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Discussion paper

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Modeling Individual Choices in Experiments: Reply to Conte and Moffatt

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Abstract

In a comment to Cappelen, Hole, Sørensen, and Tungodden (2007b), Conte and Moffatt (2009) challenge our use of a random utility model when studying individual choices in a fairness experiment. They propose an alternative approach, what we call the random behavioral model, and they show that the choice of modeling strategy has profound implications for our understanding of the observed behavior. In this note, we discuss how the two approaches differ, and we show that the random behavioral model of Conte and Moffatt (2009) fails to fit the data from our fairness experiment.

A number of recent experimental papers have attempted to link people's behavior in experiments more closely to individual choice models (Andreoni and Miller 2002; Bellemare, Kröger, and van Soest 2008; Cappelen et al. 2007b; Cox, Friedman, and Gjerstad 2007). This is an important development, because it allows for a closer study of how richer motivational structures fit into the classical framework of utility maximization, and it has been strongly encouraged by, among others, Manski (2002): "I believe that experimental economics has progressed to the point where it would be beneficial to move beyond the prevalent exploratory mode of analysis towards formal inference on the distribution of decision rules that yield observed choices" (p. 890). At the same time, this development raises some important methodological issues, and Conte and Moffatt (2009), henceforth CM, provide a welcome and important contribution to this discussion by comparing the two main approaches in the literature, the random utility approach and what we call the random behavioral approach. They do so in the context of our paper (Cappelen et al. 2007b), henceforth CHST, and they show that the choice of modeling strategy has profound implications for our understanding of the observed behavior.

The two approaches typically differ in two ways, as illustrated by comparing the random utility model in CHST with the random behavioral model in CM.

First, in contrast to the random behavioral approach, most random utility models rely on a discrete choice set. Second, random utility models include the random term in the specification of the utility function, whereas random behavioral models add the random term to the maximizing argument of the deterministic utility function. In this note, in the context of the fairness experiment presented in CHST, we discuss which of these features matter in explaining the different results derived from the two models, and the extent to which they can be justified when modeling individual choices in experiments more generally.

1 Background

In the fairness experiment presented in CHST, people first make investments and then decide how to share the total return between themselves and another participant. The basic theoretical framework is that people in their distributive choices make a trade-off between pecuniary gains and fairness considerations, where there are three reasonable fairness ideals; equal division (*Strict Egalitarianism*), division proportional to investment (*Liberal Egalitarianism*), and division according to individual return (*Libertarianism*). Based on a simple random utility model, CHST estimate the share of the population motivated by each of the three fairness ideals and the distribution of the weight people attach to fairness considerations. To compare, within the same theoretical framework, CM estimate the same parameters on the basis of a random behavioral model.

CM argue that a random behavioral model better fits the experimental design in CHST, and they show that such a model would not support our main findings. In particular, they show that our finding of a share of the participants being motivated by the libertarian fairness ideal relies on the use of a random utility model. When applying a random behavioral model, the preferred specification only contains individuals motivated by the strict egalitarian and the liberal egalitarian fairness ideals. This difference is certainly important, and their analysis may indicate that there is less heterogeneity in fairness perceptions in society than suggested by our study. Hence, it is interesting to understand what explains these differences in results and which model better fits the data of the experiment.

The two upper panels in Figure 1 provide a first cut on how well the models fit the data, by comparing the actual cumulative distribution of offers with the cumulative distribution predicted by the models. As we can see, the CM-model fits nicely the share of individuals taking everything for themselves, whereas the CHST-model fits nicely the share of individuals dividing equally and, more generally, the discrete distribution of offers.

In order to shed more light on the differences between the two models, we now turn to a detailed discussion of the two features that typically distinguish a random utility model and a random behavioral model.

2 Discrete or continuous?

Random utility models are usually formulated on discrete choice sets. In line with this tradition, the CHST-model assumes that the participants were constrained to discrete levels of 50 Norwegian kroner (NOK), approximately 6.25 US dollars, in their distributional choices, even though they could actually choose any division of the overall return.

As shown in Table 1, this assumption is not at all crucial for our main findings. When estimating the random utility model for alternative choice grids of 100 NOK, 10 NOK, and 1 NOK, we find the same shares of the population being motivated by each of the fairness ideals. Computational constraints limit the possibility of letting the choice grid approach a continuum, but there is no reason to expect other results for finer choice grids. Indeed, there is nothing in the random utility framework itself that restricts application to discrete alternatives. By way of illustration, Ben-Akiva and Watanatada (1981) and Ben-Akiva, Litinas, and Tsunokawa (1985) develop a continuous random utility model (on the plane) by taking the limit of a multinomial logit model on a discrete grid as the grid becomes successively finer, and Resnick and Roy (1991) and Dagsvik (1994) develop continuous random utility models from first principles.[1]

However, given that individuals actually choose numbers that are multiples of 50 NOK, it makes sense to incorporate this feature in the empirical model. As shown in Figure 1, the CHST-model fits the observed data much better than if we assume choice grids of 10 NOK and 1 NOK.[2] Figure 1 also shows that the fit could be improved by estimating the model on a choice grid of 100 NOK. However, given that five participants actually made choices that are not multiples of 100 NOK (but of 50 NOK), we find it appropriate to restrict the formulation of the model to respect the observed choice patterns. We also find it reasonable to assume that the preference for round numbers is independent of the questions of interest for our study, and thus we do not model it explicitly when formulating the utility function.

In sum, the fact that the CHST-model assumes a discrete choice set in line with the observed behavior contributes to explain why it has a better overall fit than the CM-model, but this is not at all essential for our main findings.[3]Even with finer choice grids, we obtain the same population share estimates for the different fairness ideals. More generally, it is important to note that the random

[1]CM claim that random utility models "are appropriate only when the alternatives in the choice set cannot be ordered in any natural way". We fail to understand the basis for this claim. Why is it inappropriate to apply random utility models to choice sets that are naturally ordered?

[2]In fact, a Kolmogorov-Smirnov test of the hypothesis that the data are generated from the model would be rejected for the finer choice grids ($p < 0.001$), but not for the choice grid of 50 NOK ($p = 0.31$).

[3]The CM-model fails the Kolmogorov-Smirnov test, $p < 0.001$.

utility approach is not in principle restricted to discrete choice sets, but can also be formulated on a continuum.

3 How to model randomness?

The fundamental difference between the two approaches is how the random element is taken into account in the empirical model. In a random utility model, the random term is added to the utility derived from an alternative in the choice set, and the prediction is then that an individual chooses the alternative with the highest total utility (that is, the sum of the utility derived from the deterministic part and the utility derived from the random part). In a random behavioral model, as presented by CM, the random term is added to the maximizing argument of the deterministic utility function, and hence the prediction is that an individual chooses randomly in the neighborhood of this maximizing argument. In short, we may refer to this as a distinction between random utility and random behavior.[4]

To study whether random utility or random behavior is more important in the fairness experiment in CHST, we consider the set of situations where all fairness ideals justify an equal distribution of the overall return. In such situations, the deterministic part of the model would predict that all individuals should take at least 50 percent for themselves, and only a random term could explain why some individuals take less. Hence, by comparing the fit of the CHST-model and the CM-model for the cumulative distribution of offers above 50 percent in these situations, we can get a better understanding of the relative importance of these two aspects of randomness. As shown in Figure 2, it turns out that no individual offers more than 50 percent to the other participant in these situations. This is in stark contrast to the predictions from the CM-model, which is that 14 percent of the individuals should make such offers, but in line with the predictions of the CHST-model.

Intuitively, if random behavior was important in the experiment, then we should not observe a large mass choosing the fair division in these situations. The random behavior should imply that individuals assigning strict priority to fairness choose in the neighborhood of the fair solution, some above and some below, as illustrated by the predictions of the CM-model. In contrast, we observe that 45 percent of the participants choose precisely the fair division. This pattern is consistent with a random utility model, however, as illustrated by the predictions

[4]In a random utility model, all predicted choice probabilities are within the choice set. In contrast, in a random behavioral model, the latent preferred allocation might be outside the choice set, and thus, as discussed in CM, it has to be censored to fit the choice set. This also explains why the CM-model fits nicely the share of individuals taking everything for themselves. In order to fit the data at this point, the CM-model actively uses censoring by assuming that this share has a deterministic maximum outside the actual choice set.

of the CHST-model. For the most fair-minded participants, the deterministic utility loss of deviating from fair division completely outweighs the random utility term.

It is also instructive to see how the assumption of random behavior makes the CM-model biased against finding libertarians. If such a model were to allow for some libertarians, then the assumption of random behavior would imply that there should be some offers above what can be justified by all three fairness ideals. But there is not a single such observation in the data set, and hence the CM-model ends up explaining libertarian behavior as random behavior by strict egalitarians and liberal egalitarians. In contrast, the combination of random utility and libertarian behavior is consistent with data, because the random utility term does not make libertarians assigning strict priority to fairness offer more than what is justified by the libertarian fairness ideal.

In sum, the fundamental distinction between the random utility approach and the random behavioral approach is how randomness is modeled. We have shown that the assumption of random behavior is not justified in the fairness experiment in CHST, and also how this assumption makes the CM-model misinterpret libertarian behavior as random behavior.

4 Concluding remarks

CM provide an interesting discussion of how to model individual choices in experimental situations, even though their random behavioral model fails to fit the data from the fairness experiment in CHST. For this particular study, we find strong support for random utility as opposed to random behavior. We can also clearly reject the claim that libertarians barely exist.

A follow-up study of this experiment adds support to the finding of libertarians in CHST (Cappelen, Drange Hole, Sørensen, and Tungodden 2007a). In this study, ahead of taking part in the same fairness experiment as in CHST, we asked participants to report what they considered to be the fairest sharing rule in such situations.[5] In addition, along the same lines as suggested by CM, we calculated the posterior probability of each participant being of a particular fairness type. This allowed us to compare the self-reported classification and the choice-based classification. Interestingly, a substantial share of the participants self-reported to be libertarians, and most of these also revealed a libertarian pattern in their actual choices. We take this to be indicative of there being a non-negligible share of libertarians in society, alongside egalitarians and liberal egalitarians, and thus that there is substantial heterogeneity in people's fairness perceptions. This is also in line with what is typically observed in political debates and public life, where the libertarian view is commonly expressed.

[5] We did not refer to the label libertarianism in the question, but only provided descriptions of the sharing rules.

There is also reason to believe that random utility is more important than random behavior in experimental studies more generally. Experiments allow the researcher to observe precisely the choices of individuals, and thus the experimental setting rules out one possible source of random behavior in observed choices, namely measurement errors. However, more research in the vein of CM is needed in order to gain further understanding of this important methodological issue.

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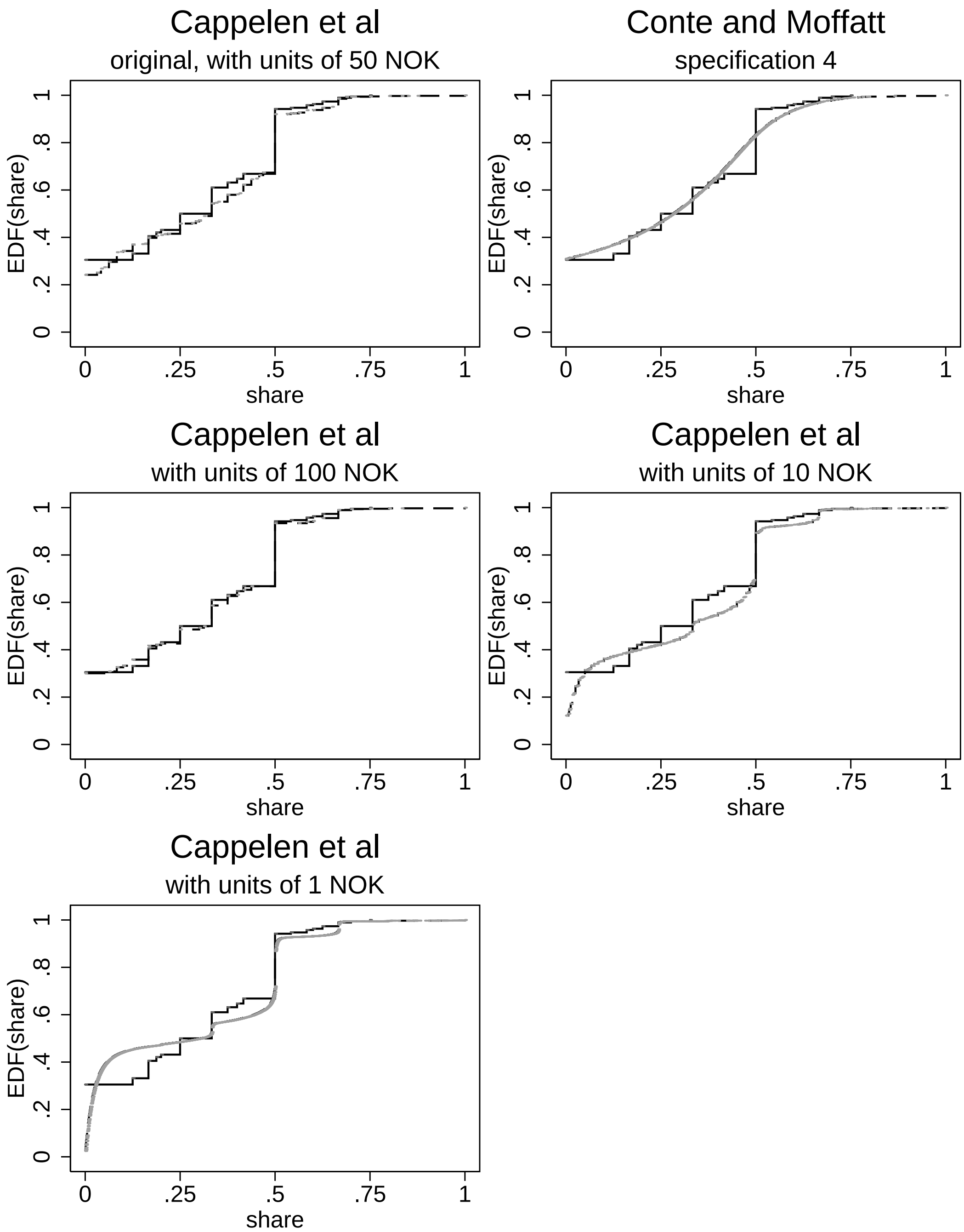

Figure 1: Empirical distribution function of offers made and predictions from the estimated models

Note: Offers are calculated as shares of total income produced. The solid lines represent experimental data, whereas the dashed lines represent predictions from the models estimated in Table 1 and in Table 1 in CM. Predictions are made at the distributional situations in the dataset (using 500 simulated samples).

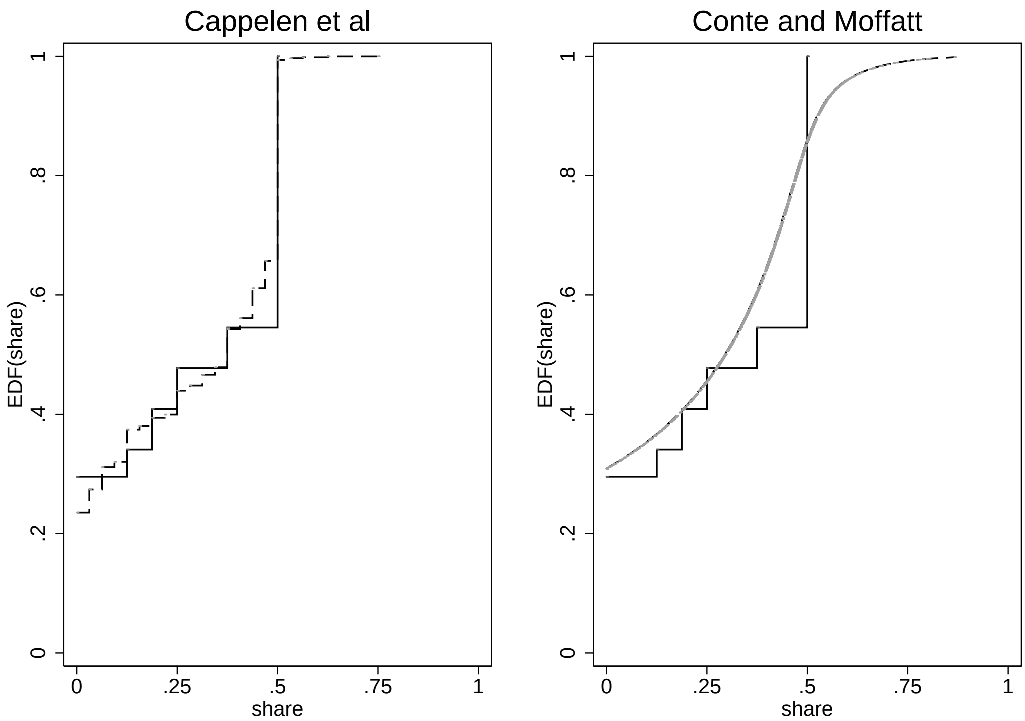

Figure 2: Empirical distribution function of offers made and predictions from the estimated models in non-ambiguous situations

Note: Offers are calculated as shares of total income produced in situations where participants with the same return have made the same investment. The solid lines represent experimental data, whereas the dashed lines represent predictions from the preferred specifications in CHST and in CM. Predictions made at the distributional situations in the dataset (using 500 simulated samples).

	Fineness of choice grid			
	1 NOK	10 NOK	**50 NOK**	100 NOK
λ^{SE}, share strict egalitarian	0.448	0.445	0.435	0.441
	(0.081)	(0.083)	(0.090)	(0.097)
λ^{LE}, share liberal egalitarian	0.369	0.372	0.381	0.382
	(0.078)	(0.081)	(0.088)	(0.095)
λ^{L}, share libertarian	0.183	0.182	0.184	0.176
	(0.060)	(0.060)	(0.066)	(0.069)
γ, marginal utility of money	56.052	48.699	28.359	23.601
	(3.207)	(3.544)	(3.589)	(3.625)
ζ, mean of $\log(\beta)$	6.010	6.368	5.385	4.890
	(0.366)	(0.397)	(0.349)	(0.352)
σ, standard deviation of $\log(\beta)$	9.244	4.893	3.371	2.409
	(1.032)	(0.608)	(0.530)	(0.391)
Log likelihood	−879.97	−547.97	−337.58	−253.53

Table 1: Estimates of CHST model with different fineness of the choice grid. Money is scaled in units of 1000 NOK. One estimate of the population shares and its standard error is calculated residually in each specification. Maximization of the likelihood using the FmOpt library (Ferrall 2005).

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