Economics and Behaviour

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Wintersemester 2015

Karlsruher Institut für Technologie

Preface

This script has been created by Martin Belica in WS 2015/16. It is an unofficial script and contains notes from the lectures by Prof. Dr. Szech at the KIT as well as from some exercises.

Content of teaching

The course covers topics from behavioural economics with regard to contents and methods. In addition, the students gain insight into the design of economic experiments. Furthermore, the students will become acquainted with reading and critically evaluating current research papers in the field of behavioural economics.

Prerequisites
None. Recommendations: Basic knowledge of microeconomics and statistics are recommended.

Aim
The students gain insight into fundamental topics in behavioural economics; get to know different research methods in the field of behavioural economics; learn to critically evaluate experimental designs; get introduced to current research papers in behavioural economics; become acquainted with the technical terminology in English.

Bibliography

- Kahnemann, Daniel: Thinking, Fast and Slow. Farrar, Straus and Giroux, 2011.
- Ariely, Dan: Predictably irrational. New York: Harper Collins, 2008.
- Ariely, Dan: The Upside of Irrationality. New York: HarperCollins, 2011.

Exam information (inofficial)
The exam will...

- last 1h with 60 points to achieve, which means in average 1 minute per point is planned
- consist of 2-4 exercises
- have 2-4 subtasks per exercise

Theory is relevant but the papers are the focus: one has to be able to explain the design, recap main questions and results and maybe to argue about importance, errors and improvement suggestions.

Contents

1 Introduction to behavioural and experimental economics

First we have to clarify the kind of analysation we use for a game theoretical situations we distinguish between

- **prescriptive** - means containing an indication of approval or disapproval
- **normative** - means relating to a given model

or the kind of equilibrium

	complete information	**incomplete information**
static games	Nash-Equilibrium	Bayesian-Nash-Equilibrium
dynamic games	Perfect Nash-Equilibrium	Perfect Bayesian-Nash-Equilibrium

Where the following definitions hold:

Definition 1.0.1 (static game)
A static game is one in which all players make decisions (or select a strategy) simultaneously, without knowledge of the strategies that are being chosen by other players. Even though the decisions may be made at different points in time, the game is simultaneous because each player has no information about the decisions of others; thus, it is as if the decisions are made simultaneously. Simultaneous games are represented by the normal form and solved using the concept of a Nash equilibrium.

Definition 1.0.2 (dynamic game)
When players interact by playing a similar stage game (such as the prisoner's dilemma) numerous times, the game is called a dynamic, or repeated game. Unlike simultaneous games, players have at least some information about the strategies chosen on others and thus may contingent their play on past moves.

Definition 1.0.3
In a game of **complete information**, the structure of the game and the payoff functions of the players are commonly known but players may not see all of the moves made by other players (for instance, the initial placement of ships in Battleship); there may also be a chance element (as in most card games). Conversely, in games of perfect information, every player observes other players' moves, but may lack some information on others' payoffs, or on the structure of the game.

Remark 1.0.4 (imperfect vs incomplete information)
In a game of imperfect information, players are simply unaware of the actions chosen by other players. However they know who the other players are hat their possible strategies/actions are

and are, what their possible strategies/actions are, and the preferences/payoffs of these other players. Hence, information about the other players in imperfect information is complete.

In **incomplete information** games, players may or may not know some information about the other players, e.g. their "type", their strategies, payoffs or their preferences.

Proposition 1.0.5
Experimental economists generally adhere to the following methodological guidelines:

- Incentivise subjects with real monetary payoffs (trustworthy).
- Publish full experimental instructions (transparency).
- Do not use deception (honesty).
- Avoid introducing specific, concrete context (generalisation).

2 Standard theoretic basics for analysis of strategic behaviour

2.1 Homo oeconomicus

What does homo oeconomicus imply? We assume for a homo oeconomicus two main characteristics:

1. Rationality
2. Maximising his/her utility

2.2 Games in strategic form

A **game in strategic form** is completely characterised by $\{N, S, u\}$ where

1. N is the number of players and for player n would that mean $n \in \{1, \dots, N\}$.
2. For each player we have a set of *pure* strategies S.
3. For each player $n \in \{1, \dots, N\}$ we have an expected utility function $u : S \to \mathbb{R}$

For two players ($P1$ and $P2$) and two possible signals (lets call them a and b) we use the matrix form, where $u_i(x, y)$ represents the utility function for player i given the signal x for $P1$ and the signal y for $P2$ with $x, y \in \{a, b\}$

$P1$ / $P2$	**a**	**b**
a	$(u_1(a,a), u_2(a,a))$	$(u_1(a,b), u_2(a,b))$
b	$(u_1(b,a), u_2(b,a))$	$(u_1(b,b), u_2(b,b))$

We call a **set of strategies** complete plan of actions for each situation in a game.

Example 2.2.1 (Prisoner's Dilemma)
Image, two members of a criminal gang are arrested and imprisoned. Each prisoner is in solitary confinement with no means of communicating with the other. The prosecutors lack sufficient evidence to convict the pair on the principal charge. They hope to get both sentenced to a year in prison on a lesser charge. Simultaneously, the prosecutors offer each prisoner a bargain. Each prisoner is given the opportunity either to: betray the other by testifying that the other committed the crime, or to cooperate with the other by remaining silent. The offer is:

- If A and B each betray the other, each of them serves 6 years in prison

- If A betrays B but B remains silent, A will be set free and B will serve 9 years in prison (and vice versa)
- If A and B both remain silent, both of them will only serve 1 year in prison (on the lesser charge)

P1 / P2	**defects**	**cooperates**
defects	$(-6,-6)$	$(0,-9)$
cooperates	$(-9,0)$	$(-1,-1)$

Other Interpretations of the Prisoner's Dilemma

- Collusion on prices
- Investing in human capital vs. arming for a war
- Buying a SUV vs. a smaller car

2.2.1 Dominant strategies

Definition 2.2.2 (Strict dominance)
A strategy s_i'' is strictly dominated if and only if there exists another strategy s_i' such that

$$u(s_i', s_{-i}) \geq u(s_i'', s_{-i}) \quad \forall s_{-i} \in S_i$$

In the Prisoner's Dilemma *cooperate* is strictly dominated by $defect$. Simply the elimination of strictly dominated strategies leads to the prediction of $(defects, defects)$, even though $(cooperates, cooperates)$ would result in a lower prison sentence.

Example 2.2.3
Iterated elimination of strictly dominated strategies leads to

- for Player 2: l strictly dominates r
- after having eliminated r we can further eliminate d, since d is then strictly dominated by u

Important to notice is that here, the prediction we derived relies immensely on the rationality of all players.

Definition 2.2.4 (Weak dominance)
A strategy s_i'' is weakly dominated by s_i' if and only if for all possible outcomes

$$u(s_i', s_{-i}) \geq u(s_i'', s_{-i}) \quad \forall s_{-i} \in S_i$$

and there exists at least one outcome where

$$u(s_i', s_{-i}) > u(s_i'', s_{-i}) \quad \forall s_{-i} \in S_i$$

2.2.2 Nash-Equilibrium

Definition 2.2.5 (A strategy profile)
We call a vector $S = (S_1, \ldots, S_N)$ of dimension N that specifies a strategy for every player in the game a strategy profile.

Definition 2.2.6 (Nash-Equilibrium)
An informal definition of a Nash-Equilibrium would be that it is the mutual best response for every player, therefore a strategy profile in which no player can do better by unilaterally changing their strategy.
Defining it formally would mean: a strategy profile $x^* \in S$ is a Nash-Equilibrium if no unilateral deviation in strategy by any single player is profitable for tat player, that is

$$\forall i \in \{1, \ldots, N\}, x_i \in S_i : \quad u_i(x_i^*, x_{-i}^*) \geq u_i(x_i, x_{-i}^*)$$

Example 2.2.7 (Battle of the sexes)
The next example is a two-player coordination game.
Image a couple that agreed to meet this evening, but both individually cannot recall if they will be attending the opera or a football match. The husband would most of all like to go to the football game. The wife would like to go to the opera. Both would prefer to go to the same place rather than different ones.

Hence, the Battle of sexes in strategic form could look something like:

M / F	**football**	**opera**
football	$(1, 2)$	$(0, 0)$
opera	$(0, 0)$	$(2, 1)$

2 The two Nash-Equilibriums in this game are $(opera, opera)$ and $(football, football)$ since

$$u_i(opera, opera) \geq u_i(football, opera) \quad \forall i \in \{1, 2\}$$

Example 2.2.8 (The Beauty-Contest)
Keynes described the action of rational agents in a market using an analogy based on a fictional newspaper contest, in which entrants are asked to choose the six most attractive faces from a hundred photographs. Those who picked the most popular faces are then eligible for a prize. The agents has to consider that not his preferred choice is the optimal strategy but the one with the highest chances to be chosen by all others.

The rest is missing in my notes.

2.2.3 Sub-game-Perfect Nash-Equilibrium

Example 2.2.9 (Dictator-Game)
Proposer P can split up 10 € (up to €-level) between him and a Receiver R.

- Question 1: Assume for a minute the Proposer P is totally selfish and only cares about his own profits. Is there a strictly dominant strategy for P?
  Yes! $(10, 0)$ (money Proposer, money Receiver) is strictly dominant.

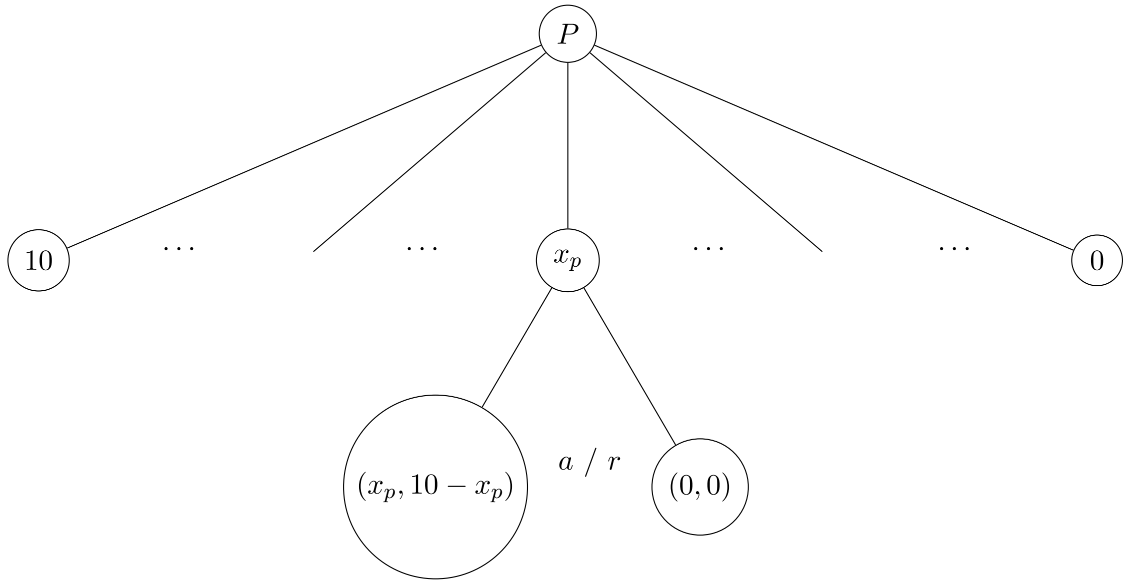
- Question 2: What if P is a pure altruist and just cares about the money R gets?
  Then $(0, 10)$ is strictly dominant.

The Dictator-Game is nicely analysed by Christoph Engel in his book *Dictator-Games: A meta study (2011)*. In the following part we'd like to look at a modification of the Dictator-Game:

Example 2.2.10 (Ultimatum-Game)
The Ultimatum-Game is a dynamic game under complete information.
We look at two players in two stages. The first player (the proposer (P)) receives a sum of money ($M = 10$) and proposes how to divide the sum between himself (x_p), where $x_p \in \{0, 1, 2, \ldots, 10\}$, and another player ($10 - x_p$). The second player (the responder (R)) chooses to either accept or reject this proposal. If the second player accepts, the money is split according to the proposal. If the second player reject, neither player receives any money.

Lets sum this up again:

- P proposes split up $(x_p, 10 - x_p)$
- R accepts or rejects
  - If R accepts (a), proposal becomes implemented. P receives x_p and R $10 - x_p$
  - If R rejects (r), the whole money gets destroyed.



A strategy set in this game would have to look like

- Proposer sets a x_p
- Receiver decides for *any* x_p that might come up if he'd accept or reject that offer.

(a strategy needs to specify a complete action plan.)

1. Question: Can the outcome $(5, 5)$ be stabilised as a Nash-Equilibrium?
Answer: Yes. Say P proposes $x_p = 5$ and the strategy set for R is defined by accepting for any

value of $x_p \leq 5$ and rejecting the offer for values larger then 5.
In this situation $(5, 5)$ would be stabilised as a Nash-Equilibrium.

2. Question: Is there another Nash-Equilibrium that stabilises the $(5, 5)$ outcome?
Answer: Yes. If P again proposes $x_p = 5$ and the strategy set for R is defined by accepting for only $x_p = 5$ and rejecting for any other case, so $x_p \neq 5$.

3. Question: Can $(0, 10)$ be stabilised as a Nash-Equilibrium?
Answer: Yes. We set the strategy for P as $x_p = 0$ and for R demand accepting for $x_p = 0$ and rejecting for any other case, meaning for $x_p \geq 1$.

As we can see the Nash-Equilibrium can lead to an infinite amount of outcomes some of them even with implausible threats. We'd therefore like to refine this kind of equilibrium which leads us to the (sub-game) perfect Nash-Equilibrium.

Definition 2.2.11 (Sub-game)
A sub-game is any part of a game that meets the following criteria:

- It has a single initial node that is the only member of that node's information set (i.e. the initial node is in a singleton information set).
- If a node is contained in the sub-game then so are all of its successors
- If a node in a particular information set is in the sub-game then all members of that information set belong to the sub-game.
- and finally the node must not contain a deterministic state but instead at least one non-trivial choice

Definition 2.2.12 ((Sub-game-)Perfect Nash-Equilibrium)
A strategy profile is a Sub-game-Perfect Nash-Equilibrium if it represents a Nash equilibrium of every sub-game of the original game. Informally, this means that if the players played any smaller game that consisted of only one part of the larger game and their behaviour represents a Nash equilibrium of that smaller game, then their behaviour is a sub-game perfect equilibrium of the larger game.

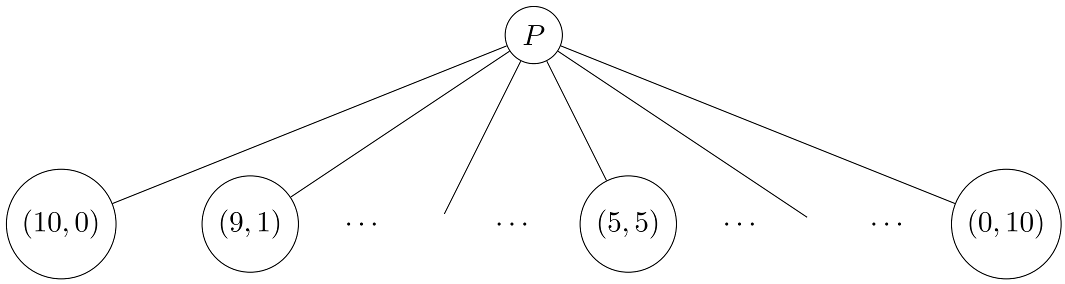
How to find a Perfect Nash-Equilibrium:

1. Define (one set of) optimal actions for the last sub-game
2. Replace that decision nodes with the respective outcome
3. Repeat (1) and (2) until the first decision node.

Example 2.2.13 (Sequel to the Ultimatum-Game)
Searching for the Perfect Nash-Equilibrium in this case leads to:

1. Defining the optimal actions
    - In the case P chooses $x_p = 10$, then R receives $10 - x_p = 0$ and he is indifferent between refusing and accepting. Let's assume for now he'd accept in this case.
    - In all other cases, meaning $x_p \in [0, 10)$, would R receive $10 - x_p > 0$. Therefore he would accept the offer in all cases.

2. Now we can reduce the game to the following game tree



3. Since we have already reached the first node, a simple analyse of the reduced situation for Nash-Equilibriums returns the Sub-Game-Perfect Nash-Equilibrium. In this situation P is supposed to chose $x_p = 10$ since it results in the highest utility value.

$\Rightarrow$ P playing $x_p = 10$ together with R always accepting constitutes a Sub-game-Perfect Nash-Equilibrium.

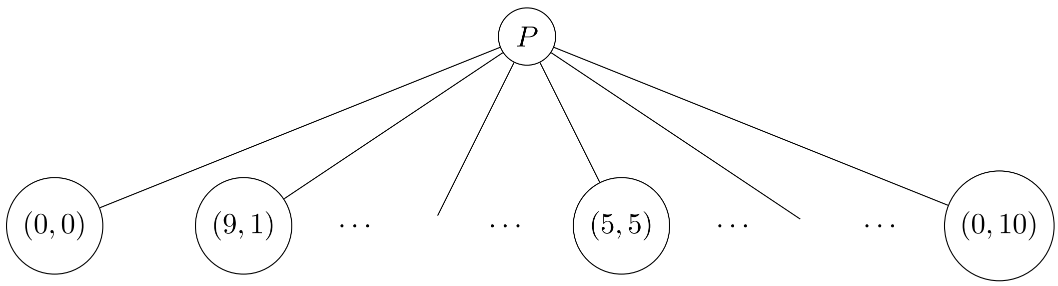
If we'd look for another equilibrium it yields

1. the optimal actions

   - Again, in all cases $x_p \in [0, 10)$ would R receive $10 - x_p > 0$, therefore he'd accept the offer in all cases.

   - If he now would refuse to the offer $x_p = 10$ it would be plausible therefore sub-game perfect, since he indifferent between both choices.

2. the tree changes only slightly:



$\Rightarrow$ P playing $x_p = 9$ together with R always accepting if $x_p < 10$ and refuses for $x_p = 10$ also constitutes a Sub-game-Perfect Nash-Equilibrium.

Example 2.2.14 (Guessing-Game / Beauty-Contest)
In a game with at least two players we can describe the sequel for the Guessing-Game as following

- $n \geq 2$ players
- Every player guesses a number $b_i \in \{0, 1, 2, \ldots, 100\}$
- Goal is to guess b_i as close as possible to $\frac{p}{n} \cdot \sum_{i=1}^{n} b_i = p \cdot \varnothing, \quad p \in (0, 1)$
- The best guess (closes to $p \cdot \varnothing$) wins, in case of a tie a random device that is 'fair' decides who win the price $P > 0$

1. Question: Is $(0, \dots, 0)$ a Nash-Equilibrium?
Answer: Yes. Assume all bidders except for bidder i bid 0.

- if bidder i bids 0 expected win equals $\frac{1}{n}P$
- if bidder i bids something above 0 his expected profit is going to be 0 as 0 is closer to $p \cdot \varnothing$ then the bet $b > 0$ of player i:

$$p \cdot \varnothing = p\frac{(n-1)0 + 1b}{n} = p\frac{b}{n}$$

$$d\left(b, p\frac{b}{n}\right) > d\left(p\frac{b}{n}, 0\right) \iff \left|b - p\frac{b}{n}\right| > \left|p\frac{b}{n}\right|$$

and since $b > p \cdot \varnothing$ we can simplify this further to

$$b > (p \cdot b) \cdot \frac{2}{n} \quad \text{and this holds since } n \geq 2 \text{ and } p < 1.$$

2. Question: is $(0, \dots, 0)$ the unique Nash-Equilibrium here?
Answer: Yes, since:

$$b_i^* \leq \frac{1}{2}\frac{\sum_{j\neq i} b_j^*}{n-1}$$

$$\begin{aligned}\Rightarrow \sum_{i=1}^{n} b_i^* \leq \frac{1}{2}\frac{\sum_{i=1}^{n}\sum_{j\neq i} b_j^*}{n-1} &= \frac{1}{2}\frac{(n-1)\sum_{j=1}^{n} b_j^*}{n-1} \\ &= \frac{1}{2}\sum_{j=1}^{n} b_j^*\end{aligned}$$

$$\iff \sum_{i=1}^{n} b_i^* \leq \frac{1}{2}\sum_{i=1}^{n} b_i^*$$

therefore only $(0, \dots, 0)$ can be a Nash-Equilibrium in this situation.

3. Question: is $(0, \dots, 0)$ also a strictly dominant strategy?
Answer: No. By analysing the following situation we find a counterexample:
50 players. 48 of them bid the number 100, bidder 49 bids 0 then the optimal strategy for player 50 is to bid 97.
Therefore 0 is not the best answer and cannot be a strictly dominant strategy.

3 An ultimatum game with multidimensional response strategies

3.1 Presented papers

- Güth, W.; Levati, M.V.; Nardi, C.; Soraperra, I. (2014): An ultimatum game with multidimensional response strategies. In Jena Economic Research Papers, FriedrichSchiller University and Max Planck Institute of Economics, Jena, Germany (Ultimatum Game)
  - **An ultimatum game with multidimensional response strategies**
    Negotiations frequently end in conflict after one party rejects a final offer. In a large-scale Internet experiment, we investigate whether a 24-hour cooling-off period leads to fewer rejections in ultimatum bargaining. We conduct a standard cash treatment and a lottery treatment, where subjects receive lottery tickets for several large prizes. In the lottery treatment, unfair offers are less frequently rejected, and cooling off reduces the rejection rate further. In the cash treatment, rejections are more frequent and remain so after cooling off. We also study the effect of subjects' degree of "cognitive reflection" on their behaviour.

4 Cooling Off in Negotiations: Does It Work?

4.1 Presented papers

- Oechssler, J.; Roider, A.; Schmitz, P. (2015): Cooling Off in Negotioations: Does it Work?. Journal of Institutional and Theoretical Economics JITE J Inst Theor Econ 171, (2015). (Ultimatum Game)

5 Level k as a prominent example of a nonstandard/behavioural approach

5.1 Presented papers

- Nagel, R. (1995): *Unraveling in Guessing Games: An Experimental Study.* In: American Economic Review.
  - **Unraveling in Guessing Games: An Experimental Study**
    Consider the following game: a large number of players have to state in several rounds simultaneously a number in the closed interval [0, 100]. The winner is the person whose chosen number is closest to the mean of all chosen numbers multiplied by a parameter p, where p is common knowledge. The payoff to the winner is a fixed amount, which is independent of the stated number and p. If there is a tie, the prize is divided equally among the winners. The other players whose chosen numbers are further away receive nothing.
- Müller, J.; Schwieren, C. (2011): *More than Meets the Eye: an Eye-tracking Experiment on the Beauty Contest Game*
  - **More than Meets the Eye: an Eye-tracking Experiment on the Beauty Contest Game**
    The beauty contest game has been used to analyse how many steps of reasoning subjects are able to perform. A common finding is that a majority seem to have low levels of reasoning. We use eye-tracking to investigate not only the number chosen in the game, but also the strategies in use and the numbers contemplated. We can show that not all cases that are seemingly level-1 or level-2 thinking indeed are – they might be highly sophisticated adaptations to beliefs about other people's limited reasoning abilities.

6 Organizations and Markets: The role of market incentives

6.1 Presented papers

- Gneezy, U.; Rustichini, A. (2000): *Pay Enough or Don't Pay at All*. In: Quarterly Journal of Economics.
- Gneezy, U.; Rustichini, A. (2000): *A Fine is a Prise*. In: The Journal of Legal Studies. (monetary incentives)
- Sebastian Kube, Michel Andre Marechal and Clemens Puppe (2012): *The Currency or Reciprocity: Gift Exchange in the Workplace*. In: American Economics Revie. (money versus non-monetary incentives)
- Charness, G.; Grieco, D. (2014): *Creativity and Financial Incentives*

7 Organizations and Markets: The role of moral dimensions of markets and organizations

7.1 Presented papers

- Falk, A.; Szech, N. (2013): *Morals and Markets.* In: Science (moral dimensions)
- Malmendier, U.; Schmidt, K. (2012): *You Owe Me.* In: DOI (moral dimensions)
- Kerschbamer, R.; Neururer, D.; Sutter, M. (2014): *How Customers' insurance coverage induces sellers' misbehaviour in markets for credence goods*

8 Ethics in science

8.1 Pleasures of Skill and Moral Conduct

Background:

- Jeremy Bentham points out fourteen different ”simple” sources of pleasures for humans
- In this short list, number three are the ”pleasure of skill” while number five are ”the pleasure of a good name”.
- Yet if being skilful is of crucial importance to people then this can oppose the possibility to keep a good name

As an example: The Manhattan Project. After the dropping of the plutonium bomb on Nagasaki, numerous members of the Manhattan Project started worrying about moral implications. Many of the scientists suffered from e.g depressions.

The Self-Image is so relevant in this concept. Both the desire for mastery and acting in accordance with moral values originate from the same source, a desire for positive self-image.

The remaining question is therefore: does morality in some (everyday) situations get traded off against skilfulness?

8.2 Moral and Markets

Examples for market designs where the idea of introducing (money) market/ free market is current:

- trading markets for emission certificates. To reduce pollution by restricting emission output per country a contract was design, but it allowed trad. M. Sandel was concerned that if we put a money value on pollution it might be less moral concerning to pollute.
- Allocation of organs market, you might be able to trade an incompatible organ for an compatible if available. People start discussing if money should not be introduced in this market instead of just the trading market.
- Adoption: high income families can provide well for children and therefore might be preferred on the
- In California child baring is allowed to be traded for money

Restricted markets:

- Employment markets are regulated, so exploitation is not so present.

The paper presented was on the topic of "moral and markets"by Prof. Szech. It is linked on ilias but this is roughly the topic:

The possibility that market interactions may erode moral values is a long-standing, but controversial, hypothesis in the social sciences, ethic and philosophy. Markets are accused to transform human values in exchange blues and goods into commodities. It has also been argues that market institutions may influence preferences in general with a tendency to make people.

Michael Sandal analysed that with technological progress and the increasing ubiquity of market ideas, since markets continue to enter further and further domains of our social life.

Further, there is the doux commerce hypothesis, meaning that the entering of market in our social life might improve our situation in many ways...

8.3 Presented papers

- Falk, A.; Szech, N. (2016): *Pleasures of Skill and Moral Conduct.* KIT working paper. (non-monetary incentives and morals)
- Russell, B. (1960): *The Social Responsibilities of Scientists.* In: Science, New Series.
- William 0. Baker and more (1961): *The Moral UnNeutrality of Science: The scientist's special responsibility are examined an address given at the 1960 AAAS annual meeting.* In: Science.

9 Non-standard utility

9.1 Anticipatory utility

The standard utility approach statey an already deterministic situation on an indiviuals behaviour and his utility function can't not changed by additional information. Nevertheless:

- Some students decide not to look up their exam grades while on vacation, therefore they refuse gathering free and more important static information to (better) enjoy their free time
- Some people with potentially severe diseases avoid getting tested for them.

One could argue that even with a bad result they don't have to act upon it, they don't have to behave differently, so why do this situation occur?

Maybe learning about the future affects well-being today derived from their **beliefs** about the future.

In Psychology one distinguishes between:

- monitors: people who really want to know what is going to happen. E.g. some people want to know every step of their upcoming surgery even though it won't change the outcome
- blunders: subjects who don't want the additional information

Behavioural Economics by Caplin/Leahy (2001, 2004) tries to combine those two fields

Maybe some people prefer to stick to their Bayesian's priors instead of getting tested because they incorporate their **beliefs** into their well-being (utility)

What if there is an instrumental cost in getting tested?

- Caplin/Eliaz (2003): social cost (e.g. HIV tests in america)
- Köszegi (2003, 2006): (same as next)
- Szech/Schweizer (2015) : individual well-being

As solution is propused in both papers the one from Caplin/Eliaz and the one from Szech/Schweizer: coarse tests may be helpful.

Maybe sometimes people are able to bias their beliefs away from the Bayesian:

Brunnermeier and Parker (2005) and also Oster, Shoulsen, Dorsey (2013) showed that some people might have high risk of inheriting diseases but can convince themselves that the risk is way lower, where this is more then simple optimism.

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