Written Exam at the Department of Economics summer 2021

Foundations of Behavioral Economics

Final Exam

21 June 2021

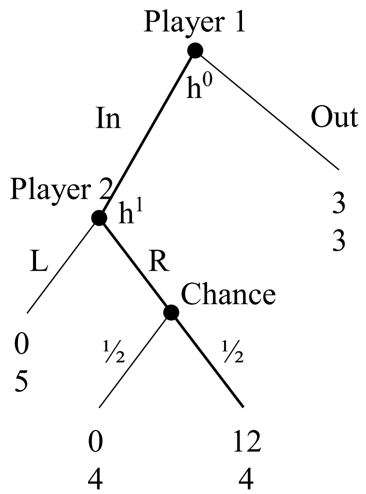
(3-hour closed book exam)

Note: The following illustrations are a sketch of how to solve the exam questions, rather than a fullfledged "solution manual". Some derivations of results are omitted for brevity and some responses only exemplify possible solutions to the questions (in both cases, further details can be found in the lecture notes of the respective sections).

Question 1 (weight: 30%)

a) *Guilt Aversion:* Consider the two-player game below. Both players have two actions. Note player 2's action R is a flip of a coin that associates a 50% chance to two different outcomes. The numbers connected with the terminal histories are monetary payoffs. The upper number is the material payoff of player 1, the lower number is the material payoff of player 2.

Assume players are motivated by simple Charness and Dufwenberg (2006) belief-dependent guilt aversion. Denote the sensitivity to guilt of player 2 by γ_2. Is a feeling of guilt connected to both actions of player 2? How do Charness and Dufwenberg (2006) formalize this feeling of guilt? In addition, for which value of γ_2 will player 2 play R in equilibrium (Remember: in equilibrium beliefs have to be correct)? Explain the intuition for this result in words as well.



Points to be included:

Is a feeling of guilt connected to both actions of player 2?

No. Player 2 might only feel guilty in connection with his/her choice L.

How do Charness and Dufwenberg (2006) formalize this feeling of guilt?

Charness and Dufwenberg (2006) argue that guilt is connected to a feeling of let down. In the context of player 2, player 2 feels that he lets down player 1 by taking an action that gives player 1 less than what player 2 thinks player 1 expects to get.

Formally, in history h^1 player 2 believes player 1 expects to get $(1-b)*0+b*[½*0+½*12]=b*6$ where b is player 2's belief about player 1's belief about the likelihood with which player 2 chooses r.

Given this, player 2's belief-dependent guilt aversion utility from choosing L is:

$U^2(L|h^1) = 5- \gamma_2*b*6$ where γ_2 is player 2's sensitivity to guilt.

In addition, for which value of γ_2 will player 2 play R in equilibrium (Remember: in equilibrium beliefs have to be correct)? Explain the intuition for this result in words as well.

Note, that player 2 chooses R in equilibrium if $U^2(L|h^1) = 5- \gamma_2*b*6 < 4 = U^2(R|h^1)$ with b=1. Remember, beliefs have to be correct in equilibrium.

Such that: $5- \gamma_2*1*6 < 4 \rightarrow \gamma_2 > 1/6$. So, if γ_2 is strong enough playing R (and accepting a lower on payoff to avoid a feeling of guilt) is an equilibrium behavior of player 2.

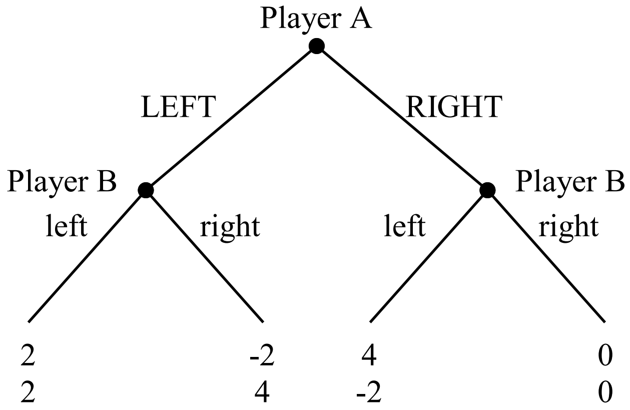
b) *Inequity Aversion:* Assume now that there are two players that are motivated by Fehr and Schmidt (1999) inequity aversion. Consider a dictator game in which one of the two is the dictator and the other player is the passive player. Formally characterize the optimal behavior of the dictator? Explain the intuition for this result in words as well. In doing this, please comment on the prediction's realism and how the model could be changed such that it provides predictions which are more in line with experimental findings.

Points to be included:

Points to include in the answer to this question can be found on lecture slides 18-19 of lecture 03 on Inequity Aversion and the associated mandatory reading material:

Section VI of the article: Fehr, Ernst, and Klaus M. Schmidt. "A Theory of Fairness, Competition, and Cooperation." The Quarterly Journal of Economics, vol. 114, no. 3, 1999, pp. 817–868.

c) *Reciprocity*: Formally explain the theory of sequential reciprocity by Dufwenberg and Kirchsteiger (2004). In doing so, state the belief-dependent utility function and explain its parts in detail. Consider now the two player game below and assume that both players A and B are motivated by belief-dependent reciprocity:



Remember, payoffs above are the material payoffs of players. For which sensitivities of reciprocity Y_1, Y_2 is the joint strategy profile (LEFT; (left,right)) a sequential reciprocity equilibrium? Explain the intuition in words as well.

Points to be included:

For which sensitivities of reciprocity Y1, Y2 is the joint strategy profile (LEFT; (left,right)) a sequential reciprocity equilibrium? Explain the intuition in words as well.

Lets concentrate on player B first – backward induction.

The history after player A has chosen RIGHT:

As a first observation, if player A chooses RIGHT it is definitely worse (in material) terms for player B than choosing LEFT independent of player B's second order belief in the two histories that player B can choose following player A's actions.

This implies that player B definitely feels unkindly treated after player A's choice RIGHT. Given this, what will player B choose? Player B can accept a payoff of -2 for him/herself (by choosing 'left') and be kind to player A or choose 'right' and get a higher payoff of 0.

Note, in the model by Dufwenberg and Kirchsteiger, to have an incentive to give up own payoff a player has to perceive the other player to be kind. Which is definitely not the case in this history, which is why player B has no incentive to accept a lower than maximum material payoff at this point. Player B will choose 'right' no matter what.

The history after player A has chosen LEFT:

Note first that if A chooses LEFT, 2 can give player A a material payoff of at least -2 and at most 2, so the "equitable" payoff is 0 (= the average of -2 and 2). If player B chooses left, player A receives 2. Therefore, player B's kindness of playing left is 2-½[-2+2]=2. Similarly, B's kindness of choosing right is -2½[-2+2]=−2. In order to calculate how kind player B believes player A is after choosing LEFT, we have to specify B's belief of A's belief about B's choice after LEFT. Denote this by $p \in [0, 1]$. Then B's belief about how much payoff A intends to give to B by choosing LEFT is $p*2 + (1 - p)*4$, and since B's payoff resulting from A's choice of RIGHT would be 0, B's belief about A's kindness from choosing LEFT is $[p*2+(1-p)*4] - [½*(p \cdot 2 + (1-p)*4 + 0)] = 2 - p$, with the first term in squared brackets denoting B's actual payoff and the second squared bracket denoting B's "equitable payoff." This implies that when A cooperates and the second order belief is p, B's utility of left is given by $2+Y2 \cdot 2 \cdot (2-p)$, whereas B's utility of right is $4 + Y2(-2)(2 - p)$. The former is larger than the latter in equilibrium (i.e. with p=1) if $Y2 > ½$.

What about player A?

Assume now that Y2>½ such that (left, right) is an equilibrium behavior for player B.

Given player B's behavior A can give B a material payoff of at least 0 and at most 2. Hence, the "equitable" payoff is 1. If A chooses LEFT, B receives 2. Therefore, A's kindness of playing LEFT is 2-½[2+0] =1. Similarly, A's kindness of RIGHT is 0-½[2+0]=−1. In order to calculate how kind A believes that B is we have to specify A's belief about what B believes that A will do. Denote by $q \in [0, 1]$ this second order belief of A choosing LEFT. Then A believes that B believes that she gives player A a material payoff of $q*2+ (1 - q) \cdot 0$ by choosing her equilibrium strategy (left, right). If B always chooses left, A's payoff is $q \cdot 2 + (1 - q) \cdot 4$, whereas if B always chooses right, A's payoff is $q \cdot (-2)+ (1 - q) \cdot 0$. Hence, A's belief about 2's kindness from choosing left after LEFT and right after RIGHT is given by

$q \cdot 2 + (1 - q) \cdot 0 - 0.5 [q \cdot 2 + (1 - q) \cdot 4 + q \cdot (-2) + (1- q) \cdot 0] = 4 \cdot q - 2$,

with the first term in squared brackets denoting A's actual payoff and the second term in squared bracket denoting A's "equitable payoff." This implies that when B plays the equilibrium strategy and the second order belief is q, A's utility of LEFT is given by $2 + Y1 \cdot 1 \cdot (4 \cdot q -2)$, whereas A's utility of defection is $0+Y1 \cdot (-1)(4 \cdot q -2)$. The former is larger than the latter if $Y1 > 0$ at q=1.

Question 2 (weight: 30%)

A movie lover who owns no money has received a cinema voucher as a birthday present. He can use the voucher to go to the cinema on one of the next three Saturdays. In the upcoming three weeks, the movie program consists of...

- an average movie (utility $u_1 = 7$) on the first Saturday ($t = 1$)
- good movie ($u_2 = 15$) on the second Saturday ($t = 2$)
- and an excellent movie ($u_3 = 25$) on the third Saturday ($t = T = 3$)

The agent maximizes an intertemporal utility function of the following form

$$U_t = u_t + \beta \sum_{\tau=1}^{T-t} \delta^\tau u_{t+\tau}$$

e.g, in period t=1:

$$U_1 = u_1 + \beta(\delta u_2 + \delta^2 u_3)$$

a) When does the agent initially plan to go to the cinema if his discounting parameters are $\beta = 1$, $\delta=0.8$? When does he actually go?

Let $\hat{t}$ denote the date at which the agent plans to go to the movies.
Since

$$U_1(\hat{t} = 3) = 0 + 0 + (0.8)^2 25 > U_1(\hat{t} = 2) = 0 + (0.8) * 15 + 0 > U_1(\hat{t} = 1) = 7 + 0 + 0$$

the agent plans to go to the cinema in t= 3.

As the agent is time consistent (β=1), he also follows through on this plan in period 2:

$$U_2(\hat{t} = 3) = (0.8) * 25 > U_2(\hat{t} = 2) = 15$$

b) When does the agent plan to go to the cinema if he is present-biased and naive?

- Assume that his discounting parameters are $\beta=0.5$, $\delta=0.8$, and the agent's period-t "self" believes that all future selves will not be present-biased (i.e., $\hat{\beta} = 1$).
- Does the agent actually stick to his consumption plan from period t = 1? Explain.

With β=0.5 , δ=0.8 and naïve beliefs, his initial plan is to go to the cinema in t=3:

$$U_1(\hat{t} = 3) = 0.5 * (0.8)^2 * 25 > U_1(\hat{t} = 1) = 7 > U_1(\hat{t} = 2) = 0.5 * 0.8 * 15$$

In t= 2,

$$U_2(\hat{t} = 3) = 0.5 * 0.8 * 25 < U_2(\hat{t} = 2) = 15,$$

so he breaks his original plan and goes to the cinema in t=2. This is the case since, from t=1's perspective, both t=2 and t=3 lie in the future and are therefore discounted with the additional factor β*. In t=2, however, going to the cinema immediately gets an additional weight due to the agent's present bias, whereas* β *affects only consumption in t=3. In t=1, he is thus overly optimistic regarding his future willingness to wait another period.*

c) When does the agent actually go to the movies if he is present biased but fully sophisticated?
   - Assume that the agent's discounting parameters are again β=0.5 , δ=0.8, but that in contrast to part b) the agent is fully aware of his future self-control problems (i.e., $\hat{\beta} = 0.5$).
   - How does the agent's consumption plan in period t = 1 differ from the one of the naive agent from part b)? What is the intuition behind this result?

The sophisticated agent foresees that $U_2(\hat{t} = 3) = 0.5 * 0.8 * 25 < U_2(\hat{t} = 2) = 15$ *and that, in t=2, he thus prefers going to the cinema to waiting another period.*

In t=1, he is thus realistically pessimistic about his future self-control problem (in contrast to the agent from part b). He therefore only compares the alternative $\hat{t} = 2$ *vs.* $\hat{t} = 1$*. Since*

$$U_1(\hat{t} = 1) = 7 > U_1(\hat{t} = 2) = 0.5 * 0.8 * 15,$$

he goes to the cinema immediately in t=1.

d) Now assume that the cinema introduces a new deposit service for the voucher: on the first Saturday, the cinema offers to keep the voucher until week t=3 (i.e., the voucher is stored by the cinema and can only be picked up on the third Saturday). The fee for the deposit service is 0.5 (to be paid in t = 1). Does any of the agents from parts a), b) or c) make use of this service? Substantiate your answers.
   - Assume for part d) that the agent has received the required 0.5 as an additional birthday gift (i.e., he can now in principle afford the deposit service). If he does not use the money for the deposit service, he spends it for buying popcorn when watching the selected movie (which gives him additional utility of u_t = 0.5).

Agent from part a) does not buy the service: buying the service would yield (lifetime) utility $U_1(\hat{t} = 3) = 0.5 * 0.8^2 * 25$*, not buying yields* $U_1(\hat{t} = 3) = 0.5 * 0.8^2 * (25 + 0.5)$ *which is higher.*

Agent from part b) also does not buy the service: in t=1, he believes that he will be willing to wait until t=3, yielding expected utility $U_1(\hat{t} = 3) = 0.5 * 0.8^2 * (25 + 0.5)$ *without the service and* $U_1(\hat{t} = 3) = 0.5 * 0.8^2 * (25)$ *with the service → he thus thinks that the service would be a waste of money (although we know from part b) above that he would benefit from buying it).*

Agent from part c) does buy the service: with the service, he can guarantee himself $U_1(\hat{t}=3) = 0.5 * 0.8^2 * (25) = 8$. *This is higher than the alternative of going to the cinema and eating popcorn immediately in t=1,* $U_1(\hat{t}=1) = 7 + 0.5$.

Question 3 (weight: 25%)

Imagine you are analyzing people's labor supply. You assume that the labor supply function—i.e., the (log) hours of work per day offered by workers, h^S, as a function of the (log) hourly wage, w—has the following form:

$$\ln h^S(w) = \beta \ln w.$$

β is a parameter and determines the wage elasticity of labor supply. Camerer, Babcock, Loewenstein, and Thaler (1997) estimate a labor supply function of exactly this type for New York City cab drivers. Their empirical specification is

$$\ln h_i = \beta \ln w_i + \varepsilon_i.$$

Here, i indexes the observations, $i = 1, \ldots, N$. ε_i is an error term with $E[\varepsilon_i] = 0$. β is the parameter to be estimated.

a) Why are New York City cab drivers a good sample for studying individual labor supply (as opposed to, say, high school teachers)?
   - State first what the ideal setup would consist of regarding (*i*) the flexibility of working hours and (*ii*) temporary vs. permanent wage shocks, and explain why NYC cab drivers fulfil the required characteristics well.
   - Second, explain why these characteristics are important to differentiate between the standard life-cycle model of labor supply and models involving income targeting / reference-dependent preferences.
   - Third, mention empirical correlations that Camerer et al. check to investigate that these criteria / their identification assumptions are actually met.

Compare lecture notes from lecture 12_Reference Dependence and discussion in Camerer et al.

Ideal setup requires

- *workers with flexibility of work hours and effort;*
- *exogenous, transitory wage changes; and*
- *an idea to what extent wage changes are anticipated or surprising.*

NYC cab drivers have the following characteristics:

- *They face wages that fluctuate on a daily basis due to demand shocks (weather, holidays, conventions): many transitory wage changes.*
- *Rates per mile set by law—but spend less time searching for customers on busy days, yielding a higher hourly wage.*
- *High flexibility of labor supply: free to drive for as many hours as they like during a shift (typically up to 12 hours in NYC).*

- *Drivers own cab or rent cab at a fixed cost. Drivers keep 100% of fares ("selling the firm to the worker").*

Characteristics allow to differentiate between the standard life-cycle model and models involving income targeting / reference-dependence:

- *Standard life cycle model predicts positive labor supply elasticity for* transitory *wage changes, if workers can* flexibly *respond to wage changes.*
- *Models with reference dependence and daily income targets may feature negative labor supply elasticity for transitory wage changes (idea: income target is easier to meet on high-wage days).*

Camerer et al. check the following correlations to support their identification assumptions:

- *Correlation of wages (within-driver) across days is close to zero, hence each day can be considered in isolation. Wealth effects of wage changes are negligible.*
- *Within-day autocorrelation (within-driver) of wages is non-negative. If it were, also standard model would predict stopping early for high (early) wages.*

b) Briefly summarize the main findings of the paper. Focus on the following questions:
   - What is the sign of the estimated wage elasticity, β, according to the paper's main (OLS) specifications?
   - Are there systematic differences in the estimated β coefficients for different subgroups of taxi drivers?
   - What are possible sources of these differences?

Points to include in the discussion:

- *Main OLS estimates exhibit negative labor-supply elastiscities*
- *Some estimates indicate positive elasticities for more experienced drivers*
- *Unclear whether this is due to learning of selection effects*

c) Camerer et al. (1997) cannot observe the hourly wage w_i directly. Instead, they calculate it as the earnings of an entire day, divided by the number of hours worked on that day. In this case, what happens with the estimate of β in the presence of measurement error, i.e., if hours are not recorded perfectly but with noise and if one uses OLS regression?
   - What is this effect called, and what sign does it have? Explain.
   - How do Camerer et al. address this problem?

In the presence of measurement error, calculating w_i this way leads to the so-called "division bias" or "attenuation bias." In the words of Camerer et al. (1997), "Since the average hourly wage is computed by dividing daily revenue by reported hours, overstated hours will produce high hours–low wage observations and understated hours produce low hours–high wage observations, creating spuriously negative elasticities." That is, the estimate of β is downward-biased—simply because there is a purely mechanical negative relation between the dependent variable and the explanatory variable.

To address this problem, Camerer et al. provide IV estimates, where the wage of other workers on a given day is used as an instrument for worker i's wage. The estimated supply elasticities are still mostly negative.

Question 4 (weight: 15%)

a) What is the "endowment effect"?
   - Please give a precise definition.
   - Illustrate the effect by briefly describing the classic experiment with which the effect was first established (sketch the design idea, the identification strategy, and the main finding of the experiment).

   - *Endowment effect = an individual's (perceived) value of a good depends on whether the individual is endowed with the good or not*
   - *See description of the experiment and results by Kahneman et al. (1990) in lecture notes "8-9_Reference Dependence.pdf"*

b) Sketch graphically how the endowment effect can be explained with a Kahneman-Tversky value-function.

   - *see slide 43 in lecture notes "8-9_Reference Dependence.pdf"*

c) In an experiment conducted at a sportscard show, List (2003) observes an endowment effect among (nondealer) visitors of the show, but he finds no endowment effect for sportscard dealers. How could the Kőszegi/Rabin model of reference-dependent preferences help to understand these findings?

Reference point in the Kőszegi/Rabin model is determined by rational expectations about possible outcomes.

- *Non-dealer visitors may rationally expect to keep the initially assigned card which they received as a reward for filling out the survey → Experience loss feelings when "giving up" the card in exchange of another card → endowment effect*
- *Professional dealers may (rationally) expect to trade the sportscard again → no gain/loss feelings when exchanging one card against another → no endowment effect regarding their initially assigned card.*