Written Exam for the B.Sc. / M.Sc. in Economics 2009-I

Behavioral Economics and Finance

Master's Course

December 19, 2008

(2-hour, closed book exam)

EXAM PAPER INCLUDING ANSWERS

(1) **Social Preferences: There is by now a large amount of evidence showing that people are not only motivated by their material self-interest. People also seem to care about others' outcomes as well as intentions. Against the background of this empirical finding models of "distributional concerns" and "reciprocity" have been developed. During the course we more specifically studied the model of "Inequality Aversion" of Fehr and Schmidt (QJE, 1999) and the model of "Sequential Reciprocity" of Dufwenberg and Kirchsteiger (GEB, 2004).**

(1a) In the model of "Inequality Aversion" by Fehr and Schmidt (QJE, 1999) it is assumed that people maximize a utility function that differs from pure egoism. State the utility function that is proposed in Fehr and Schmidt (QJE, 1999) and describe its different parts intuitively. Furthermore, explain why their model can explain positive payments in the "dictator game" in which one person, "the dictator", has to divide an amount of e.g. 100$ between himself and an other person.

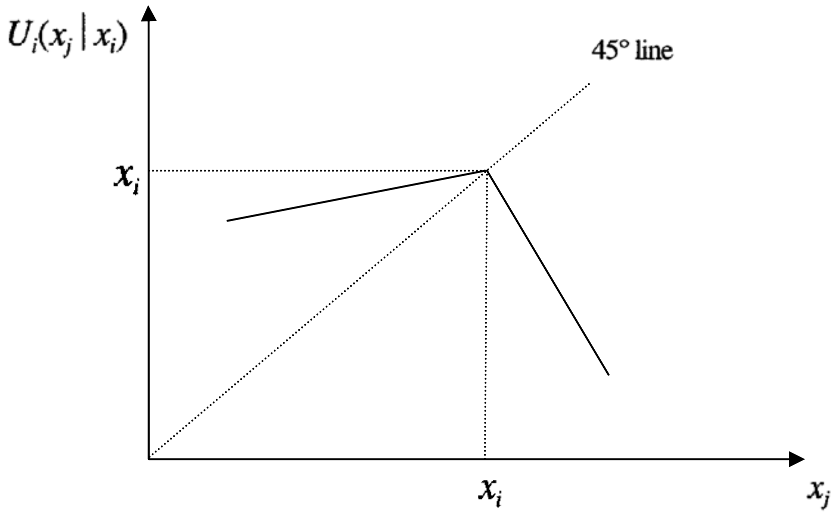
Answer: There is by now a lot of evidence that shows that people are not only concerned about their own monetary payoff. They also care about the payoffs that other people get, or in other words, the distribution of payoffs. They seem to dislike big payoff differences to their advantage as well as to their disadvantage. Fehr and Schmidt (QJE, 1999) have come up with a model to formalize this empirical finding. They assume that any person *i* maximizes the following utility function:

$$U_i(x) = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\},$$

where x_i is person i's own monetary payoff, $\alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\}$ is person i's utility from a payoff disadvantage relative to any other person $j \neq i$ and $\beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\}$ is person i's utility from a payoff advantage relative to any other person $j \neq i$.

As one can easily see, his own payoff x_i enters positively player i's utility function meaning that he derives utility from his own payoff. On the other hand, however, the α- and β-term enter negatively the utility function meaning that person i suffers a utility loss from a payoff advantage and disadvantage. He is inequality averse. Given this specification, in a two player setting, with a player i and j, player i's utility function obtains a maximum at $x_j = x_i$ given his own monetary payoff x_i.

Graphically this can be represented by:



In this Figure one can easily see that for a given monetary payoff x_i player i's utility is increasing until x_i is equal to x_j. Beyond this it is decreasing in x_j.

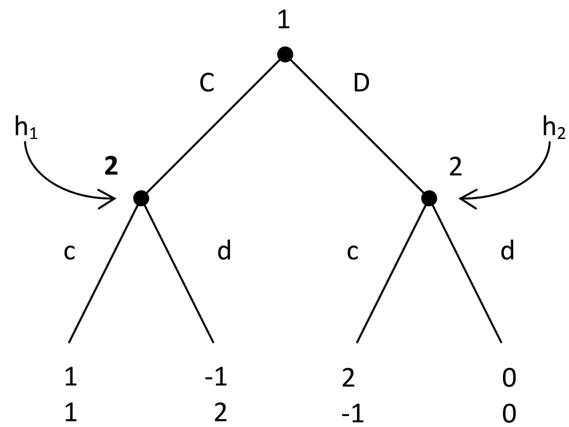
Fehr and Schmidt (1999) assume that (i) $\beta_i \leq \alpha_i$ and (ii) $0 \leq \beta_i < 1$. As captured in assumption (i), they assume that people suffer more from a payoff disadvantage relative to a payoff advantage. Furthermore, as captured in assumption (ii), they rule out the existences of subjects who like to be better off than others (i.e. $\beta_i \geq 0$) and the existence of subjects that like to "burn" money to reduce their payoff advantage compared to another player (i.e. $\beta_i < 1$).

In case there are more than 2 players the disutility from inequality has been normalized by dividing the second and third term by *(n-1)* so as to make sure that the relative impact of inequality aversion on player i's payoff is independent of the number of players.

Note, for simplicity it is assumed that people are self-centered, i.e. they only care about the inequality between themselves and others and not the inequality between the others.

In the dictator game a person, i.e. the dictator, has the possibility to divide a certain amount *x* (e.g. 100) of money between himself and another person. Traditional economic theory assumes that people are only concerned about their own monetary payoff. Obviously, a dictator only concerned about his own payoff would refuse to give anything (or give the lowest possible amount) to the other person. A person that is motivated by inequality aversion à la Fehr and Schmidt (1999), however, would give a positive amount so as to reduce the inequality between himself and the other person. In fact as can be inferred from the utility function above, if a person has $\beta_i > 0.5$ than he would like to give a share of 50% of the amount x to the other player. On the other hand, if he has a $\beta_i < 0.5$ he would like to keep every thing himself. The reason for this lies in the derivative of the utility function with respect to x_i. Hence, positive payments in the dictator game can be explained by a $\beta_i > 0.5$, which means the dictator gets more disutility by the payoff difference between him and the other than utility from his own payoff.

(1b) **In the model of "Sequential Reciprocity" by Dufwenberg and Kirchsteiger (GEB, 2004) it is assumed that people have belief-dependent preferences. State the utility function that they propose and explain how kindness perceptions (i.e. the λ_{iji}) depend on players first- and second-order beliefs. Furthermore consider the following "Sequential Prisoners Dilemma":**



A player 2 that is motivated by reciprocity à la Dufwenberg and Kirchsteiger (GEB, 2004) will definitely choose defect (d) in history h_2 as (i) he feels unkindly treated and (ii) cooperation is costly. How sensitive to reciprocity does he have to be to choose cooperation (c) with certainty in history h_1? Give the intuition.

Answer: Dufwenberg and Kirchsteiger (2004) consider the following utility function:

$$\begin{aligned} U_i\left(a_i(h), \left(b_{ij}(h), \left(c_{ijk}(h)\right)_{k\neq j}\right)_{j\neq i}\right) \\ = \pi_i\left(a_i(h), \left(b_{ij}(h)\right)_{j\neq i}\right) \\ + \sum_{j\in N\setminus\{i\}} \left(Y_{ij}\cdot\kappa_{ij}\left(a_i(h), \left(b_{ij}(h)\right)_{j\neq i}\right)\cdot\lambda_{iji}\left(b_{ij}(h), \left(c_{ijk}(h)\right)_{k\neq j}\right)\right), \end{aligned}$$

This means player i's utility is a function of his own (updated) strategy $a_i(h)$, his belief about the strategy that the others (i.e. $j\neq N\setminus\{i\}$) play $b_{ij}(h)$ (first-order belief) and his belief over the belief of the other players about his strategy $c_{iji}(h)$ (second-order belief). Player i is assumed to care about his expected monetary payoff π_i, his perception about the kindness of others λ_{iji} and his perception about his own kindness towards others κ_{ij}. Note, Y_{ij} is an exogenously given positive parameter capturing player i's sensitivity to reciprocity to any player j. As one can see from the above utility function, player i is reciprocal in as much as he wants to repay perceived unkindness (negative λ_{iji}) by unkindness (negative κ_{ij}) and perceived kindness (positive λ_{iji}) by kindness (positive κ_{ij}).

As one can also see, kindness perceptions (i.e. λ_{iji}) depend on players first- and second-order beliefs. In any history h of the game players evaluate how much they think player j intends to give them relative to what they think he could intend to give them minimally and maximally. In the evaluation of what they think player j intends to give them they need their (updated) belief about his strategy and their (updated) belief about his belief about the strategies of all other players $i \neq N \backslash \{j\}$. Consider e.g. history h_1 in the game presented above. Player 2's updated belief about player 1's strategy is simply the strategy that player 1 has played in the initial history i.e. C. Now, given this, player 2's belief about player 1's belief about player 2's strategy determines what player 2 believes that player 1 intends to give him. Assume for example that $c_{212}(h_1)=(c,d)$. This means, player 2 believes that player 1 believes that he will play c following history h_1. Hence, given $b_{21}(h_1)=C$ and $c_{212}(h_1)=(c,d)$, player 2 believes that player 1 intends to give him 1. He also believes however that given his second order belief $c_{212}(h_1)=(c,d)$ player 1 could have intended to give him 0 by playing D in the initial history. Perceived kindness $\lambda_{212}(h_1)$ is hence calculated as follows: 1-1/2(1+0)=1/2. Players evaluate what others intend to give them relative to the average that they could intend to give them. This shows how the perceived kindness of players depends on the first- and second-order beliefs. Note, player 2's kindness towards player 1 can be calculated in a similar fashion. Player 2 knows that the minimum and the maximum that he can do for player 1 in history h_1 is 1 and -1. Hence by choosing c in history h_1 his kindness towards player 1 is $\kappa_{21}(c)=1-1/2(1+(-1))=1$ and $\kappa_{21}(d)=-1-1/2(1+(-1))=-1$.

How sensitive to reciprocity does player 2 have to be in order to choose c in history h_1? In history h_1 player 2 has to evaluate whether it gives more utility to play c or d. He will choose c whenever it gives a higher utility. This means he will choose c in h_1 whenever the following inequality holds:

$$1 + Y \times 1 \times 1/2 \geq 2 + Y \times -1 \times 1/2 \, ,$$

where 1 and -1 are respectively player 2's kindness towards player 1 by choosing respectively c and d. This inequality holds if $Y \geq 1$. Intuitively, if player 2's sensitivity to reciprocity is stronger (or equal) to 1 he rather forgoes a monetary gain of 1 in order to repay player 1's kindness with kindness.

(2) Prospect Theory: Against the background of a lot of experimental evidence at odds with "expected utility theory" Kahneman and Tversky (Econometrica, 1979) developed "prospect theory".

(2a) In "prospect theory" it is assumed that people take decisions by first "editing" and then "evaluating". Explain these two "phases". State the value function proposed by Kahneman and Tversky (Econometrica, 1979) and explain it. Furthermore, explain the decision weight π(p) and its salient properties (e.g. $\pi(p) > p$ for small values of p).

Answer: Prospect theory assumes that people first edit the different prospects that they can choose between to somehow simplify them and then evaluate them. A complete description of these two phases can be found in Wilkinson (2008), "An Introduction to Behavioral Economics", pp. 99-102 or in Kahneman and Tversky (1979), "Prospect Theory: An Analysis of Decision under Risk", pp. 274-275.

The value function that is proposed by Kahneman and Tversky (1979) is: $U = \sum_i \pi(p_i) v(x_i)$.

$\pi(p_i)$ represents the decision weight that a person attaches to the outcome x_i. It is a function of the probability with which x_i occurs, p_i. $v(x_i)$, on the other hand, is the value function. It represents the (utility) value that a person attaches to a certain outcome x_i. The decision weights $\pi(p_i)$ should not simply be interpreted as measures of degree or belief as in subjective probability theory. They do not obey the probability axioms. Decision weights measure the impact of events on the desirability of prospects, and not merely the perceived likelihood of these events. On the basis of experimental evidence the authors make the following assumptions concerning the decision weight (i.e. the salient properties of this weighing function):

(i) Naturally it is an increasing function of the probability p_i with $\pi(0)=0$ and $\pi(1)=1$. This means,

outcomes contingent on an impossible event are ignored, and the scale is normalized so that $\pi(p)$ is the ratio of the weight associated with the probability p to the weight associated with the certain event.

(ii) For small values of p π is a sub-additive function of p. This means, $\pi(rp) > r\pi(p)$ for $0< r <1$. This

leads e.g. to $\frac{\pi(0.001)}{\pi(0.002)} > \frac{1}{2}$

(iii) Small probabilities are overweighted: $\pi(p) > p$ (see also figure 4 on p 283 of Kahneman and

Tversky (1979)).

(iv) Although $\pi(p) > p$ for low probabilities, there is evidence to suggest that, for all $0 < p < 1$, $\pi(p) + \pi(1-p) < p$. Kahneman and Tversky (1979) label this property subcertainty.

(v) Subproportionality – see Kahneman and Tversky (1979) p.282

These are the assumptions made by Kahneman and Tversky (1979) concerning the decision weighing function. They are based on empirical evidence.

On the other hand they have proposed that the value function $v(x_i)$ is (i) defined on deviations from the reference point; (ii) generally concave for gains and commonly convex for losses; (iii) steeper for losses than for gains. A value function which satisfies these properties is displayed in Figure 3 on p. 279 of Kahneman and Tversky (1979). As explained above, according to prospect theory people edit prospects and then evaluate them on the basis of the value function V. Given the assumption made regarding the value function $v(x_i)$ and the decision weights $\pi(p_i)$ as presented above, they pick the prospect giving them the highest value V.

(2b) Describe the "disposition effect" that can be observed on the stock market and how it can be explained by "prospect theory".

Answer: The disposition effect simply means that investors have a tendency to hold on to stock that have lost value too long and are more eager to sell stocks that have rise in price. It has been argued that this tendency involves both loss aversion and reference points. The disposition effect can be explained by prospect theory because in prospect theory people (i) evaluate prospects relative to a reference point (with e.g. the purchase price acting as a reference point) and (ii) are loss averse. They are loss averse because it is assumed that the value function is asymmetrically s-shaped i.e. given the same variation in absolute value, there is a bigger impact of losses than of gains.

(3) Myopic Loss Aversion and the Equity Premium Puzzle: There is a large discrepancy between returns on stocks and fixed income securities. This discrepancy is difficult to explain with traditional assumptions about choices under risk and uncertainty – the "equity premium puzzle".

(3a) Explain why traditional expected utility theory is difficult to reconcile with the empirically observed discrepancy between returns on fixed income securities and stocks.

Answer: There is a large discrepancy between returns on stocks and fixed income securities. Traditional theory assumes that people are only concerned about the expected return of their assets. Assuming risk neutrality this means, if one asset type implies a larger expected return, people should invest into it – bidding down its price until the expected returns are equalized.

Only risk aversion can explain a potential difference between returns of stocks and fixed income securities in the traditional expected utility framework. However, it has been shown that in order to reconcile the much higher return on equity stock compared to government bonds e.g. in the United States, individuals must have implausibly high risk aversion according to standard economics models. This means traditional expected utility theory is very difficult to reconcile with the equity premium puzzle.

(3b) Explain what myopic loss aversion is and explain intuitively why it can explain the "equity premium puzzle".

Answer: First, what is myopic loss aversion? The answer to this question can best be illustrated by an example taken from Benartzi and Thaler (1995) pp 74-75: "Consider the problem first posed by Samuelson [1963]. Samuelson asked a colleague whether he would be willing to accept the following bet: a 50 percent chance to win $200 and a 50 percent chance to lose $100. The colleague turned this bet down, but announced that he was happy to accept 100 such bets. This exchange provoked Samuelson into proving a theorem showing that his colleague was irrational.2 Of more interest here is what the colleague offered as his rationale for turning down the bet: "I won't bet because I would feel the $100 loss more than the $200 gain." This sentiment is the intuition behind the concept of loss aversion. One simple utility function that would capture this notion is the following:

$$U(c) = \begin{matrix} x & x \geq 0 \\ 2.5x & x < 0 \end{matrix}$$

where x is a change in wealth relative to the status quo. The role of mental accounting is illustrated by noting that if Samuelson's colleague had this utility function he would turn down one bet but accept two or more as long as he did not have to watch the bet being played out. The distribution of outcomes created by the portfolio of two bets {$400, .25; $100, .50; -$200, .25} yields positive expected utility with the hypothesized utility function, though of course simple repetitions of the single bet are unattractive if evaluated one at a time. As this example illustrates, when decision-makers are loss averse, they will be more willing to take risks if they evaluate their performance (or have their performance evaluated) infrequently.” This means they are more willing to take the risk involved in such a bet if they evaluate the losses and gains more infrequently, because they will suffer less from the psychological costs associated with any loss. “Put another way, two factors contribute to a decision maker being unwilling to bear the risks associated with such a bet, loss aversion and a short evaluation period. We refer to this combination as myopic loss aversion. “

Second, how can myopic loss aversion explain the equity premium puzzle? The relevance of myopic loss aversion to “the equity premium puzzle can be seen by considering the problem facing an investor with the utility function defined above. Suppose that the investor must choose between a risky asset that pays an expected 7 percent per year with a standard deviation of 20 percent (like stocks) and a safe asset that pays a sure 1 percent. By the same logic that applied to Samuelson's colleague, the attractiveness of the risky asset will depend on the time horizon of the investor. The longer the investor intends to hold the asset, the more attractive the risky asset will appear, so long the investment is not evaluated frequently” (Benartzi and Thaler (1995) p 75). Along the lines of this example it has been shown in Bernatzi and Thaler (1995) that if one assumes that investors evaluate their gains and losses ones a year, then myopic loss aversion can well explain the empirically observed fact that people hold portfolios which contain between 30-55 % of stock and the rest bonds.