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7 February 2014

Dynamic Repeated Random Dictatorship and Gender Discrimination

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07.02.2014

Abstract To reduce the cognitive experimenter demand effect we embed a dictator game in a more complex decision environment, a dynamic household savings decision problem, thus rendering the dictator decision to share some endowment less salient. We then use this game in a laboratory experiment to investigate gender specific allocation behaviour and discrimination. We observe that dictators treat females nicer than males independent of their own gender. Participants are not aware of their discriminating behaviour.

Keywords repeated dictator game · altruistic preferences · gender discrimination
JEL Codes: C73 C91 D91

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1 Introduction

Dictator games have been extensively used to study unselfish behaviour both in economics and psychology (see, e.g., Camerer 2003; Engel 2011). Recently the external validity of the observations was questioned again; the extent of anonymous altruism observed in these games seems to be exaggerated and an artefact of experimentation (Bardsley 2008) and confounded by experimenter demand effects (Zizzo 2010, 2013). Being told in a laboratory experiment that one is allowed and given the opportunity to share some endowment may induce sharing behaviour that otherwise would not be observed to the same extend (List 2007; Winking and Mizer 2013).

Zizzo (2010) argues that *non-deceptive obfuscation* is suited for reducing such cognitive experimenter demand effects in the laboratory. In this study we apply this approach of *non-deceptive obfuscation* by embedding the dictator game in a more complex decision environment that renders the dictator decision to share some endowment less salient what should reduce the cognitive experimenter demand effect. Indeed, participants are neither instructed that they will have an opportunity to share some endowment nor that they will be allowed to share some endowment with an anonymous interaction partner. Instead, we present our experiment participants with a dynamic household savings decision problem. The focus of this study is, however, less on the reduction of cognitive experimenter demand effects but on the investigation of gender specific allocation behaviour and discrimination.

To learn about intertemporal allocation, and in particular about gender differences in such problems may be interesting in itself: Switching from unitary to non-unitary models[1] to assess households' decision making allowed economists to control for factors such as relative income and age (Browning et al 1994; Phipps and Burton 1998; Pollak 2005). However, not much has been said to evidence gender differences within such a context. Browning (2000) shed a first light by introducing life expectancy to motivate further analysis. Indeed, on average, women live longer than men, and wives are younger than husbands. That said, it is to be expected that both men and women will have different incentives for saving, generating gender biases in intra-couple resource allocation choices (Anderson and Baland 2002; Commuri and Gentry 2005). This motivates the design of our experiment.

Here, however, we are mainly interested in the extend of (un)selfish behaviour, its gender specificity, and gender discrimination. Much experimental research, both from psychology and economics, was conducted to account for gender differences in terms of cooperation (Mason et al 1991; Sell et al 1993; Simpson 2003), trust and reciprocity (Eckel and Grossman 2001; Saad and Gill 2001; Razzaque 2009), altruism (Bolton and Katok 1995; Andreoni and Vesterlund 2001) and corruption (Lambsdorff and Frank 2011; Alatas et al 2009). A variety of games such as the trust, the ultimatum, and the dictator game were used in these studies and showed that gender differences prevail. Yet, looking at these studies individually no consistent pattern seems to emerge: women seem neither consistently more nor less socially oriented than men, their social preferences seem rather more context specific (Croson

[1] Unitary models refer to models where households maximize a single utility function. Non-unitary models are those considering as many utility functions as individuals in the household.

and Gneezy 2009). While in e.g. Ben-Ner et al (2004) and Houser and Schunk (2009), two studies explicitly studying the effect of the receiver's gender in the dictator game, female subjects tend to give more to males than females Engel (2011)'s meta study of dictator games reveals that women tend to give more and tend to receive more (with the dictator gender then being insignificant) than men. However, only 39 out of 131 articles analysed in Engel (2011) report on the existence or absence of (recipient) gender effects.

Hence, our contribution relies on designing a game that allows studying gender specific interpersonal allocation behaviour when the gender of the partner is known without the interpersonal allocation task being salient.

Due to its obvious procedural fairness when being implemented in the form of random dictators dictatorship is surprisingly often used outside the lab. Empirical examples of random procedures are lotteries to allocate goods and burdens (see, Elster 1988). Judges, jurors and soldiers are, for instance, frequently selected by a random device. By considering a periodic random dictatorship we allow both partners to be decisive and alter the final outcome by anticipating the allocation choice of their pairs. By investigating the interpersonal allocation behaviour in a (more natural) context, the artificiality of the standard dictator game is reduced. This would strengthen the external validity of our findings. Accordingly, this article is also a contribution in a novel context to the literature on gender differences and discrimination in economic decision making.

In section 2 we introduce the dynamic decision model with the two players F and M which is solved for the conditions used in the experiment. The experimental design is introduced in section 3. After analysing the results in section 4 our main conclusions are finally summarized in section 5.

2 The Dynamic Allocation Game

For the two players F and M let f, respectively m denote their life expectations where we assume

$$f > m > 1, \tag{1}$$

i. e. F-players live longer. Irrespective of that, M-players also face an intertemporal allocation problem. Apart from the difference in life expectations we do not impose any differences. More specifically, both partners evaluate a pattern $\zeta = (C_1, \dots, C_T)$ of consumption values C_T in periods $t = 1, \dots, T (\leqslant f)$ according to

$$\Pi_F = \prod_{t=1}^{f} C_t \quad \text{and} \quad \Pi_M = \prod_{t=1}^{m} C_t \tag{2}$$

with Π_i being the monetary earnings (in experimental currency units) of our experiment participants. Thus, partners would choose the same consumption pattern if they had identical life expectations and the same (other-regarding) utility function.

To determine ζ we assume that in every period t both partners F and M submit a proposal stating how much to spend in that period t. After that it is then independently and randomly decided (with equal probabilities) in each period $t = 1$ to m which of the two proposals is implemented, i. e. whether $C_t = y_t$ (proposal of the F-player) or $C_t = x_t$ (proposal of the M-player) applies. Of course, consumption patterns ζ are restricted by the available funds. Let $W_1 (> 0)$ denote the initial wealth which can be used for consumption purposes. Since

$$W_t = W_{t-1} - C_{t-1} \text{ for } t \geqslant 2, \tag{3}$$

early consumption restricts later consumption so that

$$0 \leqslant x_t \leqslant W_t,\ 0 \leqslant y_t \leqslant W_t \text{ and thus } 0 \leqslant C_t \leqslant W_t \tag{4}$$

must hold for all periods $t = 1, 2, \ldots$.

To derive the optimal behaviour we assume risk neutral players. We assume risk neutrality since, due to their many "lives" in the experiment, participants should mainly be motivated by what they earn on average (see also Eichberger et al 2003; Rabin 2000). The constructive proof (see the Appendix) shows that we mainly rely on dominance arguments in the sense of dominant strategies. As opposed to other game theoretic contexts, risk neutrality does not have to be commonly known.

We allow, however, for other-regarding preferences in the form of social ties (see, e.g., van Dijk and van Winden 1997; van Winden et al 2008; van Winden 2012) that can be represented by the following utility functions

$$U_F = \Pi_F \times \Pi_M^{\alpha} \quad \text{and} \quad U_M = \Pi_M \times \Pi_F^{\alpha}. \tag{5}$$

The parameter α allows for positive or negative weights on the interaction partner's earnings in the own utility. For the sake of notational simplicity we omit any indices for α. Note, however, that α is specific to each decision maker and the interaction partner.[2] Intrinsic altruistic (or spiteful) preferences can be represented by an $\alpha > 0$ (or < 0) independent of the interaction partner. In-group favouritism (see, e.g., Ahmed 2007; Chen and Li 2009) and discrimination against members of specific groups (Becker 1971; Ayres and Siegelman 1995; Büsch et al 2009) can be represented by αs that depend on the interaction partner.

For $i = F, M$ a strategy $s_i(\cdot)$ must assign a proposal (y_t, respectively x_t) for the consumption level C_t in period t for all residual wealth levels W_t in t and for all possible periods t. Optimal choices $y_t^\star(W_t)$ and $x_t^\star(W_t)$ will, of course, anticipate rational future decision making. By applying backward induction one can prove (see the Appendix)

$$y_t^\star = \begin{cases} \frac{(1+\alpha)W_t}{\alpha(m-t+1)+f-t+1} & \forall\, t \leqslant m \\ \frac{W_t}{f-t+1} = \frac{W_{m+1}}{f-m} & \text{for } m < t \leqslant f \end{cases} \tag{6}$$

and

$$x_t^\star = \frac{(1+\alpha)W_t}{\alpha(f-t+1)+m-t+1} \quad \forall\, t \leqslant m. \tag{7}$$

[2] In contrast to the above mentioned studies, for our purposes we assume α to be static within one life, i.e. one instance of the dynamic allocation game. As we will discuss in the section on experimental design each life be will rather short and the feedback on the partner's choices will be limited and stochastic, minimizing the opportunities for updating one's affective social tie what justifies our assumption.

If F does not care about M's earnings, i.e. if her $\alpha = 0$, the optimal feasible consumption proposal $y_t^\star \in \Gamma_t$ of player F simplifies to

$$y_t^\star = \frac{W_t}{f - t + 1} \quad \forall\, t \leqslant m, \tag{8}$$

resulting in consumption smoothing over the own remaining time to live. If M's earnings contribute positively to F's utility F will make bigger consumption proposals in the periods $t \leqslant m$

$$\frac{\partial y_t^\star}{\partial \alpha} = \frac{W_t(f - t + 1 - m + t - 1)}{(\alpha(f - t + 1) + m - t + 1)^2} > 0 \quad \text{for } m < f. \tag{9}$$

In the extreme, F will make consumption proposals that maximize M's earnings, smoothing the available wealth over M's remaining time to live

$$\lim_{\alpha \to \infty} y_t^\star = \frac{W_t}{m - t + 1} \quad \forall\, t \leqslant m. \tag{10}$$

If M's earnings contribute negatively to F's utility F will make smaller consumption proposals in earlier periods leading to more than own earnings maximizing remaining wealth in later periods of her life.

In the case that M does not care about F's earnings, i.e. if his $\alpha = 0$, the optimal feasible consumption proposal $x_t^\star \in \Gamma_t$ of player M simplifies to

$$x_t^\star = \frac{W_t}{m - t + 1} \quad \forall\, t \leqslant m, \tag{11}$$

consumption smoothing over the own remaining time to live. If F's earnings contribute positively to M's utility M will make smaller consumption proposals

$$\frac{\partial x_t^\star}{\partial \alpha} = \frac{W_t(m - t + 1 - f + t - 1)}{(\alpha(f - t + 1) + m - t + 1)^2} < 0 \quad \text{for } m < f. \tag{12}$$

In the extreme, M will make consumption proposals that maximize F's earnings, smoothing the available wealth over F's remaining time to live

$$\lim_{\alpha \to \infty} x_t^\star = \frac{W_t}{f - t + 1}. \tag{13}$$

If F's earnings contribute negatively to M's utility M will make bigger consumption proposals in earlier periods leading to less than own earnings maximizing remaining wealth or even no wealth in later periods of his life.

Therefore, it turns out that optimal, utility maximizing behaviour does not depend on what the other intends to do: Optimal behaviour requires consumption smoothing over the remaining (joint) life time.[3]

Although the decision problem is quite complex, e. g. in the sense of a dynamic game, the optimal behaviour is quite obvious and prominent. Thus, both players will certainly be close to their optimal conditional consumption smoothing. Since the life of the M-player will be shorter we expect the decisions of the M-player to be most

[3] Due to repeated random dictatorship consumption sequences are stochastic.

relevant for our analysis. If the M-player opportunistically consumes the whole residual endowment in the last period of his life the earnings of his F-partner in this life are then equal to zero. If the M-player leaves some endowment for consumption after his last period he reduces his own earnings but allows the F-player to earn something as well. Leaving exactly the number of units that the F-player lives longer will ensure equal earnings for both players in the according life. Thus, behaviour in this pivotal period of a life can be compared to that in standard dictator games. Whether the M-player leaves any endowment for his longer living F-partner after his last period of life may reveal insightful gender differences in our setting.

3 Experimental Design

We run four treatments with identical initial endowments $W_1 = 21$ and life expectations of $m = 4$ and $f = 6$. Consequently, with the assumption of selfish pure own earnings maximizing behaviour and the expectation to earn zero in about half of all "lives" the expected earnings of the F-player is still substantially higher than the expected earnings of the M-player. This should further limit the extent of M-players' deliberate unselfish behaviour induced by a cognitive experimenter demand effect.

Lastly, the partner's gender is always known to each participant. In treatment (i) a male assumes the position of the M-player and a female that of the F-player, and vice versa in treatment (ii). In treatment (iii) both roles are assumed by females and, finally, in treatment (iv) both roles are assumed by males. Each subject experiences only one treatment condition. This 2×2 between subjects design (see table 1) allows to distinguish between discrimination against a gender and gender specific behaviour.

In the experiment a participant experiences ten successive "lives", always assuming the same role[4] F or M what should provide better chances for learning. The first two lives are "single lives", whereas lives three to ten are "couple lives". The "single lives" at the beginning of a session make the saving decisions and optimal own earnings maximising behaviour more salient and easier to learn as there is no stochastic element that otherwise would slow down learning (see, e.g., Dittrich et al 2012). During "single lives" participants can also get used to choosing rational numbers as the optimal choices during these lives are given by $y^\star = 3.5$ and $x^\star = 5.25$; consumption choices are only restricted to be non-negative. The software used for the experiment provides access to an on-screen calculator what should reduce any impact of differing cognitive abilities between participants.

In each period within the "couple lives" both players F and M submit simultaneously a proposal stating how much to consume in that period of their current "couple life." After that it is then randomly decided with equal probabilities which of the two proposals is implemented for both participants. Participants are then informed only about the implemented proposal. Hence, a participant is not informed about the partner's proposal in a period when the partner's proposal was not implemented.

Within the "couple lives" there is no rematching. The participants are playing eight lives with the same partner. Thus, "reincarnation" only allows to learn how to

[4] In the experiment the roles were labelled 'A' and 'B'.

Table 1 Treatments and Number of Couples (Independent Observations)

Life expectation	$m = 4$	$f = 6$	# Couples
Gender	male	female	12
	male	male	13
	female	female	12
	female	male	12
Total			49

"live" with the same partner and not to diversify by playing differently with different partners. This repetition should result in a more reliable measure. This is akin to sequences of mini-dictator game decisions that are, for instance, also elicited for the Ring test of social value orientation (Liebrand and McClintock 1988) which enjoys some popularity in the experimental economics literature (see, e.g., Brosig 2002; van Dijk et al 2002; Kanagaretnam et al 2009).

If anything, this partners design should be more likely to increase the overall cooperativeness of M-players for strategic reasons than to decrease it; it reinforces the influence of reputation and repetition-based reciprocity (Andreoni and Croson 2008; Engelmann and Fischbacher 2009; Gächter and Falk 2002; Nowak 2006). This strategic incentive works in the opposite direction of our efforts to mitigate a potential cognitive experimenter demand effect. Therefore, if we still observe a decline in the number of times the M-player leaves some endowment for his partner as compared to a standard dictator game we can consider this as an indication for an effective reduction in the cognitive experimenter demand effect.

Payoffs are measured in points, summed up over all rounds, and then transformed into Euro (€) by 8 points = € 0.01. This ensures average earnings above the hourly wage of our participants which are usually in the range of € 5 to € 9. In addition to these earnings participants received a show up fee of € 2.50.

4 Experimental Procedures and Sample

The experiment was conducted at the experimental laboratory of the Max Planck Institute of Economics in Jena, Germany. Ninetyeight randomly recruited undergraduates from various departments of the Friedrich Schiller university who stated their general willingness to participate in experiments earlier participated in the experiment. While the gender composition of the various departments can be unbalanced the gender composition of the whole university and therefore of our subject pool is almost perfectly balanced (approx. 55 % females).

More than half of the subjects (55.8 %) had a partner or was even married (this was the case for three participants). About half of the participants (49 %) had a background in economics or business administration. Around one fourth was enrolled at another humanities department. Further fields of study were e. g. law or computer sciences.

After entering the lab, subjects were seated at computer terminals and received written instructions. Questions were answered privately. The experiment was pro-

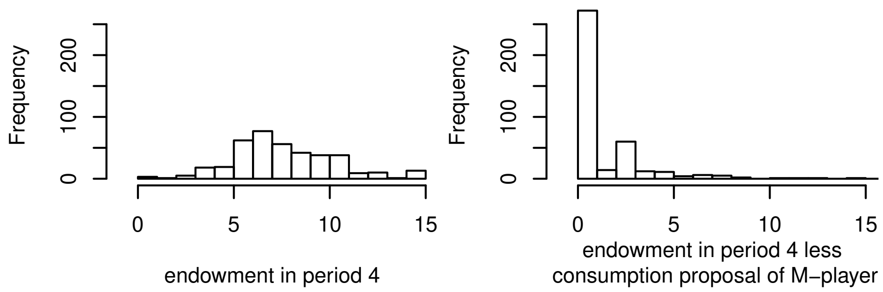

Fig. 1 Few M-players are kind: Distribution of endowments at the beginning and less the M-players' consumption proposal of period 4

grammed and performed with z-Tree (Fischbacher 2007). The participants were assigned to one of the two roles (M- or F- player) according to their gender and the assigned treatment. Each of the four treatments was performed by twelve couples, except for the male-male treatment, where thirteen "couples" participated (see table 1). Since we always invited female and male students, two or more treatments were conducted at the same time in each session. We conducted six separate sessions with 10 to 28 participants each. On average, each session took about 50 minutes in total.

M-players obtained an average total payoff of € 7.39 (SD 1.46) including the show up fee and the earnings from the two single lives. F-players obtained an average total payoff of € 10.85 (SD 3.11).

5 Experimental Results

We now analyse the M-players' decision in the fourth period of his eight "couple lives", the decision that is comparable to the decision in a standard dictator game. We then complement this with insights from a post-experimental questionnaire.

First, however, let us note that while until the end of their "single-lives" about a third of participants did not learn to perfectly smooth consumption over their remaining time to live there is no gender bias in the ability to learn consumption smoothing during the "single lives" ($p = 0.21$).

Observation 1 *Rather few* M*-players are 'kind' to their* F*-partner.*

Figure 1 shows the distribution of endowments at the beginning of period 4 over all "couple lives" and treatments and the distribution of these endowments minus the M-players' consumption proposal. If participants were choosing only own payoff maximizing consumption choices we would expect the endowments to be in the range of 5.25 to 10.5. Indeed, more then 75% of endowments are in that range; only 62 endowments are below and 34 endowments are above. Kolmogorov-Smirnov-tests show that the distributions do not differ between the four treatments.

An indicator for whether participants care for each other would be the amount left by M-players after the fourth period. In 247 out of 392 cases (63 %; or 60 % if we consider only cases where the endowment was at least 5.25) an M-player would

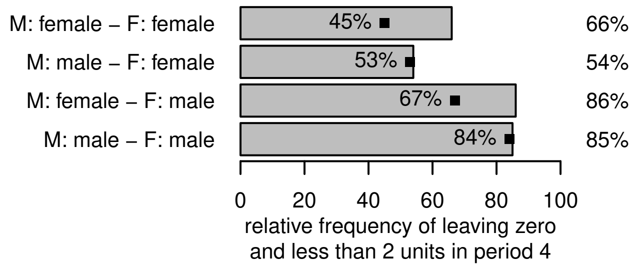

Fig. 2 Female F-players get more: Frequencies of how often an M-player would consume the whole endowment and how often he would leave less than 2 units of the endowment in period 4 in the four different gender constellations

Table 2 The M-players' consumption proposal depends only on the F-players' gender: ANOVA for number of times the M-players leaves less than two units in period four based on a multilevel logistic model

Factor	Deviance	Resid. Df	Resid Dev.	F	$P[> F]$
maximal model		48	319.65		
M-Gender	1.82	47	317.83	0.304	0.58
F-Gender	33.94	46	283.89	5.681	0.02
M-Gender:F-Gender	0.43	45	283.46	0.073	0.79
reduced model		48	319.65		
F-Gender	33.42	47	286.23	5.786	0.02

not have left anything for his partner. This is considerably higher than the 36% of participants not sharing their endowment reported in the meta-study of Engel (2011). While we may consider this a successful reduction of the cognitive experimenter demand effect a substantial amount of unselfish behaviour remains.

Observation 2 *Regardless of the M-player's own gender a female F-player is treated much kinder than a male F-player.*

There are substantial differences considering the gender constellations as can be seen in Figure 2. Corroborating the results of Engel (2011)'s meta study a male F-player is left more often with nothing or with less than 2 units than a female F-player independent of the M-players' gender. While female M-players also leave amounts between 0 and 2 (and more) units for their partner, male M-players either leave nothing or 2 and more units in period 4.

A logistic regression on the relative number of times an M-player would leave less than two units after period 4 shows that female F-players have a significantly lower probability of having an endowment of less than two units in period 5 ($p = 0.02$). There are no significant differences with respect to the gender of the M-player, the relevant dictator. The results of the correspondong ANOVA[5] can be found in table 2. The model includes a factor for the gender of the M-player, a factor for the gender

[5] While the model reported here has only one observation for each participant we also ran a repeated measures ANOVA on all individual fourth period choices of the eight "couple lives" to test for "lives" effects that may indicate any learning dynamics. We found none ($F = 1.14, df = 7, p = 0.34$).

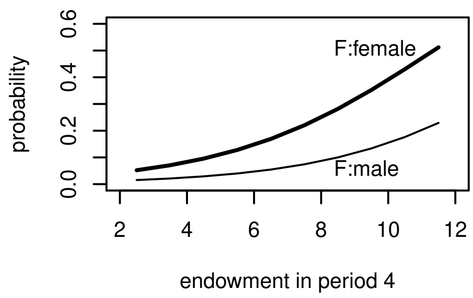

Fig. 3 The estimated probability for an M-player leaving at least two units in period 4 is increasing with the endowment and is bigger if the F-player is female

of the F-player, and the interaction of these factors. Note, that we have to control for overdispersion. This maximal model can be reduced by stepwise elimination of factors that do not significantly contribute to the explanatory power. The minimal adequate model contains only the factor for the F-player's gender.

Analysing the relative number of times an M-player consumes the whole endowment yields the same result: only the factor for the F-player's gender is significant ($p = 0.02$).

Based on a multilevel logistic regression in which we also include the available endowment for each consumption decision we compute expected probabilities of leaving at least two units in period 4. As can be seen in figure 3, corroborating the results of Andreoni and Miller (2002), M-players are more likely to leave at least two units of endowment after period 4 when it is less costly for them, i.e. when there is relatively more endowment left at the beginning of period 4. Of course, the more favourable treatment of female F-players can also be seen here.

To provide a more complete description of the data we depict in figure 4 the mean consumption proposals over all couple lives but separate for each couple and implied endowments left for the F-player after period 4, the M-players' end of life, assuming future consumption proposals would equal the current one. Since the endowment in each period $t \geqslant 2$ is stochastic the raw consumption proposals are not easily compared. We, therefore, plot the consumption proposals relative to the optimal consumption proposal for an M-player with $\alpha = 0$ according to equation (11). The overall means of these values for each period are given in table 3. For better comparison of the distribution of proposals between male and female M-players the plotted values are sorted from low to high for each period.

The M-players' consumption proposals are rather heterogeneous. We observe both over- and under-consumption, implying a range of negative and positive α-values. The distribution of consumption proposals for male and female M-players seems almost identical. Indeed, separate Kruskal-Wallis tests for each period do not show any significant differences at the 5% level but for the fourth period supporting again our above observation.

The overall lower mean value in table 3 for period 4 can be explained by the fact that even the spiteful, over-consuming M-players can not consume more than the available endowment in period 4.

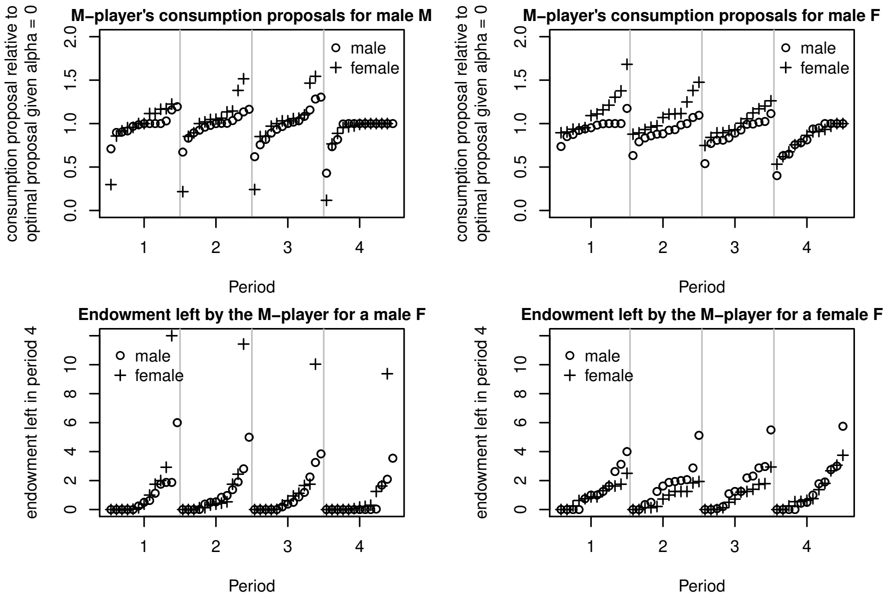

Fig. 4 M-players are more altruistic towards female F-players independent of their own gender

Table 3 Average consumption proposals relatrive to the optimal proposal given $\alpha = 0$

	Gender of Player		Period			
	M	F	1	2	3	4
M-player	male	male	0.98	0.98	0.99	0.92
	female	male	0.98	1.03	1.02	0.89
	male	female	0.95	0.91	0.90	0.83
	female	female	1.13	1.10	1.00	0.83
F-player	male	male	1.09	1.10	1.09	1.05
	male	female	1.01	0.98	1.01	1.09
	female	male	0.98	0.90	0.94	0.93
	female	female	0.94	0.96	0.94	0.94

To complete the description of the data we depict in figure 5 the F-players' mean consumption proposals over all couple lives but separate for each couple. The plotted values are constructed in the same way as above, using equation (8) to compute the optimal proposal for $\alpha = 0$. The overall means can also be found in table 3.

Again, we observe rather heterogeneous choices and under- and over-consumption, implying negative and positive α-values. While table 3 seems to indicate that F-players are nicer to male M-players independent of their own gender, i.e. F-players consume relatively more when paired with a male M-player, separate Kruskal-Wallis tests for each period do not indicate any statistically significant differences ($p > 0.1$).

Observation 3 *The favourable treatment of female* F*-players seems not to be a result of deliberate intentions; participants are not aware of their gender discrimination.*

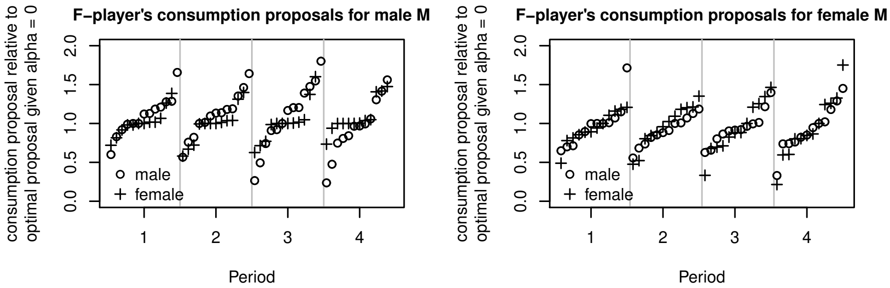

Fig. 5 There are no differences in the F-players' consumption proposals with regard to their own gender or the M-players' gender

Are these gender discriminating choices reflected in our participants' self-assessment? With the help of a post-experimental questionnaire we derived a measure for subjective fairness attitude. Additionally, we asked whether females are fairer than males, whether females are fairer towards other females than towards males (subjective female solidarity) and whether males are fairer towards other males than towards females (subjective male solidarity). The questionnaire consisted of several statements that were to be evaluated on a scale from one to six standing for completely wrong and absolutely right. Some statements were repeatedly presented but each time rephrased and put in a different way such that we get a more reliable measure in the aggregate.

Our measure for subjective fairness attitude reveals that females assess themselves fairer than males assess themselves (Wilcoxon, $p = 0.01$).

This leads directly to the question whether females are also considered fairer than males by our participants. This is negated considering the whole population (Wilcoxon, $p < 0.01$).[6] Whereby on average females themselves seem to be even more diffident than males (Wilcoxon, $p < 0.01$) in evaluating who is the fairer gender.

Though not significant at the 5 % level, we want to present the quite revealing rank correlation between subjective fairness attitude and the evaluation whether females are fairer than males: $\mathrm{cor}_{\mathrm{female}} = -0.29$ ($p = 0.05$) and $\mathrm{cor}_{\mathrm{male}} = 0.10$ ($p = 0.48$). As can be seen, females with a higher subjective fairness attitude tend to negate the question whether females are fairer than males. Whereas, males with a higher subjective fairness attitude tend to affirm this question. Consequently, both genders seem to be rather chary.

Eventually, both, males and females, negate the question whether females are fairer towards their own gender than towards males (Wilcoxon, $p < 0.01$; female sub-sample $p < 0.01$; male sub-sample $p = 0.04$); and they also agree to negate the question whether males are fairer towards their own gender than towards females (Wilcoxon, $p < 0.01$; female sub-sample $p < 0.01$; male sub-sample $p < 0.01$).

Finally, we asked our participants with whom they would like to repeat the experiment, a female or a male. About two thirds of the participants are indifferent.

[6] We test whether the observed score of the measure is different from the neutral score, i.e. the mid-point of the scale.

The remaining third stating some preferences for a female or male partner shows no significant inclination either.

These observations are supported by the following rather anecdotal evidence. After the experiment some participants firmly rejected the possibility that there might be any difference between the two genders. The most common reaction was the expressed disbelieve in anyone conditioning his or her behaviour in the experiment on the gender of his or her partner. A similar observation is reported by Fershtman and Gneezy (2001) whose participants where totally amazed after being debriefed by the fact that they discriminated against one group without being aware of it.

To sum up, while the post-experimental individual self assessment reflects own behaviour during the experiment the assessment of the respective group behaviour does only partly so. Although male rivalry and chivalry seem to be at least subconsciously anticipated female solidarity is not. Thus, the observed behaviour, in particular the general preferential treatment of females, seems not to be a result of mature and well reasoned intentions. Participants are not fully aware of their own discriminating behaviour.

6 Discussion

In this study we embedded a dictator game in a more complex decision environment, a dynamic household savings decision problem, to render the dictator decision to share some endowment less salient what should reduce the cognitive experimenter demand effect that would otherwise lead to an exaggerated level of observed altruism (Bardsley 2008; Zizzo 2010). This in turn would strengthen the external validity of our findings. We then used this game in a laboratory experiment to investigate gender specific allocation behaviour and discrimination.

Compared to a standard dictator game, we indeed observe a substantially lower probability of sharing anything of the endowment indicating that we have successfully reduced the potential cognitive experimenter demand effect. In general rather few M-players are 'kind' to their F-partner in the sense of leaving some endowment for consumption after the fourth and last period of M's life. On the other hand, being 'kind' depends on the gender of the F-partner. Regardless of her partner's gender a female F-player is treated in a kinder way than a male F-player. This is in line with the results of Engel (2011)'s meta study of dictator games – based on 39 articles reporting on the existence or absence of gender effects out of a total of 131 analysed articles – which showed that women tend to give more and tend to receive more (with the dictator gender then being insignificant) than men.

Since this positive discrimination is independent of the decision makers' own gender it can not be driven by their cognitive abilities.

Further, the results of a post-experimental questionnaire indicate that this feature of their behaviour is not anticipated by our participants. Thus, the observed behaviour may be deduced from a rather instinctive female solidarity and men's chivalry towards the opposite gender.

It is interesting to note that this positive discrimination of females may compensate the potential negative economic effect of their true longer life expectation outside the laboratory and the implied gender bias in intra-couple intertemporal resource allocation. Moreover, partnerships outside the laboratory may last long enough to reinforce the partnership specific affective social ties and thus to amplify the effect of the observed positive discrimination.

From our experiment we conclude that indeed the behaviour of participants in experiments depend on their partner. Surprisingly men and women do not act very differently since they both discriminate men and favour women. Yet, they are not aware of this. When running experiments one should therefore take care that the composition of a single session is not biased towards either gender. Otherwise the participants may form beliefs that they will interact most probable with only one of the two genders and thus may act differently. Further, since gender effects are only reported if significant the evidence so far is somewhat ambiguous. To shed more light on whether or not there really exists a robust gender difference in economic decision making one should always test for these differences and report the test results even if they indicate that there is no significant difference.

Appendix

A Instructions (translation)

The following experiment consists of ten rounds. A round consists of several periods. In each round, money can be earned in a fictitious currency (points). On completion of the experiment the aggregate of all per-round earnings is paid out in cash, based on the relationship of 8 points = € 0.01. You will also receive an additional basic amount of € 2.50 for participating.

In principle, the task of a round is to distribute an initially available amount S of 21.00 points onto several periods.

For greater clarity, the amount that is spent by a participant in period one will be referred to as x_1, that of period two as x_2, etc. Accordingly, you are required to spend a certain amount x_t in any experienced life period t. In the next period you will only have the residual balance $S - x_1 - \ldots - x_t$ available for spending. A round's earnings are calculated as the product of all single amounts that were spent in each experienced life period during this round. You should further note: When spending a zero-amount in a period, you will earn nothing in that round (since one of the factors is zero in this case).
There are two different types of participants:

- A-participants for whom a round consists of six periods. (their per-round earnings G are calculated as: $G = x_1x_2x_3x_4x_5x_6$)
- B-participants for whom a round consists of the first four periods. (their per-round earnings G are calculated as: $G = x_1x_2x_3x_4$)

Before round one begins, you will be told which type (A or B) you are and, hence, how many periods you live per round.

In rounds one and two you make your decisions absolutely independently of other participants' decisions.

In round three and all subsequent rounds (up to round ten) you will be allotted to some other participant. This other participant (allotted to you) will be of the other type, i. e. if you are a type A participant with six periods to live, your allotted other participant will only live four periods in that same round and vice versa. You remain allotted to the same participant during all eight rounds. This participant can either be female or male. Which gender the participant (allotted to you) has, you will be told at the beginning of the third round.

Each pair of participants then decides for each period t simultaneously with, and independently of, the other participant how much he/she wants to spend in a given period. After both participants have made their decision, one of the two decisions is drawn by lot. This drawn-by-lot decision will be valid for both participants, i. e. it becomes the amount of spending x_t for that particular period t and for both participants (A and B). The amount is deducted from the residual budget of the two participants. For the first four periods of every round, decisions are determined in this manner. In periods five and six, the participant who lives through six periods, can make his/her autonomous decisions again. Per-round earnings are calculated for both participants as described above. During the entire experiment, a button in the lower left screen corner is available for access to a pocket computer.

Your entries will remain anonymous because we are only able to assign any of your data to your code number – not to your person. If you have any questions concerning the experiment, please, raise your hand. We will then try to answer your questions privately. Please do not speak with your neighbours since any exchange of information will render your data useless for our purposes. In that case we will have to exclude you from the experiment and refrain from paying you any money.

B Questionnaire (translation)

All statements of the questionnaire except for the first were answered on a six point scale raging from completely wrong to completely right.

- If you were to repeat this experiment with whom would you prefer to interact?
  Options: with a man, with a woman, I do not care
- Women are fairer towards women than towards men.
- The experiment was unfair.
- I did not understand what I was supposed to do.
- Men are fairer towards men than towards women.
- Men are more egoistic than women.
- I had barely influence on my earnings.
- I am satisfied with my decisions in this experiment.
- I felt treated fair in this experiment.
- Women are fairer than men.
- In this experiment I was especially fair.
- All should get the same amount of money just for participating and regardless of their performance in this experiment.
- The main point is I earned a lot.
- I do not care for the earnings of other participants.
- My decisions in this experiment were easy.
- My partner in this experiment is simpatico.

C Constructive Derivation of Benchmark Solution

We prove (i) that the parameter α describing the weight of the partner's earnings in one's own utility function determines together with the remaining times to live how much of the total wealth should be consumed during the joint life time of both, M and F-players, and how much should be left for the remaining periods of the F-players longer life, and (ii) that conditional conditional consumption smoothing in the sense of consuming that amount which results from spreading the so determined available funds equally over one's own remaining joint life time is optimal for both players at any $t \leqslant m$ and for the remaining periods of the F-player's longer life after $t = m$.

C.1 The F-Players Optimal Consumption Proposals

First, let $u^F(W, C)$ denote the log utility of F and $E[\cdot]$ the expectation operator then

$$E[u^F(W,C)] = \sum_{t=0}^{f} E[f(C_t,t)] + \alpha \sum_{t=0}^{m} E[f(C_t,t)] \quad \text{with} \quad f(C_t,t) = \log C_t, \tag{14}$$

where C_t is an element of the set of feasible consumption decisions Γ_t, i. e. $C_t \in \Gamma_t = \{0 \leqslant C_t \leqslant W_t\}$. C_t is randomly dictated by player M or F. With x_t and y_t denoting the consumption proposal of M and F respectively we get

$$E[f(C_t(x_t, y_t), t)] = \begin{cases} \frac{1}{2}\log x_t + \frac{1}{2}\log y_t & \text{for } t \leqslant m \\ \log y_t & \text{for } m < t \leqslant f \end{cases} \tag{15}$$

and

$$E[T(W_t, C_t(x_t, y_t), t)] = \begin{cases} W_t - \left(\frac{1}{2}x_t + \frac{1}{2}y_t\right) = E[W_{t+1}] & \text{for } t \leqslant m \\ W_t - y_t = E[W_{t+1}] & \text{for } m < t \leqslant f \end{cases} \tag{16}$$

defining the expected transition of wealth from period t to $t+1$. Assuming a program, y, that maximizes the above expected utility, we can define the following value function at time t as:

$$V^\star(W_t, t) = \max_{y^t = (y_t, \ldots, y_f)} (1+\alpha) \sum_{\tau=t}^{m} E[f(C_\tau(x_\tau, y_\tau), \tau)] + \sum_{\tau=m+1}^{f} E[f(C_\tau(x_\tau, y_\tau), \tau)] \tag{17}$$

Assume we know that $V^\star(W_{t+1}, t+1) = V(W_{t+1}, t+1)$ and that $y^{t\star} = (y_t^\star, \ldots, y_m^\star)$ is the program that maximizes (17). By the Principle of Optimality we know that if the optimal decision today is $y^{t\star} = (y_t^\star, \ldots, y_f^\star)$, then the sequence $y^{t+1\star} = (y_{t+1}^\star, \ldots, y_f^\star)$ will be optimal starting tomorrow. Thus, we can write:

$$\begin{aligned} V^\star(W_t, t) &= (1+\alpha)E[f(C_t(x_t, y_t^\star), t)] + V^\star(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \\ &= (1+\alpha)E[f(C_t(x_t, y_t^\star), t)] + V(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \quad \text{for } t \leqslant m \\ &\text{and} \\ V^\star(W_t, t) &= E[f(C_t(x_t, y_t^\star), t)] + V^\star(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \\ &= E[f(C_t(x_t, y_t^\star), t)] + V(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \quad \text{for } t > m \end{aligned} \tag{18}$$

If there was a $\hat{y}_t \in \Gamma_t$ such that

$$\begin{aligned} &(1+\alpha)E[f(C_t(x_t, \hat{y}_t), t)] + V(E[T(W_t, C_t(x_t, \hat{y}_t), t)], t+1) > \\ &\quad (1+\alpha)E[f(C_t(x_t, y_t^\star), t)] + V(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \end{aligned} \tag{19}$$

then there would be a program $\hat{y}^t$ that would result in a higher value for $V^\star$ than $y^{t\star}$, where $\hat{y}^{t+1}$ is the program that maximizes

$$V(E[T(W_t, C_t(x_t, \hat{y}_t), t)], t+1) = V^\star(E[T(W_t, C_t(x_t, \hat{y}_t), t)], t+1). \tag{20}$$

The existence of such a program, however, would contradict the optimality of $y^{t\star}$. Therefore there cannot be such a $\hat{y}_t$ and thus:

$$V^\star(W_t, t) = \begin{cases} \max_{y_t \in \Gamma_t} & [(1+\alpha)E[f(C_t(x_t, y_t), t)] + \\ & V(E[T(W_t, C_t(x_t, y_t), t)], t+1)] \quad \text{for } t \leqslant m \\ \max_{y_t \in \Gamma_t} & [E[f(C_t(x_t, y_t), t)] + \\ & V(E[T(W_t, C_t(x_t, y_t), t)], t+1)] \quad \text{for } t > m \end{cases} \tag{21}$$

that leads to $V^\star(W_t, t) = V(W_t, t)$.

By the first order condition for y_t we have for all W and $t \leqslant m$ at the optimum:

$$\begin{aligned} (1+\alpha)\frac{\partial E[f]}{\partial y_t}(C_t(x_t, y_t^\star), t) + &\frac{\partial V}{\partial E[T]}(E[T(W_t, C_t(x_t, y_t^\star), t)], t+1) \\ &\times \frac{\partial E[T]}{\partial y_t}(W_t, C_t(x_t, y_t^\star), t) = 0. \end{aligned} \tag{22}$$

For $t > m$ we obtain the same equation without the factor $1+\alpha$. We substitute (22) for $\partial V/\partial E[T]$ into

$$\frac{\partial V}{\partial W_t}(W_t,t) = \frac{\partial E[f]}{\partial W_t}(C_t(x_t,y_t^\star),t)+\frac{\partial V}{\partial E[T]}(E[T(W_t,C_t(x_t,y_t^\star),t)],t+1) \times \frac{\partial E[T]}{\partial W_t}(W_t,C_t(x_t,y_t^\star),t) \tag{23}$$

and get for $t \leqslant m$

$$\frac{\partial V}{\partial W_t}(W_t,t) = \frac{\partial E[f]}{\partial W_t}(C_t(x_t,y_t^\star),t) - (1+\alpha)\frac{\partial E[f]}{\partial y_t}(C_t(x_t,y_t^\star),t)\frac{\frac{\partial E[T]}{\partial W_t}(W_t,C_t(x_t,y_t^\star),t)}{\frac{\partial E[T]}{\partial y_t}(W_t,C_t(x_t,y_t^\star),t)}. \tag{24}$$

The Euler equation can then be derived with the help of $\partial V/\partial W_{t+1}$:

$$(1+\alpha)\frac{\partial E[f]}{\partial y_t}(C_t(x_t,y_t^\star),t) + \left(\frac{\partial E[f]}{\partial W_{t+1}}(C_{t+1}(x_t,y_t^\star),t+1) -(1+\alpha)\frac{\partial E[f]}{\partial y_{t+1}}(C_{t+1}(x_{t+1},y_{t+1}^\star),t+1)\times\frac{\frac{\partial E[T]}{\partial W_{t+1}}(W_{t+1},C_{t+1}(x_{t+1},y_{t+1}^\star),t+1)}{\frac{\partial E[T]}{\partial y_{t+1}}(W_{t+1},C_{t+1}(x_{t+1},y_{t+1}^\star),t+1)}\right) \times\frac{\partial E[T]}{\partial y_t}(W_t,C_t(x_t,y_t^\star),t) = 0. \tag{25}$$

We can now solve for the optimal consumption proposal of player F. The Euler equation reduces finally to

$$\frac{1+\alpha}{2y_t^\star}+\left(0+\frac{1+\alpha}{y_{t+1}^\star}\right)\left(-\frac{1}{2}\right)=0 \quad\Rightarrow\quad y_t^\star = y_{t+1}^\star \quad \text{for } t < m$$
$$\text{and} \tag{26}$$
$$\frac{1}{2y_t^\star}+\left(0+\frac{1}{y_{t+1}^\star}\right)\left(-\frac{1}{2}\right)=0 \quad\Rightarrow\quad y_t^\star = y_{t+1}^\star \quad \text{for } t > m$$

It immediately follows that for $t > m$ player F will spread the available wealth equally over the remaining periods

$$y_t^\star = \frac{W_t}{f-t+1} = \frac{W_{m+1}}{f-m} \quad \text{for } t > m \tag{27}$$

At $t = m$ the value function V that player F tries to maximize can hence also be written as

$$V(W_m,m) = (1+\alpha)\,(0.5\log x_m + 0.5\log y_m) + \left(0.5(f-m)\log\frac{W_m-x_m}{f-m}+0.5(f-m)\log\frac{W_m-y_m}{f-m}\right) \tag{28}$$

Therefore follows

$$\frac{\partial V(W_m,m)}{\partial y_m} = 0.5\frac{1+\alpha}{y_m^\star} - 0.5\frac{(f-m)}{W_m-y_m^\star} = 0 \tag{29}$$

$$y_m^\star = \frac{(1+\alpha)W_m}{\alpha+f-m+1}. \tag{30}$$

Using equation (26) allows us then to conclude that the optimal feasible consumption proposal $y_t^\star \in \Gamma_t$ of player F is

$$y_t^\star = \frac{(1+\alpha)W_t}{\alpha(m-t+1)+f-t+1} \quad \forall\, t \leqslant m. \tag{31}$$

At any time the choice of the optimal consumption proposal $y_t^\star$ does not depend on present or future choices of M's consumption proposal $x_{t+i}\,\forall\, i \geqslant 0$ but only on present available funds W_t, the own remaining time to live $f-t+1$, and until period $t = m$ the parameter α and the M-player's remaining time to live $m-t+1$.

C.2 The M-Players Optimal Consumption Proposals

The M-player's optimal consumption proposals can be derived in an analogous manner. In the following we therefore only sketch this derivation.

First, while keeping the above definitions let $u^M(W,C)$ denote the log utility of M then

$$E[u^M(W,C)] = \sum_{t=0}^{m} E[f(C_t,t)] + \alpha \sum_{t=0}^{f} E[f(C_t,t)] \quad \text{with} \quad f(C_t,t) = \log C_t, \tag{32}$$

Assuming a program, x, that maximizes the above expected utility, we can define the following value function at time t as:

$$V^\star(W_t,t) = \max_{x^t=(x_t,\dots,x_m)} (1+\alpha) \sum_{\tau=t}^{m} E[f(C_\tau(x_\tau,y_\tau),\tau)] + \alpha \sum_{\tau=m+1}^{f} E[f(C_\tau(x_\tau,y_\tau),\tau)] \tag{33}$$

and analogous to the above proof for player F we obtain

$$V^\star(W_t,t) = \max_{x_t\in\Gamma_t} [(1+\alpha)E[f(C_t(x_t,y_t),t)] + V(E[T(W_t,C_t(x_t,y_t),t)],t+1)] \tag{34}$$

that leads to $V^\star(W_t,t) = V(W_t,t)$ and eventually to the Euler equation

$$\begin{aligned} &(1+\alpha)\frac{\partial E[f]}{\partial x_t}(C_t(x_t^\star,y_t),t) + \left(\frac{\partial E[f]}{\partial W_{t+1}}(C_{t+1}(x_t^\star,y_t),t+1)\right. \\ &\left. -(1+\alpha)\frac{\partial E[f]}{\partial x_{t+1}}(C_{t+1}(x_{t+1}^\star,y_{t+1}),t+1) \times \frac{\frac{\partial E[T]}{\partial W_{t+1}}(W_{t+1},C_{t+1}(x_{t+1}^\star,y_{t+1}),t+1)}{\frac{\partial E[T]}{\partial x_{t+1}}(W_{t+1},C_{t+1}(x_{t+1}^\star,y_{t+1}),t+1)}\right) \\ &\times \frac{\partial E[T]}{\partial x_t}(W_t,C_t(x_t^\star,y_t),t) = 0. \end{aligned} \tag{35}$$

This Euler equation reduces to

$$\frac{1+\alpha}{2x_t^\star} + \left(0 + \frac{1+\alpha}{x_{t+1}^\star}\right)\left(-\frac{1}{2}\right) = 0 \quad \Rightarrow \quad x_t^\star = x_{t+1}^\star \quad \text{for } t < m \tag{36}$$

At $t = m$ the value function V that player M tries to maximize can be written as

$$\begin{aligned} V(W_m,m) =& (1+\alpha)\,(0.5\log x_m + 0.5\log y_t) \\ &+ \alpha\left(0.5(f-m)\log\frac{W_m - x_m}{f-m} + 0.5(f-m)\log\frac{W_m - y_m}{f-m}\right) \end{aligned} \tag{37}$$

what makes use of the F-players optimal consumption in periods $t > m$ described in equation (27). Therefore follows

$$\frac{\partial V(W_m,m)}{\partial x_m} = 0.5\frac{1+\alpha}{x_m^\star} + 0.5\frac{(1+\alpha)(f-m)}{x_m^\star - W_m} = 0 \tag{38}$$

$$x_m^\star = \frac{(1+\alpha)W_m}{\alpha(f-m+1)+1}. \tag{39}$$

Using equation (36) allows us then to conclude that the optimal feasible consumption proposal $x_t^\star \in \Gamma_t$ of player M is

$$x_t^\star = \frac{(1+\alpha)W_t}{\alpha(f-t+1)+m-t+1} \quad \forall\, t \leqslant m. \tag{40}$$

At any time the choice of the optimal consumption proposal $x_t^\star$ does not depend on present or future choices of F's consumption proposal $y_{t+i}\,\forall\, i \geqslant 0$ but only on present available funds W_t, the own remaining time to live $m-t+1$, and parameter α and F's remaining time to live $f-t+1$ if $\alpha \neq 0$.

Acknowledgements We benefited from helpful conversations with Boris Maciejovsky, Werner Güth, Katinka Pantz and Paul Pezanis-Christou, and the comments of one anonymous referee. Research assistance was provided by Torsten Weiland.

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