others	22.582	2.063	19	21	23	24	25	170
Household composition								
Partnered	22.304	2.279	19	21	23	24	25	956
Children	22.645	2.189	19	21	23	24	25	490

Figure 1: The construction of the CCEI for a simple violation of GARP

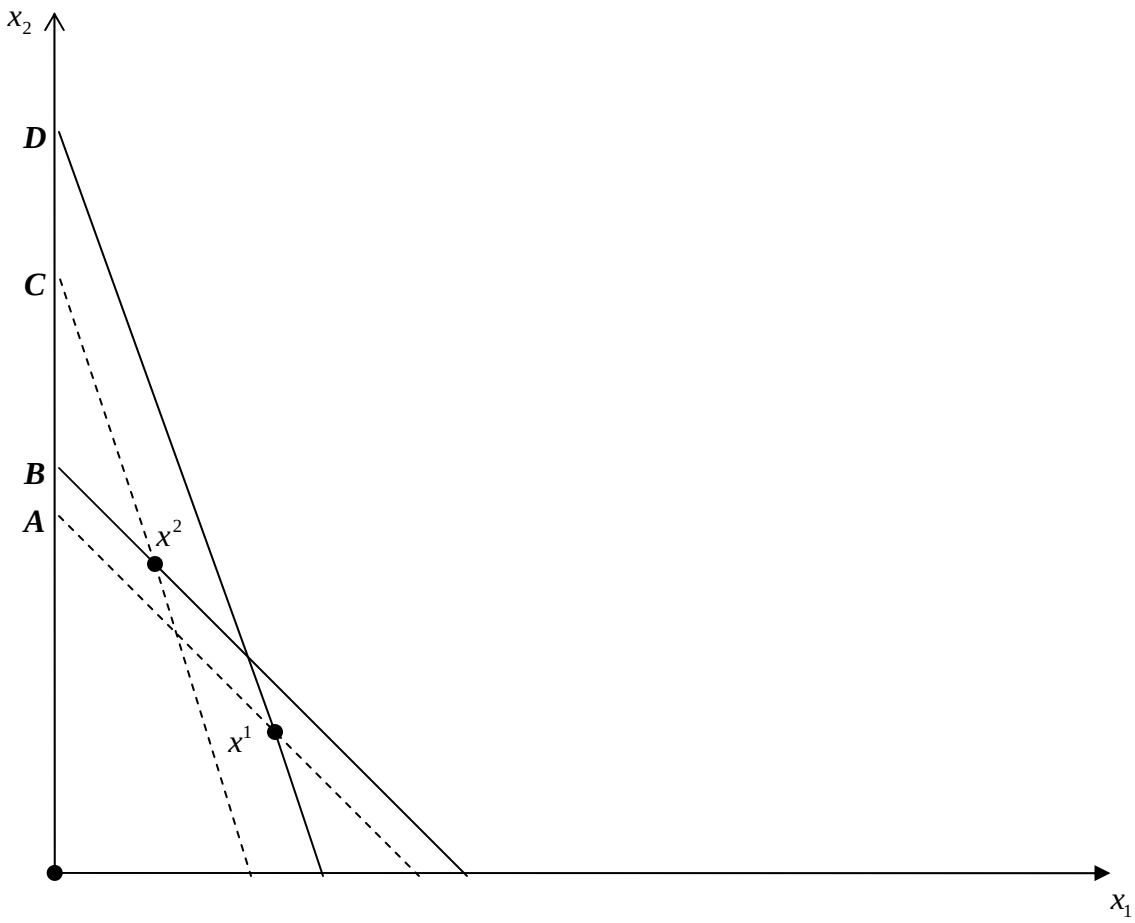


Figure 2A. Varian (1990, 1991) scores

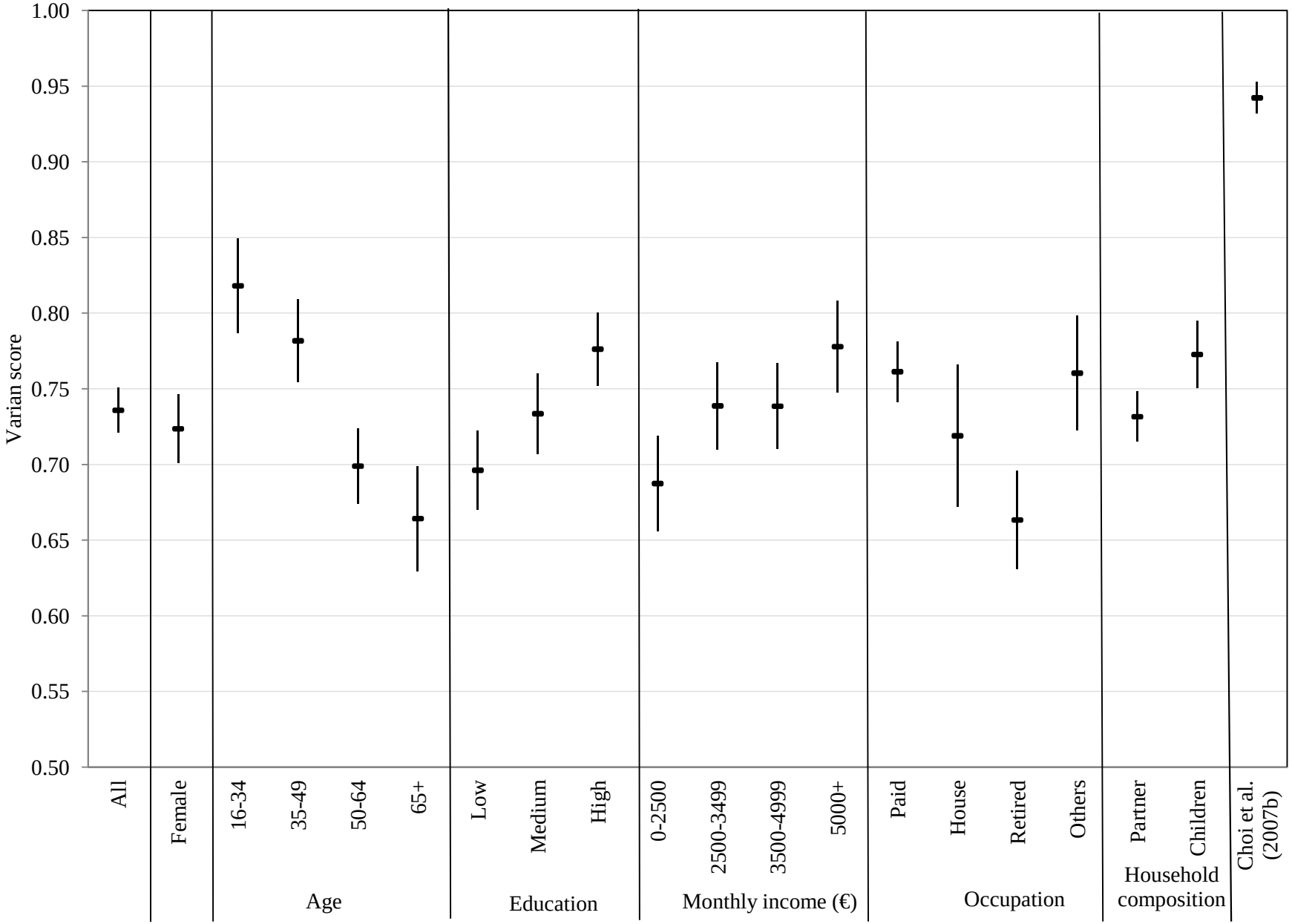


Figure 2B. Houtman and Maks (1985) scores

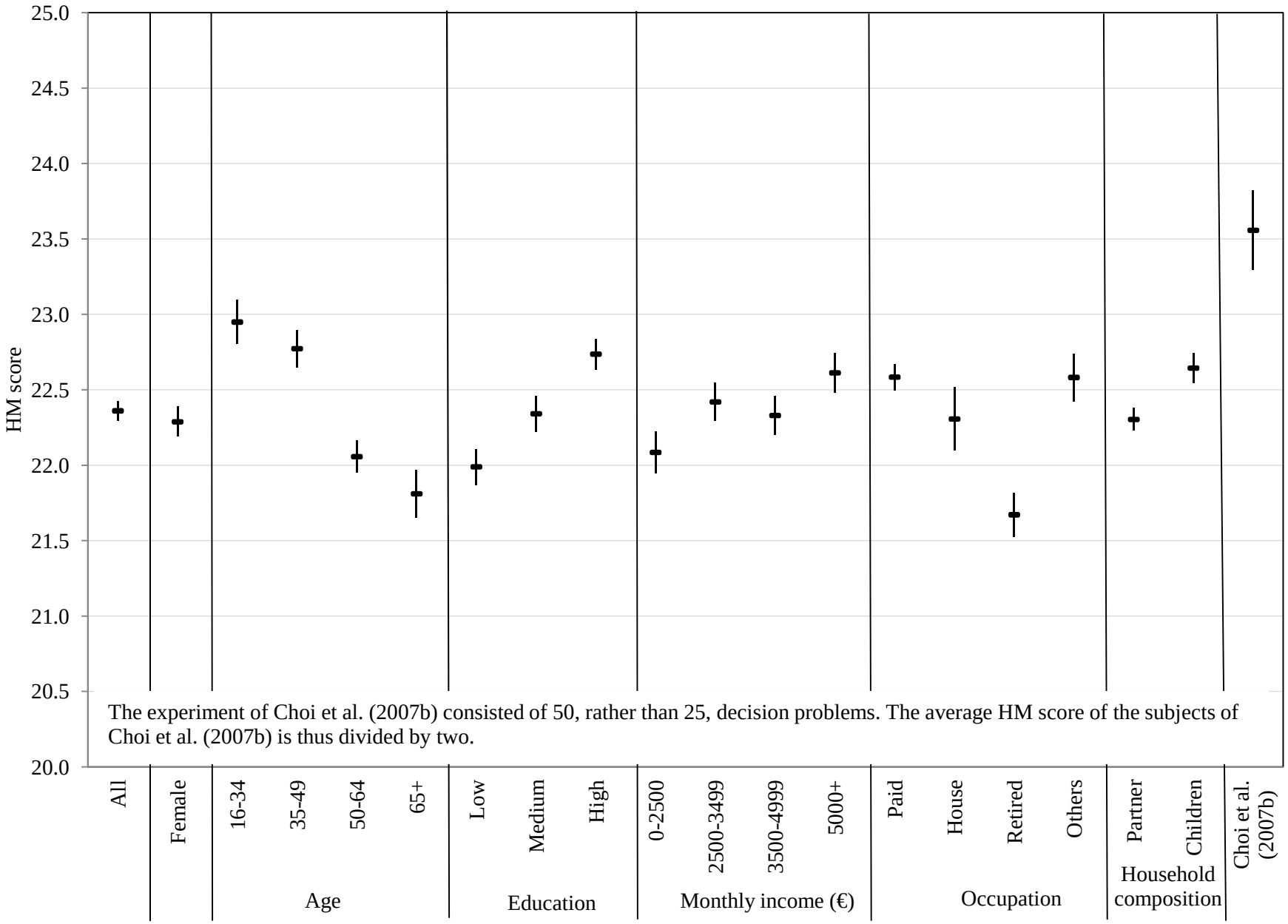
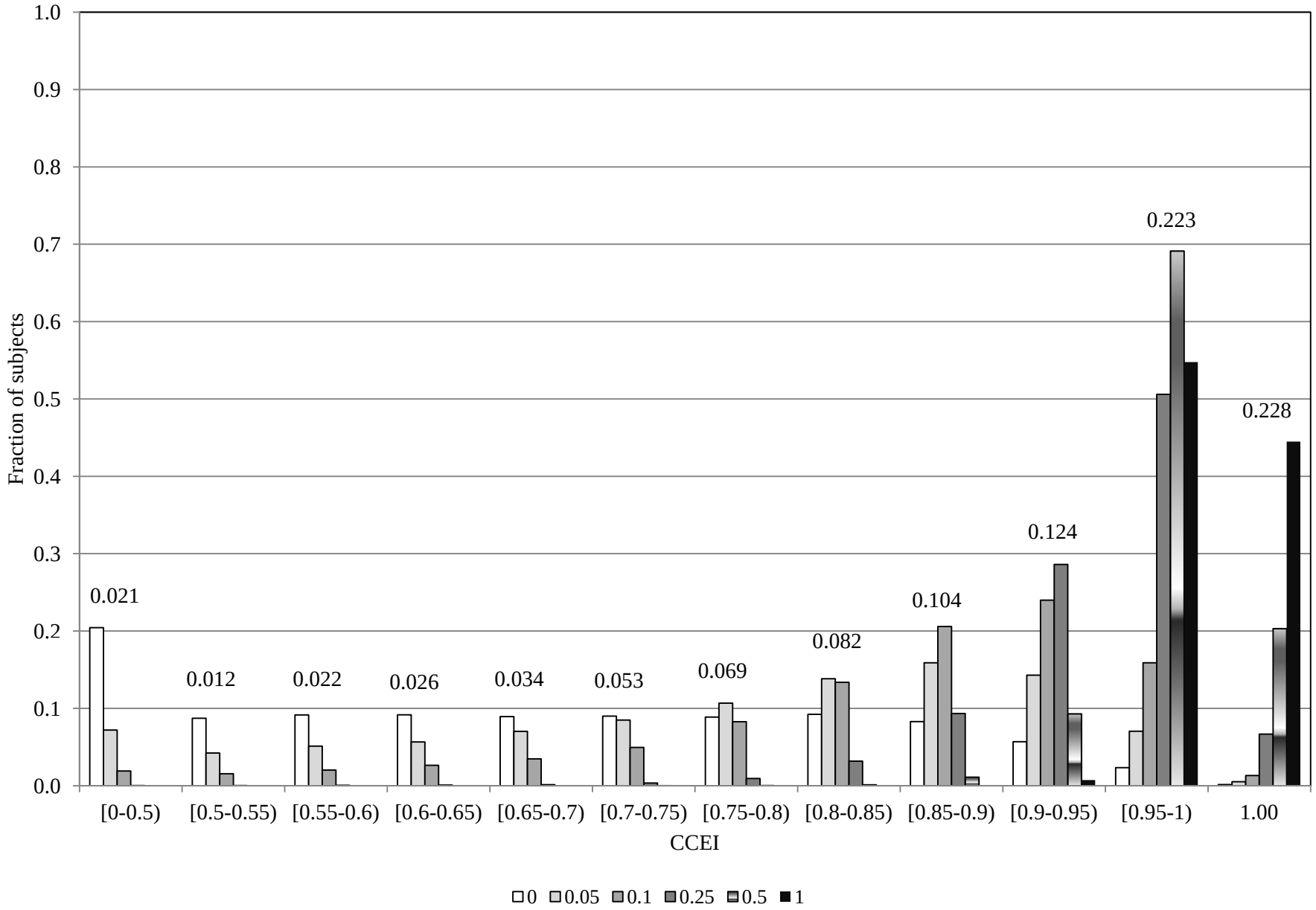


Figure 3.The distributions of CCEI scores of simulated subjects



Appendix III

Tables for the Varian (1990, 1991) and Houtman and Maks (1985) (HM) indices

Table 2A. The correlation between Varian (1990, 1991) scores and subjects' individual characteristics (OLS)

	(1)	(2)
Constant	0.766***	0.631***
	(0.042)	(0.045)
Female	-0.044***	-0.02
	(0.016)	(0.018)
Age		
35-49	-0.037*	-0.028
	(0.022)	(0.025)
50-64	-0.109***	-0.128***
	(0.022)	(0.025)
65+	-0.122***	-0.116***
	(0.036)	(0.038)
Education		
Medium	0.023	0.027
	(0.019)	(0.021)
High	0.065***	0.076***
	(0.020)	(0.022)
Income		
€2500-3499	0.043**	0.052**
	(0.022)	(0.023)
€3500-4999	0.035	0.03
	(0.023)	(0.024)
€5000+	0.062**	0.054**
	(0.024)	(0.027)
Occupation		
Paid work	0.026	0.049
	(0.031)	(0.032)
House work	0.070*	0.073**
	(0.036)	(0.037)
Others	0.056	0.052
	(0.034)	(0.036)
Household composition		
Partner	-0.044**	-0.050**
	(0.020)	(0.022)
# of children	0.003	0.003
	(0.008)	(0.009)
R^2	0.076	0.084
# of obs.	1182	1182

Omitted categories: male, age under 35, low education (primary and lower secondary education), household gross monthly income under €2500, retired, and not having a partner. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively. Since the the Varian (1990, 1991) score is a number between zero and one, we repeated the estimations reported in columns (1) and (2) using a fractional regression model (Papke and Wooldridge, 1996). The two specifications yield similar results.

Table 2B. The correlation between Houtman and Maks (1985) scores and subjects' individual characteristics (OLS)

	(1)	(2)
Constant	3.100***	3.644***
	(0.016)	(0.023)
Female	-0.015**	-0.023***
	(0.006)	(0.009)
Age		
35-49	-0.008	-0.02
	(0.008)	(0.012)
50-64	-0.034***	-0.081***
	(0.008)	(0.012)
65+	-0.028**	-0.087***
	(0.014)	(0.020)
Education		
Medium	0.012	0.017
	(0.008)	(0.011)
High	0.032***	0.036***
	(0.008)	(0.011)
Income		
€2500-3499	0.013	0.01
	(0.008)	(0.011)
€3500-4999	0.005	0.007
	(0.009)	(0.012)
€5000+	0.012	0.026*
	(0.009)	(0.013)
Occupation		
Paid work	0.026**	0.018
	(0.012)	(0.017)
House work	0.042***	0.054***
	(0.014)	(0.019)
Others	0.038***	0.025
	(0.013)	(0.019)
Household composition		
Partner	-0.017**	-0.019*
	(0.008)	(0.011)
# of children	0.000	-0.005
	(0.003)	(0.004)
R^2	0.072	0.064
# of obs.	1182	1182

Table 3A. The relationship between Varian (1990, 1991) scores and wealth

	(1)	(2)	(3)
Varian	0.472*	0.410	38689.6
	(0.270)	(0.256)	(29774.9)
Log 2008 household income	0.589***	0.610***	
	(0.132)	(0.127)	
2008 household income			1.788***
			(0.352)
Female	-0.317	-0.361**	-32392.1
	(0.178)	(0.165)	(17515.7)
Partnered	0.649***	0.593***	45702.5***
	(0.182)	(0.172)	(17180.1)
# of children	0.092	0.109	14386.6
	(0.092)	(0.085)	(8305.1)
Age	-0.303	-0.001	-18868.4
	(0.348)	(0.208)	(30437.2)
Age^2	0.007	0.002	459.2
	(0.006)	(0.004)	(528.1)
Age^3	0.000	0.000	-2.8
	(0.000)	(0.000)	(2.9)
Education			
Pre-vocational	0.255	0.234	14029.2
	(0.466)	(0.464)	(43202.6)
Pre-university	0.633	0.559	59569.6
	(0.479)	(0.477)	(44552.7)
Senior vocational training	0.407	0.412	28268.7
	(0.477)	(0.471)	(42185.5)
Vocational college	0.483	0.519	31647.9
	(0.453)	(0.450)	(41916.0)
University	0.728	0.686	78497.6
	(0.475)	(0.467)	(47680.3)
Occupation			
Paid work	0.224	0.243	-11296.9
	(0.325)	(0.324)	(26851.3)
House work	0.583	0.624	18987.8
	(0.411)	(0.416)	(31273.1)
Retired	0.104	0.168	14846.9
	(0.321)	(0.320)	(35313.0)
Constant	7.147	1.025	135277.0
	(6.451)	(3.602)	(563058.8)
R^2	0.173	0.214	0.186
# of obs.	517	566	568

The groupings of different levels of education are based on the categorization of Statistics Netherlands (Centraal Bureau voor de Statistiek). For a complete description see http://www.centerdata.nl/en/centerpanel. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 3B. The relationship between Houtman and Maks (1985) scores and wealth

	(1)	(2)	(3)
Houtman and Maks	0.072**	0.070**	4346.3
	(0.032)	(0.030)	(3288.8)
Log 2008 household income	0.596***	0.617***	
	(0.131)	(0.126)	
2008 household income			1.805***
			(0.351)
Female	-0.313*	-0.357**	-32523.2*
	(0.177)	(0.165)	(17606.7)
Partnered	0.657***	0.596***	46145.1***
	(0.181)	(0.171)	(17166.2)
# of children	0.099	0.114	14709.6*
	(0.092)	(0.085)	(8323.7)
Age	-0.292	-0.002	-19214.0
	(0.347)	(0.207)	(30290.5)
Age^2	0.006	0.002	463.6
	(0.006)	(0.004)	(526.5)
Age^3	0.000	0.000	-2.9
	(0.000)	(0.000)	(2.9)
Education			
Pre-vocational	0.266	0.245	14291.2
	(0.454)	(0.452)	(43111.8)
Pre-university	0.616	0.543	58547.4
	(0.468)	(0.467)	(44339.9)
Senior vocational training	0.416	0.424	28265.2
	(0.465)	(0.460)	(42096.3)
Vocational college	0.481	0.513	31474.5
	(0.441)	(0.439)	(41764.0)
University	0.717	0.670	78008.4
	(0.464)	(0.456)	(47538.1)
Occupation			
Paid work	0.202	0.224	-12028.2
	(0.325)	(0.323)	(26782.6)
House work	0.547	0.589	18039.2
	(0.410)	(0.415)	(31329.4)
Retired	0.109	0.174	14968.8
	(0.321)	(0.319)	(35095.1)
Constant	5.633	-0.289	74781.8
	(6.445)	(3.576)	(563169.5)
R^2	0.176	0.218	0.186
# of obs.	517	566	568

Table 4A. The robustness of the correlation between Varian (1990, 1991) scores and wealth to the inclusion of controls for unobserved constraints

	(1)	(2)	(3)	(4)	(5)
Varian	0.440	0.475*	0.720**	0.698**	0.521*
	(0.271)	(0.276)	(0.297)	(0.290)	(0.276)
Log household income					
2008	18.807	1	0.549***	0.289*	0.622***
	(14.767)		(0.137)	(0.167)	(0.128)
2008^2	(2.093)				
	(1.547)				
2008^3	0.078				
	(0.053)				
2006				0.229	
				(0.228)	
2004				0.218	
				(0.173)	
Female	-0.292	-0.207	-0.348*	-0.307	-0.326*
	(0.182)	(0.174)	(0.186)	(0.187)	(0.176)
Partnered	0.594***	0.559***	0.730***	0.703***	0.637***
	(0.181)	(0.178)	(0.193)	(0.193)	(0.180)
# of children	0.093	0.103	0.021	0.034	0.090
	(0.091)	(0.096)	(0.098)	(0.095)	(0.092)
Age	-0.353	-0.234	-0.287	-0.253	-0.299
	(0.352)	(0.355)	(0.374)	(0.376)	(0.349)
Age^2	0.007	0.005	0.007	0.006	0.007
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
Pre-vocational	0.300	0.325	0.243	0.142	
	(0.474)	(0.494)	(0.491)	(0.534)	
Pre-university	0.657	0.622	0.580	0.483	
	(0.487)	(0.504)	(0.507)	(0.552)	
Senior vocational training	0.420	0.439	0.447	0.364	
	(0.484)	(0.503)	(0.503)	(0.546)	
Vocational college	0.490	0.451	0.559	0.410	
	(0.463)	(0.479)	(0.474)	(0.520)	
University	0.611	0.666	0.844*	0.658	
	(0.486)	(0.496)	(0.490)	(0.537)	
Occupation					
Paid work	0.242	(0.015)	0.509	0.434	0.227
	(0.328)	(0.336)	(0.358)	(0.355)	(0.327)
House work	0.584	0.426	0.768*	0.740*	0.476
	(0.413)	(0.430)	(0.445)	(0.443)	(0.408)
Retired	0.119	(0.032)	0.345	0.233	0.104
	(0.323)	(0.336)	(0.365)	(0.368)	(0.324)
Constant	-43.132	1.736	6.578	4.225	7.274
	(46.694)	(6.564)	(6.961)	(7.145)	(6.522)
R^2	0.181		0.196	0.208	0.171
# of obs.	517	517	449	449	517

Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 4B. The robustness of the correlation between Houtman and Maks (1985) scores and wealth to the inclusion of controls for unobserved constraints

	(1)	(2)	(3)	(4)	(5)
Houtman and Maks	0.069**	0.076**	0.095***	0.093***	0.079**
	(0.032)	(0.032)	(0.035)	(0.035)	(0.032)
Log household income					
2008	18.737	1	0.557***	0.291*	0.628***
	(14.765)	.	(0.136)	(0.165)	(0.127)
2008^2	(2.087)				
	(1.546)				
2008^3	0.078				
	(0.053)				
2006				0.256	
				(0.230)	
2004				0.197	
				(0.175)	
Female	-0.286	-0.203*	-0.343*	-0.299	-0.321*
	(0.181)	(0.174)	(0.185)	(0.186)	(0.176)
Partnered	0.601***	0.570***	0.737***	0.709***	0.648***
	(0.180)	(0.178)	(0.192)	(0.193)	(0.179)
# of children	0.100	0.11	0.032	0.046	0.098
	(0.091)	(0.096)	(0.098)	(0.095)	(0.092)
Age	-0.342	-0.224	-0.272	-0.237	-0.288
	(0.351)	(0.354)	(0.375)	(0.376)	(0.348)
Age^2	0.007	0.005	0.006	0.006	0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
Pre-vocational	0.311	0.335	0.261	0.160	
	(0.462)	(0.481)	(0.474)	(0.516)	
Pre-university	0.640	0.603	0.554	0.459	
	(0.477)	(0.492)	(0.492)	(0.535)	
Senior vocational training	0.428	0.447	0.462	0.379	
	(0.474)	(0.490)	(0.487)	(0.529)	
Vocational college	0.486	0.448	0.566	0.419	
	(0.452)	(0.466)	(0.457)	(0.502)	
University	0.598	0.654	0.844*	0.660	
	(0.477)	(0.483)	(0.474)	(0.521)	
Occupation					
Paid work	0.220	(0.034)	0.475	0.402	0.201
	(0.327)	(0.335)	(0.357)	(0.354)	(0.326)
House work	0.547	0.390	0.723	0.696	0.442
	(0.412)	(0.429)	(0.446)	(0.443)	(0.407)
Retired	0.124	(0.024)	0.336	0.224	0.108
	(0.323)	(0.335)	(0.364)	(0.366)	(0.324)
Constant	-44.334	0.201	4.667	2.309	5.624
	(46.710)	(6.573)	(6.978)	(7.143)	(6.513)
R^2	0.184		0.200	0.211	0.175
# of obs.	517	517	449	449	517

Table 5A. The robustness of the correlation between Varian (1990, 1991) scores and wealth to the inclusion of controls for unobserved preferences and beliefs

	(1)	(2)	(3)	(4)	(5)
Varian	0.469*	0.466*	0.484*	0.423	0.428
	(0.271)	(0.275)	(0.276)	(0.308)	(0.307)
Risk tolerance					
Quantitative (experiment)	-0.660	-0.689	-0.644		
	(0.710)	(0.709)	(0.715)		
Qualitative (survey)		0.008	0.014		
		(0.075)	(0.076)		
Qualitative (survey) missing		-0.154	-0.115		
		(0.339)	(0.490)		
Conscientiousness			0.093		
			(0.073)		
			-0.060		
			(0.670)		
Longevity expectations					-0.032
					(0.041)
Log 2008 household income	0.593***	0.585***	0.579***	0.448***	0.439***
	(0.132)	(0.131)	(0.133)	(0.124)	(0.124)
Female	-0.321*	-0.318*	-0.331*	-0.423***	-0.425***
	(0.178)	(0.182)	(0.182)	(0.187)	(0.187)
Partnered	0.651***	0.653***	0.637***	0.681***	0.682***
	(0.182)	(0.182)	(0.183)	(0.205)	(0.206)
# of children	0.089	0.090	0.086	0.076	0.084
	(0.093)	(0.093)	(0.092)	(0.101)	(0.101)
Age	-0.308	-0.304	-0.280	-0.164	-0.184
	(0.347)	(0.347)	(0.347)	(0.901)	(0.899)
Age^2	0.007	0.007	0.006	0.005	0.005
	(0.006)	(0.006)	(0.006)	(0.017)	(0.017)
Age^3	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
Pre-vocational	0.246	0.244	0.274	0.706	0.756
	(0.469)	(0.465)	(0.465)	(0.584)	(0.587)
Pre-university	0.635	0.630	0.664	0.820	0.881
	(0.481)	(0.474)	(0.471)	(0.605)	(0.617)
Senior vocational training	0.399	0.400	0.430	0.802	0.862
	(0.480)	(0.478)	(0.477)	(0.593)	(0.598)
Vocational college	0.473	0.473	0.495	0.955*	1.011*
	(0.457)	(0.451)	(0.450)	(0.572)	(0.577)
University	0.733	0.728	0.755	1.126*	1.186***
	(0.478)	(0.475)	(0.473)	(0.600)	(0.603)
Occupation					
Paid work	0.222	0.218	0.247	0.356	0.394
	(0.325)	(0.325)	(0.326)	(0.342)	(0.351)
House work	0.585	0.594	0.606	0.660	0.699
	(0.412)	(0.413)	(0.420)	(0.465)	(0.469)
Retired	0.111	0.107	0.133	0.567	0.608
	(0.323)	(0.324)	(0.325)	(0.410)	(0.420)
Constant	7.650	7.713	7.283	4.972	5.589
	(6.396)	(6.396)	(6.439)	(15.150)	(15.147)
R^2	0.172	0.169	0.169	0.158	0.157
# of obs.	517	517	517	414	414

Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 5B. The robustness of the correlation between Houtman and Maks (1985) scores and wealth to the inclusion of controls for unobserved preferences and beliefs

	(1)	(2)	(3)	(4)	(5)
Houtman and Maks	0.071**	0.071**	0.074**	0.071**	0.072**
	(0.032)	(0.032)	(0.032)	(0.035)	(0.036)
Risk tolerance					
Quantitative (experiment)	-0.659	-0.690	-0.644		
	(0.701)	(0.700)	(0.706)		
Qualitative (survey)		0.008	0.015		
		(0.074)	(0.076)		
Qualitative (survey) missing		-0.171	-0.125		
		(0.333)	(0.474)		
Conscientiousness			0.098		
			(0.073)		
			-0.075		
			(0.660)		
Longevity expectations					-0.033
					(0.041)
Log 2008 household income	0.600***	0.592***	0.586***	0.453***	0.444***
	(0.131)	(0.130)	(0.131)	(0.123)	(0.122)
Female	-0.316*	-0.313*	-0.327*	-0.422**	-0.424**
	(0.178)	(0.181)	(0.182)	(0.187)	(0.187)
Partnered	0.659***	0.661***	0.645***	0.693***	0.694***
	(0.181)	(0.181)	(0.182)	(0.205)	(0.205)
# of children	0.096	0.097	0.093	0.082	0.090
	(0.093)	(0.093)	(0.093)	(0.101)	(0.101)
Age	-0.297	-0.293	-0.267	-0.149	-0.170
	(0.346)	(0.346)	(0.346)	(0.903)	(0.901)
Age^2	0.007	0.006	0.006	0.005	0.005
	(0.006)	(0.006)	(0.006)	(0.018)	(0.017)
Age^3	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	(0.000)	(0.000)
Education					
Pre-vocational	0.257	0.255	0.287	0.7	0.751
	(0.457)	(0.452)	(0.453)	(0.570)	(0.572)
Pre-university	0.618	0.612	0.647	0.788	0.851
	(0.470)	(0.464)	(0.462)	(0.594)	(0.606)
Senior vocational training	0.408	0.409	0.441	0.792	0.855
	(0.469)	(0.466)	(0.466)	(0.580)	(0.584)
Vocational college	0.470	0.471	0.493	0.933*	0.991*
	(0.445)	(0.439)	(0.439)	(0.558)	(0.563)
University	0.722	0.716	0.745	1.09*	1.152*
	(0.468)	(0.464)	(0.462)	(0.586)	(0.589)
Occupation					
Paid work	0.199	0.195	0.224	0.334	0.374
	(0.325)	(0.325)	(0.325)	(0.341)	(0.350)
House work	0.549	0.559	0.570	0.618	0.658
	(0.411)	(0.412)	(0.420)	(0.463)	(0.467)
Retired	0.116	0.112	0.140	0.560	0.602
	(0.322)	(0.323)	(0.323)	(0.411)	(0.421)
Constant	6.139	6.200	5.684	3.410	4.029
	(6.388)	(6.381)	(6.414)	(15.216)	(15.210)
R^2	0.176	0.173	0.173	0.162	0.162
# of obs.	517	517	517	414	414

Table 6A. Evaluating alternative measures of decision-making quality

	(1)	(2)	(3)	(4)
Varian	0.182	0.657**	0.577*	0.371
	(0.403)	(0.332)	(0.334)	(0.280)
Varian (combined dataset)	0.354			
	(0.366)			
von Gaudecker et al. (2011)			0.915*	
			(0.489)	
Cognitive Reflection Test				0.125*
				(0.072)
Cognitive Reflection Test missing				-0.236
				(0.233)
Log 2008 household income	0.592***	0.398***	0.392***	0.581***
	(0.132)	(0.155)	(0.154)	(0.132)
Female	-0.316*	-0.221	-0.210	-0.297*
	(0.178)	(0.212)	(0.212)	(0.177)
Partnered	0.655***	0.899***	0.918***	0.689***
	(0.182)	(0.230)	(0.228)	(0.181)
# of children	0.088	0.109	0.100	0.093
	(0.092)	(0.112)	(0.112)	(0.092)
Age	-0.307	-0.434	-0.361	-0.327
	(0.346)	(0.361)	(0.363)	(0.351)
Age^2	0.007	0.009	0.008	0.007
	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	0.247	0.165	0.0793	0.196
	(0.465)	(0.506)	(0.471)	(0.466)
Pre-university	0.613	0.555	0.376	0.565
	(0.479)	(0.527)	(0.471)	(0.474)
Senior vocational training	0.403	0.281	0.126	0.333
	(0.476)	(0.531)	(0.491)	(0.476)
Vocational college	0.469	0.688	0.581	0.387
	(0.453)	(0.487)	(0.453)	(0.451)
University	0.701	0.759	0.58	0.588
	(0.475)	(0.503)	(0.468)	(0.477)
Occupation				
Paid work	0.222	0.843	0.747	0.199
	(0.327)	(0.494)	(0.491)	(0.322)
House work	0.577	0.791	0.773	0.559
	(0.413)	(0.571)	(0.567)	(0.408)
Retired	0.109	0.465	0.423	0.057
	(0.323)	(0.477)	(0.469)	(0.315)
Constant	7.171	10.653	8.969	7.724
	(6.419)	(6.913)	(6.963)	(6.497)
R^2	0.172	0.215	0.218	0.176
# of obs.	517	326	326	517

The scores for the combined dataset is computed after combining the actual data from the experiment and the mirror-image data. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 6B. Evaluating alternative measures of decision-making quality

	(1)	(2)	(3)	(4)
Houtman and Maks	0.063	0.096**	0.084**	0.059*
	(0.040)	(0.038)	(0.037)	(0.033)
HM (combined dataset)	0.006			
	(0.017)			
von Gaudecker et al. (2011)			0.848*	
			(0.482)	
Cognitive Reflection Test (CRT)				0.111
				(0.072)
CRT missing				-0.244
				(0.236)
Log 2008 household income	0.593***	0.407***	0.400***	0.587***
	(0.130)	(0.154)	(0.154)	(0.131)
Female	-0.313*	-0.217	-0.207	-0.297*
	(0.178)	(0.210)	(0.210)	(0.177)
Partnered	0.659***	0.911***	0.927***	0.692***
	(0.180)	(0.228)	(0.226)	(0.181)
# of children	0.100	0.116	0.107	0.099
	(0.093)	(0.112)	(0.111)	(0.092)
Age	-0.293	-0.416	-0.352	-0.317
	(0.348)	(0.355)	(0.359)	(0.350)
Age^2	0.007	0.009	0.007	0.007
	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	0.266	0.153	0.076	0.207
	(0.453)	(0.467)	(0.439)	(0.456)
Pre-university	0.616	0.493	0.336	0.555
	(0.468)	(0.487)	(0.461)	(0.466)
Senior vocational training	0.416	0.301	0.156	0.345
	(0.465)	(0.490)	(0.463)	(0.467)
Vocational college	0.481	0.680	0.583	0.393
	(0.441)	(0.444)	(0.418)	(0.442)
University	0.713	0.740	0.578	0.591
	(0.464)	(0.466)	(0.440)	(0.469)
Occupation				
Paid work	0.204	0.837	0.749	0.183
	(0.324)	(0.490)	(0.488)	(0.321)
House work	0.542	0.751	0.739	0.532
	(0.412)	(0.564)	(0.562)	(0.408)
Retired	0.107	0.478	0.438	0.067
	(0.321)	(0.472)	(0.465)	(0.314)
Constant	5.610	8.560	7.274	6.456
	(6.448)	(6.847)	(6.924)	(6.485)
R^2	0.175	0.219	0.221	0.179
# of obs.	517	326	326	517

Table 7A. The sources of the relationship between households' net worth and Varian (1990, 1991) scores

	(1) Have checking	(2) Fraction in checking	(3) Have saving	(4) Fraction in saving
Varian	0.01	-0.028	-0.006	-0.056
	(0.013)	(0.025)	(0.030)	(0.048)
Log 2008 household income	0.001	-0.029**	0.003	-0.068***
	(0.002)	(0.013)	(0.010)	(0.021)
Female	0.007	0.023	0.015	0.038
	(0.005)	(0.020)	(0.019)	(0.033)
Partnered	-0.005	-0.031	0.017	-0.054
	(0.004)	(0.020)	(0.022)	(0.033)
# of children	0.000	-0.004	-0.025*	-0.043***
	(0.001)	(0.010)	(0.014)	(0.013)
Age	-0.003	0.026	-0.007	-0.002
	(0.009)	(0.048)	(0.046)	(0.067)
Age^2	0.000	-0.001	0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	-0.007	0.003	0.038	0.011
	(0.007)	(0.063)	(0.069)	(0.085)
Pre-university	-0.017	-0.022	-0.005	-0.074
	(0.018)	(0.063)	(0.075)	(0.087)
Senior vocational training	0.005	0.000	0.044	-0.041
	(0.004)	(0.063)	(0.069)	(0.086)
Vocational college	0.002	-0.007	0.012	-0.041
	(0.002)	(0.061)	(0.069)	(0.083)
University	0.003	0.007	0.017	-0.078
	(0.003)	(0.065)	(0.073)	(0.086)
Occupation				
Paid work	(0.004)	(0.013)	0.014	0.060
	(0.003)	(0.034)	(0.037)	(0.052)
House work	(0.001)	(0.033)	(0.015)	(0.032)
	(0.002)	(0.047)	(0.051)	(0.065)
Retired	(0.001)	(0.014)	0.016	0.068
	(0.002)	(0.034)	(0.039)	(0.056)
Constant	1.019***	0.031	1.074	1.334
	(0.185)	(0.825)	(0.848)	(1.289)
R^2	-0.009	0.017	-0.012	0.080
# of obs.	512	512	502	502

Table 7A.
(Continued)

	(5) Have stocks	(6) Fraction in stocks	(7) Have a house	(8) Fraction in house
Varian	0.081	0.011	0.097	0.094
	(0.083)	(0.024)	(0.075)	(0.066)
Log 2008 household income	0.149***	0.013	0.135***	0.097***
	(0.031)	(0.009)	(0.029)	(0.024)
Female	0.007	0.009	-0.039	-0.067
	(0.050)	(0.013)	(0.050)	(0.043)
Partnered	0.004	-0.006	0.206***	0.126***
	(0.049)	(0.014)	(0.051)	(0.045)
# of children	0.003	0.000	0.049**	0.064***
	(0.026)	(0.007)	(0.020)	(0.019)
Age	0.079	0.013	-0.030	-0.013
	(0.098)	(0.022)	(0.091)	(0.074)
Age^2	-0.001	0.000	0.001	0.000
	(0.002)	(0.000)	(0.002)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	-0.070	-0.042	0.025	0.064
	(0.127)	(0.049)	(0.122)	(0.110)
Pre-university	0.036	-0.012	0.097	0.080
	(0.138)	(0.053)	(0.128)	(0.115)
Senior vocational training	-0.047	-0.030	0.064	0.065
	(0.131)	(0.048)	(0.124)	(0.112)
Vocational college	0.020	-0.025	0.084	0.057
	(0.128)	(0.049)	(0.121)	(0.108)
University	0.193	0.008	0.097	0.069
	(0.136)	(0.051)	(0.126)	(0.113)
Occupation				
Paid work	0.074	(0.025)	0.048	0.024
	(0.079)	(0.031)	(0.077)	(0.070)
House work	0.015	(0.041)	0.098	0.155
	(0.101)	(0.029)	(0.104)	(0.091)
Retired	0.051	(0.019)	(0.018)	0.039
	(0.090)	(0.029)	(0.083)	(0.073)
Constant	-3.083*	-0.335	-0.713	-0.856
	(1.858)	(0.396)	(1.762)	(1.427)
R^2	0.079	0.003	0.140	0.114
# of obs.	514	514	479	479

Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 7B. The sources of the relationship between households' net worth and Houtman and Maks (1985) scores

	(1) Have checking	(2) Fraction in checking	(3) Have saving	(4) Fraction in saving
Houtman and Maks	0.001	-0.007**	0.003	-0.005
	(0.001)	(0.003)	(0.004)	(0.006)
Log 2008 household income	0.001	-0.030**	0.003	-0.069***
	(0.002)	(0.012)	(0.010)	(0.021)
Female	0.007	0.022	0.016	0.039
	(0.005)	(0.019)	(0.019)	(0.033)
Partnered	-0.005	-0.032	0.018	-0.054
	(0.004)	(0.020)	(0.022)	(0.033)
# of children	0.000	-0.004	-0.025*	-0.044***
	(0.001)	(0.009)	(0.014)	(0.013)
Age	-0.003	0.024	-0.006	-0.002
	(0.009)	(0.048)	(0.046)	(0.067)
Age^2	0.000	0.000	0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	-0.007	0.002	0.039	0.009
	(0.007)	(0.063)	(0.069)	(0.084)
Pre-university	-0.017	-0.021	-0.005	-0.075
	(0.018)	(0.063)	(0.075)	(0.087)
Senior vocational training	0.005	-0.001	0.045	-0.044
	(0.004)	(0.063)	(0.069)	(0.086)
Vocational college	0.002	-0.005	0.012	-0.044
	(0.003)	(0.062)	(0.070)	(0.083)
University	0.004	0.010	0.015	-0.080
	(0.003)	(0.065)	(0.073)	(0.086)
Occupation				
Paid work	(0.004)	(0.011)	0.013	0.062
	(0.004)	(0.034)	(0.037)	(0.052)
House work	(0.001)	(0.028)	(0.018)	(0.031)
	(0.002)	(0.047)	(0.051)	(0.065)
Retired	(0.001)	(0.016)	0.017	0.068
	(0.002)	(0.034)	(0.039)	(0.057)
Constant	1.012***	0.220	0.980	1.407
	(0.201)	(0.824)	(0.854)	(1.317)
R^2	-0.010	0.024	-0.012	0.079
# of obs.	512	512	502	502

Table 7B.
(Continued)

	(5)	(6)	(7)	(8)
	Have stocks	Fraction in stocks	Have a house	Fraction in house
Houtman and Maks	0.014	0.001	0.016*	0.011
	(0.010)	(0.002)	(0.009)	(0.008)
Log 2008 household income	0.150***	0.013	0.137***	0.098***
	(0.031)	(0.009)	(0.029)	(0.024)
Female	0.008	0.009	-0.038	-0.066
	(0.050)	(0.013)	(0.050)	(0.043)
Partnered	0.006	-0.006	0.208***	0.127***
	(0.049)	(0.014)	(0.051)	(0.045)
# of children	0.004	0.001	0.050**	0.065***
	(0.026)	(0.007)	(0.020)	(0.019)
Age	0.081	0.013	-0.022	-0.009
	(0.098)	(0.022)	(0.091)	(0.074)
Age^2	-0.001	0.000	0.001	0.000
	(0.002)	0.000	(0.002)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	0.000	(0.000)	0.000
Education				
Pre-vocational	-0.065	-0.042	0.026	0.065
	(0.127)	(0.049)	(0.117)	(0.106)
Pre-university	0.036	-0.012	0.092	0.077
	(0.137)	(0.053)	(0.124)	(0.112)
Senior vocational training	-0.041	-0.029	0.066	0.067
	(0.131)	(0.048)	(0.119)	(0.109)
Vocational college	0.022	-0.024	0.082	0.057
	(0.127)	(0.049)	(0.116)	(0.105)
University	0.193	0.009	0.092	0.068
	(0.135)	(0.051)	(0.121)	(0.110)
Occupation				
Paid work	0.070	(0.025)	0.043	0.020
	(0.079)	(0.031)	(0.077)	(0.070)
House work	0.006	(0.041)	0.089	0.150
	(0.101)	(0.029)	(0.103)	(0.091)
Retired	0.053	(0.019)	(0.017)	0.039
	(0.089)	(0.029)	(0.083)	(0.073)
Constant	-3.382*	-0.332	-1.179	-1.122
	(1.868)	(0.398)	(1.789)	(1.469)
R^2	0.081	0.002	0.143	0.114
# of obs.	514	514	479	479

Online Appendix IV
First-order stochastic dominance

Beyond consistency, we ask whether choices can be reconciled with a utility function with some normatively appealing properties. In decision-making under uncertainty, it is natural to ask whether choices are also consistent with the *dominance principle* in the sense of Hadar and Russell (1969)–that is, the requirement that an allocation should be preferred to another, regardless of subjects' risk attitudes, if it yields unambiguously higher monetary payoff. The dominance principle is compelling and generally accepted in decision theory. To test whether choice behavior satisfies stochastic dominance, we combine the actual data from the experiment and the mirror-image data, compute the CCEI for this combined data set, and compare that number to the CCEI for the actual data. This measures the extent of GARP violations *and* violations of stochastic dominance (for a given subject).

A simple violation of dominance is illustrated in Figure 1 below. The budget line is defined by the straight line AE and the axes measure the value of a possible allocation in each of the two states. The point B, which lies on the 45 degree line, corresponds to an allocation with a certain outcome. The individual chooses allocation x (position along AB), but could have chosen any allocation x' (position along CD) such that $F_{x'} \leq F_x$ where $F_{x'}$ and F_x are the resulting payoff distributions. If this individual only cares about the distribution of monetary payoffs, then he will be willing to pay a positive price for a lottery yielding $F_{x'} - F_x$, which has only nonpositive payoffs (that is, for a lottery in which each account had an equal probability of being chosen).[1] Notice that any decision to allocate fewer points to the cheaper account (that is, corresponding to a position along AB) violates dominance but need not involve a violation of GARP, whereas any decision to allocate more points to the cheaper account (that is, corresponding to a position along BE) never violates dominance.

[Figure 1 here]

We use expected payoff calculations to assess how closely individual choice behavior complies with dominance. Suppose that we observe an individual choosing allocation x at prices p where $F_{x'} \leq F_x$ for some x' such that $p \cdot x' = 1$. The extent to which allocation x violates dominance can be measured by its expected return as a fraction of the *maximal* expected return that could be achieved by choosing an allocation x'. The construction of this violation index is also illustrated in Figure 1 above. The point D corresponds to the allocation x' with the highest expected return, yielding the largest upward probabilistic shift (referring to Figure 1, the outcome "α points" is shifted up to "γ points" and the outcome "β points" in unchanged). This suggests the following approach. For each observation (p^i, x^i), if no feasible allocation dominates the chosen allocation, then it has the highest value possible of one. Otherwise, it has a value less than one; specifically $(\alpha + \beta)/(\gamma + \beta)$, as illustrated in Figure 3. Since a single number

[1] More precisely, we can identify an allocation with the resulting probability distribution over payoffs if preferences satisfy the *reduction principle*; that is, $(x_1, x_2) \sim (x_2, x_1)$ because they generate the same payoff distribution.

is desired for each subject, we average this violation index across all decision problems. Table 1 below reports summary statistics and percentile values. We report the statistics for all subjects, as well as the statistics by socioeconomic categories.

[Table 1 here]

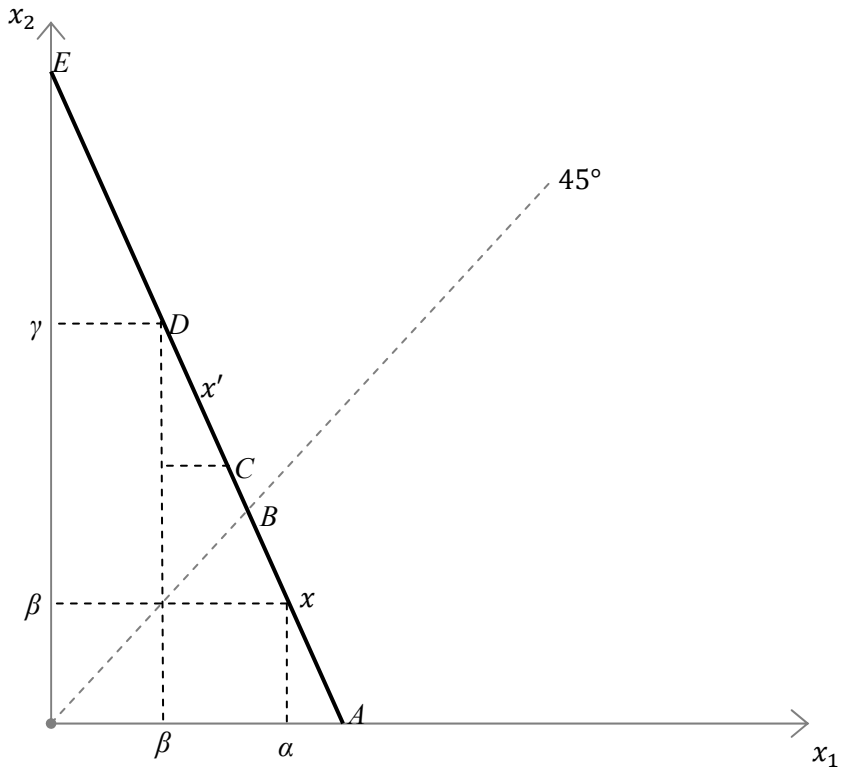
Over all subjects, the stochastic dominance scores averaged 0.959. Out of the 1,182 subjects, 1,057 subjects, (89.4 percent) have first-order stochastic dominance scores above 0.90, and of those, 839 subjects (70.1 percent) have scores above 0.95. The mean first-order stochastic dominance score for a random sample of 25,000 simulated subjects is 0.920, but only 73.5 percent and 18.6 percent of the random simulated subjects' first-order stochastic dominance scores were above the 0.90 and 0.95 thresholds, respectively (each of the simulated subjects makes 25 choices from randomly generated budget lines in the same way as the human subjects do).

Overall, the choices made by subjects in our experiment also show low rates of stochastic dominance violations, which decrease with education level and increase with age. There is also some heterogeneity in the stochastic dominance scores within and across categories. We also note that there is considerable heterogeneity in the CCEI and stochastic dominance, and that their values are positively correlated ($\rho = 0.446$). We obtain very similar econometric results when we replace the CCEI score for the combined data set with this stochastic dominance measure in our regression analysis. In particular, if we replace the combined CCEI score with this first-order stochastic dominance measure in specification (1) of Table 6, the estimated coefficient on the CCEI is 1.335 with a standard error of 0.624 (p-value $= 0.032$). The estimated coefficient on the stochastic dominance measure is 0.111 with a standard error of 1.601 (p-value $= 0.945$).

Additional Reference

Hadar, Josef, and William R. Russell. 1969. "Rules for Ordering Uncertain Prospects," *American Economic Review,* 59(1):25-34.

Figure 1. A violation of first-order stochastic dominance



The individual can choose any allocation x' (position along CD) but prefers allocation x (position along AB) such that $F_{x'} \leq F_x$ where $F_{x'}$ and F_x are the resulting payoff distributions.

Table 1. First-order stochastic dominance scores

			Percentiles					
	Mean	Std. Dev.	10	25	50	75	90	# of obs.
All	0.959	0.951	0.998	0.992	0.977	0.944	0.897	1182
Female	0.961	0.957	0.998	0.991	0.977	0.945	0.905	537
Age								
16-34	0.966	0.951	1.000	0.997	0.986	0.953	0.904	219
35-49	0.969	0.958	0.999	0.995	0.985	0.963	0.910	309
50-64	0.953	0.949	0.996	0.988	0.967	0.937	0.896	421
65+	0.949	0.948	0.995	0.988	0.965	0.926	0.874	233
Education								
Low	0.953	0.951	0.996	0.989	0.969	0.936	0.886	397
Medium	0.961	0.956	0.998	0.991	0.977	0.948	0.906	351
High	0.963	0.947	1.000	0.995	0.984	0.948	0.901	430
Household monthly incoı								
€0-2499	0.955	0.953	0.996	0.988	0.972	0.937	0.888	269
€2500-3499	0.960	0.953	0.997	0.991	0.977	0.948	0.909	302
€3500-4999	0.958	0.948	0.999	0.993	0.978	0.941	0.892	345
€5000+	0.962	0.948	0.999	0.994	0.982	0.953	0.897	266
Occupation								
Paid work	0.964	0.954	0.999	0.993	0.982	0.949	0.907	628
House work	0.957	0.952	0.999	0.991	0.976	0.941	0.888	137
Retired	0.948	0.948	0.995	0.986	0.963	0.928	0.876	247
Others	0.957	0.944	0.999	0.992	0.978	0.946	0.887	170
Household composition								
Partnered	0.958	0.951	0.998	0.992	0.977	0.942	0.896	956
Children	0.962	0.951	0.999	0.993	0.982	0.952	0.901	490

Online Appendix V
Sample selection

Our analysis is based on the non-randomly selected subsample of participants. The lack of observations on panel members who chose not to participate or did not complete the experiment creates a missing data problem. Next, we use Heckman's sample selection model to analyze the correlates of the CCEI and the Varian (1990, 1991) measure. For the measure proposed by Houtman and Maks (1985) (HM) we estimate the sample selection model of Terza (1998). Our *exclusion restriction* rests on the number of completed CentERpanel questionnaires as a fraction of the total invitations to participate in the three months prior to our experiment entering the participation equation but not being conditionally correlated with rationality. Our identifying assumption is that this "participation ratio" influences the participation in our experiment but does not influence the laboratory outcomes of interest (Bellemare et al., 2008).

The estimation results are reported in Tables 1-3 below. In column (1), we omit the nonparticipants, focusing on the subsample of participants and dropouts in the data. In column (2), we repeat the estimation reported in column (1), after adding the nonparticipants. We obtain qualitatively similar results on the reduced sample and the entire sample. Finally, testing the null hypothesis that the correlation coefficient ρ ($\sigma \times \rho$ for the HM measure) is zero is equivalent to testing for sample selection. In columns (1) and (2), we find that ρ is indistinguishable from zero and thus we find no evidence of bias. We interpret these results to indicate that self-selection is not importantly driving the results. It is also noteworthy that in both specifications the coefficient on the exclusion restriction variable is positive and significant, and that many sociodemographic categories are significantly correlated with participation. In columns (3) and (4), we repeat the estimation reported in columns (1) and (2) using the CCEI scores for the combined data set and obtain similar results.

[Tables 1-3 here]

Additional references

1) **Houtman, Martijn, and J. A. H. Maks.** 1985. "Determining all Maximal Data Subsets Consistent with Revealed Preference," *Kwantitatieve Methoden*, 19: 89-104.

2) **Terza, Joseph V.** 1998. "Estimating Count Data Models with Endogenous Switching: Sample Selection and Endogenous Treatment Effects." *Journal of Econometrics*, 84(1): 129-154.

3) **Varian, Hal R.** 1990. "Goodness-of-Fit in Optimizing Models," *Journal of Econometrics*, 46(1-2): 125-140.

4) **Varian, Hal R.** 1991. "Goodness-of-Fit for Revealed Preference Tests." Mimeo.

Table 1. The correlation between CCEI scores and subjects' individual characteristics

	(1)		(2)	
	Outcome	Selection	Outcome	Selection
Constant	.888***	.544*	.891***	-2.077***
	(.022)	(.311)	(.023)	(.209)
Female	-.024***	.084	-.024***	-.031
	(.009)	(.103)	(.009)	(.068)
Age				
35-49	-.016	-.556**	-.016	-.133
	(.011)	(.230)	(.011)	(.102)
50-64	-.051***	-1.024***	-.052***	-.393***
	(.011)	(.220)	(.011)	(.102)
65+	-.050**	-1.556***	-.051**	-.824***
	(.021)	(.263)	(.020)	(.154)
Education				
Medium	.009	.191	.009	-.036
	(.011)	(.122)	(.011)	(.081)
High	.026**	.168	.026**	.006
	(.011)	(.117)	(.011)	(.084)
Income				
€2500-3499	.025**	.303**	.025**	.281***
	(.012)	(.125)	(.012)	(.094)
€3500-4999	.019	.426***	.019	.186**
	(.013)	(.141)	(.014)	(.094)
€5000+	.033**	.064	.033**	.080
	(.014)	(.147)	(.014)	(.106)
Occupation				
Paid work	.028	-.202	.029	-.040
	(.018)	(.172)	(.018)	(.131)
House work	.046**	.108	.046**	.083
	(.020)	(.200)	(.020)	(.148)
Others	.037**	.081	.037*	.110
	(.019)	(.196)	(.019)	(.147)
Household composition				
Partnered	-.026**	.262**	-.027**	.123
	(.011)	(.119)	(.011)	(.092)
# of children	.001	.145**	.001	.031
	(.004)	(.068)	(.004)	(.036)
Participation ratio		1.231***		3.387***
		(.205)		(.125)
ρ		-.028		-.047
		(.083)		(.063)
Log peudolikelihood		210.856		-371.973
# of obs.		1372		2340

(continued)

	(3)		(4)	
	Outcome	Selection	Outcome	Selection
Constant	.759***	.545*	.757***	-2.067***
	(.043)	(.314)	(.038)	(.208)
Female	-.013	.084	-.011	-.032
	(.015)	(.104)	(.015)	(.068)
Age				
35-49	-.001	-.554**	-.009	-.135
	(.022)	(.223)	(.020)	(.101)
50-64	-.062**	-1.023***	-.079***	-.397***
	(.024)	(.212)	(.020)	(.102)
65+	-.049	-1.557***	-.078**	-.822***
	(.042)	(.258)	(.032)	(.154)
Education				
Medium	.016	.191	.021	-.036
	(.018)	(.120)	(.017)	(.081)
High	.054***	.169	.059***	.007
	(.018)	(.117)	(.018)	(.084)
Income				
€2500-3499	.017	.304**	.022	.276***
	(.021)	(.127)	(.019)	(.093)
€3500-4999	-.006	.428***	.003	.174*
	(.022)	(.138)	(.020)	(.094)
€5000+	.015	.065	.018	.075
	(.022)	(.145)	(.022)	(.106)
Occupation				
Paid work	.034	-.203	.031	-.035
	(.027)	(.173)	(.026)	(.131)
House work	.036	.109	.038	.075
	(.030)	(.205)	(.030)	(.148)
Others	.032	.081	.034	.110
	(.030)	(.193)	(.030)	(.146)
Household composition				
Partnered	-.032	.261**	-.026	.126
	(.020)	(.115)	(.018)	(.091)
# of children	-.000	.145**	.002	.028
	(.007)	(.062)	(.007)	(.036)
Participation ratio		1.230***		3.378***
		(.234)		(.125)
ρ	-.396		-.155	
			(.075)	
Log peudolikelihood			-949.787	
# of obs.	1372		2340	

Dependent variables: (1) and (2) CCEI; (3) and (4) CCEI for the combined data set. Omitted categories: male, age under 35, low education (primary or pre-vocational secondary education), household gross monthly income under €2500, retired, and not having a partner. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 2. The correlation between Varian (1990, 1991) scores and subjects' individual characteristics

	(1)		(2)	
	Outcome	Selection	Outcome	Selection
Constant	.766***	.545*	.771***	-2.077***
	(.043)	(.311)	(.043)	(.209)
Female	-.044***	.0838863	-.044***	-.031
	(.016)	(.103)	(.016)	(.068)
Age				
35-49	-.037*	-.554**	-.038*	-.133
	(.022)	(.230)	(.022)	(.102)
50-64	-.109***	-1.023***	-.109***	-.393***
	(.022)	(.219)	(.022)	(.102)
65+	-.123***	-1.557***	-.122***	-.824***
	(.038)	(.263)	(.036)	(.1539)
Education				
Medium	.023	.191	.023	-.036
	(.019)	(.122)	(.019)	(.081)
High	.065***	.169	.065***	.006
	(.020)	(.117)	(.020)	(.084)
Income				
€2500-3499	.043**	.304**	.042*	.281***
	(.022)	(.125)	(.022)	(.094)
€3500-4999	.035	.428***	.035	.186**
	(.023)	(.140)	(.023)	(.094)
€5000+	.062**	.065	.062**	.081
	(.024)	(.146)	(.024)	(.105)
Occupation				
Paid work	.026	-.203	.026	-.040
	(.031)	(.172)	(.031)	(.131)
House work	.070**	.109	.070*	.083
	(.036)	(.200)	(.036)	(.147)
Others	.056	.080	.055	.110
	(.034)	(.196)	(.034)	(.147)
Household composition				
Partnered	-.043**	.261**	-.044**	.123
	(.020)	(.119)	(.020)	(.091)
# of children	.003	.145**	.003	.031
	(.008)	(.068)	(.008)	(.036)
Participation ratio		1.230***		3.387***
		(.205)		(.125)
ρ	.003		-.034	
	(.123)		(.067)	
Log peudolikelihood	-517.655		-1098.21	
# of obs.	1372		2339	

(continued)

	(3)		(4)	
	Outcome	Selection	Outcome	Selection
Constant	.654***	.525*	0.661***	-2.068***
	(.050)	(.311)	(.047)	(.209)
Female	-.021	.087	-.020	-.031
	(.018)	(.103)	(.018)	(.068)
Age				
35-49	-.023	-.571**	-.032	-.137
	(.026)	(.229)	(.025)	(.101)
50-64	-.114***	-1.019***	-.132***	-.399***
	(.031)	(.221)	(.025)	(.102)
65+	-.086	-1.541***	-.112***	-.823***
	(.053)	(.270)	(.038)	(.154)
Education				
Medium	.025	.184	.030	-.034
	(.022)	(.121)	(.021)	(.081)
High	.071***	.156	.075***	.006
	(.022)	(.118)	(.022)	(.084)
Income				
€2500-3499	.044*	.289**	.047**	.276***
	(.025)	(.128)	(.023)	(.093)
€3500-4999	.019	.414***	.026	.175*
	(.027)	(.142)	(.024)	(.094)
€5000+	.052*	.070	.055**	.078
	(.027)	(.148)	(.027)	(.106)
Occupation				
Paid work	.053	-.189	.051	-.035
	(.033)	(.175)	(.032)	(.131)
House work	.071*	.108	.071*	.070
	(.037)	(.201)	(.037)	(.148)
Others	.050	.079	.051	.109
	(.036)	(.195)	(.036)	(.146)
Household composition				
Partnered	-.058**	.262**	-.054**	.125
	(.024)	(.118)	(.022)	(.091)
# of children	.002	.145**	.004	.028
	(.009)	(.067)	(.009)	(.035)
Participation ratio		1.250***		3.379***
		(.205)		(.125)
ρ		-.303		-.172
		(.319)		(.071)
Log peudolikelihood		-614.986		-1195.508
# of obs.		1372		2340

Dependent variables: (1) and (2) Varian scores; (3) and (4) Varian scores for the combined data set. Omitted categories: male, age under 35, low education (primary or pre-vocational secondary education), household gross monthly income under €2500, retired, and not having a partner. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 3. The correlation between HM scores and subjects' individual characteristics

	(1)		(2)	
	Outcome	Selection	Outcome	Selection
Constant	3.100***	.544*	3.100***	-2.077***
	(.018)	(.311)	(.016)	(.209)
Female	-.016**	.084	-.016**	-.031
	(.006)	(.103)	(.006)	(.068)
Age				
35-49	-.009	-.556**	-.008	-.133
	(.009)	(.230)	(.008)	(.102)
50-64	-.036***	-1.024***	-.034***	-.393***
	(.010)	(.220)	(.008)	(.102)
65+	-.031	-1.556***	-.028*	-.824***
	(.020)	(.263)	(.014)	(.154)
Education				
Medium	.013	.191	.012	-.036
	(.008)	(.122)	(.008)	(.081)
High	.032***	.168	.032***	.006
	(.008)	(.117)	(.008)	(.084)
Income				
€2500-3499	.014	.303**	.013	.281***
	(.009)	(.125)	(.008)	(.094)
€3500-4999	.006	.426***	.005	.186**
	(.010)	(.141)	(.009)	(.094)
€5000+	.012	.064	.012	.080
	(.009)	(.147)	(.009)	(.106)
Occupation				
Paid work	.026**	-.202	.026**	-.040
	(.013)	(.172)	(.012)	(.131)
House work	.043***	.108	.043***	.083
	(.014)	(.200)	(.015)	(.148)
Others	.039***	.081	.039***	.110
	(.013)	(.196)	(.013)	(.147)
Household composition				
Partnered	-.016*	.262**	-.017**	.123
	(.008)	(.119)	(.008)	(.092)
# of children	.001	.145**	.000	.031
	(.003)	(.068)	(.003)	(.036)
Participation ratio		1.231***		3.387***
		(.205)		(.125)
$\sigma \times \rho$	.009		-.001	
	(.037)		(.007)	
Log peudolikelihood	.072	-471.96	.072	-1055.01
# of obs.	1372		2340	

(continued)

	(3)		(4)	
	Outcome	Selection	Outcome	Selection
Constant	3.659***	.545*	3.655***	-2.073***
	(0.025)	(.314)	(.022)	(.194)
Female	-.025**	.084	-.024**	-.032
	(.010)	(.104)	(.010)	(.068)
Age				
35-49	-.016	-.554**	-.022*	-.131
	(.013)	(.223)	(.012)	(.098)
50-64	-.071***	-1.023***	-.083***	-.398***
	(.016)	(.212)	(.013)	(.100)
65+	-.066**	-1.557***	-.086***	-.824***
	(.030)	(.258)	(.020)	(.154)
Education				
Medium	.014	.191	.017	-.032
	(.012)	(.120)	(.012)	(.081)
High	.034***	.169	.037***	.010
	(.012)	(.117)	(.011)	(.082)
Income				
€2500-3499	.005	.304**	.009	.281***
	(.012)	(.127)	(.010)	(.093)
€3500-4999	.001	.428***	.006	.178*
	(.014)	(.138)	(.012)	(.094)
€5000+	.025*	.065	.027**	.077
	(.014)	(.145)	(.014)	(.101)
Occupation				
Paid work	.021	-.203	.019	-.037
	(.017)	(.173)	(.017)	(.132)
House work	.053**	.109	.055**	.070
	(.022)	(.205)	(.022)	(.152)
Others	.024	.080	.025	.114
	(.021)	(.193)	(.235)	(.147)
Household composition				
Partnered	-.024**	.261**	-.020*	.125
	(.012)	(.115)	(.011)	(.087)
# of children	-.007	.145**	-.005	.028
	(.005)	(.062)	(.005)	(.035)
Participation ratio		1.230***		3.380***
		(.234)		(.123)
$\sigma \times \rho$	-.059		-.018*	
	(.054)		(.010)	
Log peudolikelihood	.099	-471.96	.101	-1055.011
# of obs.	1372		2340	

Dependent variables: (1) and (2) HM scores; (3) and (4) HM scores for the combined data set. Omitted categories: male, age under 35, low education (primary or pre-vocational secondary education), household gross monthly income under €2500, retired, and not having a partner. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 4. The robustness of the correlation between CCEI scores and wealth to the inclusion of controls for unobserved constraints

	(1)	(2)	(3)	(4)	(5)
CCEI	1.322**	1.318**	1.925***	1.888***	1.441**
	(0.570)	(0.574)	(0.672)	(0.652)	(0.578)
Log household income					
2008	19.770	1.000	0.544***	0.285*	0.616***
	(14.629)	.	(0.137)	(0.165)	(0.128)
2008^2	-2.194				
	(1.533)				
2008^3	0.082				
	(0.053)				
2006				0.232	
				(0.231)	
2004				0.215	
				(0.174)	
Female	-0.291	-0.201	-0.337*	-0.296	-0.321*
	(0.181)	(0.173)	(0.185)	(0.186)	(0.176)
Partnered	0.598***	0.561***	0.734***	0.707***	0.641***
	(0.181)	(0.178)	(0.192)	(0.193)	(0.179)
# of children	0.091	0.101	0.018	0.031	0.088
	(0.092)	(0.096)	(0.099)	(0.095)	(0.093)
Age	-0.352	-0.234	-0.285	-0.251	-0.299
	(0.350)	(0.354)	(0.373)	(0.374)	(0.347)
Age^2	0.007	0.006	0.007	0.006	0.007
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
Pre-vocational	0.313	0.339	0.266	0.165	
	(0.472)	(0.493)	(0.488)	(0.530)	
Pre-university	0.659	0.622	0.575	0.479	
	(0.486)	(0.504)	(0.505)	(0.548)	
Senior vocational training	0.430	0.448	0.467	0.383	
	(0.481)	(0.501)	(0.498)	(0.540)	
Vocational college	0.497	0.458	0.564	0.415	
	(0.461)	(0.478)	(0.471)	(0.516)	
University	0.607	0.664	0.832	0.646	
	(0.485)	(0.495)	(0.487)	(0.534)	
Occupation					
Paid work	0.226	(0.036)	0.493	0.420	0.207
	(0.324)	(0.334)	(0.355)	(0.353)	(0.324)
House work	0.553	0.395	0.734*	0.707	0.446
	(0.407)	(0.426)	(0.438)	(0.436)	(0.404)
Retired	0.147	(0.007)	0.393	0.281	0.132
	(0.320)	(0.334)	(0.361)	(0.364)	(0.321)
Constant	-47.059	0.864	5.354	3.016	6.398
	(46.275)	(6.545)	(6.93)	(7.109)	(6.484)
R^2	0.187		0.205	0.217	0.177
# of obs.	517	517	449	449	517

Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Appendix VI

Tables 4-7 with age, education and occupation estimates

Table 5. The robustness of the correlation between CCEI scores and wealth to the inclusion of controls for unobserved preferences and beliefs

	(1)	(2)	(3)	(4)	(5)
CCEI	1.379**	1.396**	1.404**	1.214*	1.237**
	(0.568)	(0.568)	(0.569)	(0.625)	(0.623)
Risk tolerance					
Quantitative (experiment)	-0.768	-0.808	-0.766		
	(0.714)	(0.711)	(0.718)		
Qualitative (survey)		0.017	0.023		
		(0.074)	(0.076)		
Qualitative (survey) missing		-0.190	-0.162		
		(0.335)	(0.482)		
Conscientiousness			0.089		
			(0.072)		
Conscientiousness missing			-0.040		
			(0.668)		
Longevity expectations					-0.034
					(0.040)
Log 2008 household income	0.589***	0.578***	0.572***	0.443***	0.434***
	(0.132)	(0.131)	(0.133)	(0.123)	(0.123)
Female	-0.316*	-0.310*	-0.323*	-0.415**	-0.417**
	(0.177)	(0.181)	(0.181)	(0.186)	(0.186)
Partnered	0.655***	0.658***	0.642***	0.686***	0.687***
	(0.181)	(0.181)	(0.182)	(0.204)	(0.205)
# of children	0.086	0.087	0.083	0.075	0.083
	(0.093)	(0.093)	(0.093)	(0.102)	(0.102)
Age	-0.308	-0.303	-0.280	-0.137	-0.158
	(0.345)	(0.345)	(0.345)	(0.904)	(0.902)
Age^2	0.007	0.007	0.006	0.005	0.005
	(0.006)	(0.006)	(0.006)	(0.018)	(0.018)
Age^3	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
Pre-vocational	0.258	0.257	0.286	0.728	0.782
	(0.468)	(0.462)	(0.463)	(0.583)	(0.585)
Pre-university	0.637	0.632	0.663	0.834	0.899
	(0.481)	(0.473)	(0.470)	(0.604)	(0.616)
Senior vocational training	0.406	0.410	0.439	0.822	0.887
	(0.478)	(0.474)	(0.473)	(0.590)	(0.595)
Vocational college	0.477	0.480	0.500	0.975*	1.035*
	(0.455)	(0.449)	(0.448)	(0.571)	(0.576)
University	0.729	0.723	0.749	1.137*	1.201**
	(0.477)	(0.473)	(0.471)	(0.599)	(0.602)
Occupation					
Paid work	0.203	0.199	0.226	0.340	0.381
	(0.322)	(0.322)	(0.323)	(0.338)	(0.347)
House work	0.552	0.562	0.574	0.631	0.672
	(0.407)	(0.408)	(0.415)	(0.459)	(0.463)
Retired	0.140	0.136	0.161	0.578	0.622
	(0.320)	(0.320)	(0.321)	(0.406)	(0.417)
Constant	6.840	6.883	6.496	3.777	4.411
	(6.361)	(6.357)	(6.395)	(15.258)	(15.256)
R^2	0.179	0.176	0.176	0.163	0.163
# of obs.	517	517	517	414	414

Risk aversion in the experiment is measured by the average fraction of tokens allocated to the cheaper asset. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 6. Evaluating alternative measures of decision-making quality

	(1)	(2)	(3)	(4)
CCEI	1.253*	1.401*	1.269*	1.177**
	(0.712)	(0.729)	(0.729)	(0.583)
CCEI (combined dataset)	0.099			
	(0.380)			
von Gaudecker et al. (2011)			0.927*	
			(0.485)	
Cognitive Reflection Test				0.120*
				(0.071)
Cognitive Reflection Test missing				-0.203
				(0.237)
Log 2008 household income	0.586***	0.388*	0.383*	0.577***
	(0.132)	(0.155)	(0.154)	(0.132)
Female	-0.314*	-0.218	-0.207	-0.292*
	(0.177)	(0.212)	(0.211)	(0.176)
Partnered	0.653***	0.907***	0.926***	0.690***
	(0.181)	(0.230)	(0.228)	(0.181)
# of children	0.089	0.105	0.096	0.091
	(0.093)	(0.114)	(0.113)	(0.092)
Age	-0.301	-0.437	-0.361	-0.323
	(0.346)	(0.363)	(0.363)	(0.349)
Age^2	0.007	0.009	0.008	0.007
	(0.006)	(0.006)	(0.006)	(0.006)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	0.266	0.183	0.093	0.213
	(0.5)	(0.504)	(0.468)	(0.464)
Pre-university	0.629	0.56	0.375	0.569
	(0.5)	(0.524)	(0.487)	(0.474)
Senior vocational training	0.412	0.316	0.153	0.345
	(0.5)	(0.527)	(0.490)	(0.473)
Vocational college	0.484	0.727	0.611	0.396
	(0.5)	(0.482)	(0.448)	(0.450)
University	0.716	0.779	0.592	0.590
	(0.5)	(0.500)	(0.463)	(0.476)
Occupation				
Paid work	0.210	0.819	0.725	0.184
	(0.324)	(0.489)	(0.486)	(0.319)
House work	0.555	0.770	0.754	0.530
	(0.406)	(0.565)	(0.561)	(0.403)
Retired	0.135	0.507	0.461	0.084
	(0.319)	(0.478)	(0.469)	(0.312)
Constant	6.237	10.056	8.355	6.855
	(6.424)	(6.976)	(6.990)	(6.464)
R^2	0.177	0.225	0.232	0.181
# of obs.	517	326	326	517

The CCEI scores for the combined dataset is computed after combining the actual data from the experiment and the mirror-image data. Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.

Table 7. The sources of the relationship between households' net worth and CCEI scores

	(1) Have checking	(2) Fraction in checking	(3) Have saving	(4) Fraction in saving
CCEI	0.03	-0.098*	-0.047	-0.162*
	(0.032)	(0.057)	(0.053)	(0.097)
Log 2008 household income	0.001	-0.029**	0.003	-0.068***
	(0.002)	(0.013)	(0.010)	(0.021)
Female	0.007	0.023	0.014	0.038
	(0.005)	(0.020)	(0.019)	(0.033)
Partnered	-0.005	-0.031	0.017	-0.054
	(0.004)	(0.020)	(0.022)	(0.033)
# of children	0.000	-0.004	-0.025*	-0.043***
	(0.001)	(0.010)	(0.014)	(0.013)
Age	-0.003	0.025	-0.007	-0.002
	(0.009)	(0.048)	(0.046)	(0.067)
Age^2	0.000	-0.001	0.000	0.000
	0.000	(0.001)	(0.001)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	-0.007	0.002	0.038	0.010
	(0.007)	(0.063)	(0.068)	(0.084)
Pre-university	-0.017	-0.022	-0.005	-0.074
	(0.018)	(0.063)	(0.075)	(0.087)
Senior vocational training	0.005	0.000	0.044	-0.041
	(0.004)	(0.063)	(0.069)	(0.085)
Vocational college	0.002	-0.007	0.013	-0.042
	(0.003)	(0.061)	(0.069)	(0.083)
University	0.003	0.008	0.018	-0.077
	(0.003)	(0.064)	(0.073)	(0.086)
Occupation				
Paid work	(0.005)	(0.012)	0.014	0.063
	(0.004)	(0.034)	(0.037)	(0.051)
House work	(0.002)	(0.030)	(0.012)	(0.028)
	(0.002)	(0.047)	(0.051)	(0.065)
Retired	(0.000)	(0.017)	0.015	0.065
	(0.002)	(0.033)	(0.039)	(0.056)
Constant	0.998***	0.106	1.126	1.448
	(0.172)	(0.822)	(0.848)	(1.288)
R^2	-0.007	0.021	-0.011	0.083
# of obs.	512	512	502	502

Table 7.
(Continued)

	(5) Have stocks	(6) Fraction in stocks	(7) Have a house	(8) Fraction in house
CCEI	0.167	0.001	0.352**	0.324**
	(0.163)	(0.050)	(0.152)	(0.129)
Log 2008 household income	0.148***	0.013	0.134***	0.096***
	(0.031)	(0.009)	(0.029)	(0.024)
Female	0.007	0.009	-0.038	-0.066
	(0.050)	(0.013)	(0.050)	(0.043)
Partnered	0.005	-0.007	0.207***	0.127***
	(0.049)	(0.014)	(0.051)	(0.044)
# of children	0.003	0.000	0.048**	0.063***
	(0.026)	(0.007)	(0.020)	(0.019)
Age	0.078	0.013	-0.025	-0.009
	(0.098)	(0.022)	(0.090)	(0.073)
Age^2	-0.001	0.000	0.001	0.000
	(0.002)	0.000	(0.002)	(0.001)
Age^3	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Education				
Pre-vocational	-0.069	-0.042	0.029	0.068
	(0.127)	(0.049)	(0.123)	(0.110)
Pre-university	0.036	-0.012	0.096	0.079
	(0.137)	(0.053)	(0.128)	(0.115)
Senior vocational training	-0.045	-0.030	0.067	0.068
	(0.131)	(0.048)	(0.124)	(0.112)
Vocational college	0.022	-0.024	0.085	0.058
	(0.127)	(0.049)	(0.121)	(0.108)
University	0.195	0.009	0.094	0.067
	(0.135)	(0.051)	(0.126)	(0.113)
Occupation				
Paid work	0.071	(0.025)	0.043	0.018
	(0.080)	(0.031)	(0.076)	(0.069)
House work	0.012	(0.040)	0.088	0.146
	(0.101)	(0.029)	(0.102)	(0.089)
Retired	0.054	(0.020)	(0.013)	0.044
	(0.090)	(0.029)	(0.081)	(0.071)
Constant	-3.152*	-0.317	-1.047	-1.151
	(1.856)	(0.398)	(1.760)	(1.419)
R^2	0.079	0.002	0.148	0.123
# of obs.	514	514	479	479

Standard errors in parentheses. *, **, and *** indicate 10, 5, and 1 percent significance levels, respectively.