Quantitative Economics —MW24.2
Experimental Economics[1]

Oliver Kirchkamp

Contents

Overview

- experimental economics $\leftrightarrow$ rest of economics
- experimental methods
- conducting experiments

[1]The picture on the first page is taken from Andrea Alciato's Les Emblemes, Paris, p 16 (In silentium), reproduced from Glasgow University Library: SM25, Chrestien Wechel, 1542

Chapter 1

Introduction

1.1 Introduction — why behavioural economics?

Behavioural and experimental approaches are fairly new to economics, let us, therefore, briefly look at the development of experimental studies in other disciplines.

Today physics is an experimental science. This was not always the case.
It is easy to understand how economics works when we have a look at other fields and check how they use experimental methods

1.1.1 Historical example

Heliocentric vs. geocentric model of the universe

- Problem: determine position on the open sea.

$\rightarrow$ Needed: a precise and simple model that explains movements of stars and planets

Different theories:

- Claudius Ptolemy ca. 100–160: geocentric model
- Consistency with established theories

- Chronicles 1,16:30 "…the world also shall be stable, that it be not moved…".
- Psalm 104.5: "[LORD,] who laid the foundations of the earth, that it should never be removed."
- Ecclesiastes 1.5: "The sun also ariseth, and the sun goeth down, and hasteneth to his place where he arose."

- Consistency with observable data:
  - If the Earth actually spun on an axis, why didn't objects fly off the spinning Earth?
  - If the Earth was in motion around the sun, why didn't it leave behind the birds flying in the air?
  - If the Earth was actually on an orbit around the sun, why wasn't a parallax effect observed?
- Claudius Ptolemy ca. 100–160: geocentric model
- Nicolaus Copernicus: 1473–1543
  - Ptolemaic model is too complicated
- Galileo Galilei: 1564–1642
  - Instead of studying stars only with his telescope, Galilei models the mechanics of the planets with the help of a pendulum and inclined planes.
  - The laws of motion in Galilei's lab fit the Copernican Model, but not Ptolemaic system

  → Galilei as the founder of modern physics

Heliocentric model:

- Consistency with observable data (both in- and outside the lab)
- Simplicity

- We find a **simple theory** that explains behaviour on the inclined plane.

- This theory can be **tested extensively** in the lab.
- Finally, this theory can be used to explain movements of the planets.

Galilei (and Isaac Newton, 1643-1727) as founding father of modern natural sciences.

Samuelson and Nordhaus (1985) Principles of Economics, p. 8:

> "…One possible way of figuring out economic laws …is by controlled experiments …Economists [unfortunately] …cannot perform the controlled experiments of chemists or biologists because they cannot easily control other important factors. Like astronomers or meteorologists, they generally must be content largely to observe."

Blanchard (1997) Macroeconomics:

> "…When an engineer wants to find out how the temperature affects material's conductivity, she builds an experiment in which she changes the temperature, makes sure that everything else remains the same, and looks at the change in conductivity. But macroeconomists who want to find out, for example, how changes in the money supply affect aggregate activity cannot perform such controlled experiments; they cannot make the world stop while they ask the central bank to change the money supply"

Misunderstanding:

- Physicists do not really move planets in their experiments
- Economic experimenters do not really have to change …
  - Central bank policy
  - Labour market policy
  - Foreign trade policy
  - ⋮

  To find out how these policies work…

- Both build a model in a laboratory situation.

Trust

- Model of a bridge in an engineer's lab → real bridge !
- Model of the labour market in an economist's lab → real labour market ?

In both cases model and reality differ. If something works in the lab, it need not work in real life. If something fails in the lab, it might also fail in real life

Anyway. . . Winners of the Nobel prize who study economic behavioural rationality:

- 1988: Maurice Allais
- 1994: Reinhard Selten
- 1998: Amartya Sen
- 2000: Daniel L. Mc.Fadden
- 2001: George A. Akerlof
- 2002: Daniel Kahneman and Vernon L. Smith
- 2004: Edward C. Prescott
- 2005: Robert J. Aumann and Thomas C. Schelling
- 2009: Elinor Ostrom

An experiment

You are **buyer** $\boxed{2}$: At the beginning of the game you do not own any objects. During the game you can buy objects. Objects that you own at the end of the game have a value according to the following table

	Value	Price	Profit
1.	300		
2.	250		
all remaining	0		

You are **seller** $\boxed{4}$. At the beginning of the game you own two objects. During the game you can sell these objects. Objects that you own at the end of the game have a value according to the following table

	Value	Price	Profit
1.	150		
2.	100		
all remaining	0		

The theory behind this experiment

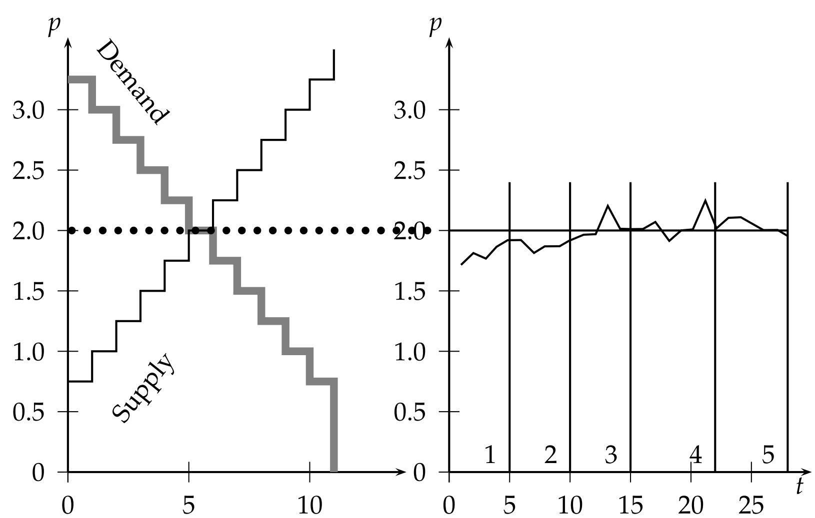
Market equilibrium with perfect competition

- Edward H. Chamberlin (1948), "An experimental imperfect market", Journal of Political Economy, 56, p. 95–108.

  46 **decentralised** markets

- Vernon Smith (1962) Journal of Political Economy

  Centralised market, open order book



Recap of the classroom experiment

- external validity

- internal validity
  - participants (recruiting, selection)
    - representativeness (professional traders)
    - repeated participation
  - instructions (was the experiment clear to all)
    - script for instructions, presentation by outsider
    - control questions
    - repetition
  - running the experiment
    - paper+pencil experiment
    - computerised experiment
    - classroom experiment
  - simple experimental structure
  - "neutral" instructions
  - incentives (salient, monotonic, dominant / hypothetical)
  - anonymity
  - deception / honesty

Behavioural/experimental economics → new discipline, since ca. 1950

- How empirical are other sciences?
- Let us compare different ways to test theories.

Testing theories

- Theology **Math 5:3** Blessed [are] the poor in spirit: for theirs is the kingdom of heaven
- Physics **law of free fall:** $s = \frac{1}{2}g \cdot t^2$
- Economics **1st welfare theorem**: Each Walrasian equilibrium is weakly Pareto efficient.

	Physics	Economics
abstract concepts	electric/magnetic field, light waves, quarks, ...	preferences, utility functions, equilibria, ...
method	unity of theory and experiment	???
measure-ment	sharp	noisy → econometrics

1.2 Theories and data?

Field: (OECD, federal bureau of census, ...)
few independent observations (1 country = 1 observation?)
endogeneous policy
uncontrolled parameters
field experiments are rare

Theory:
many models
conjectures
predictions
policy recommendations

Laboratory:
many observations
long time-series
flexibel modelling
controlled parameters
what-if experiments
replication
but it is not the field

1.2.1 Definition: Theory

Theory

assumptions
axioms
definitions
→
conclusions
rules of inference
→
interpretation

Model

Theory

A theory is a tautology. (as long as it is internally correct)
(some people want something more (informativeness, testability), see below)

Desirable properties of theories:

- Internally correct (tautology, author made no mistakes in his or her derivations)
- Testable, informative (we can map elements of the theory to observables in the field)
- Simple, parsimonious (allows understanding the complexity of the field)
- Robust (holds (rather precise), even if assumptions are not fulfilled)

? Accurate (captures a relevant element of the real world (or is this the ratio between "robust" and "simple"?))

Alternative definition of a theory (Larry Samuelson, 2005)

Real world: $F : X^\infty \to S^\infty$

Theory: $f : X^N \to \Delta\Delta S^M$

Internal correctness:

- can we falsify a theory? — no, unless the author made a mistake in his or her derivations.

Testability:

- what does it mean that a theory is "testable in real life"?
- do we have to duplicate a theory in "real life"? $\to$ no: why duplicate a tautology
- does this mean that a theory needs no relation to "real life"?

Simplicity:

Why do we want theories to be simple?

Maps are simple and inaccurate models The map of Jena (see figure 1.1) is simple and inaccurate. Due to its simplicity it is more useful than a 1:1 map.

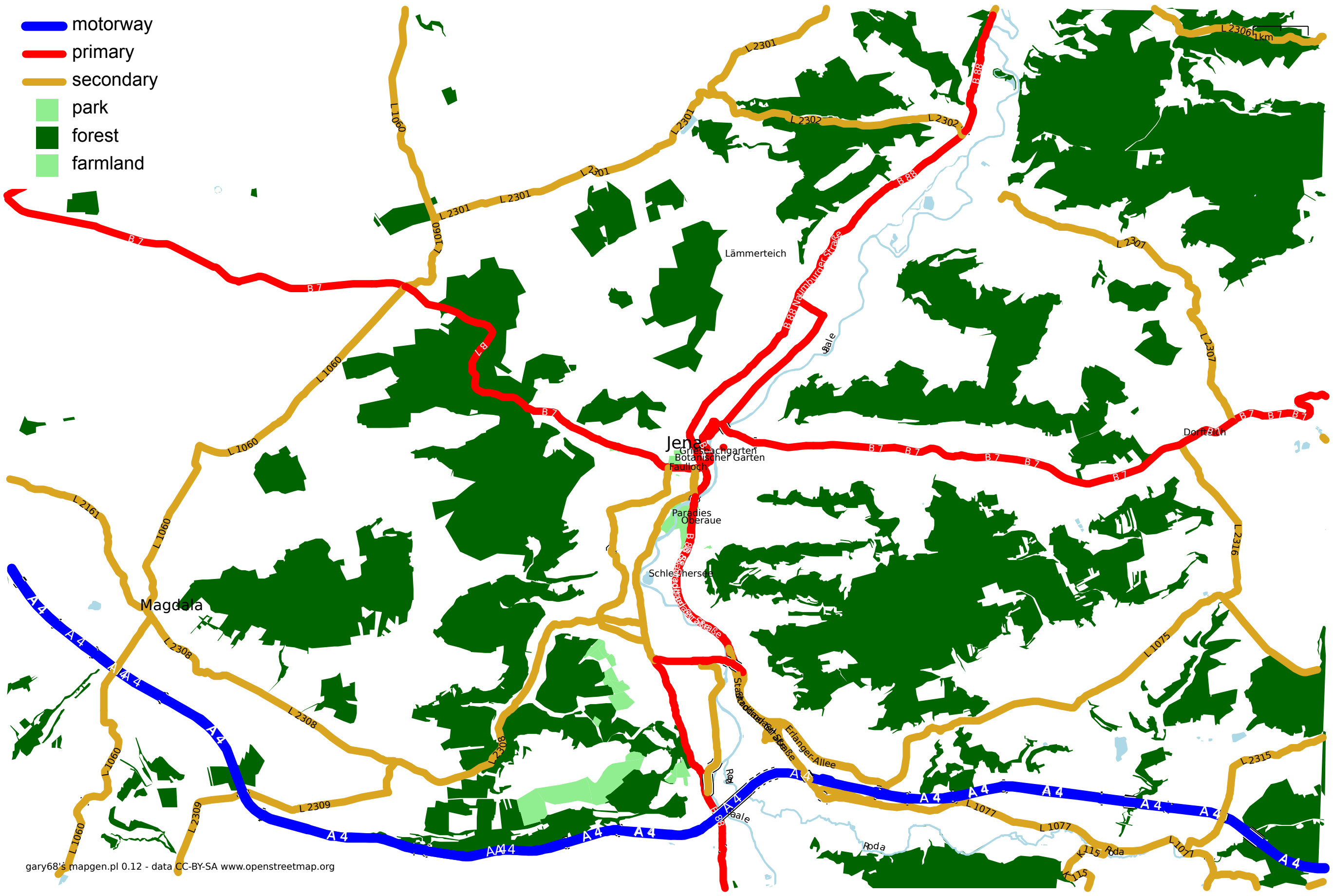
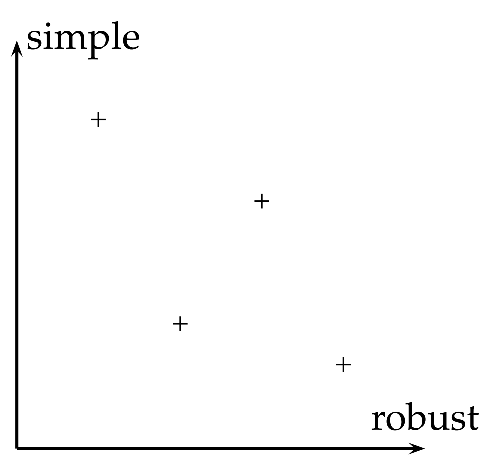


Figure 1.1: A simple map

More on simplicity

Desirable properties of theories:



- Internally correct
- Testable, informative
- Simple, parsimonious
- Robust

? Accurate

Note: There is a trade-off between these properties!

A theory is supposed to provide a simple, and, hence, inaccurate and imprecise representation of the world.

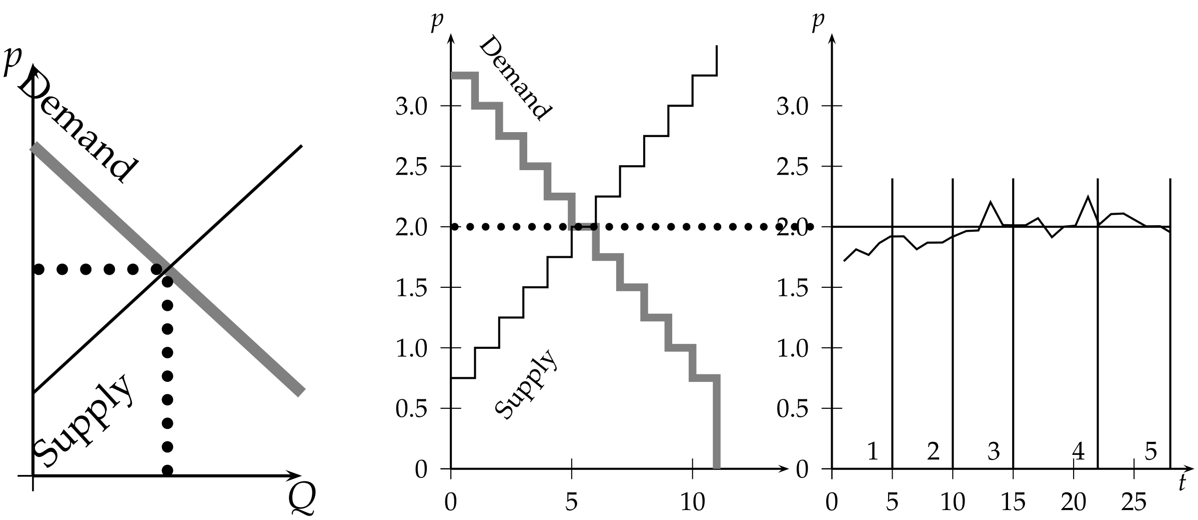


Figure 1.2: Market equilibrium with perfect competition

(to avoid misunderstandings: we should not confuse models and theories. A map is a model.)

Example 2 - market equilibrium with perfect competition (See figure 1.2)
Assumptions of this theory?
→ efficient allocation, trade at equilibrium prices, equilibrium quantity

Simplicity: market equilibrium with perfect competition

- Should a theory be close to the real life?

→ No: too difficult to analyse, we have real life already

- Example: Frankfurt stock exchange — we can duplicate this, but why?
- Theories simplify → to reveal structure.
- E.g., only one asset, only 2 traders…

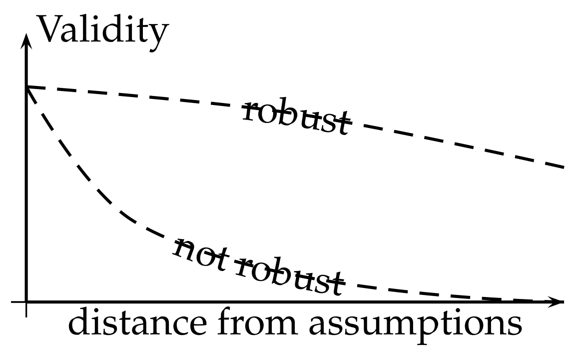
Robustness:

- In real life the **assumptions** of the theory of perfect competition **never hold**
  is this theory therefore useless?

- No — at least not if it is “robust”

  Vernon Smith’s experiment, Journal of Political Economy 1962 allows us to better understand **robustness** of the theory of perfect competition.
- Wouldn’t it be better to study real markets from real life?

  No — in real life we do not know demand and supply, we can not check whether allocations are efficient, prices are given by the intersection of demand and supply,. . .



Recap: Desirable properties of theories:

- Internally correct (tautology, author made no mistakes in his or her derivations)
- Testable, informative (we can map elements of the theory to observables in the field)
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? Accurate (captures a relevant element of the real world (or is this the ratio between “robust” and “simple”?))

1.2.2 Sources of data

Cost and quality of data

	cost of obtaining data	quality of data
field	often already there	has often been produced for non-scientific puposes. quality is often doubtful
lab	has the be produced	produced by the researcher who is responsible for its quality

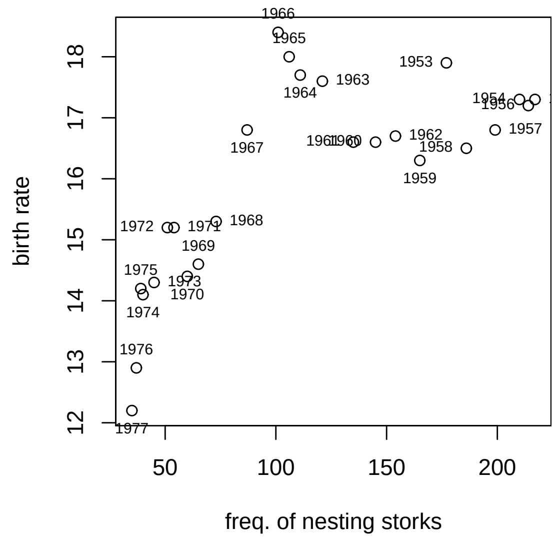
Control

	uncontrolled process	controlled experiment
field	inflation, unemployment	experiment with job training programs (LaLonde, 1986)
lab	Penicillin (Alexander Fleming, 1928)	asset market in the lab (V. Smith, 1962)

Why do we want experimental control?

Examples for problems that arise due to lack of control

- Storks in Denmark $\rightarrow$ birth rate (or industrialisation?)
- Sales of christmas trees $\rightarrow$ christmas
- Higher crop yields under trees: bird droppings as fertilizer, shade — luminists versus aviophiles (Leamer, 1983, “Let’s take the Con out of Econometrics”, AER 73, p. 31–43).



Can one do experiments in the field?

- Loss of control
  - no lab
- Gain of control
  - more time for decisions
  - control for age, profession, sex (heterogeneous groups of participants)

Implementation of experiments

Formats

- Where:
  - Classroom / Laboratory / Field
- How:
  - Paper & Pencil, Computerised Experiments
- Decisions:
  - Direct response method (choices are made for a given situation and role)

- Strategy method (choices are made for all situations of a given role)
- Strategy vector method (choices are made for all situations of all roles)
  * Emotions might be stronger with direct response
  * Treatment effects might be larger with direct response
  * Strategy method might require a simpler design (fewer choices)
  * With repetition participants become familiar with the experiment. Then they are less susceptible to details of the implementation (Brands, Charness, 2011)

- Payoff / cost
  - monetary
  - real effort, real pain, real reward

Experiments with a heterogeneous group of participants

- Beauty-Contest Games:
  - Bosch-Domènech, Montalvo, Nagel, Satorra (2002):
    * large number of participants: 1476 participants from Financial Times, 3696 Expansión, 2728 Spektrum der Wissenschaft
    * wide spectrum of participants
    * more "information seeking"
    * coalition formation
    * large stakes: Club Class Tickets to New York or Chicago, 100 000 Pesetas (600€), 1000 DM (500€)

- Myopic Loss Aversion (loss aversion + evaluate long term investments frequently):
  - Haigh and List (2005, students / 54 traders from Chicago Board of Trade): professional traders suffer <u>more</u> from myopic loss aversion

- Trust games:
  - Fehr and List (2004, 126 students, 76 CEOs): CEOs are more trusting, more trustworthy, and punish less

- Bellemare and Kröger (2006, 100 students, 499 CentER-panel): age: hump-shaped trust, u-shaped trustworthiness,
  females trust more and are less trustworthy
- Bornhorst, Ichino, Kirchkamp, Schlag, Winter (2010, 110 EUI students): trust and trustworthiness increase with age
- Sutter and Kocher (2007, 662 participants from different age groups): hump-shaped trust, increasing trustworthiness

- Ultimatum games:
  - Roth, Prasnikar, Okuno-Fujiwara, Zamir (1991, 79 students of different nationalities)
  - Murnighan and Saxon (1998, 331 children): generosity decreases with age, acceptance rates decrease
  - Harbaugh, Krause, Liday (2002, 310 children): generosity increases with age but decreases with size, acceptance rates decrease with age
    females are more generous
  - Güth, Schmidt, Sutter (2003, 1035 readers of the Berliner Zeitung): more fairness in the mail than in the internet
  - Güth, Schmidt, Sutter (2007, 5132 readers of Die Zeit, 3Person-Ultimatum): fairness increases with age, rejection rate also increases with age
  - Köhler, Kuklys, Struck, Fischer (2007, 334 adults): generosity increases with age and income
  - Bellemare, Kröger, van Soest (2008, 1213 CentER panel, Ultimatum+Dictator game): generosity increases with age
    inconsistent expectations
- Prisoners' dilemma games
  - List (2006): Friend or Foe
- Volunteer's Dilemma
  - Diekmann: Email Experiment
- Risk

- Blavatskyy and Pogrebna (2006): Affari Tuoi (Italian version of "Deal or No Deal" on Rai Uno)
- Hartley, Lanot, Walker (2006): Who wants to be a millionaire
- Lindquist, Säve-Söderbergh (2006): Jeopardy

Control and field experiments

- LaLonde (1986) "Evaluating the Econometrics Evaluations of Training Programs with Experimental Data", AER, 76, p. 604–620.

  → How could we evaluate training programs without experiments? What are main hypotheses, what are ancillary hypotheses?

  - National Supported Work Demonstration for women who obtain AFDC support, former drug addicts, criminals, shool drop outs. Applicants were unemployed for a long time.
  - Random allocation of 6616 applicants to training
  - → 2 groups(with training/without → average income with training is increased by 900$, statistically significant.
  - what if all unemployed had been offered training. Study this group, evaluation with econometric model, account for self selection, etc. → depending on the model the effect of training is sometimes positive, sometimes negative.

1.2.3 Purpose of behavioural studies:

- testing theories
- developing theories
- theory-free what-if studies (whispering in the ears of princes)

absolute vs. comparative Experiments

- absolute: determine the absolute value of a parameter
  - velocity of light, mass of an electron, natural rate of unemployment, slope of the Phillips curve…

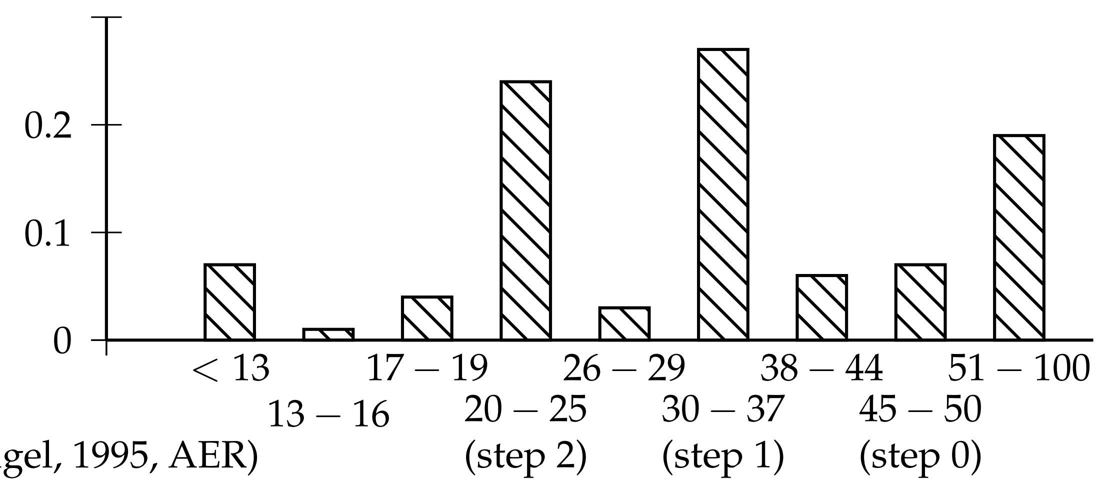
→ comparative: measure the effect of changes in parameters

- comparison of two medications, comparison of two market structures, comparison of two technologies,

1.2.4 Using experiments

Example:

- Each of you writes on a piece of paper down his or her name and one integer number between 2 and 100
- we collect all pieces of paper and determine the average number
- The player who is closest to $\frac{2}{3}$ of the average wins a prize (in case of a tie the prize will be split)
- was the winning strategy 'rational'?
  - theory: players play the equilibrium which can be found by recursively eliminating dominated strategies in this game
  - test this theory
  - → should we actually test theories?
  - what did physicists do before?

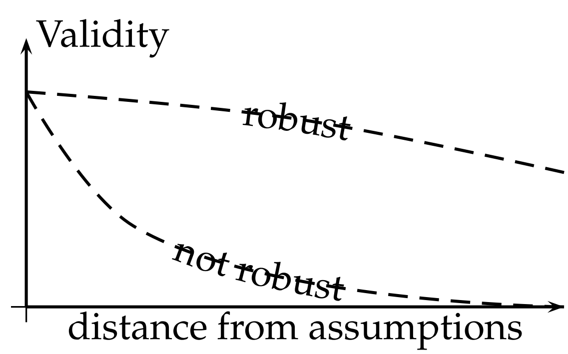


(Nagel, 1995, AER)

1.2.5 External validity

Can we generalise from our experiments? Does our experiment reflect the essential aspects of the situation in the field? — students who play for small amounts of money in the lab $\leftrightarrow$ traders at stock exchange

- Induction
  - theory has the same problem, sometimes even worse:
  - why should any theory hold in the field?
- If a theory (which claims to be general) holds in the lab, that is already a good sign
- If a theory does not even hold in the lab (where we can control most assumptions), why should the theory then hold in the field?
- If somebody comes with a second theory to explain why the lab experiment has different properties than the field, then we can test this with another experiment.



- Cleave, Nikiforakis, Slonim: Is There Selection Bias in Laboratory Experiments? (2010)
  - Classroom experiment with 1173 students
  - Elicit risk preferences and behaviour in trust game for all students
  - Ask students whether they want to participate in experiments
  - Invite those students to the lab
  - Compare behaviour of participants in the lab with those in the classroom experiment
  - $\rightarrow$ no bias

1.2.6 Internal validity

We want to find out: is there a "treatment effect" in our experiment? — does the treatment variable affect the dependent variable?

- no systematic error
- precision

$$
\begin{aligned}
\text{observation} &= \text{treatment effect} \\
&+ \text{treatment error} \\
&+ \text{unit effect} \\
&+ \text{measurement error}
\end{aligned}
$$

1.2.7 Practical advice

1. Simple experimental structure
2. Simple instructions
3. "Neutral" instructions (Strategies A+B) e.g. Liberman, V., Samuels, S.M. & Ross, L. (2004): Prisoners' dilemma game as "Wall Street Game" / "Community Game"

   Engelmann, Ortmann (2009): Gift exchange: "neutral" / "employer / worker"
4. Anonymity
5. Honesty, no deception
6. Incentives
   - Monotonic
   - Salient (in contrast to questionnaires, hypothetical questions)
   - Dominant
7. Script
   - Welcoming the subjects
   - Assigning to seats
   - Assigning to roles in the experiment
   - Presentation of instructions by outside
   - Dealing with questions

Example: internal validity E.g.: dictatorshipgame

1. Payoff in money
2. Subject with low opportunity cost
3. Subject with high learning ability

Real effort experiments

- Nut-cracking (Fahr, Irlenbusch, EL, 2000)
- Dragging a computerised ball across the screen
- Adding numbers
- Counting letters
- Solving sudokos
- Counting coins (Bortolotti, S., Devetag, G., Ortmann, A., 2009)
- Stuffing envelopes (Konow, AER, 2000)
- Constructing words (like in Scrabble)

Direct / indirect control

- Direct control of observable parameters: e.g. 2×2 design (not changing two parameters at the same time)
- Indirect control of unobservable parameters: randomise (allocate participants randomly to treatments)
- E.g. buyers and sellers in a market experiment: do not allocate roles depending on arrival time.

Factorial design

- Full factorial

  E.g. $2 \times 2 \times 2$ factorial design (3 factors are varied)

  Generally, with k factors $\rightarrow$ at least 2^k treatments.

- Fractional factorial

  Neglects interactions among factors

  Ronald Fisher (1926): "No aphorism is more frequently repeated in connection with field trials, than that we must ask Nature few questions, or, ideally, one question, at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire"

Within-subject design / accross subject design

- shoe-leather test (left/right different leather),
- not trivial if sequence effect is possible
- Within subject: ABA treatment, sequence effects, BAB treatment is necessary
- Accross subjects: more noise

Terms

- Experiment: several treatments, several sessions
- Treatment: Experiment + specific parameters
- Session: Experiment at a given date with a given group of participants
- Round: short (repeating) part of a session

date	participants	monetary policy
9.5.1997	12	dynamic, constant, dynamic
15.5.1997	6	constant, dynamic, constant
12.12.1997	17	dynamic, constant, dynamic
⋮	⋮	⋮

A first step:

1. choose any question from economics that you want to answer in an experiment (the question should be one sentence with a question mark at the end)
2. what do you know about possible answers to this question?
3. what possibilities do you see to find answers to this questions. Consider experimental and other methods.
4. what are the advantages and disadvantages of experiments?
5. could this experiment yield results that are surprising?
6. how would you conduct the experiment? Describe the essential details of the design.
7. is your design the simplest possible design?

1.2.8 Testing theories

Wind-channel experiment . . . is useful in the following situation:

- theory is not informative
- theory is too complicated
- unclear which theory to apply

Theory-testing experiment

. . . is useful if we are (or fear to be) in the following situation:

- theory is not accurate (mechanism)
- theory is not precise (prediction)

Allais Paradox (systematic deviation from theory)

	probability	prize
A	0.25	3000 €
B	0.2	4000 €

	probability	prize
A'	1	3000 €
B'	0.8	4000 €

people prefer $B \succ A$, but $A' \succ B'$.

1.2.9 Developing theories

Bargaining games

- Nash bargaining solution
- Rubinstein solution

The ultimatum bargaining game:

- Player 1: suggestion how to divide a "pie"
- Player 2: may accept or refuse
- subgame perfect solution:

→ player 1 keeps (almost) the complete pie.

Güth, Schmidtberger, Schwarz (1982)

- offer $> 30\%$
- 20 % of all offers are rejected

→ not subgame perfect

Interpretation:

- altruism of the proposer
- inequality aversion of the responder
- players do not understand the game, play a different (repeated game) with punishment
- $\left(\frac{1}{2}, \frac{1}{2}\right)$ is just a focal point

Aggregating microanomalies

- In the lab we find behavioural anomalies on the <u>micro</u> level
- Q: Do these "microanomalies" cause behavioural anomalies on the <u>macro</u> level?

1.2.10 What if experiments, policy recommendation

Whispering in the ears of princes, Windkanalexperimente

Hong and Plott (1982)

Railway companies demand that barges have to announce their prices publicly. Railway companies claim, that public availability of prices leads to more competition and less collusion among barges.

Interstate Commerce Commission has to decide.

One can find reasons (and models) both for the case of the railway companies and for the case of the barges.

Hong and Plot develop an experiment that models the market for wheat transport in autumn 1970 along the upper Missisippi and Illinois Canal.

→ aggregate supply and demand, distribution of small and large firms on each side of the market, fluctuations in demand and supply (2 months normal, 2 months high, 2 months normal).

Comparison: posted price / negotiated price

Result: posted price: prices are higher, trade volume is smaller, less efficiency. Smaller participants in the market lose, large participants gain. ...

More examples for wind-channel experiments

- Matching (medical doctors in the USA to hospitals)
- UMTS auctions
- Auctions on the internet (eBay)

In all these situation we do not test a clear-cut theoretical model.

1.2.11 Summary

- Testing **robustness** of economic theories
- developing new economic theories
- theory-free what-if studies

Limitations:

- Control (in the lab we make assumptions, too. Perhaps fewer than in the field, but we always test "observation + assumption").
- Generality (we only test finitely many parameters)
- Parameters (not all parameters can be induced in an easy way)

1.A Exercises

1. Laboratory and field experiments
   - Name different types of experiments from laboratory experiments to natural field experiments.
   - How much control do you have in each of them?
2. Experiments
   - Describe advantages and disadvantages of economic experiments.
   - List other methods to gather economic data. Describe the advantages and disadvantage of these methods.
3. Conducting laboratory experiments
   - Explain how you would conduct a laboratory experiment. Start with finding a research question and finish with writing an article.
4. Beauty Contest
   - Explain the beauty contest game.
   - What is the dominant strategy? Are you likely to win with this strategy?
   - Suppose there are only two players in a beauty contest game. What is the dominant strategy in this game? Are you likely to win with this strategy?
5. Trust Game
   - Explain the trust game.
   - What is the game theoretic solution?

- What is the efficient solution?

6. Ultimatum Game

   - Explain the ultimatum game.
   - What is the game theoretic solution?
   - What do you think happens in reality? Why?
   - Is the ultimatum game suitable to measure altruism? If not, why?
   - Which game would you use to measure altruism? Explain the game and why you think that it is suitable to measure altruism.

7. Prisoner's Dilemma

   - Explain the prisoner's dilemma.
   - What is the game theoretic solution?
   - What is the efficient solution?
   - Describe some real life examples of the prisoner's dilemma.

8. Experiment on altruism

   A junior researcher would like to conduct a study to find out if students of different subjects learn during their studies to be altruistic or selfish and whether women or men behave more altruistically. He decides to conduct an experiment to answer this question. He randomly invites 60 female and male students to three experimental sessions into the laboratory. There, he conducts a dictator game with the participants. He tells them that they will get 10 chocolate bars and that they can be "kind" and send some of these chocolate bars to some students in a different room although there are no students in a different room. The participants have to go one by one to a table visible to all subjects and place the chocolate bars they would like to give away on this table.

   - Your are the adviser of the junior researcher. Which parts of the experimental design would you advise to change? Why?
   - List the most important rules that experimental economists should follow when conducting experiments.

9. Experiment on bargaining

   Imagine you would like to find out whether students make higher offers in the ultimatum game if the other player is of the same sex. You decide to run a laboratory experiment to answer this question.

   - Please describe how you would design the experiment.
   - What are your experimental parameters?
   - Describe how you would conduct one experimental session in the laboratory.

Chapter 2

Individual choice, risk

2.1 Judgement

2.1.1 Calibration

- professionals: weather forecast $\rightarrow$ well calibrated
  $\rightarrow$ good resolution (weight on the ends of the distribution)
- write down 90% confidence intervals for the following questions…
- Are potatos from Ireland or from Peru? Which city is further to the north: Rome or New York? How confident are you that your answer is correct: $\rightarrow$ Overconficdence
- Svenson (Acto Psychologica) 1981: reported lower risk of car accidents
- Weinstein (Journal of Personality and Social Psychology) 1980: reported lower risk of unemployment
- Weinstein (Journal of Behavioral Medicine) 1982: reported lower health risk
- Lichtenstein, Fischhoff, Philipps (in Kahneman, Tversky, Judgement Under Uncertainty) 1982, precision of knowledge
- Alloy and Ahrens (JPSP) 1987, Psczczynski and Holt (JPSP), 1987: only people who are clinically depressive are realistic

- Traders at the stock exchange (Glaser, Langer, Weber): Confidence interval for future prices → Overconfidence, substantially more than students.

Related: Self attribution bias (Taylor and Brown, Psychological Bulletin, 1988): Own success is due to own skill, own failure is bad luck.

Consequences of Overconfidence:

- Investment in risky and unsuccessful strategies (Adam Smith, 1776)
- Business failures (Camerer Lovallo, AER, 1999)
- Job search, unemployment (Dubra, Review of Economic Dynamics, 2004)
- Inefficient trade of assets (Manove and Padilla, Rand, 1999, Barber und Odean, QJE, 2001)
- Inefficient investments of firms (Malmendier und Tate, Journal of Finance, 2005)
- Efficient matchings fail (Babcock and Loewenstein, Journal of Economic Perspectives, 1997)
- Inefficient lack of insurance against risk (Weinstein, Journal of Behavioral Medicine, 1982)

Scoring Rules Participants reveal probability p. Payment is $2p - p^2$ if the event realises, and $1 - p^2$ if the event does not realise.

Why is it a best reply to reveal the "true" probability?

Be p^* the true expected probability. Then the expected payoff is

$$\begin{aligned}
u &= p^*(\underline{2p} - p^2) + (1 - p^*)(\underline{\underline{1}} - p^2) \\
&= p \cdot (2p^*) + p^2 \cdot (-p^* + p^* - 1) + 1 - p^* \\
&= p \cdot (2p^*) + p^2 \cdot (-1) + 1 - p^* \\
\frac{du}{dp} &= 2p^* - 2p \stackrel{!}{=} 0 \\
& \quad p^* = p
\end{aligned}$$

Another scoring rule Again p^* is the probability of the event.
Participants reveal p, the experimenter draws a random number $r \in [0,1]$.

- If $p > r$ the participants obtains a prize $\mathcal{W}$ in case of the event (Lottery $\mathcal{P}$, i.e. with probability p^*).
- If $p \leq r$ the participant obtains a a prize $\mathcal{W}$ with probability r (Lottery $\mathcal{R}$).

(Karni, Econometrica 2008)

- If $p^* > r$: Participant prefers $\mathcal{P}$, hence, is better off with $p \geq p^*$.
- If $p^* < r$: Participant prefers $\mathcal{R}$, hence, is better of with $p \leq p^*$.

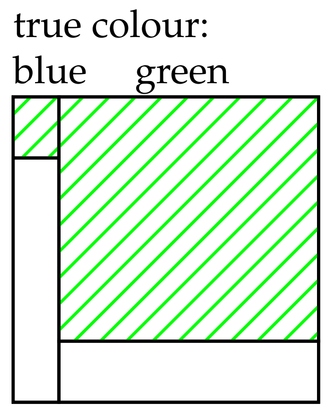
2.1.2 Bayesian Updating

Kahneman and Tversky (1972): A cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city.

- 85% of the cabs in the city are green and 15% are blue.
- A witness identified the cab as blue.
- The court tested reliablity of the witness under the same circumstances that existed on the night of the accident and found that the witness correctly identifies the color 80% of the time and failed 20% of the time.

What is the probability that the cab was blue?
Median answer: 0.8 (underweighting of base rates)

$$\frac{0.15 \cdot 0.8}{0.15 \cdot 0.8 + 0.85 \cdot 0.2} \approx 0.414$$



2.1.3 Representativeness

Kahneman and Tversky (1983): Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

Rank the following statements by their probability:

1. Linda is teacher in elementary school
2. Linda works in a bookstore and takes Yoga classes.
3. Linda is active in the feminist movement (F)
4. Linda is a psychatric social worker
5. Linda is a bank teller (B)
6. Linda is an insurance salesperson
7. Linda is a bank teller and is active in the feminist movement (F&B)

90% of participants consider (F&B) for more likely than (F) or (most of the time) (B).

(F&B) appears “more representative”.

Is the ‘Linda-problem’ really a problem?

> Camerer (1995): “...some apparent biases might occur because the specific words used, or linguistic convention subjects assume the experimenter is following, convey more information than the experimenter intends. In other words, subjects may read between the lines. The potential linguistic problem is this: in the statement ‘Linda is a feminist bank teller,’ subjects might think that this statement ‘Linda is a bank teller’ tacitly excludes feminists; they might think it actually means ‘Linda is a bank teller (and not feminist).’ If subjects interpret the wording this way none of the statements are conjunctions of others and no probability rankings are wrong.”

Charness, Karni, Levin (2009): Experiment with incentives”

- First “normal” experiment (public goods, winner’s curse, hidden information)

- during the payment for this experiment:
  - Linda problem (with/without incentives (4$), alone, in groups of two, in groups of three)

	no incentive	with incentive
T&K	85.2	
CKL, single	58.1	33.0
CKL, pairs	48.2	13.2
CKL, trios	25.6	10.4

2.1.4 False consensus

Participants are asked whether they are willing to carry for 30 minutes a sign “Eat at Joe’s”.

Participants are also asked how they expect other participants to choose.

Among those who want to do this 62% expect the others to choose the same. Among those who do not want to do this 67% expect the others to choose the same.

2.1.5 Hindsight bias

Difficulty to reconstruct a previous perspective.

Fischoff and Beyth (1975): Will Nixon meet Mao?

Camerer, Loewenstein, Weber (1989):

1. Participants obtain information about 8 less known firms including their expected profits for 1980.
2. Participants make forecasts for profits. Deviations $<$ 10% are rewarded with 1$.
3. 2 months later: other participants are additionally informed about actual profits. They have to forecast the predictions of the first group. → hindsight bias
4. Additionally: Market with assets. Return of the asset is the average forecast of the first group. → slightly smaller hindsight bias.

(Stahlberg: reverse hindsight bias)

2.2 Choice

2.2.1 Expected utility

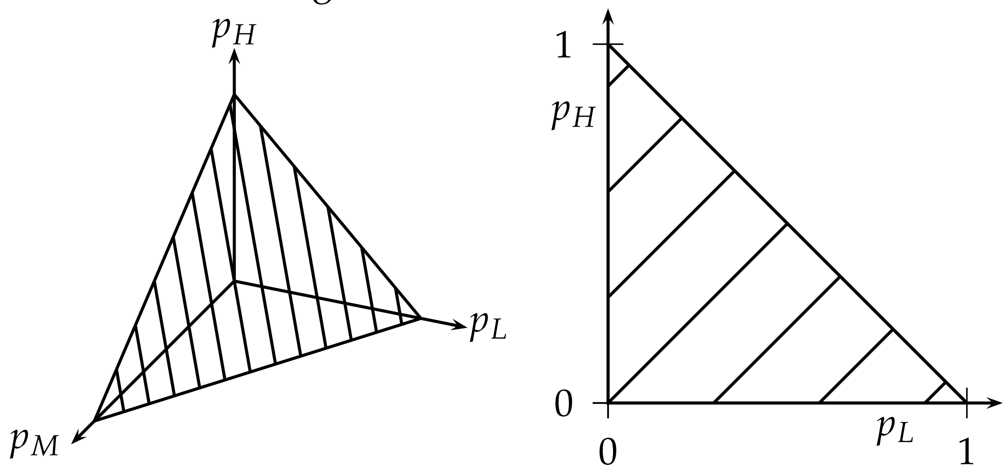
Preferences over bundles of goods

- L. L. Thurstone (1931) "The indifference function", Journal of Social Psychology, 2, p. 139–167.
- W. Allen Wallis and Milton Friedman (1942), "The empirical derivation of indifference functions", Studies in mathematical economics and econometrics in memory of Henry Schultz, Chicago, p. 175–89.)
- Stephen W. Rousseas and Albert G. Hart (1951) "Experimental verification of a composite indifference map", Journal of Political Economy 59, p. 288–318.

Preferences over lotteries

- Daniel Bernoulli (1738), "Speciment theoriae novae de mensura sortis", Commentarii Academiae Scientiarum Imperialis Petropolitanae, 5, p. 175–92.
- von Neumann und Morgenstern (1944), Theory of Games and Economic Behavior
  - normative theory: Marschak
  - positive theory: von Neumann, Morgenstern, Friedman, Savage.

a Marschak-Machina triangle:



Question: How would the indifference curves of a risk neutral decision maker look like ($p_L = 0, p_M = 3000, p_H = 4000$)

2.2.2 1944: von Neumann and Morgenstern

1. Ordering: Preferences are complete (either $X \prec Y$ or $Y \prec X$ or $X \sim Y$) and transitive ($X \succ Y \land Y \succ Z \quad \Rightarrow X \quad \succ Z$).
2. Continuity: $\forall X \succ Y \succ Z \quad \overset{\text{unique}}{\exists} \quad p : pX + (1-p)Z \sim Y$
3. Independence: $\forall X \succ Y, Z, p \in (0,1) : pX + (1-p)Z \succ pY + (1-p)Z$

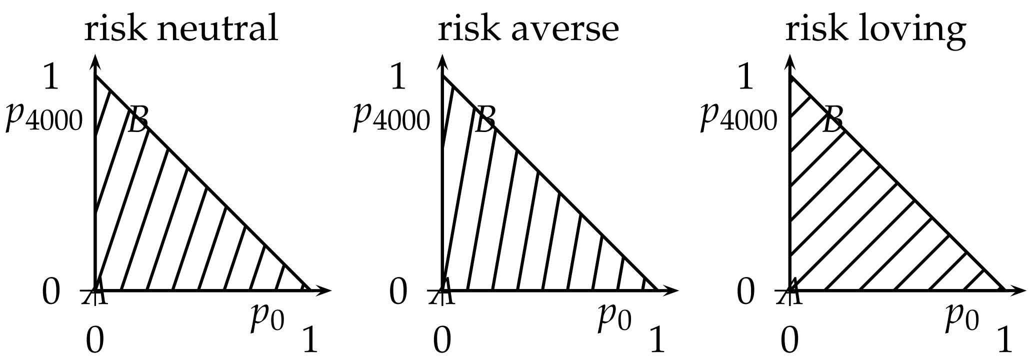
The axioms imply that preferences can be represented by a numerical utility index $u()$...

$$u(A) \geq u(B) \Leftrightarrow A \succeq B$$

...The utility of any lottery is the expected utility of the possible outcomes

$$u\left(\sum p_i X_i\right) = \sum p_i u(x_i)$$

Risk preferences in the Marschak-Machina Diagram How would the indifference curves of a risk averse decision maker look like



Why are the indifference curves parallel?
In which way are parallel indifference curves implied by the axioms?

measuring utility of lotteries

- Pairwise choice: what do you prefer:

you win 10 € with probability 1/2	you obtain with certainty 0 €
you win 10 € with probability 1/2	you obtain with certainty 1 €
you win 10 € with probability 1/2	you obtain with certainty 2 €
you win 10 € with probability 1/2	you obtain with certainty 3 €
you win 10 € with probability 1/2	you obtain with certainty 4 €
you win 10 € with probability 1/2	you obtain with certainty 5 €
you win 10 € with probability 1/2	you obtain with certainty 6 €
you win 10 € with probability 1/2	you obtain with certainty 7 €
you win 10 € with probability 1/2	you obtain with certainty 8 €
you win 10 € with probability 1/2	you obtain with certainty 9 €
you win 10 € with probability 1/2	you obtain with certainty 10 €

- Becker, DeGroot, Marschak (1964)
  - Participant obtains lottery and states willingness to pay (WTP)
  - WTP is compared with a randomly drawn prize p.
  - If $p >$ WTP, then participants have to sell the lottery at a price p otherwise the lottery is played.

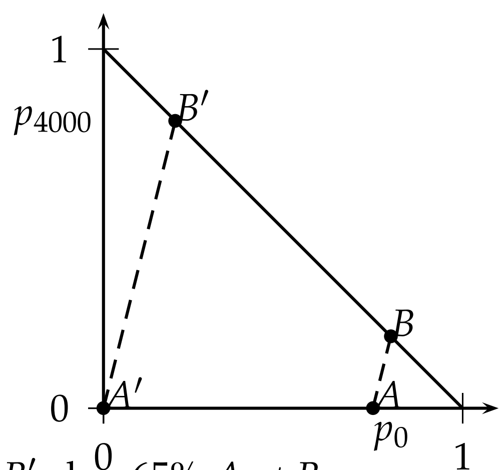
First experimental tests of von Neuman and Morgenstern's axioms

- F. Mosteller and P. Nogee (1951), "An experimental measurement of utility", Journal of Political Economy 59, p. 371–404.
  - subjects choose among lotteries with real prices
  - → construct utility function for subjects
  - make predictions regarding behaviour in further (and more complicated) lotteries
  - test predictions

2.2.3 Common-ratio

	probability	prize
A'	1	3000 €
B'	0.8	4000 €

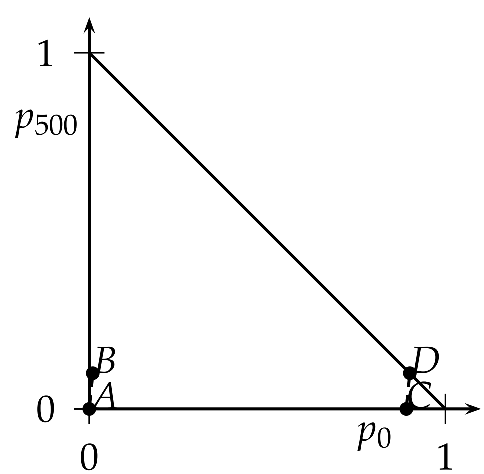
	probability	prize
A	0.25	3000 €
B	0.2	4000 €



Kahneman und Tversky (1979): 80%: $A' \succ B'$ aber 65% $A \prec B$
decision violates the independence axiom

2.2.4 Common-consequence

	0 FF	100.000.000 FF	500.000.000 FF
A		1	
B	0.01	0.89	0.1
C	0.89	0.11	0
D	0.9		0.1



$A \succ B, D \succ C$

- Maurice Allais (1949) "La gestion des houillères nationalisés et la théorie économique".

  are the civil servants of the state coal mines efficient managers.

  → idea of a questionnaire for a specific population

- Maurice Allais (1953) "Le comportement de l'homme rationnel devant le risque: Critique des postulats et axiomes de l'ecole americaine", Econometrica, 21, p. 503–546.

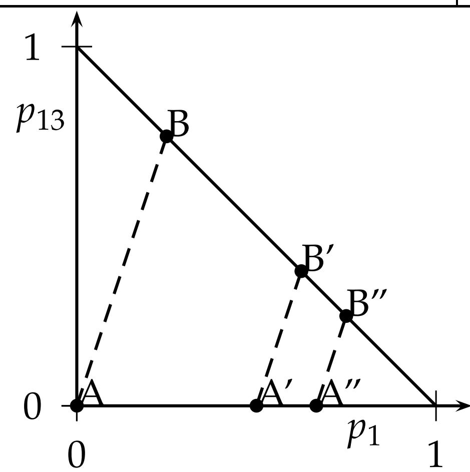
	0 FF	100.000.000 FF	500.000.000 FF
A		1	
B	0.01	0.89	0.1
C	0.89	0.11	0
D	0.9		0.1

2.2.5 Experiments with animals

Battalio, Kagel, MacDonald (1985): Rats choose among two levers (S and R). Each lever gives a lottery for food pellets.

- 2 weeks: learning phase: rats learn the distribution (alternate between free learning and forced learning (only one lever available).

	1 pellet	8 pellets	13 pellets	
A	—	1	—	0.58
B	1/4	—	3/4	
A′	1/2	1/2	—	0.49
B′	5/8	—	3/8	
A″	2/3	1/3	—	0.43
B″	3/4	—	1/4	



- Clear violation of the axiom of independence, "fanning out" of indifference curves.

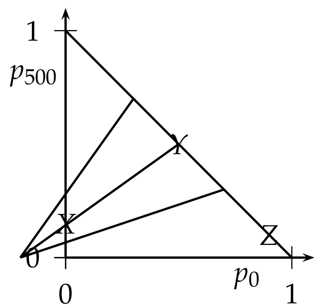
2.2.6 Weighted utility

(structure "fanning out")
replace axiom 3

$$\forall X \succ Y, Z, p \in (0,1) : pX + (1-p)Z \succ pY + (1-p)Z$$

by
weak independence:

$$\forall X \succ Y, p \in (0,1) : \underline{\exists q \text{ s.t.}} \forall Z : pX + (1-p)Z \succ \underline{q}Y + (1-\underline{q})Z$$

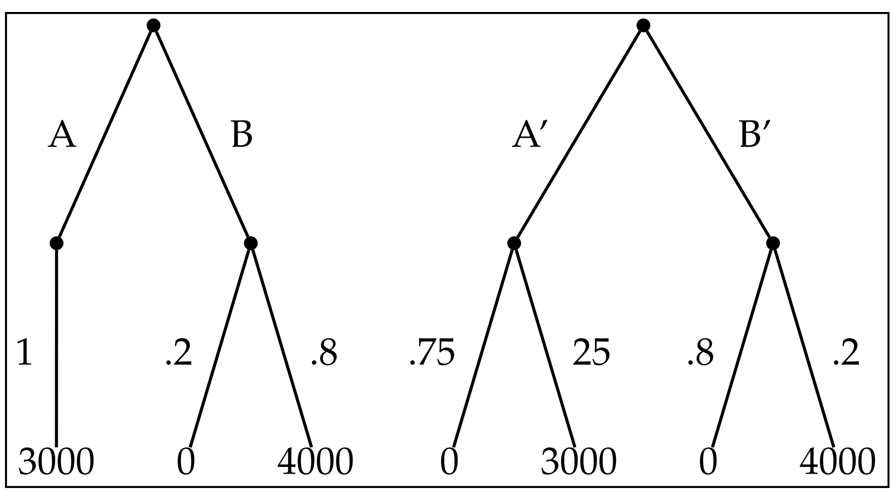


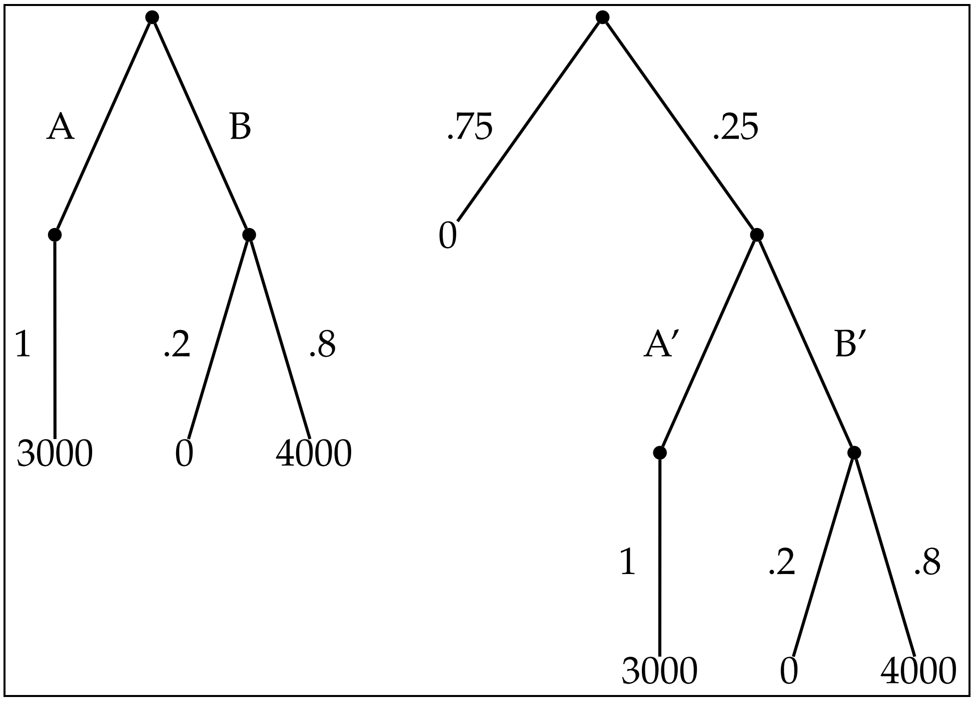
$$u\left(\sum p_i X_i\right) = \frac{\sum p_i w(x_i) u(x_i)}{\sum p_i w(x_i)}$$

Tests von fanning-out: Camerer (1989) does not find much support for fanning-out), Chew and Waller (1986) and Conslisk (1989) even find fanning in (although with hypothetical payment).

2.2.7 Framing of lotteries

we can frame the above common ratio lotteries as combined lotteries: no violation of the independence axiom.





Different risk preferences of men and women

- Men: more risk loving
- Women: more risk averse

Reason: testosterone

- measure testosterone in participant's saliva
- measure prenatal testosterone (ratio ring/index finger correlates positively with prenatal testosterone)

$\rightarrow$ attitude towards risk depends on testosterone, not on sex. (Apicella et al., 2008)

2.2.8 Ambiguity — Ellsberg Paradox

ambiguity $\equiv$ know to be missing information

(Ellsberg, 1961, Risk, ambiguity, and the savage axioms. Quarterly Journal of Economics 75:643-69)

	1 urn with 90 balls among them are		
	30 balls	60 balls	
	red	black	yellow
X	W	-	-
Y	-	W	-
X′	W	-	W
Y′	-	W	W
X″	W	-	-
Y″	-	-	W

many people choose $X \succ Y$ and $Y' \succ X'$

2.2.9 Framing

Survival and Mortality Framing of Lung Cancer Treatments:

	Survival Frame % alive		Mortality Frame % dead		Both Frames	
	Radiation	Surgery	Radiation	Surgery	Radiation	Surgery
After treatment	100	90	0	10		
After on year	77	68	23	32		
After five years	22	34	78	66		
Percentage choosing each:						
American doctors and medical students	16	84	50	50	44	56
	(87)		(80)		(223)	
Isreali doctors and medical students	20	80	44	56	34	66
	(126)		(132)		(144)	

2.A Exercises

1. Homo economicus
   - Define homo economicus.
   - Human beings are not completely rational. List some of the failures in the context of economic decision making.
2. Bayesian Updating

- 0.1% of the population of a country is affected by a certain mild disease. A medical test is used to test which persons are affected by this disease. This test shows correctly a positive result (it indicates the disease) in 98% of the persons which really have this disease. How likely is it that a person with a positive test really has this disease?
- Draw a tree diagram to find out how many of 1000 tested persons get a positive result although they do not have this disease.

3. Heuristics
   - What is a heuristic?
   - Why do humans use heuristics?
   - Give examples for heuristics.
4. von Neumann and Morgenstern-Axioms
   - List and give examples for the three axioms by von Neumann and Morgenstern.
5. Framing
   - What is meant in psychology and economics with "framing"?
   - In the lecture you have seen that framing is important when talking about the outcome of medical treatments. Can you think of other situations where framing is particularly important?
   - In which situations is it particularly important to think about how you want to formulate what you want to say?
   - What is the risk of the framing effect?
6. Risk preferences
   - In the lecture you have seen that men and women usually have different preferences for risk due to different testosterone levels (see Apicella et al. 2008, Evolution and Human Behavior).
   - In which situations of daily life could this play a role?
   - Could you infer any policy implications from this result?
7. Exam 2006, part of exercise 2

   Mary is a stock broker and wants to better understand investor preferences for risky investments.

- Experimental economists use the Marschak-Machina triangle to describe preferences over risky choices. Draw two such triangles, one with preferences for a risk-averse and one with preferences for a risk-loving person. Label your diagrams carefully and explain how one can see attitudes towards risk in these diagrams.
- To find out whether the preferences of her clients follow the axioms of von Neumann and Morgenstern Mary has asked all of them to complete a questionnaire. The questionnaire contains questions like the following: <u>Lottery A is an investment that gives you a return of £200 with probability 1. Lottery B is an investment that gives you a return of £450 with probability 1/2. Do you prefer A or B?</u> What can one say about a person who is just indifferent between A and B? Is this a risk-averse, risk-loving, or risk-neutral person?
- Mary has found out that about 50% of her clients choose A and another 50% choose B. To test the axioms of von Neumann and Morgenstern, Mary introduces another question: <u>Lottery A is an investment that gives you a return of £200 with probability 3/4. Lottery B is an investment that gives you a return of £450 with probability x. Do you prefer A or B?</u> How should Mary choose the value of x to be able to test the validity of the axioms of von Neumann and Morgenstern?
- Is it possible to compare answers to the following question with answers to the first question above and learn anything about the axioms of von Neumann and Morgenstern? <u>Lottery A is an investment that gives you a return of £2000 with probability 1. Lottery B is an investment that gives you a return of £4500 with probability 1/2. Do you prefer A or B?</u> Explain your answer.

Chapter 3

Bargaining

- Nash bargaining solution
- Rubinstein solution

3.1 The ultimatum bargaining game

(most simple form of bargaining)

- Proposer: proposes a division of a "pie".
- Responder: accepts or refuses.
  In case of refusal, both players receive nothing.

Interpretation: monopolist offers a good at a fixed price.

- subgame perfect solution:

$\rightarrow$ player 1 keeps (almost) the entire pie.

Güth, Schmidtberger, Schwarz (1982)

- offer $> 30\%$
- 20 % of all offers are refused

→ not a subgame perfect solution

Interpretation:

- altruism of the proposer
- inequality aversion of the responder
- players do not understand the game, play a different (repeated game) with punishment
- $\left(\frac{1}{2}, \frac{1}{2}\right)$ is just a focal point

3.1.1 Players do not understand the game: Binmore, Shaked, Sutton (AER, 1985)

- Subjects did not understand the GSS game. They played $\left(\frac{1}{2}, \frac{1}{2}\right)$ just because it is a focal division.

  Thus, they have to learn the game. Subjects first play a training game, then play another game.

- The training game: A two stage game:
  - 1st move: Player 1 decides how to divide a given amount of money.
  - 2nd move: Player 2 is informed about player 1's move and accepts or refuses.

    If player 2 accepts, the game ends and players will be paid following the proposal of player 1.

    If player 2 refuses, there will be a second stage (3rd and 4th move):
  - 3rd move: Player 2 decides how to divide 25% of the initial amount.
  - 4th move: Player 1 is informed about player 2's move and accepts or refuses.

    If player 1 accepts, the game ends and players will be rewarded following the proposal of player 2.

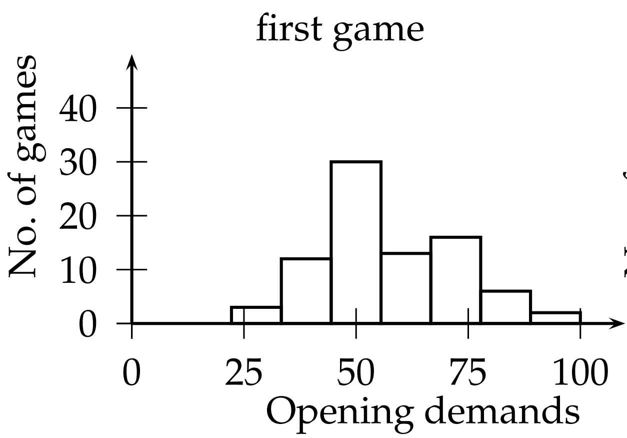
    If player 1 refuses, both players receive nothing.

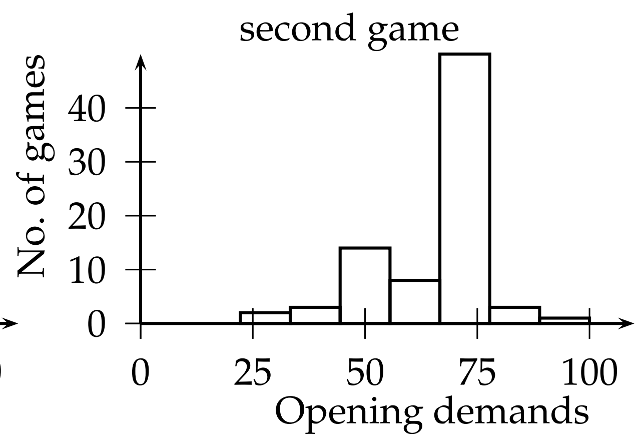
- The subgame perfect solution of the training game:

– Player 1 offers 25% in the first stage, and player 2 accepts all offers that are equal or better than 25% for player 2.

  Should we enter the second stage, then player 2 offers 0% for player 1 and player 1 accepts all offers.

- The second game:
  – Now those subjects that were in position of player 2 during the training play are in the position of player 1:





- In the training game, the average first round offer was 43%.
- In the second game, the average first round offer was 33%.

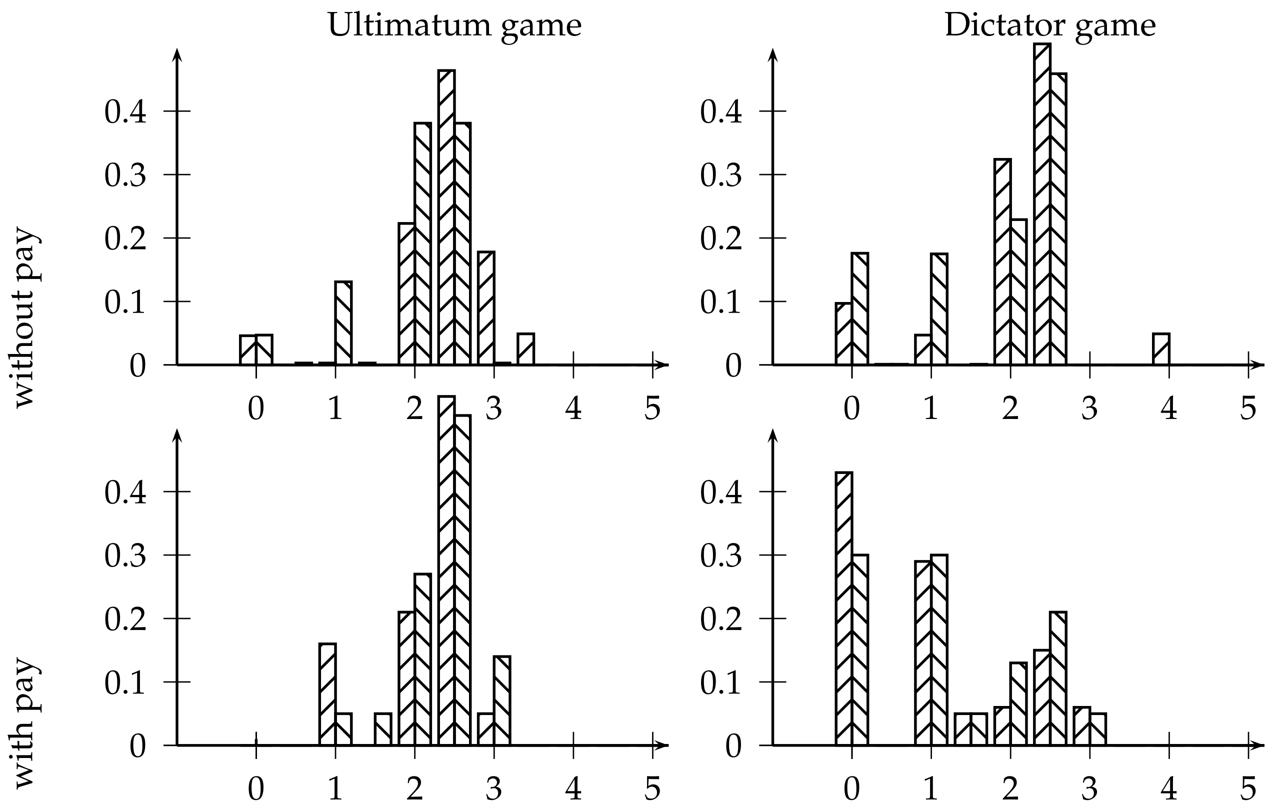
→ Players have learned the subgame perfect solution

3.1.2 Altruism vs. inequality aversion, Forsythe, Horowitz, Savin, Sefton (1994)

Dictator game: Player 2 may never reject the proposal of player 1.

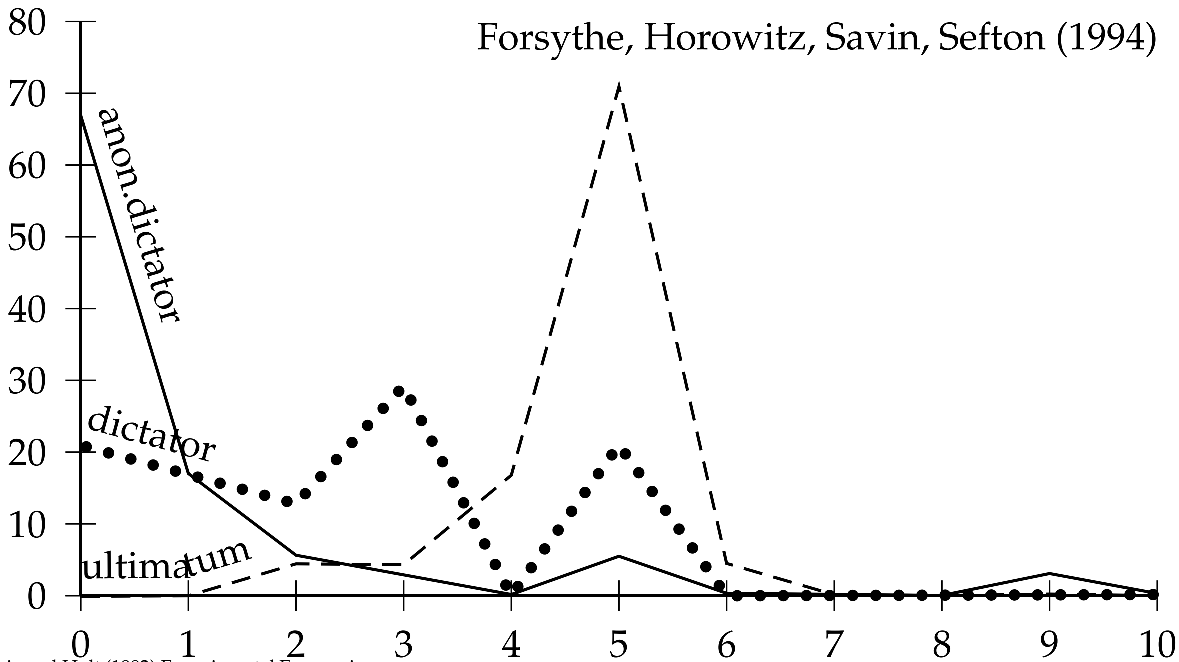
- Subjects pretend to be generous, as long as they do not have to pay for it (they may wish to please the experimenter).
- As soon as they play for real stakes, subjects are substantially less generous in the dictatorship game.
- in the double blind treatment subjects stop almost completely being generous

→ Player 1s are not fair, but try to avoid punishments.



(picture taken from Kagel, J. H., A. E. Roth, “The Handbook of Experimental Economics”, Princeton University Press, 1995).

Figure 3.1: Ultimatum und Dictator Game - Offers of Player 1 (FHSS)



from: Davis and Holt (1992) Experimental Economics

Figure 3.2: Ultimatum und Dictator Game - II - Offers of Player 1 (FHSS)

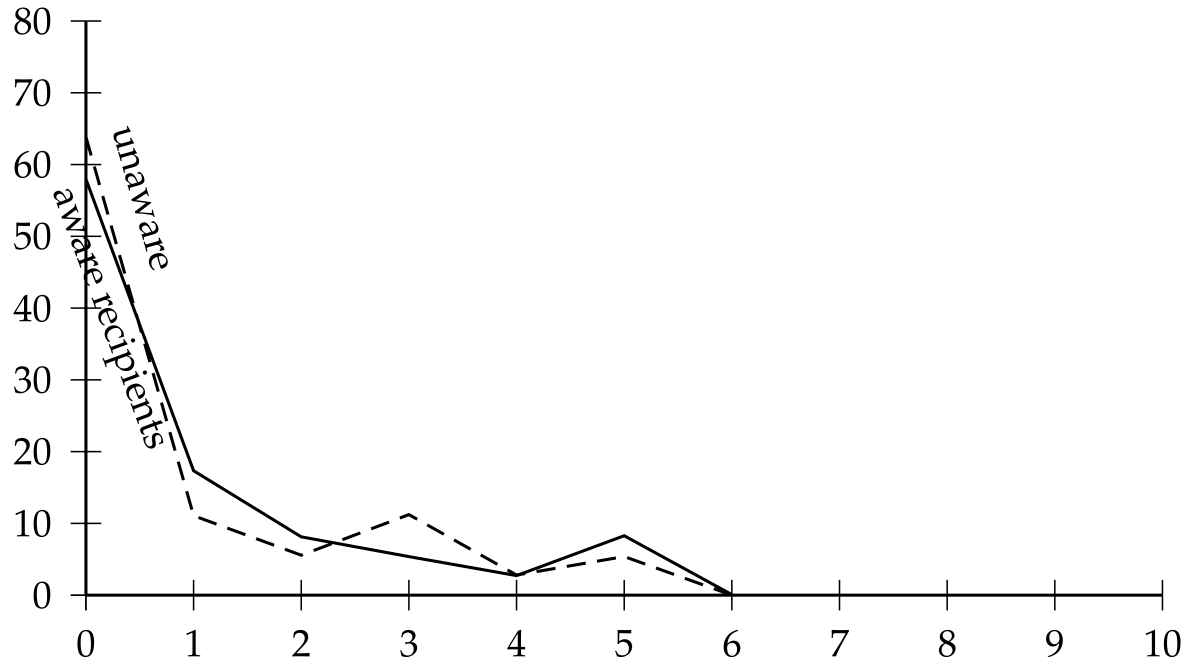
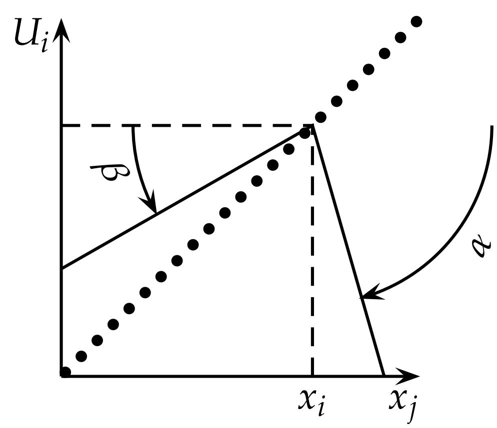


Figure 3.3: Opponents's awareness of the rules of the game (Koch & Norman, 2005)

- Nevertheless some players transfer money—why?
  - they care about their own utility?
  - they care about the other person's utility?

A model of fairness and inequality aversion (Fehr Schmidt)

$$U_i(x) = x_i - \alpha_i \max(x_j - x_i, 0) - \beta_i \max(x_i - x_j, 0), i \neq j$$



$\beta = 0$: Egoist, $\beta = 1$: Altruist, $\beta > 1$: strong inequality aversion.

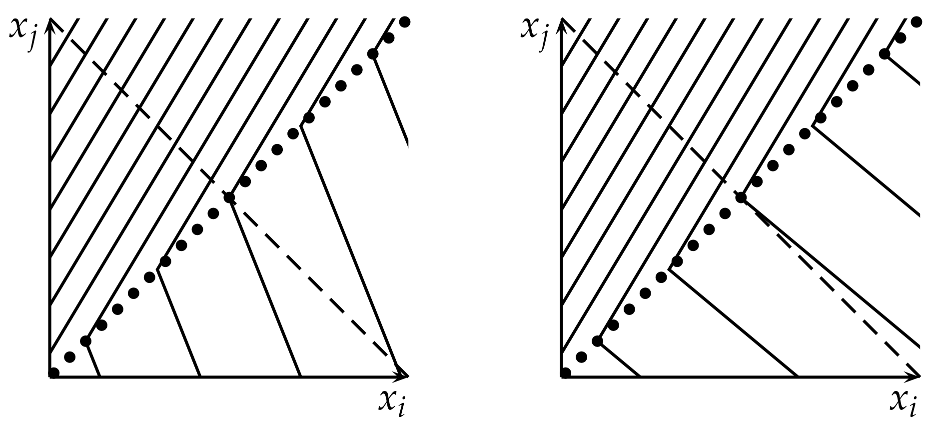
How can we represent a utility function in x_j, x_i.

$$\begin{aligned} x_j &> x_i \\ C &= x_i - \alpha_i(x_j - x_i) \\ C &= x_i - \alpha_i x_j + \alpha_i x_i \\ \alpha_i x_j &= x_i + \alpha_i x_i - C \\ x_j &= x_i \cdot \left(1 + \frac{1}{\alpha_i}\right) - \frac{C}{\alpha_i} \end{aligned}$$

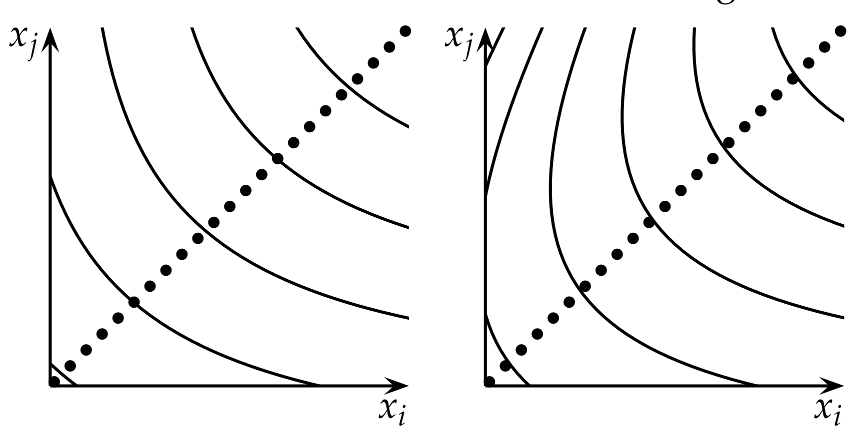
$$\begin{aligned} x_j &< x_i \\ C &= x_i - \beta_i(x_i - x_j) \\ C &= x_i - \beta_i x_i + \beta_i x_j \\ -\beta x_j &= x_i - \beta_i x_i - C \\ x_j &= x_i \cdot \left(1 - \frac{1}{\beta_i}\right) + \frac{C}{\beta_i} \end{aligned}$$

$$x_j = \begin{cases} x_i \cdot \left(1 + \frac{1}{\alpha_i}\right) - \frac{C}{\alpha_i} & \text{falls } x_j > x_i \\ x_i \cdot \left(1 - \frac{1}{\beta_i}\right) + \frac{C}{\beta_i} & \text{falls } x_j < x_i \end{cases}$$

$$x_j = \begin{cases} x_i \cdot \left(1 + \frac{1}{\alpha_i}\right) - \frac{C}{\alpha_i} & \text{falls } x_j > x_i \\ x_i \cdot \left(1 - \frac{1}{\beta_i}\right) + \frac{C}{\beta_i} & \text{falls } x_j < x_i \end{cases}$$

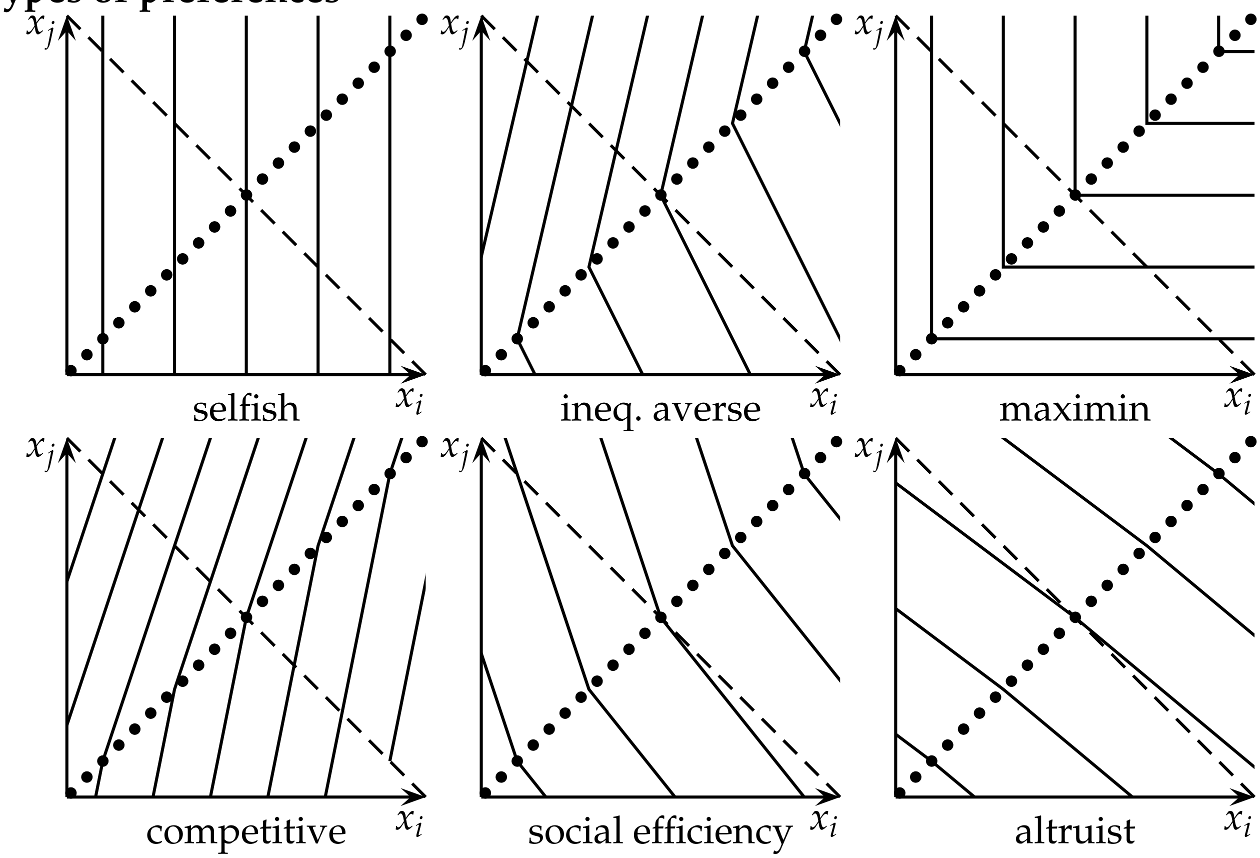


Of course, these indifference curves need not be straight lines:



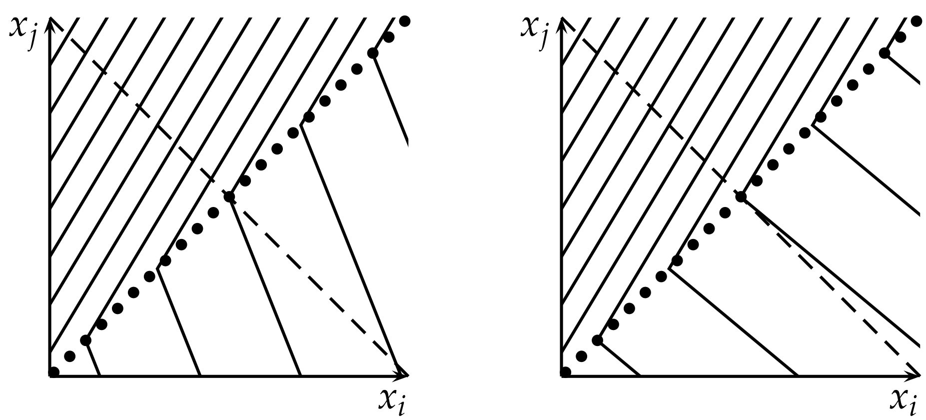
(Bolton, Ockenfels, AER, 2002)

Types of preferences



Modified Dictator game

What does the dictator game tell us

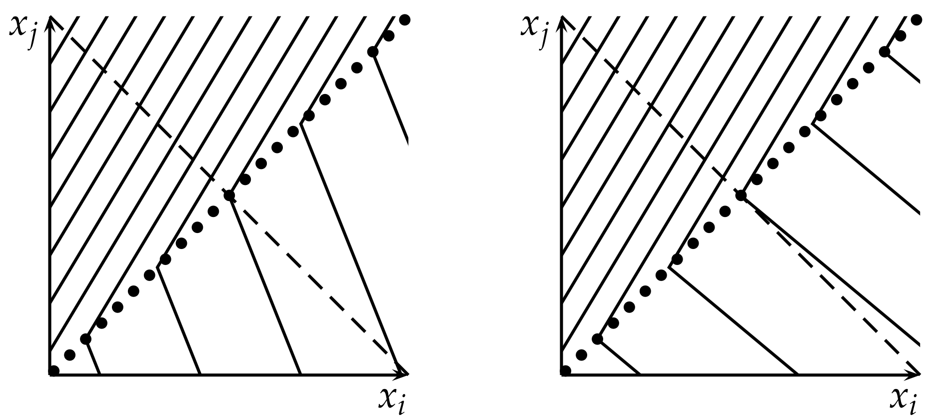


In the dictator game the dictator chooses (20,0) for $\beta < \frac{1}{2}$, and (10,10) for $\beta > \frac{1}{2}$. How can we determine β with greater precision?

A modified dictator game (Kahneman et. al (1986):

dictators choose between (10,10) and (18,2). Extended version by Engelmann et. al (2006):

(20,0) $\leftrightarrow$ (0,0)	(20,0) $\leftrightarrow$ (7,7)	(20,0) $\leftrightarrow$ (14,14)
(20,0) $\leftrightarrow$ (1,1)	(20,0) $\leftrightarrow$ (8,8)	(20,0) $\leftrightarrow$ (15,15)
(20,0) $\leftrightarrow$ (2,2)	(20,0) $\leftrightarrow$ (9,9)	(20,0) $\leftrightarrow$ (16,16)
(20,0) $\leftrightarrow$ (3,3)	(20,0) $\leftrightarrow$ (10,10)	(20,0) $\leftrightarrow$ (17,17)
(20,0) $\leftrightarrow$ (4,4)	(20,0) $\leftrightarrow$ (11,11)	(20,0) $\leftrightarrow$ (18,18)
(20,0) $\leftrightarrow$ (5,5)	(20,0) $\leftrightarrow$ (12,12)	(20,0) $\leftrightarrow$ (19,19)
(20,0) $\leftrightarrow$ (6,6)	(20,0) $\leftrightarrow$ (13,13)	(20,0) $\leftrightarrow$ (20,20)



Learning more about social preferences

- Explain the aggregate behaviour of decision makers
  - Charness and Rabin (QJE, 2002), Engelmann and Strobel (AER, 2004), Cox and Sadiraj (Economic Inquiry, 2011)

  $\rightarrow$ social efficiency, altruism, maximin
- Structure individual behaviour

  Do decision makers follow GARP?
  - Andreoni and Miller (Econometrica 2002) $\rightarrow$ of 176 decision makers only 18 violate GARP in 8 successive dictator games.

  Can we classify decision makers?

which share must one offer to you in the ultimatum game?

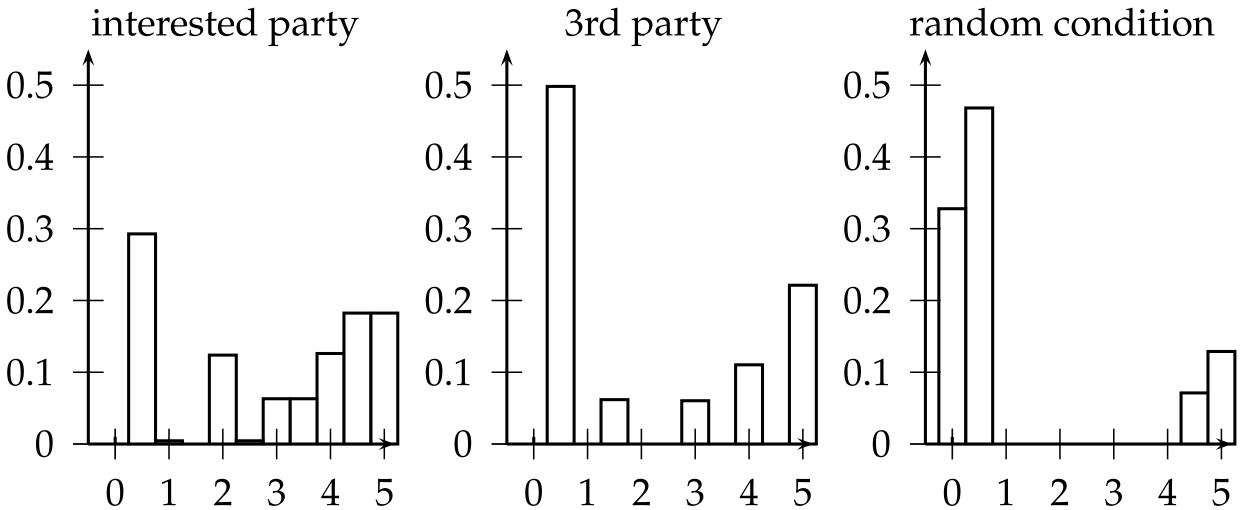


Figure 3.4: Sally Blount: When social outcomes aren't fair: The effect of causal attributions on preferences
1995, Organizational Behavior and Human Decision Processes

– Andreoni and Miller: strong selfish (23%), weak selfish (24%), strong leontief (14%), weak leontief (16%), strong perfect substitutes (6%), weak perfect substitutes (16%)
– Fisman, Kariv and Markovits (AER 2007): selfish (13%), lexself (49%), social welfare (13%), competitive (6%) and mixed preferences (19%).
– Iriberri and Rey-Biel (2009): 44% selfish, 21% social welfare maximizers, 25% inequality averse and 10% competitive

Other motives for inequality aversion

Different social preferences of men and women

- men: more competitive
- women: more inequality averse

Reason: testosterone

- measure testosterone in saliva of male participants (Burnham TC, 2007)

	N	testosterone pmol/l	σ
refuses 5$/40$	6	383	37
accepts 5$/40$	20	251	16

- over 4 weeks the level of testosterone in female participants is manipulated (Zethraeus et al. 2009)
  - more testosterone: less altruism in the dictator game, more trust, more trustworthiness (effects are not significant)

Mehta, Starmer, Sugden: Manipulate focal points.

Previous to the following game, players receive each 4 cards, randomly from a set of 8 cards, that consists of 4 aces and 4 deuces.

- Player 1 offers a division of money.
- Player 2 accepts or rejects.
- If player 2 accepts, players give their 4 aces to the experimenter or receive no money.

"The number of aces helps finding the solution of the coordination problem".

3.A Exercises

1. Dictator Game
   - Explain the dictator game.
   - What is the game theoretic solution of this game?
   - What are the differences between the standard ultimatum game and the dictator game?
2. Exam 2005, exercise 3

   Please use the term "altruism" in this exercise for the willingness to give up own resources to make another person better off (independent from your or the other person's endowment). Use the term "fairness" for the willingness to give up a resource to make sure that another person neither receives more or less than oneself.

- Remember the ultimatum bargaining game and the dictator game. What is in your opinion the essential insight that we can gain with the ultimatum bargaining game and the dictator game? If you think that other concepts besides altruism and fairness play a role, please explain what you mean with these items and how they differ from altruism and fairness.
- Do you think that one of the above mentioned games or both games in comparison would allow to distinguish between altruism and fairness? Explain your answer.
- One participant of the ultimatum game makes particularly high offers. When being asked for the reason the person explains that he knows the game from a lecture where he has learned that the responder receives always very little (this has happened for real). This reply motivates the assumption that subjects do not understand the abstract game. Presumable "fair" offers can only be explained by the fact that subjects do not know what to do and therefore they choose something in the middle. How can we test this hypothesis? Describe an experimental design and explain which auxiliary hypotheses you need.

3. Experiment on donations

   Imagine you have to write a critical report on a student's experiment. The student has conducted an experiment to see how altruistic people are. He went into a lecture with about 200 students and asked them to donate for a certain charity organization. He has noted how much everyone gave and in addition asked for socio-demographic characteristics like age, gender, and field of study.

   - Which critical points do you see in the design of the study? Which design features could lead to problems?
   - Can the student answer his question with his experimental design? Why?

4. Fairness and inequality (Fehr/Schmidt)

   - What is incorporated into the model by Fehr and Schmidt?
   - What else can you think of to be incorporated into a utility function?

5. Social preferences

- What are social preferences? Name a few.
- Which characteristics often determine social preferences?

6. Designing an experiment

- Imagine you would like to conduct your own experiment. The goal of your experiment is to see whether participants take into account the intentions of other players.
  - Frame a precise research question.
  - Describe your experimental design.
  - Describe how you would conduct the experiment.
  - Which results do you expect to find?

Chapter 4

Coordination

coordination, focal points

- Schelling (1957) “Bargaining, communication and limited war”, Journal of Conflict Resolution, 1, p. 19–36.

  coordination games:

  - Nash-demand Game for 100$.
  - Three players A, B, und C, sort the letters A, B, C in a sequence. If all choose the same sequence the person who is first in the sequence gets 6$, the second 2$, and the last 1$. If the sequence is not the same nobody gets a payoff.

4.1 Pareto efficiency

		player B	
		U_2	V_2
player A	U_1	4 3	0 0
	V_1	0 0	2 1

U_1, U_2 is Pereto efficient

		player B	
		U_2	V_2
player A	U_1	6 2	0 0
	V_1	0 0	4 8

Pareto efficiency does not help
$u_1/v_1 = \frac{2}{8}, v_2/u_2 = \frac{4}{6}$
$\rightarrow V_1, V_2$ is risk dominant

4.2 Risk dominance (Selten, Harsanyi)

player A \ player B	U_2	V_2
U_1	99, 49	0, 0
V_1	0, 0	1, 51

A more general game:

player A \ player B	U_2	V_2
U_1	u_1, u_2	0, 0
V_1	0, 0	v_1, v_2

$u_1, u_2, v_1, v_2 > 0$

- Risk of player 1 is described by u_1/v_1
- Risk of player 2 is described by v_2/u_2
- U risk dominates V if $u_1/v_1 > v_2/u_2$
- V risk dominates U if $u_1/v_1 < v_2/u_2$

The more general game...

player A \ player B	U_2	V_2
U_1	a_{11}, b_{11}	a_{12}, b_{12}
V_1	a_{21}, b_{21}	a_{22}, b_{22}

mit
$$\begin{aligned} a_{11} - a_{21} &> 0 \\ b_{11} - b_{12} &> 0 \\ a_{22} - a_{12} &> 0 \\ b_{22} - b_{21} &> 0 \end{aligned}$$

has equilibria U_1, U_2, V_1, V_2, and

$$p_{U_2} = \frac{a_{22} - a_{12}}{(a_{22} - a_{12}) + (a_{11} - a_{21})}$$
$$p_{U_1} = \frac{b_{22} - b_{12}}{(b_{22} - b_{12}) + (b_{11} - b_{21})}$$

...is best-reply equivalent to the above game if $u_1 = a_{11} - a_{21}$, $u_2 = b_{11} - b_{12}$, $v_1 = a_{22} - a_{12}$, and $v_2 = b_{22} - b_{21}$.

The best-reply structure only depends on u_1/v_1 and u_2/v_2.

4.3 Conflicts between payoff dominance and risk dominance

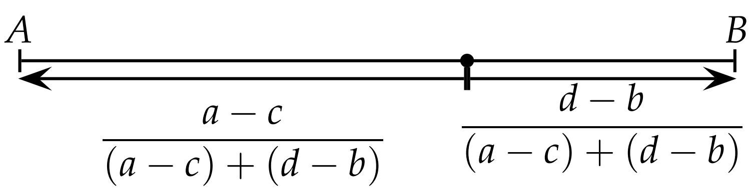
		player B	
		U_2	V_2
player A	U_1	9, 9	0, 8
	V_1	8, 0	8, 8

4.4 Theory to select equilibria

4.4.1 KMR, Young

		Spieler 1	
		A	B
Spieler 2	A	a, a	b, c
	B	c, b	d, d

In the mixed equilibrium A is played with proba. $\frac{d-b}{(a-c)+(d-b)}$.



Idea for an evolutionary dynamics with a finitely large population in discrete time:

- each period some members of the population determine their best reply given the current state of the population. They play this strategy in the next period
- with a small probability there are mistakes

Kandori, Michihiro; Mailath, George J; Rob, Rafael (1993), Learning, Mutation, and Long Run Equilibria in Games, Econometrica, vol. 61, no. 1. pp. 29-56

Young, H Peyton; (1993), The Evolution of Conventions, Econometrica, vol. 61, no. 1, January 1993, pp. 57-84.

Ellison, Glenn (1993), Econometrica, vol. 61, no. 5, September 1993, pp. 1047-71.

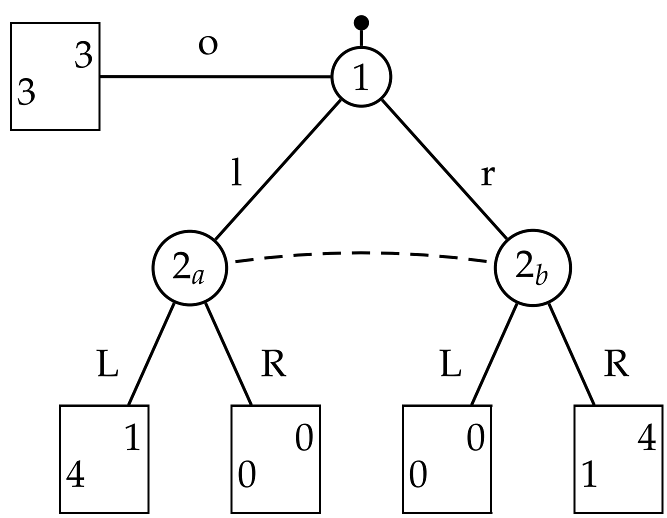
4.5 Minimum Effort Game

14-16 play the following stage game 10 times:
$u_i = 60 + 20 \cdot \min_j(x_j) - 10x_i$

		smallest chosen effort min $x_{j \neq i}$						
		1	2	3	4	5	6	7
own effort x_i	1	70	70	70	70	70	70	70
	2	60	80	80	80	80	80	80
	3	50	70	90	90	90	90	90
	4	40	60	80	100	100	100	100
	5	30	50	70	90	110	110	110
	6	20	40	60	80	100	120	120
	7	10	30	50	70	90	110	130

4.6 Median Effort Game and Forward Induction

Consider a battle of the sexes with payoffs 4 and 1. Before playing the game one player can choose to get 3.



This effect is studied by van Huyck, Battalio, Beil in a "Median Effort Game" (similar to the above Minimum Effort Game). Payoffs are

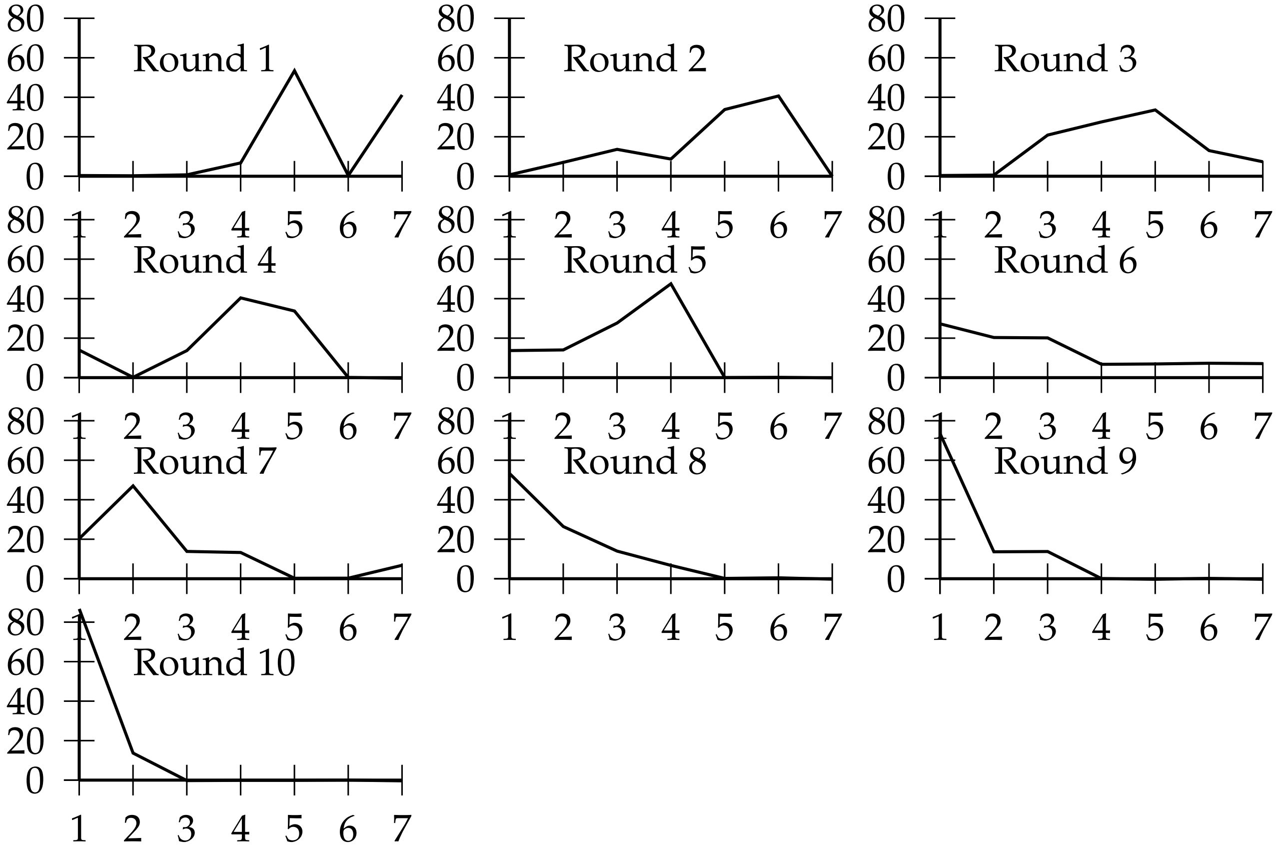


Figure 4.1: van Huyck, Battalio, Beil, 1990, Session 4

$u_i = 60 + 10 \cdot M - 5(M - x_i)^2$
where M is the median of x_i.

Results similar to the above game: Players fail to reach the payoff dominant equilibrium, instead they play an equilibrium "in the middle".

Forward Induction Now we run an auction before the game. Players bid publicly to participate in the median effort game.

Guess: the auction solves the coordination problem, Players who bid $\bar{x}$, expect to play an equilibrium where they obtain at least $\bar{x}$.

Indeed, this is observed in the experiment.

- x_i are substantially larger then without auction.
- Bids $\bar{x}$ in the auction are highly correlated with x_i in the game.

Forward induction? — perhaps — alternatively: some players are filtered out through the auction. Those players had chosen small x_i in the game.

How could one distinguish between these two explanations?

4.7 Battle of the Sexes

G :

		player B	
		U_2	V_2
player A	U_1	0, 0	200, 600
	V_1	600, 200	0, 0

Two equilibria in pure strategies (V_1, U_2, U_1, V_2), one on mixed strategies ($\frac{1}{4}U_1$, $\frac{3}{4}V_1$; $\frac{1}{4}U_2$, $\frac{3}{4}V_2$, expected payoff 150).

What should we expect in the anonymous one-shot game?

- equilibrium in pure strategies? — how should players find this equilibrium?
- mixed equilibrium, play V_1 and V_2 each with probability $\frac{3}{4}$. But then the payoff is only 150

- better: mix $\frac{1}{2}, \frac{1}{2}$, which maximises the joint payoff.
  $u_1 + u_2 = 800 \cdot p(1-q) + 800 \cdot (1-p)q$
  Differentiate with respect to p and q yields $p = q = \frac{1}{2}$. Payoff 200.
- In the experiment of (1989) (20 periods, stranger matching) V_1 and V_2 is played with prob. 0.63.
- Pre-play communication (cheap talk):
  - If cheap talk finds V_1, U_2 or U_1, V_2 then this is played with proba. 0.8.
  - Otherwise with proba. 0.71 V_1 and V_2 are played.

  → expected payoff ca. 350, more than without cheap talk.

4.8 Battle of the Sexes — Gender

G :

Spieler A \ Spieler B	A	B	C
A	100, 60	0, 0	0, 0
B	0, 0	b, b	0, 0
C	0, 0	0, 0	60, 100

$b \in \{40, 60, 80\}$

- participants react to changes in the BB-payoff
- Females use the coordination opportunity. They play more B in even pairs (=) and less in odd pairs (x), in particular those with female peers.
- Males do not use the coordination opportunity, in particular not those with female peers.

4.9 Local interaction

4.9.1 Keser, Ehrhart, Berninghaus — Coordination and Local Interaction: Experimental Evidence

Economics Letters, 1998, pp. 269-75

Subjects repeatedly played a three-player coordination game with a payoff-dominant and a risk-dominant equilibrium. Subjects interacting in fixed groups quickly coordinated on the payoff-dominant equilibrium, while those interacting with their neighbors around a circle eventually coordinated on the risk-dominant equilibrium.

Is this so surprising? Return to the definition of risk dominance:

$G:$ Spieler B

		U_2	V_2
Spieler A	U_1	a_{11}, b_{11}	a_{12}, b_{12}
	V_1	a_{21}, b_{21}	a_{22}, b_{22}

- U risk dominates V if $\frac{a_{11}-a_{21}}{a_{22}-a_{12}} > \frac{b_{22}-b_{21}}{b_{11}-b_{12}}$

now consider a symmetric game...

$G:$ Spieler B

		U_2	V_2
Spieler A	U_1	a, a	b, c
	V_1	c, b	d, d

U risk dominates V if

$$\begin{aligned}
\frac{a-c}{d-b} &> \frac{d-b}{a-c} \\
a-c &> d-b \\
\frac{a+b}{2} &> \frac{c+d}{2} \\
EU(U_1) &> EU(V_1) \text{ if } U_2 \text{ and } V_2 \text{ each with proba. } \tfrac{1}{2}
\end{aligned}$$

4.A Exercises

1. Pareto-efficiency

- What is pareto-efficiency?
- Are the following equilibria pareto-efficient?

		Player 2	
		c	d
Player 1	A	3 1	6 8
	B	7 5	2 4

		Player 2	
		c	d
Player 1	A	3 1	7 8
	B	6 5	2 4

2. Risk-dominance

- What is risk-dominance?
- Are the following equilibria risk-dominant?

		Player 2	
		c	d
Player 1	A	3 1	6 8
	B	7 5	2 4

		Player 2	
		c	d
Player 1	A	3 1	7 8
	B	6 5	2 4

3. Mixed equilibria — battle of the sexes

- Solve the following games. Find all equilibria in pure and mixed strategies.

		Player 2	
		American football	Baseball
Player 1	American football	2 4	0 0
	Baseball	0 0	4 2

		Player 2	
		After-work-party	Beach
Player 1	After-work-party	2 4	1 1
	Beach	0 0	4 2

- What is a mixed strategy?

4. Battle of the sexes — Experiment

   - During the lecture you got to know the battle of the sexes game. Describe how you would conduct the experiment in a laboratory.
   - Could you come up with some adjustments to alter the standard game? What would you learn from these adjustments?

Chapter 5

Public goods, cooperation

Definition: Public good

	excludable	non-excludable
rivalrous	private (food, clothing)	common-pool (water, fish)
non-rivalrous	club-good (cable TV)	public-good (national defense, terrestrial TV)

Notation

- n agents with endowment ω_i and private information θ_i all must make a transfer payment τ_i.
- agent i consumes $x_i = \omega_i - \tau_i$ private good
- public good y is produced at a cost of $c(y) = \kappa \cdot y \leq \sum \tau_i$
- agent i has a utility function $u_i(y, x_i, \theta_i) = v_i(y, \theta_i) + x_i$
- agents send messages m_i which are in equilibrium a best reply $\mathcal{B}(m_{-i}; \theta_i)$ given the combination of strategies of the other agents and given the own information. m_i can be the contribution to the public good, then $y(m) = \sum m_i$
- The mechanism g specifies given the messages $m = (m_1, \ldots, m_n)$, the amount of public good $y_g(m)$ and the transfer payments $\tau(m)$.

Aims

- Pareto efficiency $y^P(\theta) \in \arg\max_{y \geq 0} \left[\sum v_i(y; \theta_i) - \kappa y\right]$
- Balanced budget
- Individually rational

- Incentive compatible

We are looking for an institution that helps to provide public goods in an efficient way

voluntary contribution mechanism

$$y(m) = \sum_i m_i$$

$$\tau_i(m) = \kappa \cdot m_i$$

proportional tax

$$y(m) = \sum_i m_i$$

$$\tau_i(m) = \frac{\kappa}{n} y(m)$$

Groves Ledyard Mechanismus (Pareto efficient, but not individually rational)

$$y(m) = \sum_i m_i$$

$$\tau_i(m) = \frac{\kappa}{n} y(m) + \frac{\gamma}{2}\left(\frac{n-1}{n}(m_i - \mu_i)^2 - \sigma_i^2\right)$$

with

$$\begin{aligned} \mu_i &= \frac{1}{n-1}\sum_{j\neq i} m_j \\ \sigma_i^2 &= \frac{1}{n-2}\sum_{j\neq i}(m_j - \mu_i)^2 \end{aligned}$$

Walker mechanism

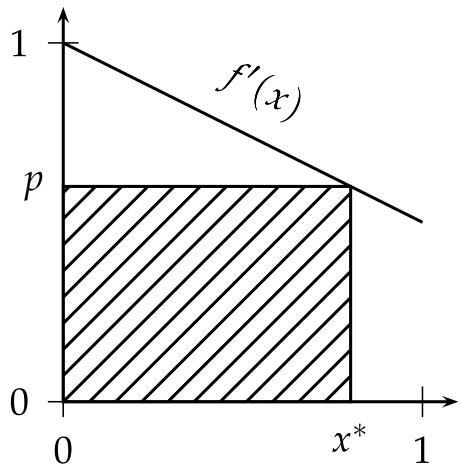
$$y(m) = \sum_i m_i$$

$$\tau_i(m) = \left(\frac{\kappa}{n} + m_{(i-1)} - m_{(i+1)}\right) \cdot y(m) \qquad \text{modulo } n$$

Lindahl mechanism

1. Agents describe their willingness to pay $v_i(y)$
2. Choose $y^* = \arg\max_y \sum_i v_i(y) - \kappa \cdot y$
3. Agents pay $y^* \cdot v_i'(y^*)$

(not incentive compatible, agents will not reveal the true v_i)



Clark Groves mechanism Utility function of individual h be

$$u_i = v_i(y) + x_i$$

where x_i is the income (transferrable).

Individuals report a utility function to the planner $m_i(y)$.

The planner chooses y^* so that $\sum_i v_i(y) - \kappa \cdot y$ is maximised.

Individuals pay taxes

$$\tau_i = \kappa \cdot y^* - \sum_{i \neq h} m_i(y^*) + \mathcal{K}(\vec{m}^{-i})$$

(where $\mathcal{K}(\vec{m}^{-i})$ is an arbitrary function of $\vec{m}$ without the component of individual i).

The utility of individual i is hence

$$u_i = v_i(y^*) - m_i(y^*) + \sum_i m^i - \kappa y^* - \mathcal{K}_i$$

Then it is a dominant strategy for i to report the true willingness to pay $m_i = v_i$.

A different m_i has no immediate impact on u_i (the m_is cancel out), it only affects y^*.

Proof: Assyme that m_i is a function of y and ζ (there is a truthfull ζ and several other ones which are not truthfull). Then the only impact of ζ is through $dy^*/d\zeta$.

$$\begin{aligned}
\frac{du_i}{d\zeta} &= \frac{dv_i(y^*)}{dy^*}\frac{dy^*}{d\zeta} - \frac{dm_i(y^*)}{dy^*}\frac{dy^*}{d\zeta} \\
&\quad + \underbrace{\frac{d(\sum_i m^i - p_y y^*)}{dy^*}}_{=0}\frac{dy^*}{d\zeta} \\
&\quad - \underbrace{\frac{d\mathcal{K}_i}{d\zeta}}_{=0} \\
&= \frac{dv_i(y^*)}{dy^*} - \frac{dm_i(y^*)}{dy^*}
\end{aligned}$$

Utility is maximised if

$$m_i = v_i + C$$

For all these mechanisms we need a theory of individual behaviour.

Standard Investment Game

5 male business administration students each obtain 5 €. Each can invest a share of this into a public good. The invested amount is doubled and shared among all members of the group.

Forecast:

- All contribute 0 € (tragedy of the commons)
- All contribute 5 € (efficient)

Neither of the two happens.

Try to understand this process to (hopefully) find institutions which yield an efficient allocation.

Comparison with double auction

- Double Auction is fairly robust against changes in parameters
- Provision of public goods is fairly sensitive

5.1 Prisoners’ dilemma

5.1.1 Melvin Dresher and Merril M. Flood, 1950 (Flood (1952) “Some experimental games”, Reserach Memorandum RM-789, RAND Corporation)

G :

		player B	
		L	R
player A	T	-1, 2	$\frac{1}{2}$, 1
	B	0, $\frac{1}{2}$	1, -1

G is played 100 times
symmetric prisoners’ dilemma?

5.1.2 Selten und Stoecker (1986)

Participants play 25 supergames, each supergame consists of 10 repeated prisoners’ dilemmas.

$\rightarrow$ learning of strategies for the repeated game
Results:

- Participants start with mutual cooperation (at least 4 periods)
- one player defects
- cooperation breaks down during the remaining periods

over time:

- first participants learn to cooperate
- then participants start to defect earlier and earlier, they learn backward induction

5.1.3 Axelrod tournaments - strategy method

200× repeated prisoners’ dilemma 14 scientists which all have published on prisoners’ dilemmas write a short computer program with their strategy for the game.

$\rightarrow$ tit-for-tat

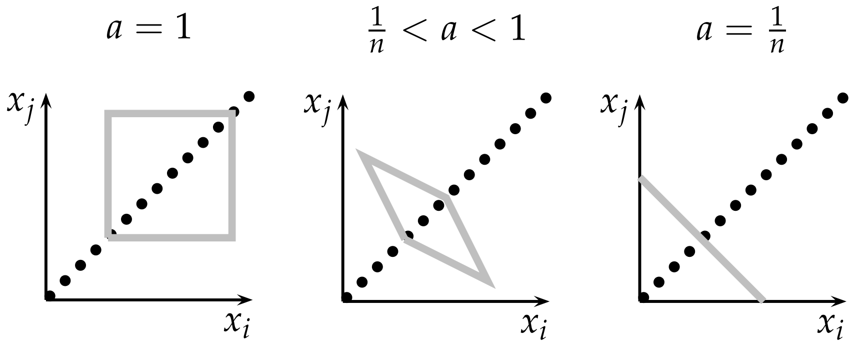
Prisoners' dilemma with constant stopping probability of 0.01 $\rightarrow$ tit-for-tat

5.1.4 Public-good problems and prisoners' dilemmas

n agents have initial endowment ω and make contributions $m_1 \dots m_n$. Payoffs:

$$u_i = \omega - m_i + a \cdot \sum_{j=1}^{n} m_j \qquad u_j = \omega - m_j + a \cdot \sum_{i=1}^{n} m_i$$

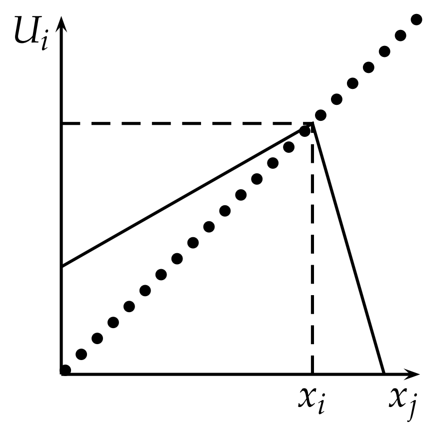
e.g. $n = 2$



		player B U_2	player B V_2
player A	U_1	5, 5	0, 6
player A	V_1	6, 0	1, 1

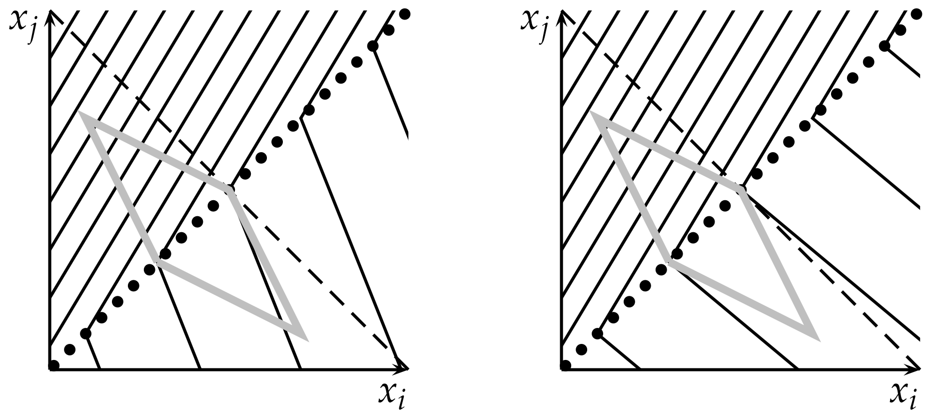
We revisit the model of inequality aversion of Fehr und Schmidt:

$$U_i(x) = x_i - \alpha_i \max(x_j - x_i, 0) - \beta_i \max(x_i - x_j, 0), i \neq j$$



$$x_j = \begin{cases} x_i \cdot \left(1 + \frac{1}{\alpha}\right) - \frac{C}{\alpha} & \text{if } x_j > x_i \\ x_i \cdot \left(1 - \frac{1}{\beta}\right) + \frac{C}{\beta} & \text{if } x_j < x_i \end{cases}$$

indifference curves in the model of inequality aversion $\beta = 0$: Egoist, $\beta = 1$: Altruist, $\beta > 1$: strong inequality aversion.



5.1.5 early free-riding experiments

These experiments seem to show that free-riding is no big problem.

Bohm (1972)

Participants are invited for an interview by the Swedish broadcasting company and receive about 10 €. They obtain the opportunity to watch a 1/2-hour program of two well known comedians — provided the willingness to pay of the audience, together with the "willingness to pay of the other groups" is higher than the cost of the presentation (100 €).

Different treatments: Participants reveal their willingness to pay (WTP) and pay…

participants pay…		n	$\bar{x}$
their WTP if the public good is produced	no incentive to exaggerate their WTP	23	1.522
pay a given percentage		29	1.768
depending on a lottery pay the entire WTP / a percentage / 1 €/ nothing		29	1.458
1 €	no incentive to underreport WTP	37	1.546
nothing	no incentive to underreport WTP	39	1.756

WTP among all five treatments was very similar
$\rightarrow$ free riding is no problem

Problems

- true WTP was not controlled
- there were no “other groups”. Bohm tries to make participants believe, the number of participants which can be exploited by free-riding is larger than the number he can afford.
- Bohn uses “counter strategic arguments”. E.g. in the first treatment

  > “…you might benefit from underreporting your willingness to pay. But, if all of you or many behaved like that, then the entire amount of 100€ could not be reached and the performance could not be shown to you.”

- In the last two treaments he said

  > “…It is easy to see that each of you who wants to see the program could gain by exaggerating his WTP. …But then we would not find out how you truely value the program. Such an exaggeration would also be unfair towards your neighbours who had to pay for something which is not really appreciated by everybody

- Is the revealed WTP a result of the treatments or a result of the counter strategic arguments?

Scherr and Babb (1975)

Compare different mechanisms. The public good consists of concert tickets and books which are donated to the library. WTP is revealed by

- voluntarily revealed WTP
- Clarke (1971) mechanism
- Loehman and Whinston (1972) mechanism

→ no significant difference

Schneider and Pommerehne (1981)

Experiment at Zurich University:

- “Representative of a publishing house” approaches students and pretends to produce a book which is relevant for the exam. This book will only be available after the exam. However, the publisher would like to obtain some feedback from the students.
- Since the publisher has only a small number of copies available, students have the possiblity to bid for the book in an auction (story: there are two other groups. The highest bids from all three groups obtains the available copies.
- The two highest bidders learn that they will obtain a copy of the book. The remaining students are told that further copies could be produced (sufficient for each one), provided they would pay (with a voluntary contribution mechanism, together with the other two groups) the cost of SFr 4200.

Willingness to pay from the auction is only marginally higher than the WTP in the voluntary contribution mechanism.

- Advantage of this design: elicit WTP within subject for both treatments
- Disadvantage: Sequence effect (could affect WTP)
- Disadvantage: individual WTP is not controlled

$\rightarrow$ free riding is no problem

5.1.6 Experimente mit kontrollierter Zahlungsbereitschaft

Smith (1979)

WTP for public good is controlled. Compare

- Groves and Ledyard (1977) mechanism
- voluntary contribution
- Wicksell mechanism (Amount of public good and contributions are determined unanimously, otherwise nothing is produced $\rightarrow$ several Nash equilibria, unclear theoretical properties).

Participants play the game several times. The “voluntary contribution” converges to free riding, the other two mechanisms converge to Lindahl prices.

5.2 Volunteer's Dilemmas

n people can produce a public good (utility is u for everybody). To do this, only a single member has to sacrifice a cost of c. But who sacrifices the cost?

- Symmetric volunteer's dilemma
- Asymmetric volunteer's dilemma

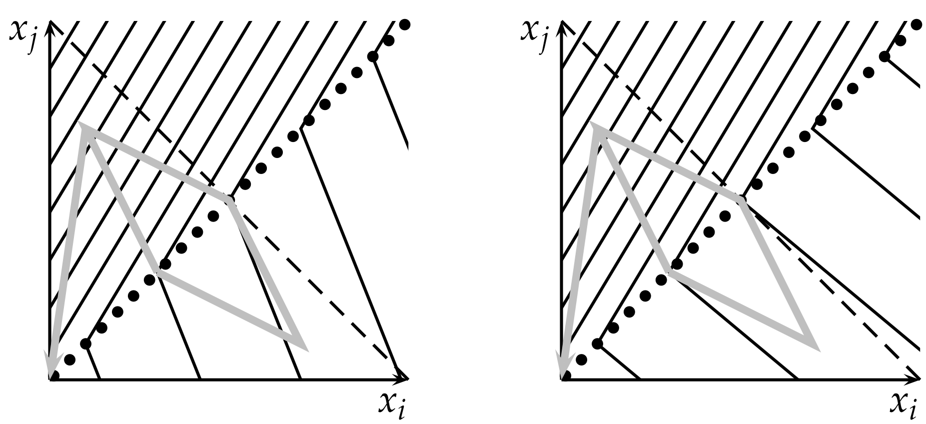
Diekmann: Email Experiment (recipient groups with different sizes). Ask for help with an easy problem / request for a newspaper article)

Dynamic extension:

- All pay auction
  $\rightarrow$ overbidding
- War of attrition
  $\rightarrow$ underbidding

5.3 Punishment

- People who jump the queue at petrol stations in the US in 1979 are shot
- Stigmatising strike-breakers



Ernst Fehr, Simon Gächter; AER 2000: Cooperation and Punishment.

- 24 participants, matched into groups of 4, within subject design:

	1	2	3	4
matching	stranger	stranger	partner	partner
punishment	punish/no p.	no p./punish	punish/no p.	no p./punish

- Each session has 10 rounds, each round has two stages:

1 public good stage:

$$u_i' = \omega - m_i + a \cdot \sum_{j=1}^{n} m_j \qquad \frac{1}{n} < a < 1 : \quad a = .4$$

2 punishment stage (optional): participants are informed about their mutual contributions m_i and can allocate punishment points p_j^i (player j punishes i)

$$u_i = u_i' \cdot \left(\max \left(0, 1 - \frac{1}{10} \sum_{j \neq i} p_j^i \right) \right) - \sum_{j \neq i} c(p_i^j)$$

p_i^j	0	1	2	3	4	5	6	7	8	9	10
$c(p_i^j)$	0	1	2	3	6	9	12	16	20	25	30

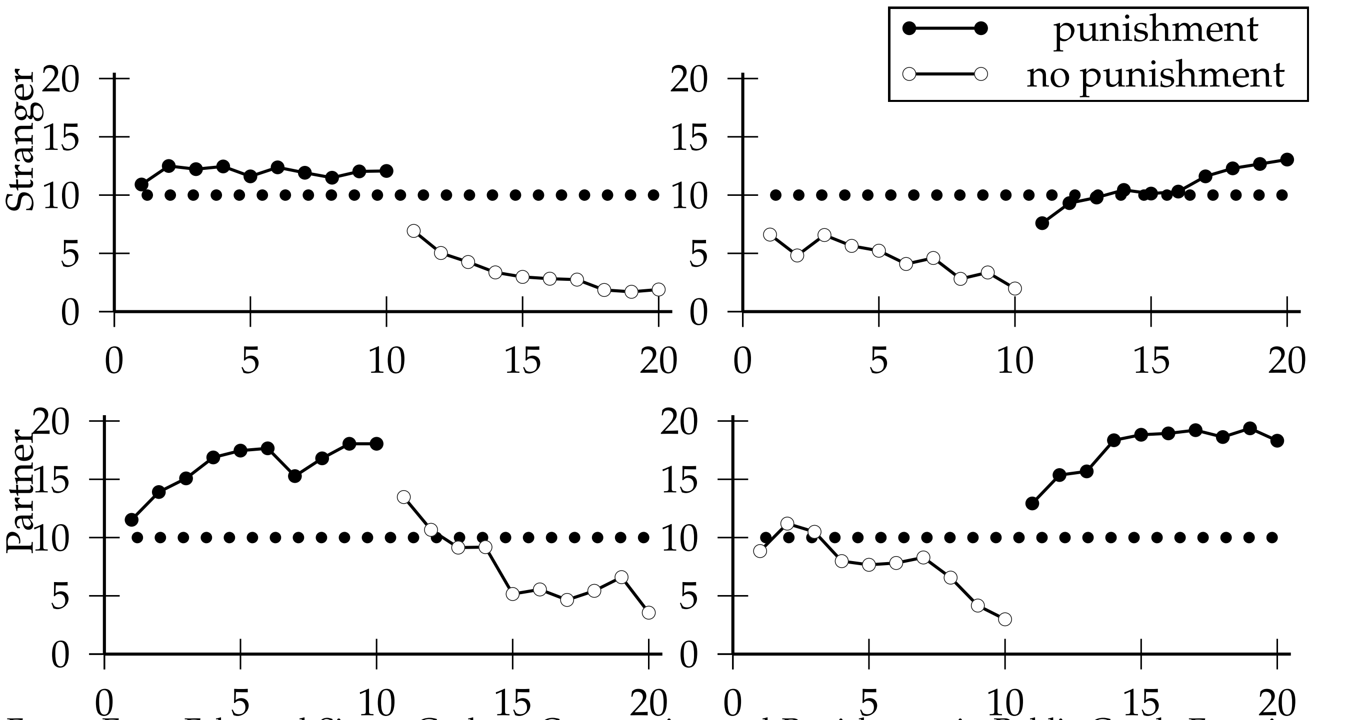
- Predictions:
  - rational world: $m_i = 0, p_i = 0$ (both partner and stranger)
  - stranger design: contribution m_i starts high, then decreases
  - partner design: m_i starts high, then conditional cooperation
  - punishment: $m_i \uparrow$
  - if $m_i \uparrow$ then $p_j^i \downarrow$

5.4 Punishment and Communication

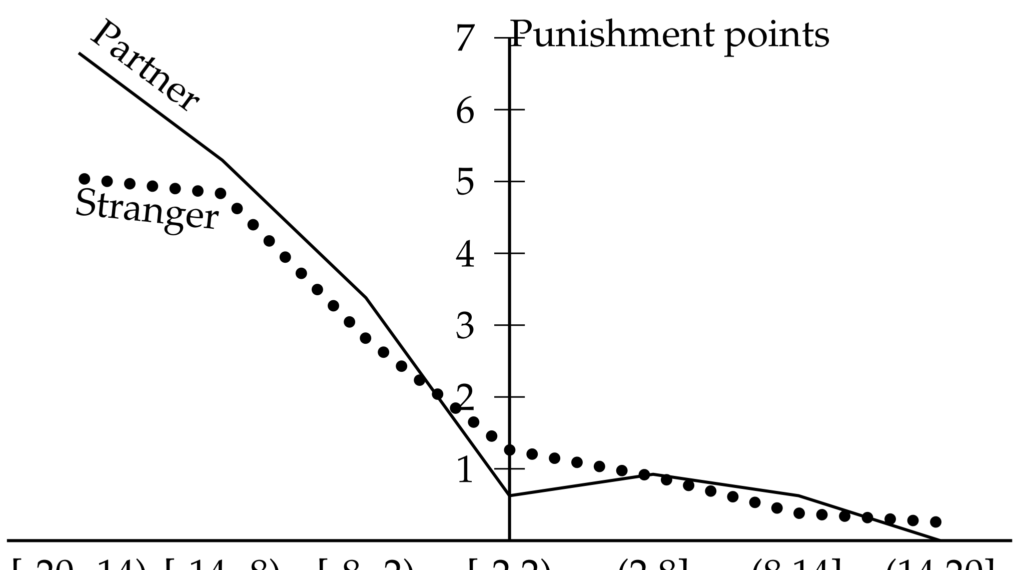
Brosig, Weimann, Yang; Communication, Reputation and Punishment in Sequential Bargaining Experiments; JITE, 2003

The following game is played in three treatments:

Contribution to public good:



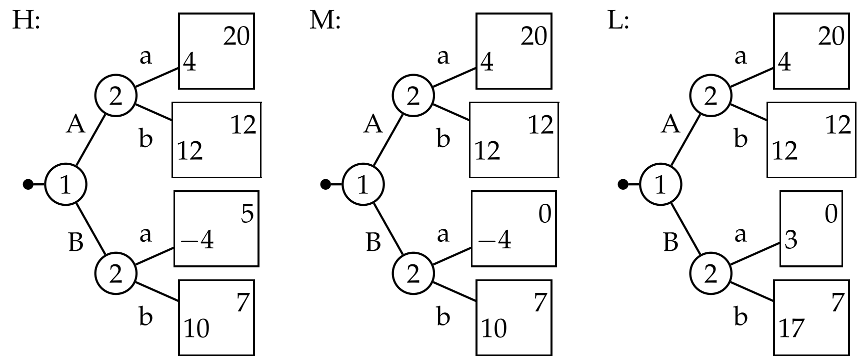
From: Ernst Fehr and Simon Gächter, Cooperation and Punishment in Public Goods Experiments, AER, 2000.



From: Ernst Fehr and Simon Gächter, Cooperation and Punishment in Public Goods Experiments, AER, 2000.

Figure 5.1: Deviation from average contribution

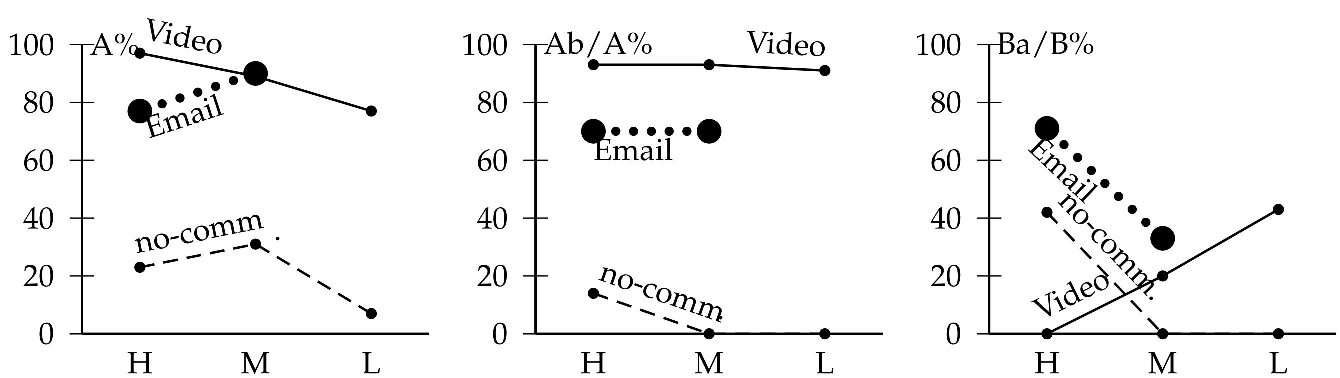
- no communcation
- email (15 minutes) before the game (no personal identity info allowed)
- face-to-face communication (15 minutes) before the game



- One subgame perfect equilibrium: Bb
- Nash equilibrium (not subgame perfect): Aa
- efficient equal split: Ab
- Punishment: Ba

Hypotheses:

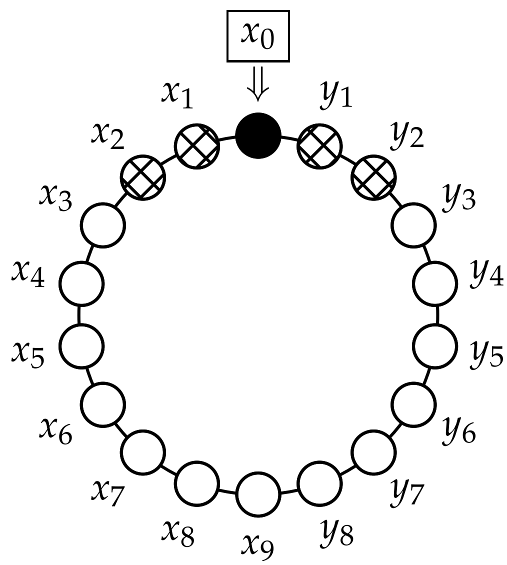
- More punishment (Ba/B) in game H than in M: → H: 42%, M: 0%, L: 0%
- More A in game M than in L: → H: 23%, M: 31%, L: 7%
- in face-to-face treatment: more A and more (Ab/A)
- no difference between email-treatment and no-communication treatment



5.5 Local public goods — cooperation in networks

- James M. Sakoda, 1949, Minidoka: An Analysis of Changing Patterns of Social Interaction.
- James M. Sakoda, 1971, The Checkerboard Model of Social Interaction.
- Robert Axelrod, 1984, The evolution of cooperation.
- Martin A. Nowak and Robert M. May, 1993, Evolutionary Games and Spatial Chaos.

→ Idea: A small core of cooperative players is successfull and is imitated in the immediate neighbourhood. Kooperation grows.

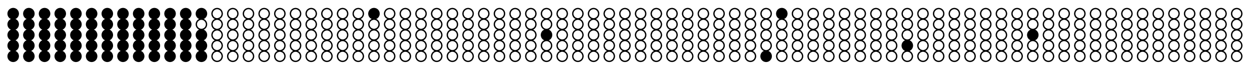


Matchings

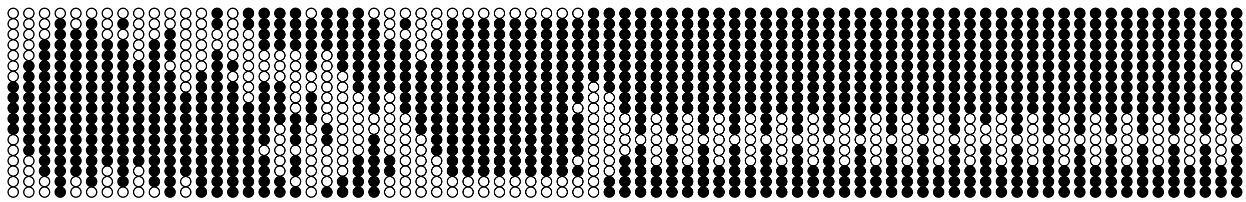
- random matching
- partner matching
- random matching in a network
- partner matching in a network

own action	number of neighbours with C 0	1	2	3	4
C	0	5	10	15	20
D	4	9	14	19	24

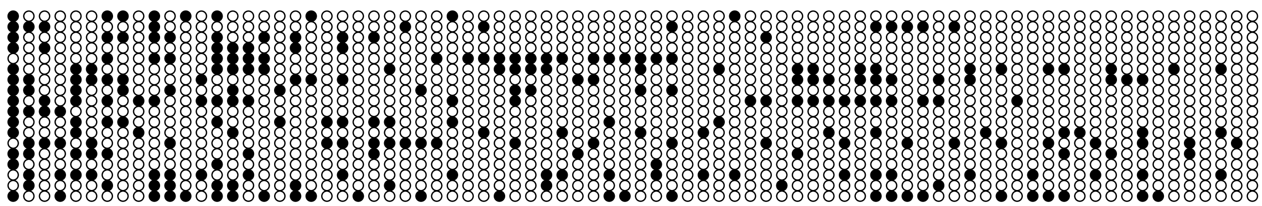
copy best in groups:



copy-best in circles:



•=cooperate, ∘=defect



•=cooperate, ∘=defect

What happens on a circle with 5 Cs, learning rule: copy best average

$\rightarrow$ cooperation can grow

- Eshel, Samuelson & Shaked
- Kirchkamp, Nagel: Experiment with information on the payoff matrix,
  - Compare groups of 5 players, circles with 18 players and neighbourhoods of 5, each 80 periods.
  - $\rightarrow$ more cooperation in groups than in circles
  - no information: $\rightarrow$ amount of cooperation remain the same.
  - no information, with "seed" in the circle: $\rightarrow$ levels of cooperation remain unchanged

5.A Exercises

1. Public Goods Game I
   - What is a public good?
   - Name some real life examples of public goods.

2. Public Goods Game II

    - Look at the following public goods game:
      4 players; $u_i = 20 - x_i + 0.2 * \sum x_i$
        - What is the game theoretic solution?
        - What is the efficient solution?
    - Look at the following public goods game:
      4 players; $u_i = 20 - x_i + 1.2 * \sum x_i$
        - What is the game theoretic solution?
        - What is the efficient solution?
    - Look at the following public goods game:
      4 players; $u_i = 20 - x_i + 0.4 * \sum x_i$
        - What is the game theoretic solution?
        - What is the efficient solution?
    - Take a look at the three public goods games above. Which requirements does the marginal per capita return have to fulfill in order to bring the participants of the public goods game into a dilemma?

3. Repeated Games

    - What are repeated games?
    - Why can solutions for repeated games be different from the same one-shot game? Describe an example.

4. Punishment in Public Goods Games

    - In the lecture you have learned about punishment as a device to maintain cooperation. Can you think of other mechanism to keep up cooperation?

5. Communication in Experiments

    - In the lecture you have learned about different means to allow communication between participants during an experiment. List them.
    - What other means to allow participants to communicate among each other can you think of?

6. Networks

    - In the lecture a circle network has been introduced. What other forms of networks can you think of?

Chapter 6

Auctions, Markets, IO

- Competition:

	1 seller	many sellers
1 buyer	bargaining	procurement auction
many buyers	auction	competitive market

- Information about valuations:
  - private values
  - common values

Market institutions:	buyers	sellers	
single sided: one seller, many buyers			
discriminating A. (1st-price)	SIM		N highest bidders pay own bid
competitive A. (2nd-price)	SIM		N highest bidders pay $N+1$ highest bid
Dutch A	SEQ		N highest bidders pay own bid
English Auction (75% of all auctions (Cassidy, 1967))	SEQ		N highest bidders pay $N+1$ highest bid
two-sided auctions: many sellers, many buyers			
Posted offer A.		SIM	
Posted bid A.	SIM		
Offer A.		SEQ	
Bid A.	SEQ		
Double A.	SEQ	SEQ	
Clearinghouse A. (NYSE opening prices)	SIM	SIM	intersection of demand and supply
Cournot		quantities	intersection of total demand and supply
Walrasian A.			until excess demand =0
decentralised bargaining	SEQ	SEQ	

6.1 Auctions

6.1.1 Overview

Auctions — dynamic pricing — 3 essential properties

quick convergence of prices

- …also with rare items
- …also with small quantities

quick reaction on changes in demand and supply

- e.g. markets for energy, bandwidth in communication networks

efficient allocations

6.2 Common value

6.2.1 Winners' curse

- Auctions for oil fields (Capen, Clapp, Campbell, 1971; Lorenz, Dougherty, 1983) → winners' curse

  strange, why should professional bidders err repeatedly?

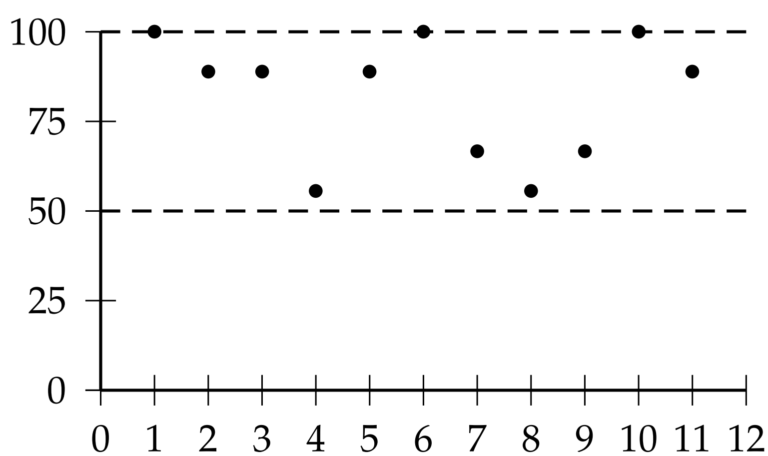
- Experiments in the lab (Bazerman, Samuelson, 1983; Kagel, Levin, 1986) → inexperienced participants suffer from the winners' curse.

Formally: asset value is ω. Individual value $v_i = \omega \quad \forall i$
Bidder i observes a signal $x_i = f_i(\omega)$
Experimental setup:

- draw x° uniformly over $[\underline{x}, \bar{x}]$.
- draw then for each participant a signal uniformly distributed over $[x^\circ - \epsilon, x^\circ + \epsilon]$.
- the highest bidder gets $x^\circ - b$.

If bidding functions are symmetric the bidder with the highest signal wins.

inexperienced bidders share of highest bids with $b > E(x^\circ|x)$



experienced bidders:

- with a small number of bidders: information about gains and losses of other bidders reduces the winners' curse.
- with a larger number of bidders: information about gains and losses of other bidders increases the winners' curse.

Limited Liability: Winners' curse in the lab could be due to limited liability.
Winners' curse in the lab could be due to limited liability. (Hansen, Lott, 1991)
Can be calculated: Kagel, Levin: $\rightarrow$is not the problem.

6.2.2 Bargaining games with asymmetric information

Akerlof, 1970, Market for lemons

- Buyers know that v is uniformly distributed over $[0, 100]$

  Valuations for buyers are $1.5v$.
- Sellers know v and accept any bid $b > v$.

What is now the expected gain of a buyer with a bid of b? The value of v is between 0 and b, in expectation $v = b/2$. The valuation for the buyer is $0.75b$. The buyer will never offer more than $b = 0$.

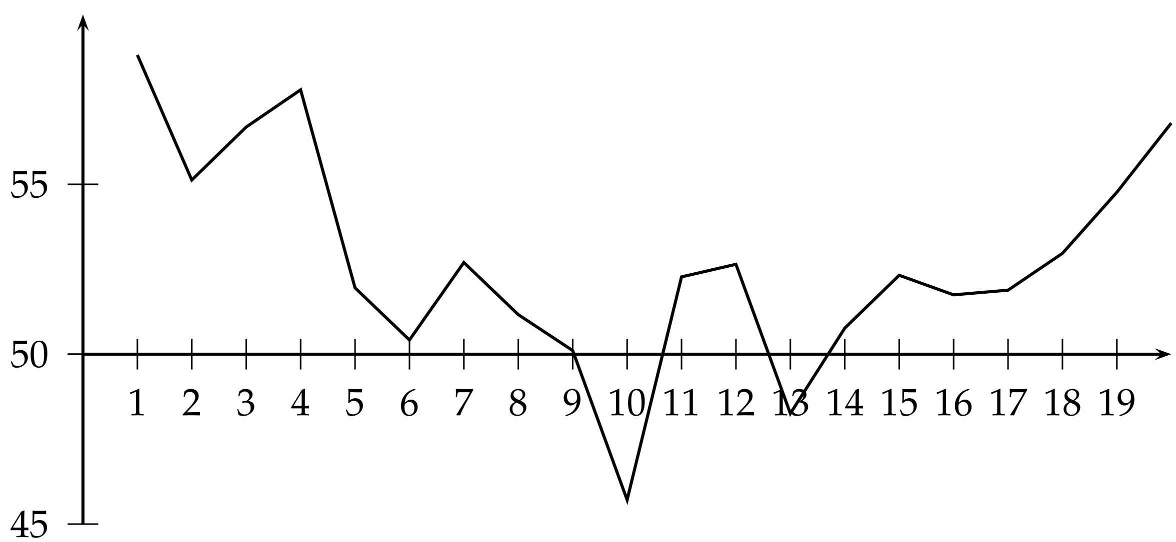


Figure 6.1: Average bids in bilateral bargaining game (Ball, Bazerman and Carroll (1991))

Bidders follow the naive strategy to bid between 50% and 75% (The figure shows a repeated experiment. Bidders do not learn to avoid the winners' curse.). (see figure 6.1)

Blind bid auctions

- Sellers know the value ν of a good. They can reveal the value or hide it.
- Bidders bid in a first price auction.

Bidders have an incentive to reveal only values when ν is high. $\rightarrow$ sequential equilibrium: If $\nu > 0$ the value is revealed.

Indeed values and bids converge to the equilibrium (figure 6.2).

6.3 Private values

(Vickrey, 1961, Journal of Finance)

values differ, are precisely known to bidders

$$u_i = s_i$$

Auctions with sealed bids

- Dutch auctions (flowers)
- First-price (B2B)
- Second-price (Stamps)

$\rightarrow$ Bidding process does not reveal any relevant information until the auction has ended

Auction with open bids

- English auction (Art)

$\rightarrow$ Bidding process offers information already during the auction

$\rightarrow$ Model the English auction as a Japanese auction (Price increases, bidders leave the auction and can not come back

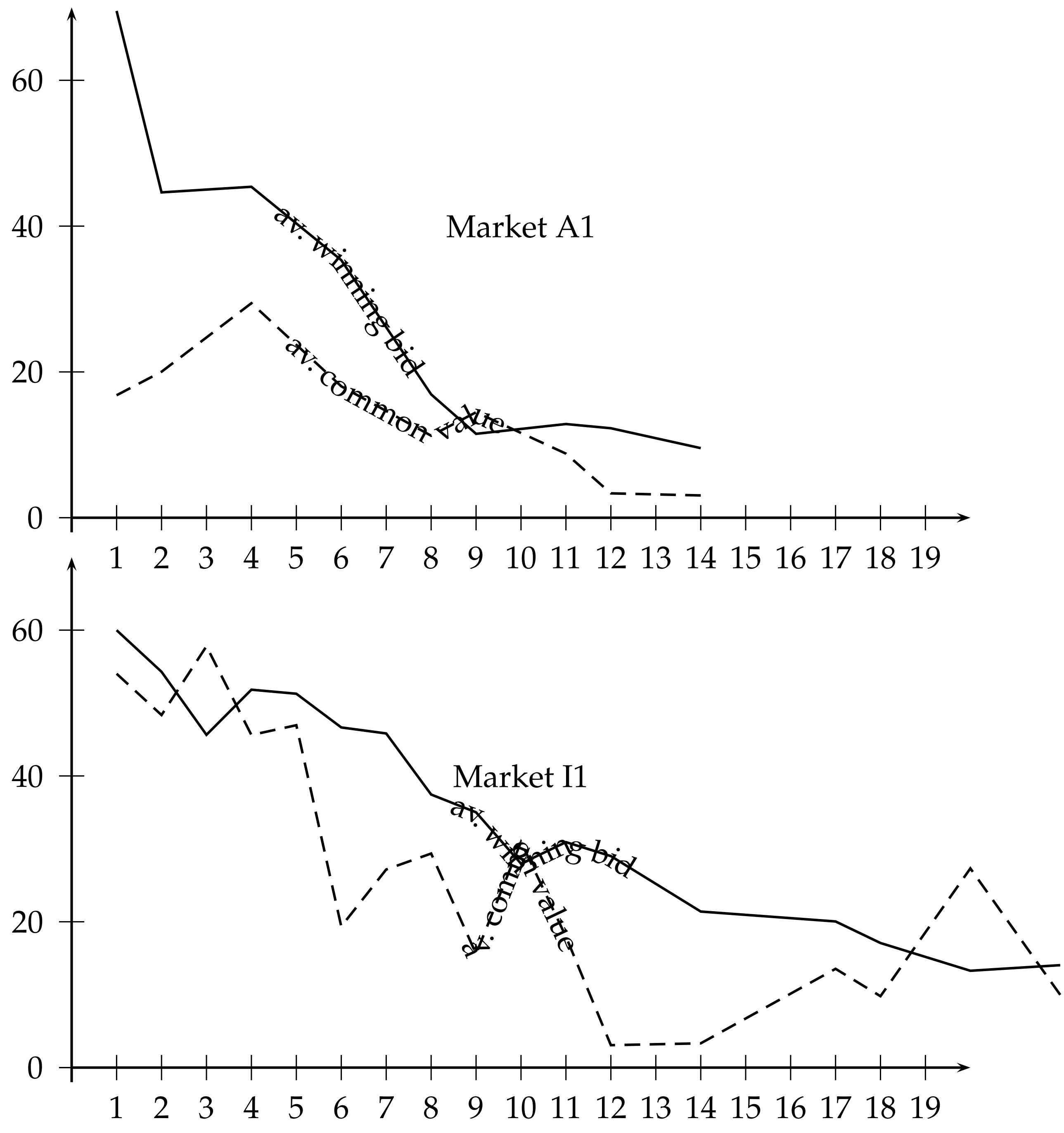


Figure 6.2: Common values and winning bids for blind bid items
Gaps in data points indicate that no items were bid in that period. (Forsythe, Isaac, Palfrey, 1989)

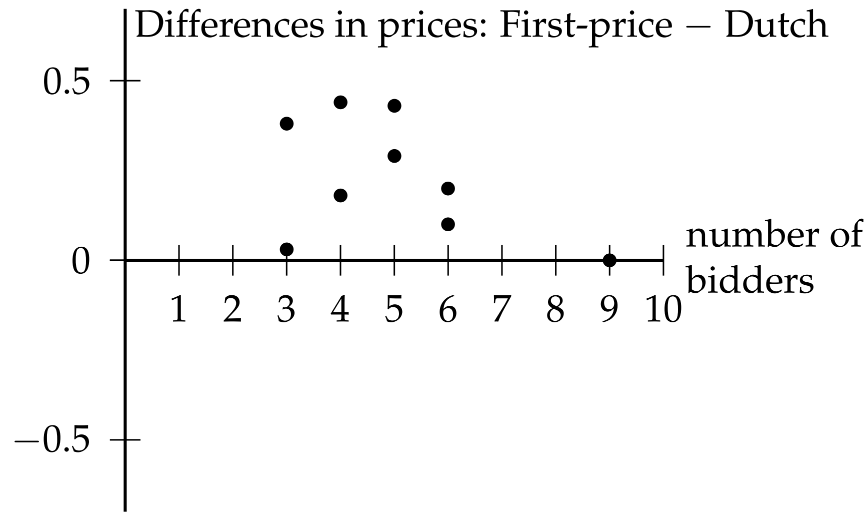


Figure 6.3: Cox, Roberson, Smith, 1982, table 7

6.3.1 Theoretical efficiency

- English + Second-price auction are efficient.
- Dutch + First-price auction are not efficient if valuations are not symmetrically distributed ('good' bidders bid less agressively than 'bad' bidders)

6.3.2 Revenue equivalence theorem

With risk neutral bidders the expected price is the same with all standard auctions (the bidders with the highest bid obtains the object (Vickrey 1961, Myerson 1981, Riley and Samuelson 1981)).

6.3.3 Equivalence of first-price and Dutch auctions

If signals are distributed uniformly:

$$b = \underline{x} + \frac{n-1}{n}(x - \underline{x})$$

Differences in prices first-price − Dutch for different n (number of bidders) see figure 6.3 on page 97.

Explanations:

- utility of suspense from waiting

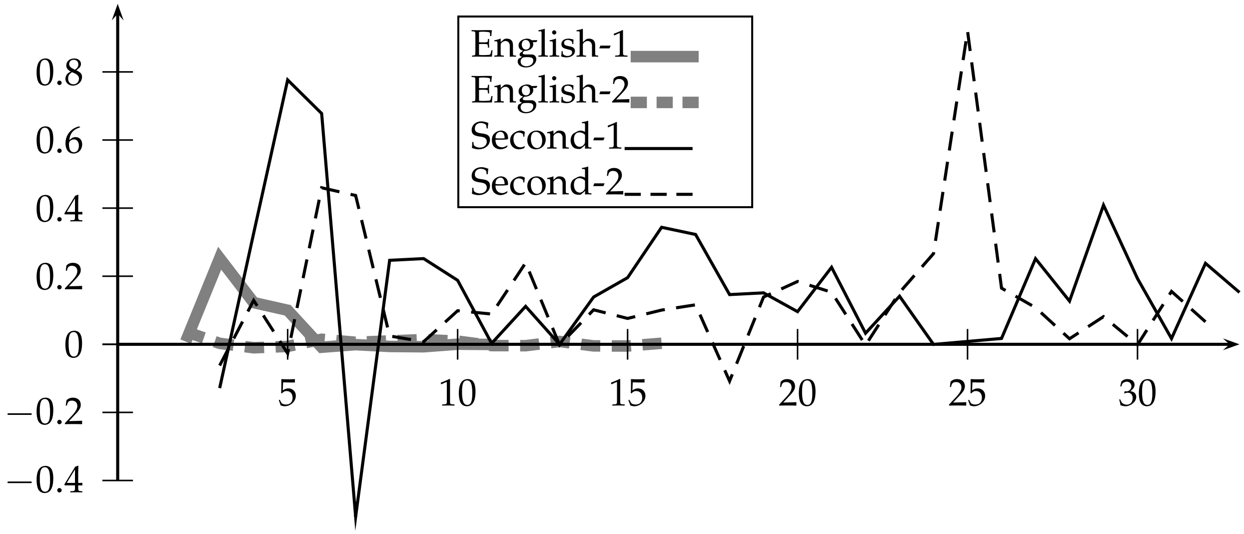


Figure 6.4: Deviations from dominant strategy price normalised by dividing trough the domain from which private values are drawn (Kagel, Harstad, Levin, 1987)

- 'false update' — if the price is decreasing in the Dutch-Auction and nobody takes the object, then the others have apparently a particularly low valuation.

How can one disentangle these explanations? (Cox et. al, 1983): Test the suspense-effect: Multiply the valuation. Under the assumption that the utility of suspense remains the same, now the difference between first-price and Dutch should be smaller. However, the difference remains the same.

6.3.4 English-auction and second-price auction

$$b = x$$

Prices should be the same, but they are different (Fig. 6.4 on page 98)

- Possible explanation: Overbidding in the second price auction increases the probability to win - the cost is not very high since only the second price must be paid.

  It is not obvious that overbidding increases the chance of winning only in those cases where one does not want to win.

- It is easier to learn bidding in the English auction.

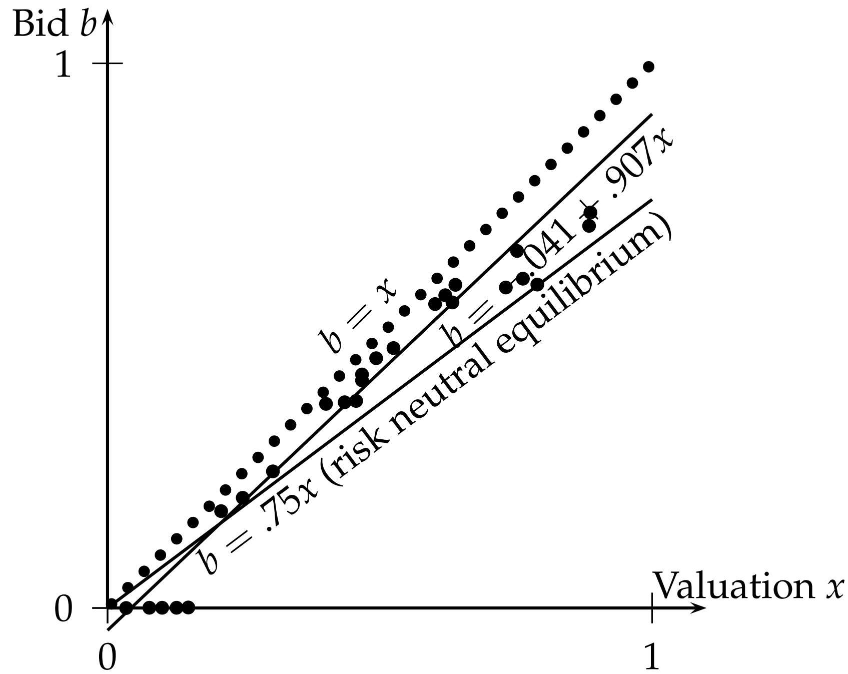


Figure 6.5: Cox, J. C., V. L. Smith, and J. M. Walker, 1988, Journal of Risk and Uncertainty

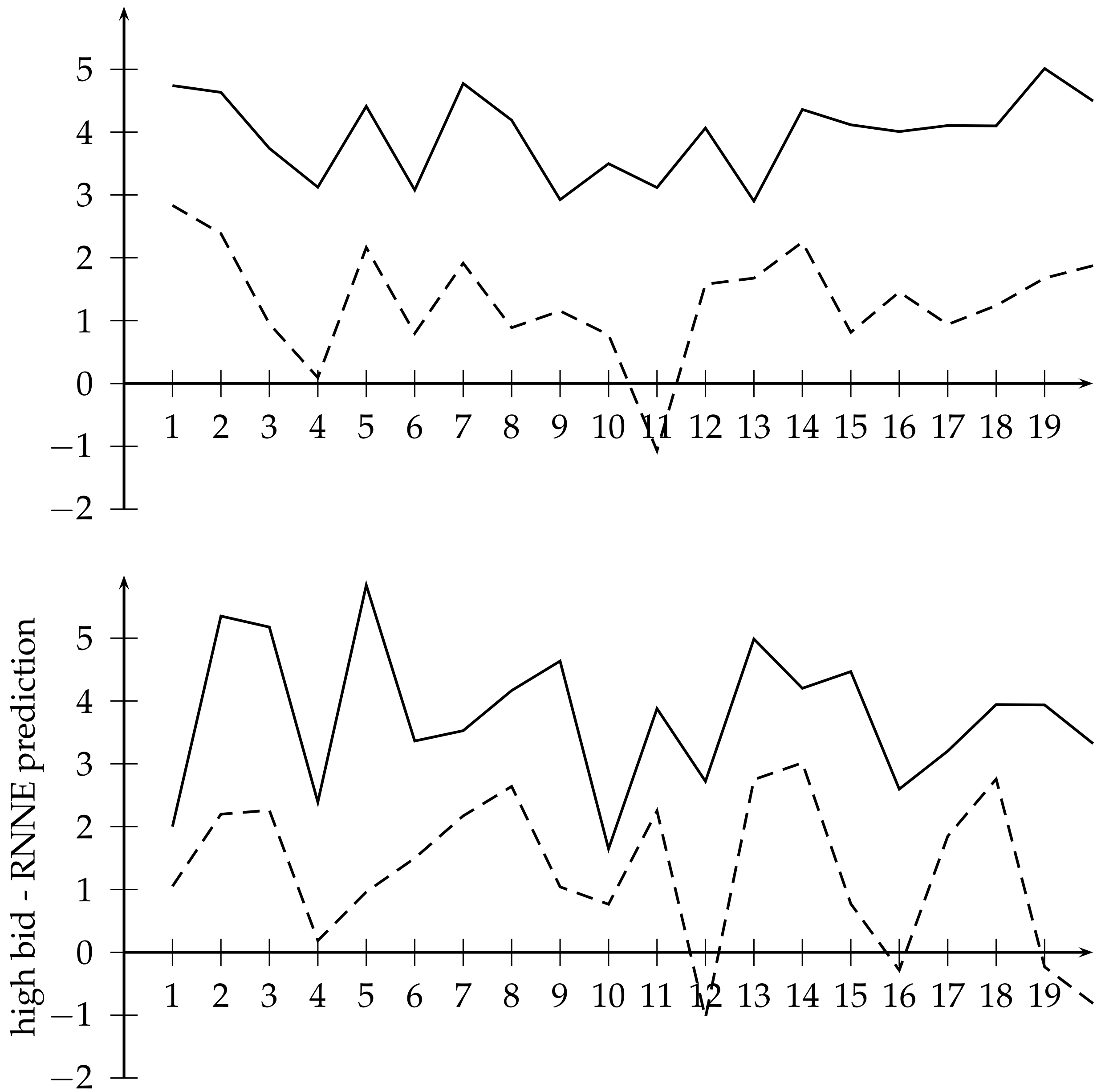
6.3.5 Risk aversion

Risk aversion does not play a role (theoretically) in the English and Second-price auction.

In a first-price (and Dutch) auction risk aversion should increase bids (and revenue). Indeed, participants bid more than in the risk-neutral EQ (Fig. 6.5, 6.6).

Approaches to test such a model.

- Specify a utility function (constant relative risk aversion, heterogeneous bidders CRRAM), and play with parameters. E.g. rescale payoffs and consider parameters of the utitlity function (which are determined through overbidding). If parameters do not depend on the rescaling we found support for the risk-aversion hypothesis.
- Binary lottery to induce risk-neutral behaviour. Fails (Cox et al. (1985), Walker et al. (1990)).
- 3rd price auctions: still overbidding (Kagel, Levin, 1993 Economic Journal)

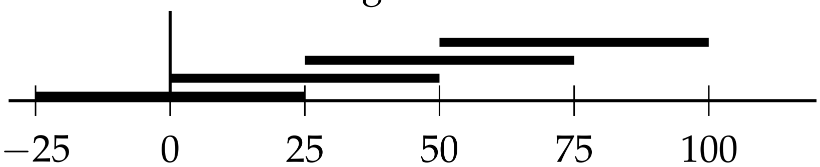


3 bidders: ________ 6 bidders: _ _ _ _ _ _ _

Figure 6.6: Overbidding in first-price auctions due to risk-aversion (Dyer, Kagel, Levin, 1989a)

6.3.6 Overbidding/Underbidding

- Choices for the experimental setup
  - small number of bidders → more experience for low valuations
  - strategy method
  - five auctions in each round
- vary three parameters:
  - different ranges for valuation $[\underline{\omega}, \bar{\omega}]$:



  - allow / not allow for negative bids
  - first-price sealed-bid auctions
- implementation:
  - between 12/2003 and 04/2005
  - at SFB 504 in Mannheim and at MaxLAB in Magdeburg, 304 subjects
  - z-Tree

6.4 Auction with interdependent valuations

Example

- 3 bidders ($i = 1, 2, 3$)
- private signals: s_i uniformly distributed
  uncorrelated
- value: $u_i = s_i + \alpha \cdot s_{i+1}$ (mod 3) $\qquad (\alpha = \frac{1}{2})$

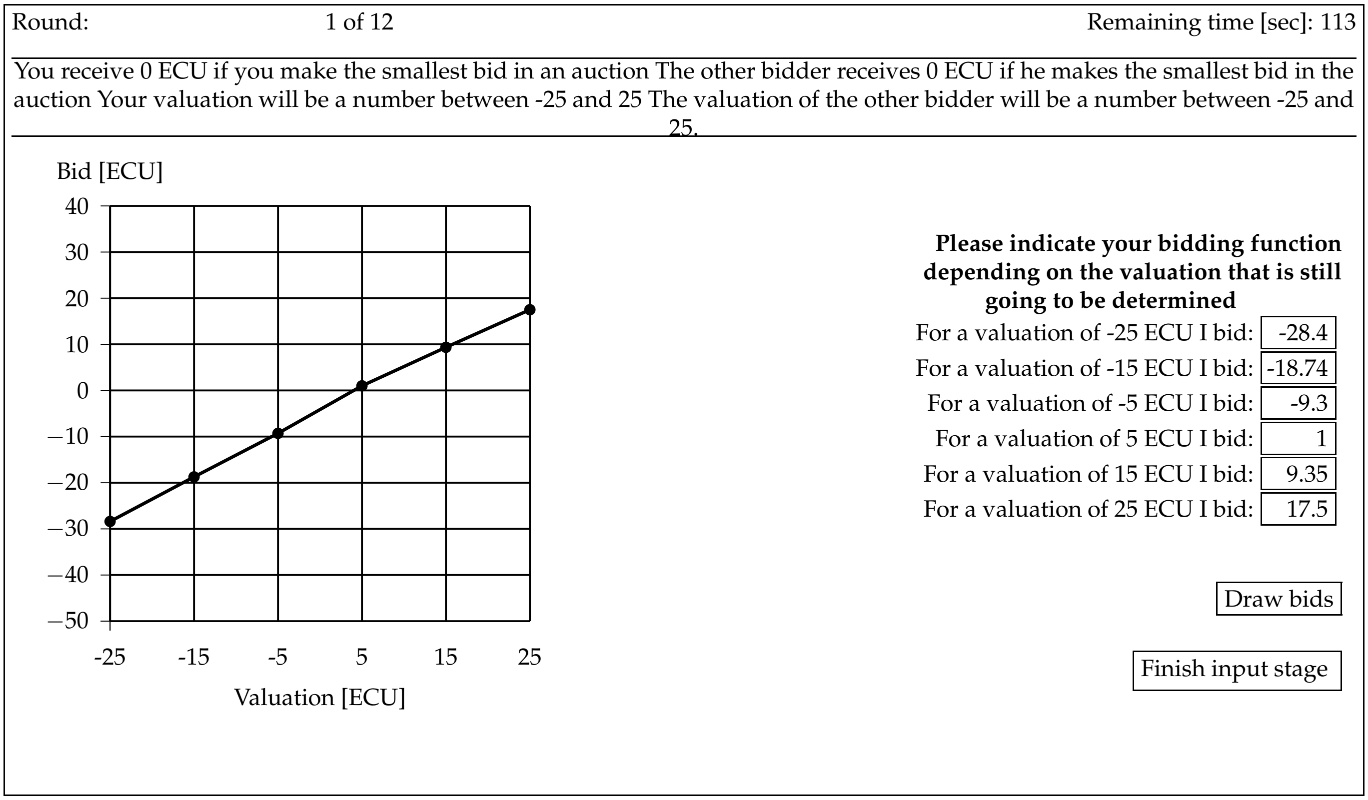


Figure 6.7: Eingabe von Bietfunktionen

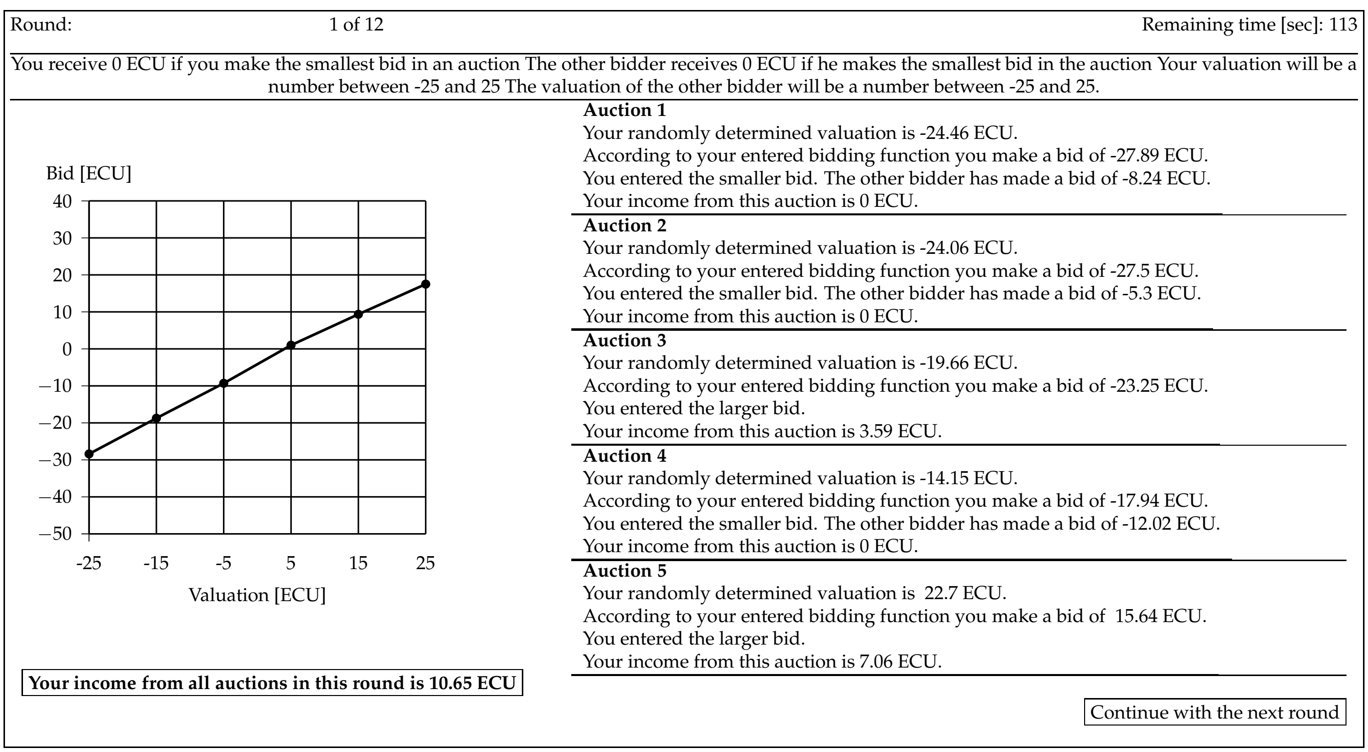


Figure 6.8: Feedback

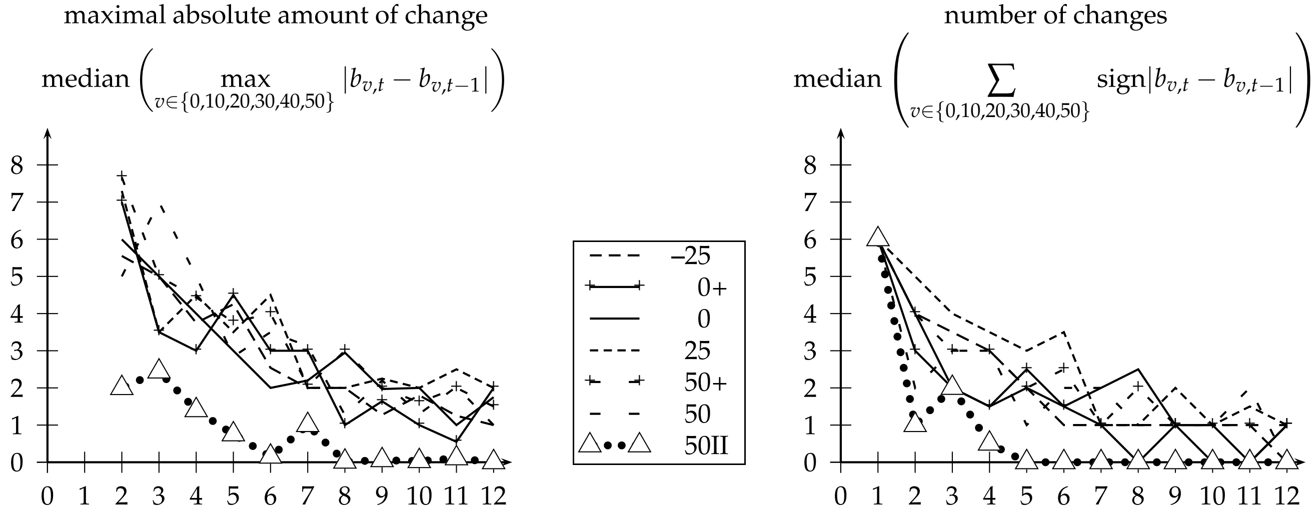


Figure 6.9: convergence of bids

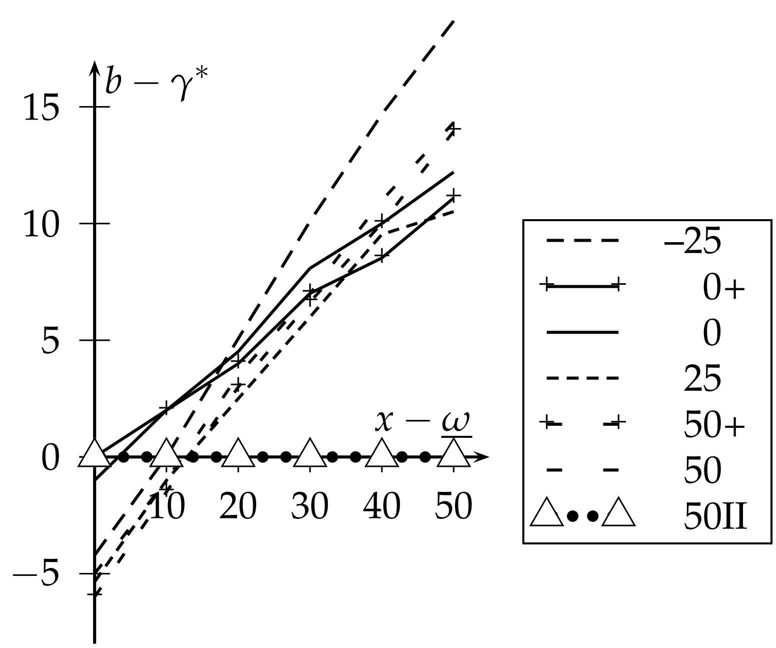


Figure 6.10: deviation from equilibrium bids

is the first to leave	$s_1 = 0$	$u_1 = 0 + \frac{1}{2}4 = 2$
	$s_2 = 4$	$u_2 = 4 + \frac{1}{2}6 = 7$ 2 has the highest valuation
in the 2nd price auction bidder 3 wins	$s_3 = 6$	$u_3 = 6 + \frac{1}{2}0 = 6$

An english auction would find an efficient allocation:

- Bidder 1 is the first to leave the auction (end of the first stage)
- Bidder 3 learns that u_3 is small and leaves the auction, too (end of the second stage, end of the auction).

Bidding functions in the first stage call the first bidder who leaves w.l.o.g. bidder 1.

we assume that bidder 2 and 3 have a bidding function in the first stage $b_1(s_2)$ und $b_1(s_3)$. bidder 1 bids B and wins the auction in the first stage only

$$B > b_1(s_2) = b_1(s_3) \quad \Leftrightarrow \quad b_1^{-1}(B) > s_2 = s_3$$

then the expected payoff is

$$u_1(B) = \int_0^{b_1^{-1}(B)} (s_1 + \alpha \cdot s_2 - b_1(s_2))\, ds_2$$

the first derivative is

$$\frac{\partial U_0}{\partial B} = (s_1 + \alpha \cdot b_1^{-1}(B) - B) b_1^{-1\prime}(B)$$

Bidding functions in the first stage

$$\text{FOC :} \qquad (s_1 + \alpha \cdot b_1^{-1}(B) - B) b_1^{-1\prime}(B) = 0$$

approach: b_1 is linear, $b_1(s) = a \cdot s$, and $b_1^{-1}(B) = B/a$.
then the first order condition is

$$(s_1 + \alpha \cdot B/a - B)/a = 0$$

solving for B yields $B = \frac{a}{a-\alpha}s$, indeed a linear function. From $\frac{a}{a-\alpha} = a$ follows the bidding function of the first stage:

$$\boxed{b_1(s) = (1+\alpha)\cdot s}$$

Bidding functions in the second stage — bidder 3
(We assume that bidder 1 made a bid of b_1 when he left the auction.
His signal s_1 can be inferred from the equilibrium bidding function.)
Bidder 3 has a simple problem.
His valuation is

$$u_3 = s_3 + \alpha s_1$$

s_3 is private information of bidder 3
s_1 can be inferred from the bid of the first bidder who left the auction.

$$\boxed{b_3(s_3) = s_3 + \alpha s_1}$$

Bidding functions in the second stage — bidder 2
bidder 2 has a hard problem.
The valuation is $u_2 = s_2 + \alpha s_3$
s_2 is private information of bidder 2
s_3 is still unknown
But we know $b_3(s_3, s_1) = s_3 + \alpha s_1$
$s_3 = b_3^{-1}(B, s_1) = B - \alpha s_1$

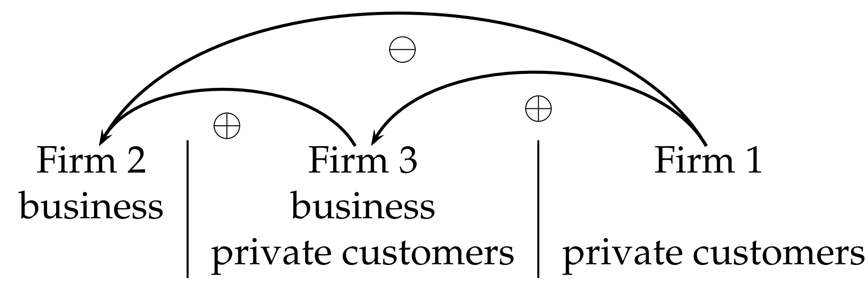
Expected payoff
$$\pi_2(B) = \int_0^{b_3^{-1}(B,s_1)} (s_2 + \alpha\cdot s_3 - b_3(s_3,s_1))\, ds_3$$
$$\frac{\partial \pi_2}{\partial B} = s_2 + \alpha\cdot(B - \alpha s_1) - B \overset{!}{=} 0$$

$$\boxed{b_2(s_2, s_1) = B = \frac{s_2 - s_1\cdot\alpha^2}{1-\alpha}}$$

Intuition for bidding function

$$\boxed{b_2(s_2, s_1) = \frac{s_2 - s_1 \cdot \alpha^2}{1-\alpha}}$$

3 firms bid for a frequency



Summary of the theory 1. stage — all bidders are still in the auction

$$b_1(s) = s_1 \cdot (1+\alpha)$$

Assume bidder 2 drops first, then in the second stage . . .

$$b_2(s_3, s_1) = \frac{s_2 - s_1\alpha^2}{1-\alpha} \qquad b_3(s_2, s_1) = s_3 + s_1\alpha$$

. . . efficient allocation with these bidding functions as long as $\alpha < 1$.

but are we, with this strange bidding function, in equilibrium? Can we exploit the advantage of the English auction?

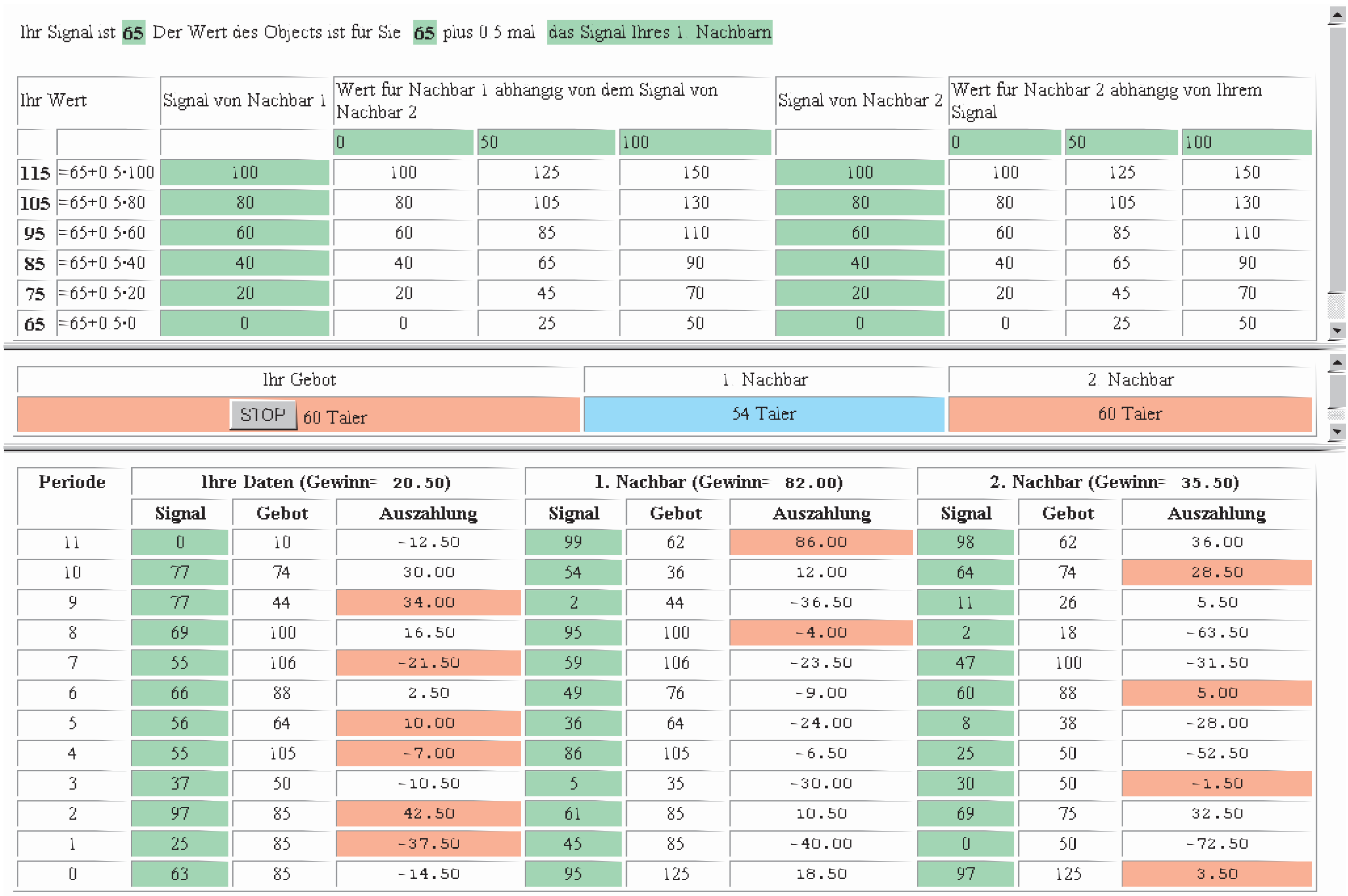
With the equilibrium strategies given above and $0 < \alpha < 1$ . . .

- the English auction always yields the efficient allocation,
- the second-price sealed-bid auction does not.

Derivation of bidding function for bidder 3:
payoff of bidder 3: $s_3 + \alpha s_2$ bidding function of 1: $s_2 + \alpha s_1$

3 wins only if

$$\underbrace{b_3}_{\text{Bid of 3}} > \underbrace{s_2 + \alpha s_1}_{\text{Bid of 1}} \quad \Leftrightarrow \quad s_2 < \underbrace{b_3 - \alpha s_1}_{\text{critical signal } s_2^*} \tag{6.1}$$



Ihr Signal ist 65 Der Wert des Objects ist für Sie 65 plus 0 5 mal das Signal Ihres 1 Nachbarn

Ihr Wert		Signal von Nachbar 1	Wert für Nachbar 1 abhängig von dem Signal von Nachbar 2			Signal von Nachbar 2	Wert für Nachbar 2 abhängig von Ihrem Signal		
			0	50	100		0	50	100
115	=65+0 5·100	100	100	125	150	100	100	125	150
105	=65+0 5·80	80	80	105	130	80	80	105	130
95	=65+0 5·60	60	60	85	110	60	60	85	110
85	=65+0 5·40	40	40	65	90	40	40	65	90
75	=65+0 5·20	20	20	45	70	20	20	45	70
65	=65+0 5·0	0	0	25	50	0	0	25	50

Ihr Gebot	1 Nachbar	2 Nachbar
STOP 60 Taler	54 Taler	60 Taler

Periode	Ihre Daten (Gewinn= 20.50)			1. Nachbar (Gewinn= 82.00)			2. Nachbar (Gewinn= 35.50)		
	Signal	Gebot	Auszahlung	Signal	Gebot	Auszahlung	Signal	Gebot	Auszahlung
11	0	10	-12.50	99	62	86.00	98	62	36.00
10	77	74	30.00	54	36	12.00	64	74	28.50
9	77	44	34.00	2	44	-36.50	11	26	5.50
8	69	100	16.50	95	100	-4.00	2	18	-63.50
7	55	106	-21.50	59	106	-23.50	47	100	-31.50
6	66	88	2.50	49	76	-9.00	60	88	5.00
5	56	64	10.00	36	64	-24.00	8	38	-28.00
4	55	105	-7.00	86	105	-6.50	25	50	-52.50
3	37	50	-10.50	5	35	-30.00	30	50	-1.50
2	97	85	42.50	61	85	10.50	69	75	32.50
1	25	85	-37.50	45	85	-40.00	0	50	-72.50
0	63	85	-14.50	95	125	18.50	97	125	3.50

Figure 6.11: Bids in the experiment

Then 3's payoff is

$$u_3 = \int_{s_1}^{b_3-\alpha s_1} \underbrace{s_3 + \alpha \cdot s_2}_{\text{own value}} - \underbrace{(s_2 + \alpha s_1)}_{\text{bid of 1}} ds_2 \tag{6.2}$$

FOC:

$$\frac{du_3}{db_3} = s_3 + b_3 \cdot (\alpha - 1) - s_1 \cdot \alpha^2 \tag{6.3}$$

$$b_3(s_3, s_1) = \frac{s_3 - s_1\alpha^2}{1-\alpha} \tag{6.4}$$

6 experiments, involving 96 participants with 2069 auctions

Estimate individual bidding functions for the second bidder who leaves the auction call the first dropper 'bidder 2', then bidding functions for the second dropper are in equilibrium…

$b_2(s_2,b_1)$	$=$	$\beta^i_2\frac{1}{1-\alpha}s_2$	$+\beta^i_1\frac{-\alpha^2}{1-\alpha^2}b_1$	$+\beta^i_c\cdot 100\cdot(1+\alpha)+\epsilon$	$b_3(s_3,b_1)$	$=$	$\beta^i_3 s_3$	$+\beta^i_1\frac{\alpha}{1+\alpha}b_1$	$+\beta^i_c\cdot 100\cdot(1+\alpha)+\epsilon$
EQ		1	1	0			1	1	0
N		0	0	1/2			0	0	1/2

censored approach:

	first bidder is bidder	second bidder is bidder		winner is bidder	
	1	2	3	2	3
b_2	$\geq \hat{b}_1$	$= \hat{b}''$	$\geq \hat{b}_1$	$\geq \hat{b}''$	$\geq \hat{b}_1$
b_3	$\geq \hat{b}_1$	$\geq \hat{b}_1$	$= \hat{b}''$	$\geq \hat{b}_1$	$\geq \hat{b}''$

where $\hat{b}_1$ lowest bid
$\hat{b}''$ second-lowest bid

○ $b_2(s_2,b_1)$	$=$	β^i_2	$\frac{1}{1-\alpha}s_2$	$+$	β^i_1	$\frac{-\alpha^2}{1-\alpha^2}b_1$	$+$	$100\cdot(1+\alpha)$	β^i_c
● $b_3(s_2,b_1)$	$=$	β^i_3	s_3	$+$	β^i_1	$\frac{\alpha}{1+\alpha}b_1$	$+$	$100\cdot(1+\alpha)$	β^i_c
equilibrium		1			1				0
naive (B)		0			0				1/2

Fraction of efficient allocations
English auction is significantly better
Equilibrium prediction: For $\alpha < 1$ the English auction is always efficient, the second-price sealed-bid auction only in 'simple' cases.
Comments…

- despite the fact that bidder 3 does not follow the equilibrium prediction the English auction is still more efficient than the second-price sealed-bid auction.
- The difference in efficiency is found where it is supposed to be — in the hard cases.

Summary

- Asymmetric interdependent valuation case is relevant
- compare English auction and second-price sealed-bid auction

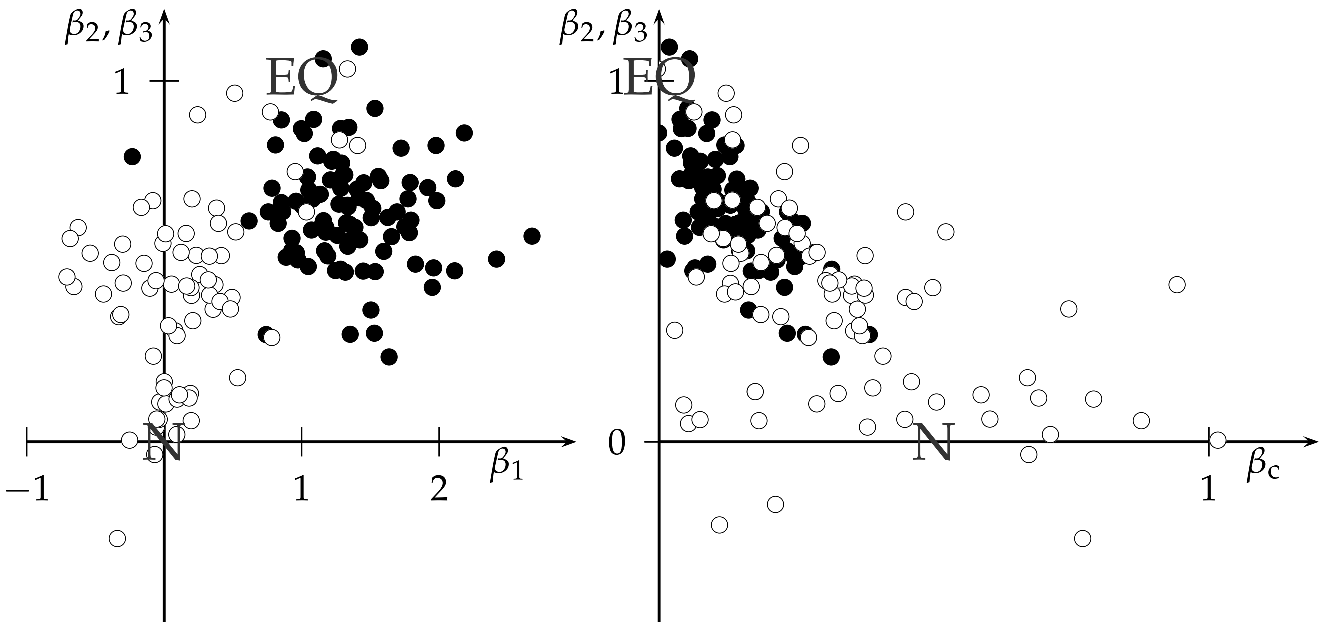


Figure 6.12: Estimated bidding functions

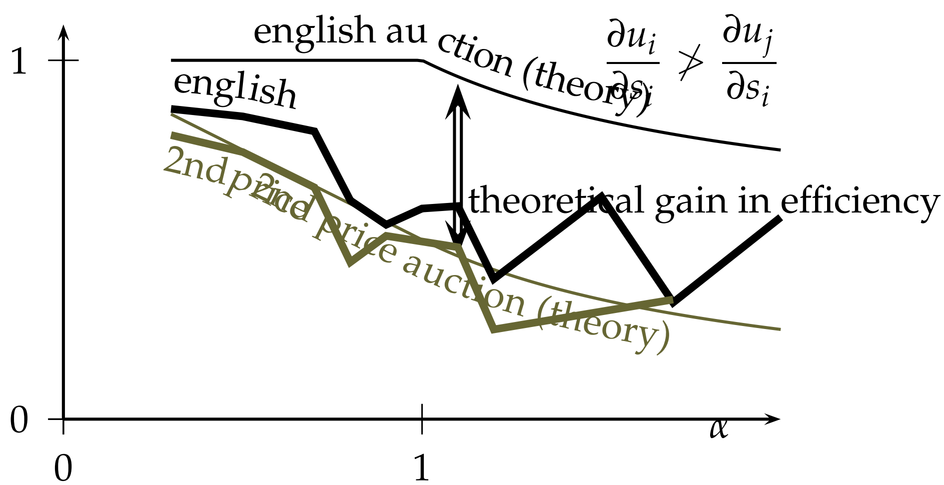
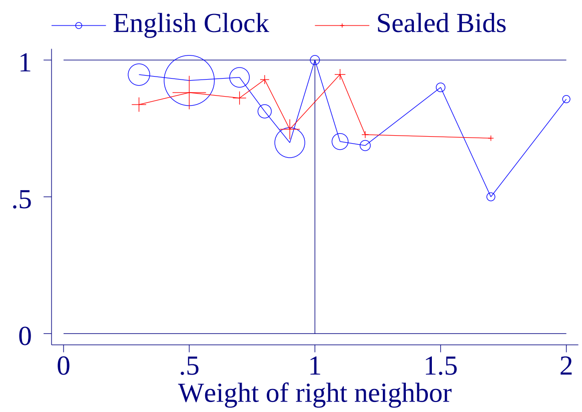


Figure 6.13: Efficiency of English and 2nd price auction

only ‘simple’ cases:

bidder with highest valuation has the highest signal

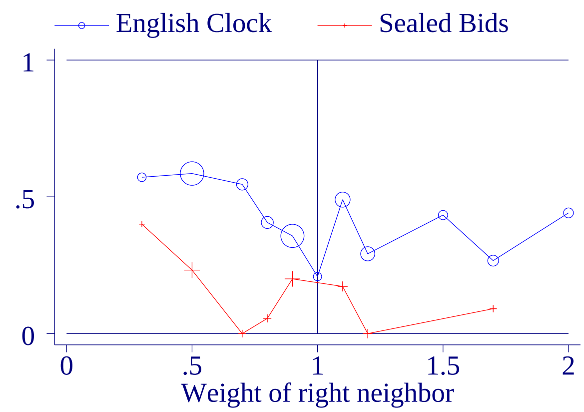


α

same efficiency

only ‘hard’ cases:

bidder with highest valuation does not have highest signal



α

English auction is better

Figure 6.14: Efficiency in different situations

Bidding: participants do not fully use the information revealed during the bidding process in the English auction.

- Bidders 1 and 2 are ok
- Bidder 3 bids a large constant

Nevertheless . . .

Efficiency: higher under English auction in ‘hard’ cases.

Summary

- We often say, English auction and second-price sealed-bid auction obtain the same efficiency.

  This holds only for extreme cases

  – own valuation is precisely known (private values)

  – all valuations are identical (purely common value)

→ **asymmetric interdependent valuations**

- in equilibrium: English auction $\succ$ Zweitpreisauktion (Maskin '92).
- can we calculate equilibrium bidding functions?
- yes, but bidding functions are complicated.
- do bidders use these or similar bidding functions?
  $\rightarrow$ estimate bidding functions:
  - in the first stage: yes!
  - direct inference from other bidders: yes!
  - indirect inference from other bidders: no!
- is the English auction still better than the 2nd price auction?
  - yes! — English auction obtains more efficiency

6.5 Markets

Market institutions:			
	buyers	sellers	
many sellers, many buyers			
Posted offer A.		SIM	
Posted bid A.	SIM		
Clearinghouse A. (NYSE opening prices)	SIM	SIM	intersection of demand and supply
Offer A.		SEQ	
Bid A.	SEQ		
Double A.	SEQ	SEQ	
Cournot		quantities	intersection of total demand and supply
Walrasian A.			until excess demand =0
decentralised bargaining	SEQ	SEQ	

6.6 History

6.6.1 Markets

perfect competition

- Edward H. Chamberlin (1948), "An experimental imperfect market", Journal of Political Economy, 56, p. 95–108.

  46 **decentralised** markets

- Vernon Smith (1962) Journal of Political Economy

  centralised market, open order book

bilateral monopoly

- Sidney Siegel and Lawrence E. Fouraker (1960) "Bargaining and group decision making. Experiments in bilateral monopoly". New York, McGraw-Hill.

  none / one / both monopolists have information about the other player's payoff.

6.7 Implementing market experiments

6.7.1 Implementation of demand and supply in DA markets

- linear demand: difficult
- step function: easier
  - each participant one step: inequalities in payoffs
  - several steps per participants → equal expected payoff

Buyer				Sellers			
	value	price	profit		value	price	profit
1.	3.5			1.	1.5		
2.	2.0			2.	1.8		
⋮				⋮			
Total				Total			

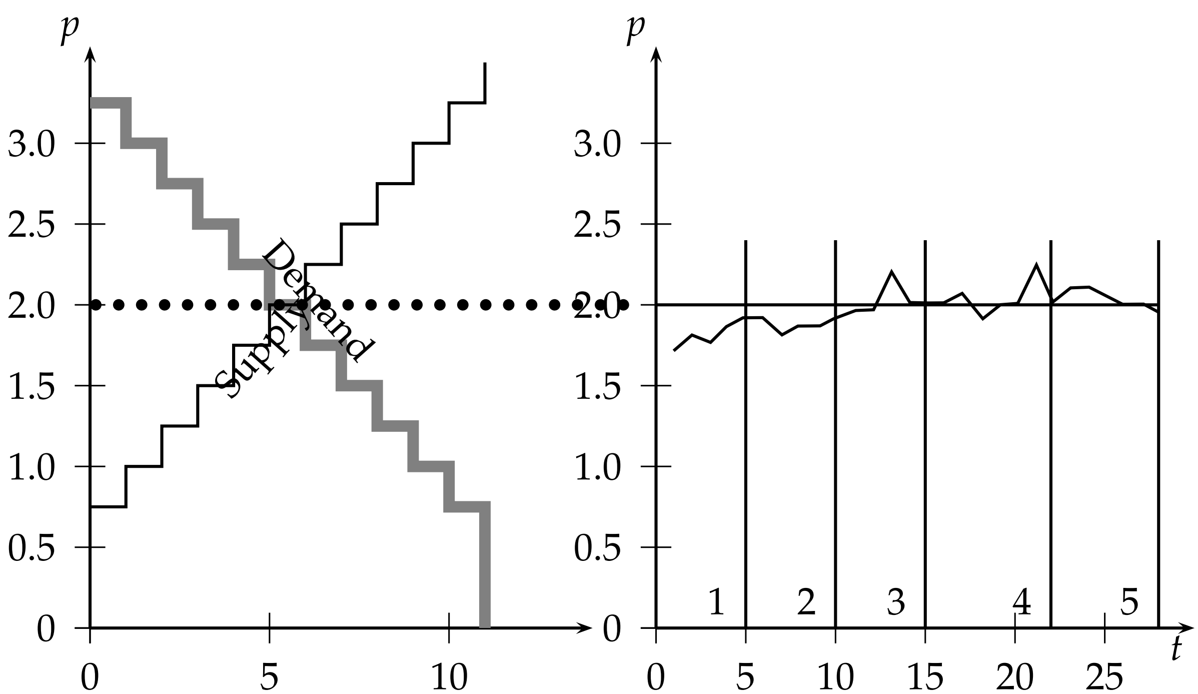


Figure 6.15: Konvergenz von Marktpreisen

Representation of contracts:

sell	buy
	⋮

6.7.2 Restrictions for bids:

- do not allow contracts that imply losses (this prevents mistakes and misunderstandings, reduces also the possibility of punishment)
- only “improving contracts” are possible
- all contracts are wiped out after each transaction

- small problem $\rightarrow$ no clear prediction of quantities
  - with stepwise demand sometimes also no clear price prediction
  - $\rightarrow$ to avoid this: steps intersect as shown below $\downarrow$

6.7.3 Measuring market behaviour

- average deviation of prices $\frac{P-P_e}{P_e} \in [-0.05, +0.05]$
- average deviation of quantities $\frac{Q-Q_e}{Q_e} \in [0, +0.05]$ (there is too much trade)
- efficiency (fraction of realised CSP+PSP), around, 99%
- prices converge quickly to competitive equilibrium (measure as coefficient of convergence):

$$\alpha^2 = \frac{\sum_{k=1}^{Q}(P_k - P_e)^2}{Q} = s_{P_k}^2 + (\bar{P}_k - P_e)^2$$

  - Q number of contracts
  - P_k price of contract k
  - P_e equilibrium price
  - $s_{P_k}^2$ variance of contract prices
  - $\bar{P}_k$ mean of contract prices

6.8 Performance of DA-markets

6.8.1 Extreme cases: box-designs with huge differences in profits

Do prices also adapt quickly in extreme cases? Smith and Williams (1989), play first 5 periods with larger demand, then 5 periods with large supply.
prices always adjust

6.8.2 Multiplicity of equilibria

Hypothesis: traders choose the average equilibrium
$\rightarrow$ prices are not average equilibrium prices, but we observe **inertia** once any price level is reached

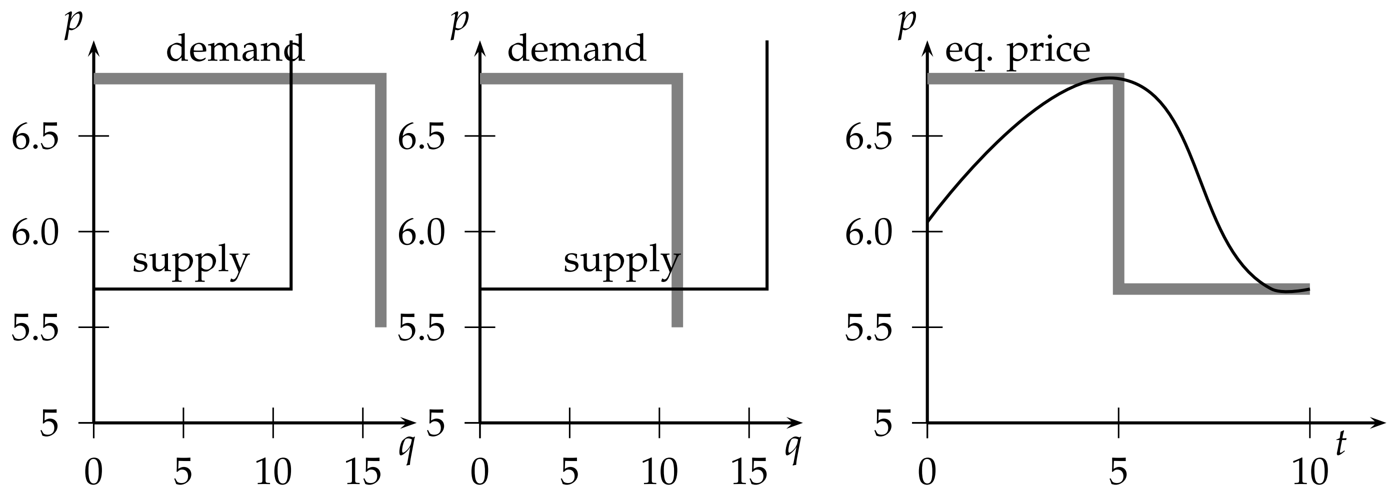


Figure 6.16: box-designs with huge differences in profits

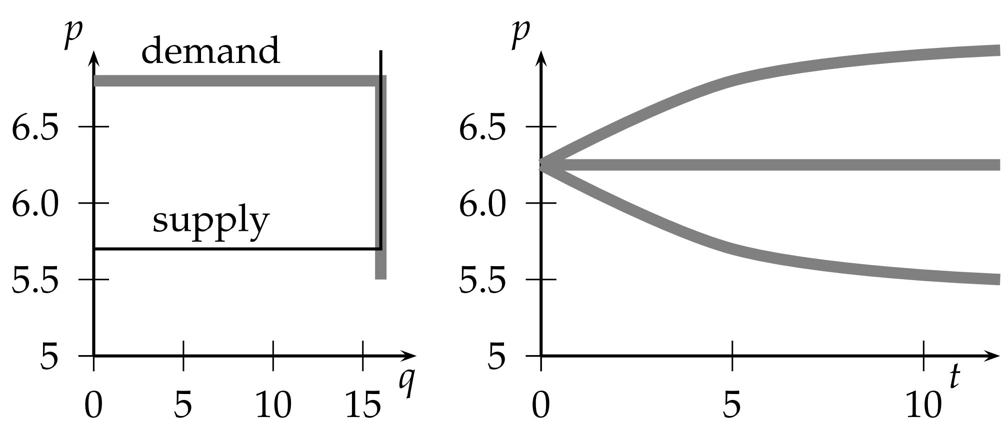


Figure 6.17: Many equilibrium prices

6.9 Market institutions and market power

6.9.1 Measuring market power

- distribution of profit (effectivity of monopoly):

$$M = \frac{\pi - \pi_{\text{comp.}}}{\pi_{textmonopoly} - \pi_{\text{comp.}}}$$

  - π actual sellers' profit
  - $\pi_{\text{comp.}}$ sellers' profit with perfect competition
  - $\pi_{textmonopoly}$ sellers' profit with cooperation

  thus:

  - $M > 1$ possible with price discrimination
  - $M = 1 \rightarrow$ Monopoly
  - $M = 0 \rightarrow$ perfect competition
  - $M < 0 \rightarrow$ market power on the demand side

6.9.2 Monopoly

Double auction Price starts at monopoly price, then drops down to competitive price (or below). Buyers realise that cheaper trades are possible. ($M = 0.36$)

Posted offer Stable monopoly price ($M = 1$)

Posted bid ($M = 0.15$) Monopolist serves first the high bidders, then profitably sells to low bidders. This is what the high bidders see…

6.9.3 Collusion

4 sellers / 4 buyers. Sellers (in a separate room) can make non-binding agreements. Cartel is not stable. First cartel quantities are sold. Then the temptation is large to sell further units $\rightarrow$ Buyers learn that cheaper trades are possible $\rightarrow$ price drops.

6.9.4 Price caps

Can price-caps be used as ‘focal point’ and thus support high prices.
→ No.

6.9.5 Contestable Markets

(Baumol, Panzar, Willig, 1982)
Situation: natural monopoly (decreasing marginal cost)

1. at least 1 rival with equal cost
2. entrants assess profitability at prices of the incumbent
3. No barriers to entry and exit (hit-and-run entry is possible)

→ Ramsey-prices (zero profits)

Coursey, Isaac, Smith (1984): Experiment with decresing marginal cost. License (2$) gives the right to enter the market. In period 1-5 the incumbent is alone in the market, in period 6 entrants can buy a license.

	Monopol	contestabler Markt
Efficiency:	49%	86%
M:	0.56	0.02

6.A Exercises

1. Winner’s curse
   - What is the winner’s curse?
   - Which reason can you imagine for the winner’s curse?
2. Sniping
   - What is sniping?
3. Market of lemons
   - What is the "market of lemons"?
   - Describe an example of a market of lemons.

4. Exam 2006, exercise 1

   John wants to set up an internet based market place to sell garden plants. He is wondering whether he should choose a first-price or a second-price auction to sell his plants. Assume that John wants to maximise his expected revenue.

   - What does theory say regarding expected revenue in these two types of auctions?
   - What does the experimental literature say regarding expected revenue in these two types of auctions?
   - John wants to run an experiment to find out more about bidding and revenue in these two types of auctions. To do that, he recruits 100 students from St Andrews University as participants. The experiment is conducted in groups of five participants. The first five participants who arrive are the first group, the next five in the next experiment are the next group, etc. Members of each group bid in a first-price auction for a geranium plant which has a market price of £3. Then, in a second stage of the experiment, members of each group bid in a second-price auction for a rosemary bush which also has a market price of £3. Which elements of John's experiment would you change?
   - John's competitor, Mike, also runs an experiment. He also recruits 100 students from St Andrews University as participants. The first 50 participants who arrive for his experiment are divided into groups of five. Each group participates in a first-price auction for a geranium. After this part of the experiment is completed, Mike continues with the next 50 participants. Again, they are divided into groups of five. Each group participates in a second-price auction for a geranium. Which elements of Mike's experiment would you change?

5. Experimental auctions

   - Find a research question related to auctions which can be implemented experimentally.
   - Describe the design of the experiment.

6. Asymmetric Information

   - What is asymmetric information?

- Give some examples for asymmetric information.

7. Market experiment

   - You are now divided into sellers and buyers. You will receive cards with your production costs c and your maximum willingness to pay w, respectively.
   - Try to find a partner with whom you can trade. Try to make the highest profit possible. The profit is computed as $\Pi = p - c$ for sellers and $\Pi = w - p$ where p denotes the selling price.

Chapter 7

Monetary Policy

Blanchard, 1997, Macroeconomics:

> "When an engineer wants to find out how the temperature affects material's conductivity, she builds an experiment in which she changes the temperature, makes sure that everything else remains the same, and looks at the change in conductivity. But macroeconomists who want to find out, for example, how changes in the money supply affect aggregate activity cannot perform such controlled experiments; they cannot make the world stop while they ask the central bank to change the money supply"

Money as a means to store value
Situation: A government wants to raise some revenue though seigniorage
$\rightarrow$ what kind of monetary policy should the government choose?

- Theory
- Field data
- Experiments

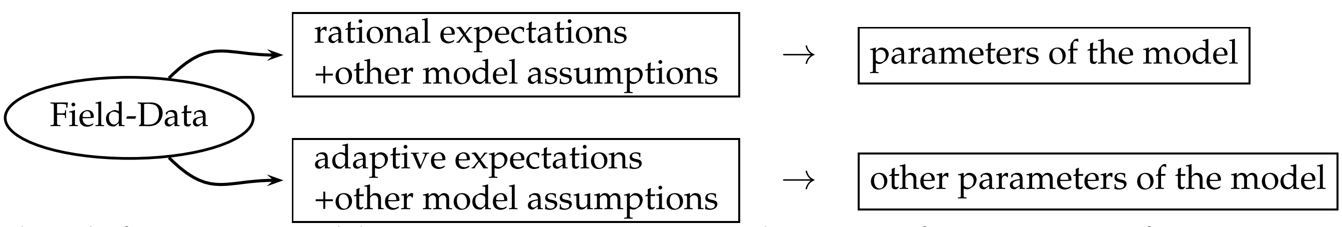
Theoretical framework Consumers **expect** money to have value in the future $\rightarrow$ they use money

adaptive expectations	**rational expectations**
• “rich” concept (1st, 2nd- order, LS- adaptive expectations) • in the model: realisations deviate systematically from expectations	• well defined concept • in the model: realisations do not deviate systematically from expectations

Why do we have to choose a concept of formation of expectations?

$\frac{d\pi}{d\mathrm{d}} > 0$	$\frac{d\pi}{d\mathrm{d}} < 0$

Field Data Identification Problem: Neither way of formation of expectations for the subjects nor the remaining parameters of the models are known.



It is hard if not impossible even to approximate the type of expectation formation from field data.

laboratory experiments

⊕ remaining Parameters can be controlled by the experimenter

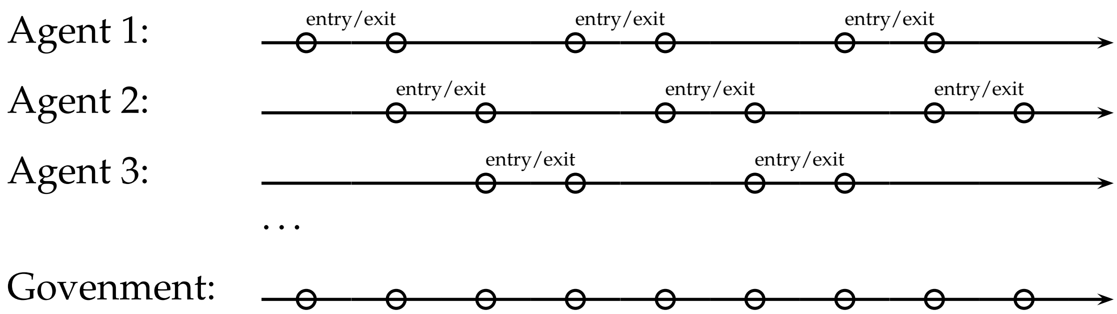
→ Type of expectation formation can be identified

7.1 A standard OLG model

- Lifetime=2 periods

  initial endowment: $\omega_1 = 600, \omega_2 = 200$

- consumption good can not be stored at all



prints money to buy ressources
(different rules to print money)

money can be stored costlessly

- Market: goods↔money
- utility of consumption:

$$U(c_1, c_2) = c_1 \cdot c_2 = (\omega_1 - s_{it}) \left(\omega_2 + s_{i,t} \frac{1}{\pi_{t+1}} \right)$$

- Inflation rate is technically defined through the market equilibrium condition:

$$\underbrace{m_t}_{\substack{\text{old agents' money} \\ \text{+ newly printed money}}} = p_t \underbrace{\sum_i s_{i,t}}_{\substack{\text{consumption} \\ \text{goods brought} \\ \text{to the market} \\ \text{by young agents}}} \tag{7.1}$$

In each period we have the same number of young and old agents.
compare two (extreme) monetary policies
parameters are chosen such that deficits are identical in equilibrum (the one that is stable with adaptive expectations).

real deficit	money growth
$m_t = m_{t-1} + p_t \cdot 0.17$	$m_t = 2.27 \cdot m_{t-1}$

7.2 Experimental Markets

How is $s_{i,t}$ and p_t determined?

Lim, Prescott, Sunder (1994, Empirical Economics)	5 min oral double auction $\rightarrow s_{i,t}, p_t$	slow, markets did not clear, noisy
Lim, Prescott, Sunder (1994), Marimon, Sunder (1993, Econometrica), Marimon, Sunder (1994, Economic Theory)	Supply Schedule: $p_{i,t}(s_{i,t}) \rightarrow p_t$	Noisy (difficult for agents to work out optimal supply schedule)
Marimon, Sunder (1996 Carnegie-Rochester Conference Series on Public Policy)	Forecasting Game $\pi^e_{t+1} \rightarrow s^*_{t,i} \equiv s_{t,i} \rightarrow p_t$	⊕ Help avoids noise ⊖ Agents are 'forced to optmise' at 2nd stage ⊖ We observe only point-forecasts
Bernasconi, Kirchkamp (2000, JME)	• graphical forecast π^e_{t+1} or $s^e_{t+1} \rightarrow s^*_{t,i}$ • Saving Decision $s_{t,i} \rightarrow p_t$ $\lesseqgtr$	⊕ Help avoids noise ⊕ We impose less restrictions on decisions ⊕ We observe more

Which central bank should determine the policy?

- European Central Bank
- Bundesbank

first result: adaptive expectations

1. Real deficit policy yields less inflation, see table 7.1.
2. Real deficit policy yields more volatility, see table 7.2

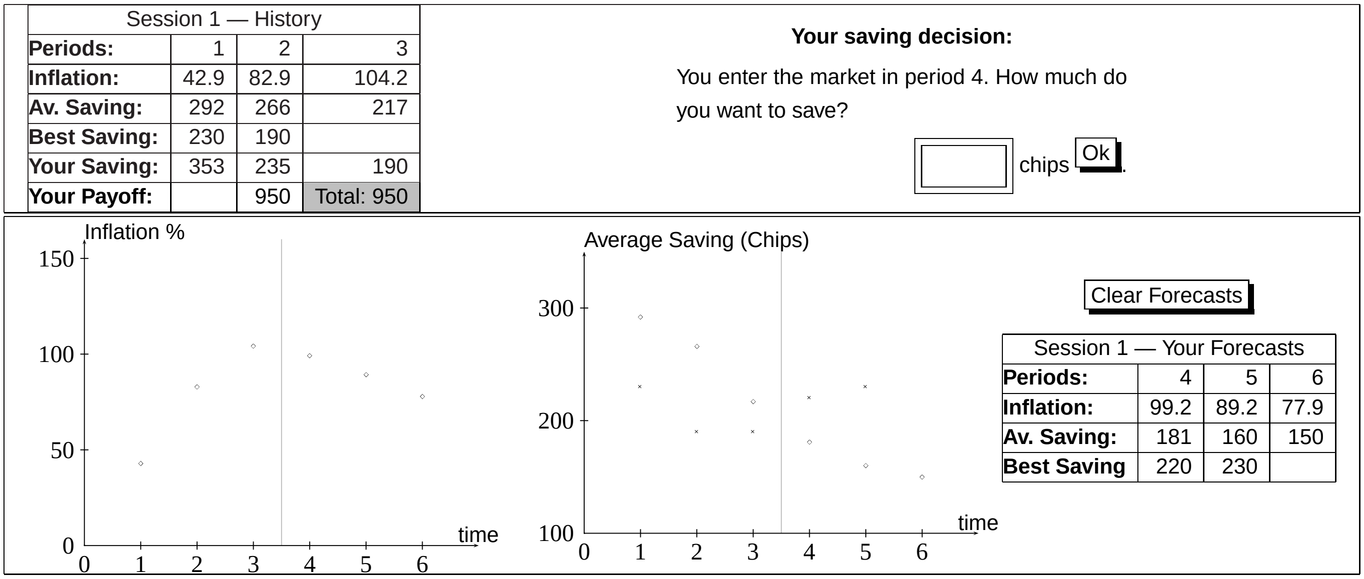


Figure 7.1: Interface in the experiment

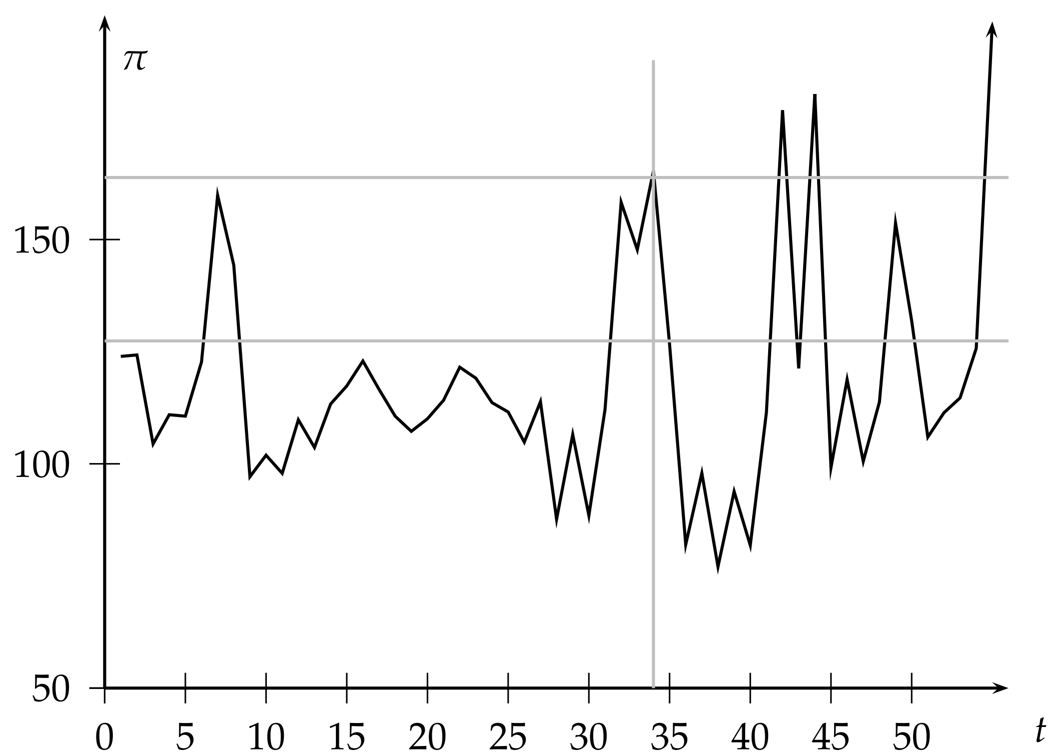


Figure 7.2: Inflation in the experiment

Is deficit the same? Is inflation the same?

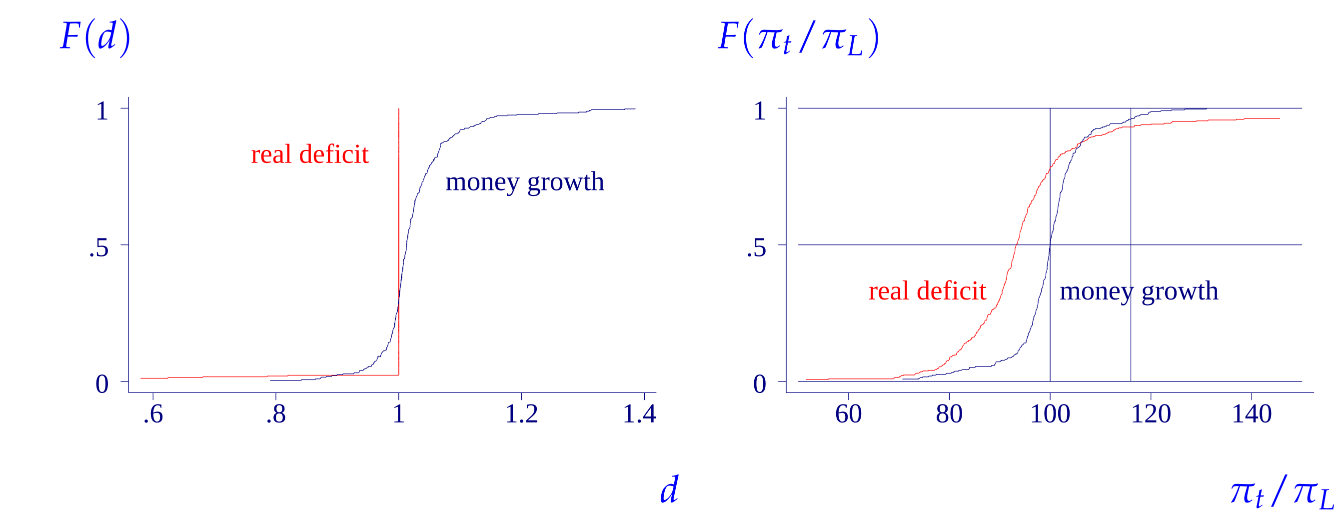


Figure 7.3: Impact of different monetary policies

$$\pi_t = \beta_{\text{deficit}} + \beta_{\text{EC}} + \beta_{\text{BuBa}} + \underbrace{\beta_e}_{\text{dummy for experiment}}$$

π_t	β	σ_β	t	$P > \lvert t \rvert$	95% conf. interval	
Firenze						53 observations
deficit	-2.890271	3.132228	-0.923	0.526	-42.689	36.90846
Mannheim						387 observations
deficit	-4.214066	.8143563	-5.175	0.004	-6.307435	-2.120696
BuBa	-4.980665	.4193907	-11.876	0.000	-6.058743	-3.902587
EC	-3.259181	.6963949	-4.680	0.005	-5.049321	-1.469041
Pavia						242 observations
deficit	-6.315529	1.350644	-4.676	0.009	-10.06552	-2.56554
BuBa	.3805164	1.350644	0.282	0.792	-3.369472	4.130505
EC			dropped			
All Places						682 observations
deficit	-5.396275	.9429633	-5.723	0.000	-7.450816	-3.341735
BuBa	-4.529684	.2609852	-17.356	0.000	-5.098322	-3.961046
EC	-3.946815	.8825854	-4.472	0.001	-5.869803	-2.023827

Table 7.1: Real deficit policy yields less inflation

Estimation of objective relative volatility $\nu_{\text{or}} = \beta_{\text{deficit}} + c$

$\nu_{\text{or}} = \ln \ln^2(\pi_t/\pi_{t-1})$	β	σ_β	t	$P > \lvert t \rvert$	95% conf. interval	
All experiments						727 observations
deficit	.6200389	.2321794	2.671	0.008	.1642148	1.075863
c	-6.344855	.1685217	-37.650	0.000	-6.675704	-6.014006

Estimation of subjective volatility $\nu_s = \beta_{\nu_{\text{or}}}\nu_{\text{or}} + \beta_{\text{deficit}} + \beta_{\text{BuBa}} + \beta_{\text{EC}} + c$

$\nu_s = \sigma_{\pi^e_{i,t}} \big/ \overline{\pi^e}_{i,t}$	β	σ_β	t	$P > \lvert t \rvert$	95% conf. interval	
All experiments						1808 observations
ν_{or}	.0948404	.009629	9.849	0.000	.0759552	.1137256
deficit	.3779502	.0607352	6.223	0.000	.2588314	.497069
BuBa	-.1558654	.0756481	-2.060	0.040	-.3042325	-.0074982
EC	-.1727994	.0764621	-2.260	0.024	-.322763	-.0228358
c	-2.839546	.0895649	-31.704	0.000	-3.015208	-2.663885

Table 7.2: 2. Real deficit policy yields more volatility

A comparison of theory and experiment:

Assumption:	Experiment:
1st order adaptive expectations?	more inertia
optimal saving?	subjects save average of past and optimal saving
point expectations for inflation?	volatility of inflation ↓ individual variance of expectations ↓ Oversaving ↙ ↘ money growth → no impact real deficit → $\pi \downarrow, \nu \uparrow$

This holds in Florence, Mannheim and Pavia independently

7.A Exercises

1. Monetary Policy

   - Imagine you would like to implement an experiment on monetary policy. Can you think of an aspect of monetary policy which could be particularly difficult to implement in an experiment?

Chapter 8

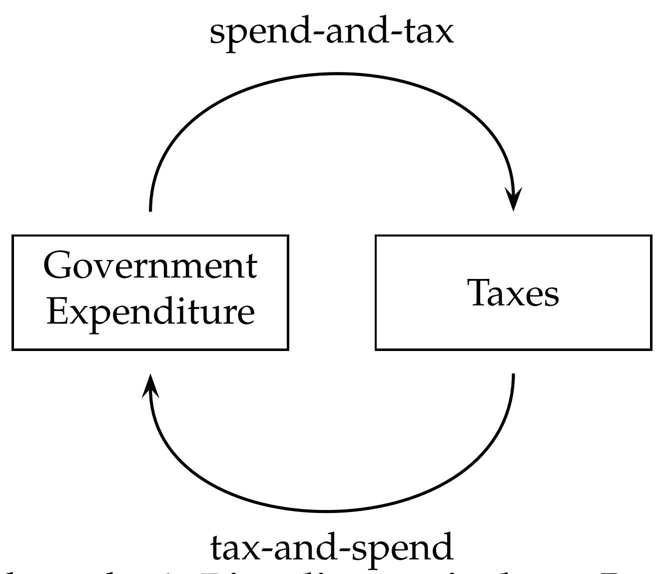
Fiscal Policy

Impact of fiscal policy on national saving, see figure 8.1

- IS-LM: investment may depend negatively on interest rate and positively on income. Tax increase shifts IS curve inwards $\rightarrow$ lower interest, less income.

  empirically: see figure 8.2

8.1 Mechanism behind fiscal policy?



- **spend-and-tax** hypothesis **Ricardian equivalence** Barro (74) Journal of Political Economy

	dS/dT	dS/dG
IS-LM	?	?
finite horizon	$+$	$-$
infinite horizon, no distortionary tax	0	0
infinite horizon, distortionary tax	$-$	$-$
Blanchard (1990), Sutherland (1995)	$+$ if B/G small $-$ otherwise	
Drazen (1990), Feldstein (1982)	$+$ ifΔT small $-$ otherwise	$-$ ifΔG small $+$ otherwise
Bertola and Drazen (1993)		$-$ ifG/Y small $+$ otherwise
Perotti (1999)	$+$ ifB/G small $(-)$ otherwise	$-$ ifB/G small $(+)$ otherwise

Figure 8.1: Impact of fiscal policy on national saving?
(from Giavazzi, Jappelli, and Pagano (2000) European Economic Review)

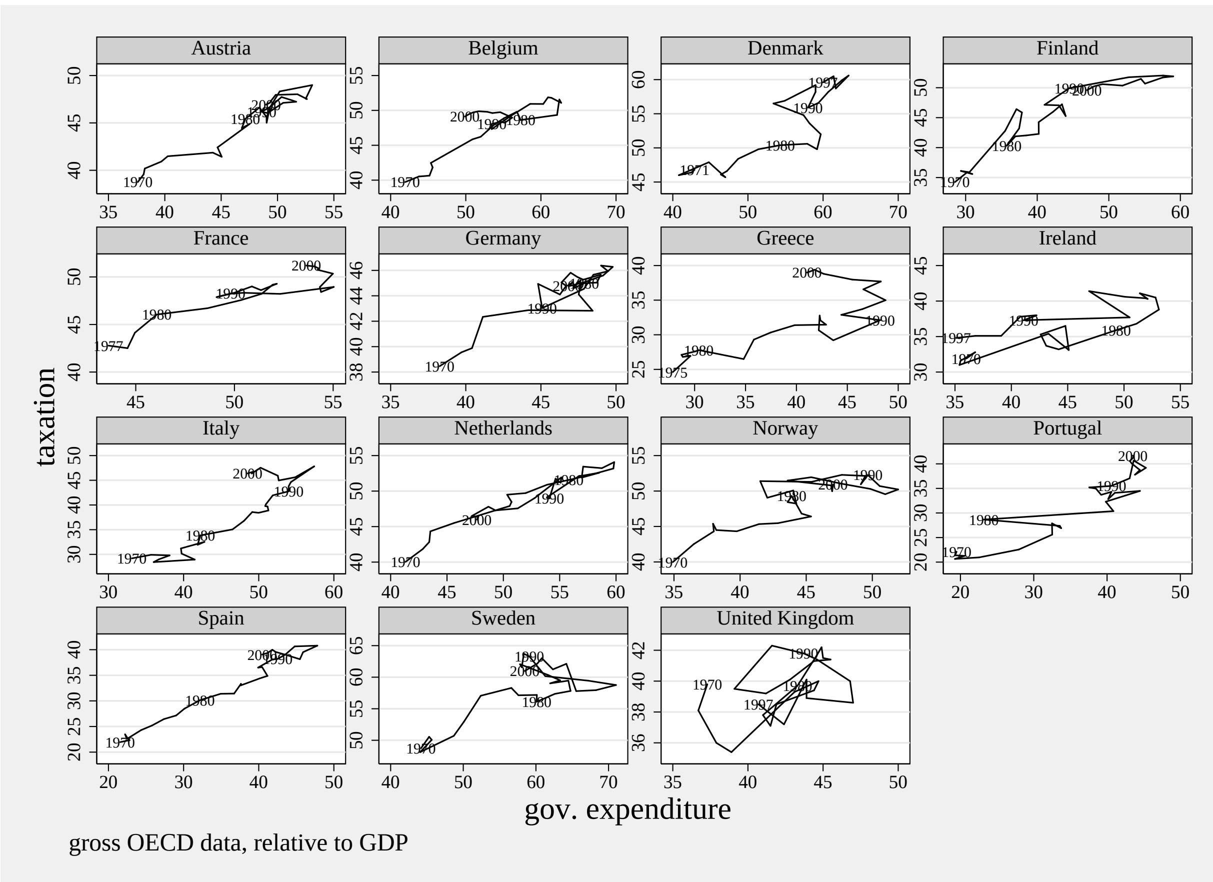


Figure 8.2: T/G in the field

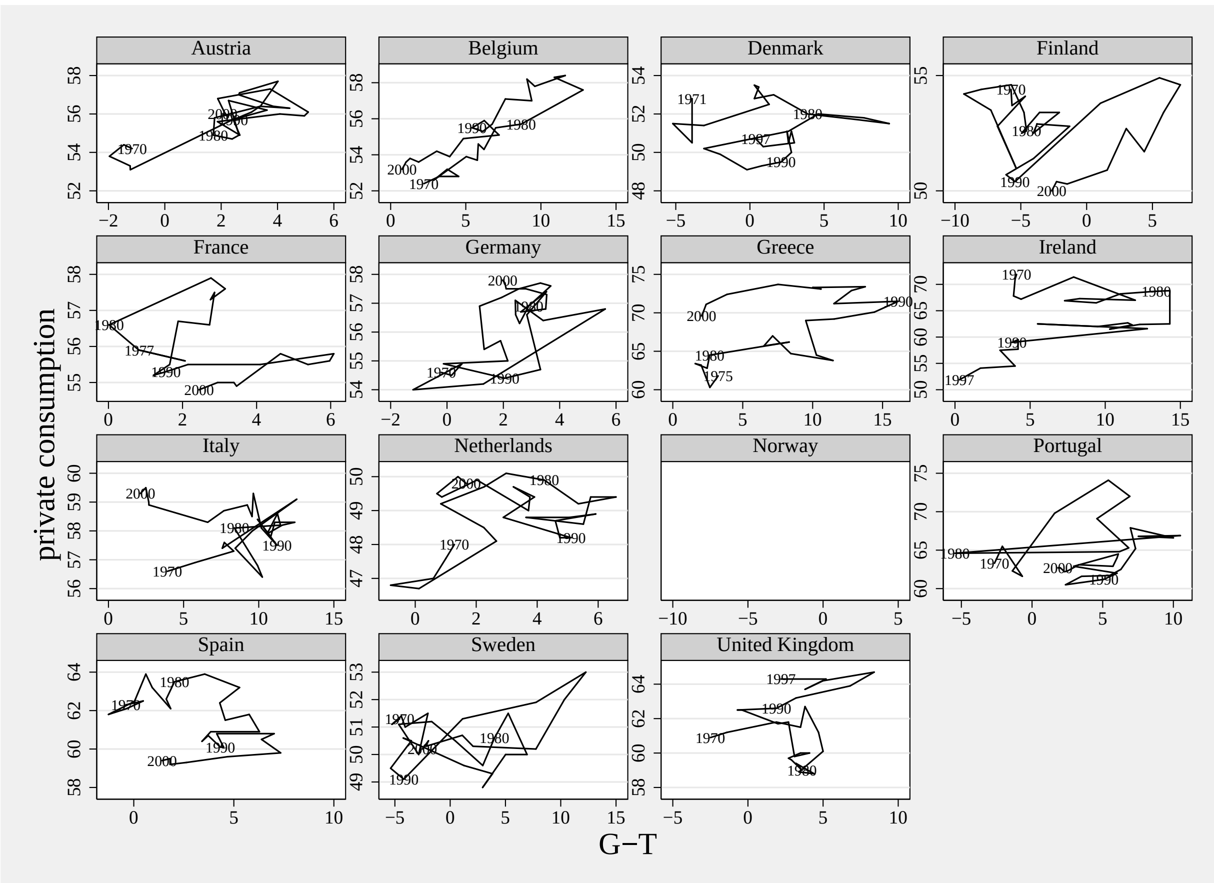


Figure 8.3: $C/(G-T)$ in the field

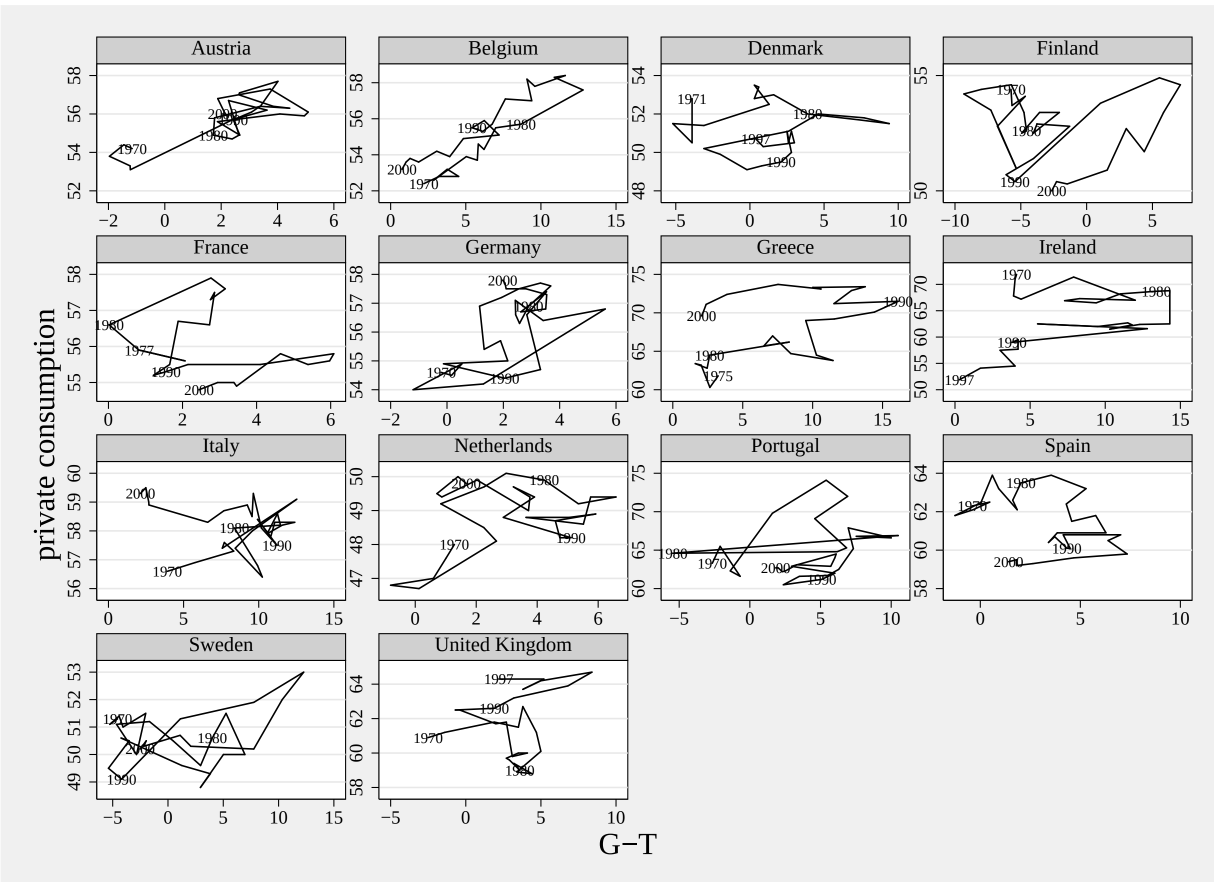


Figure 8.4: $C/(G+T)$ in the field

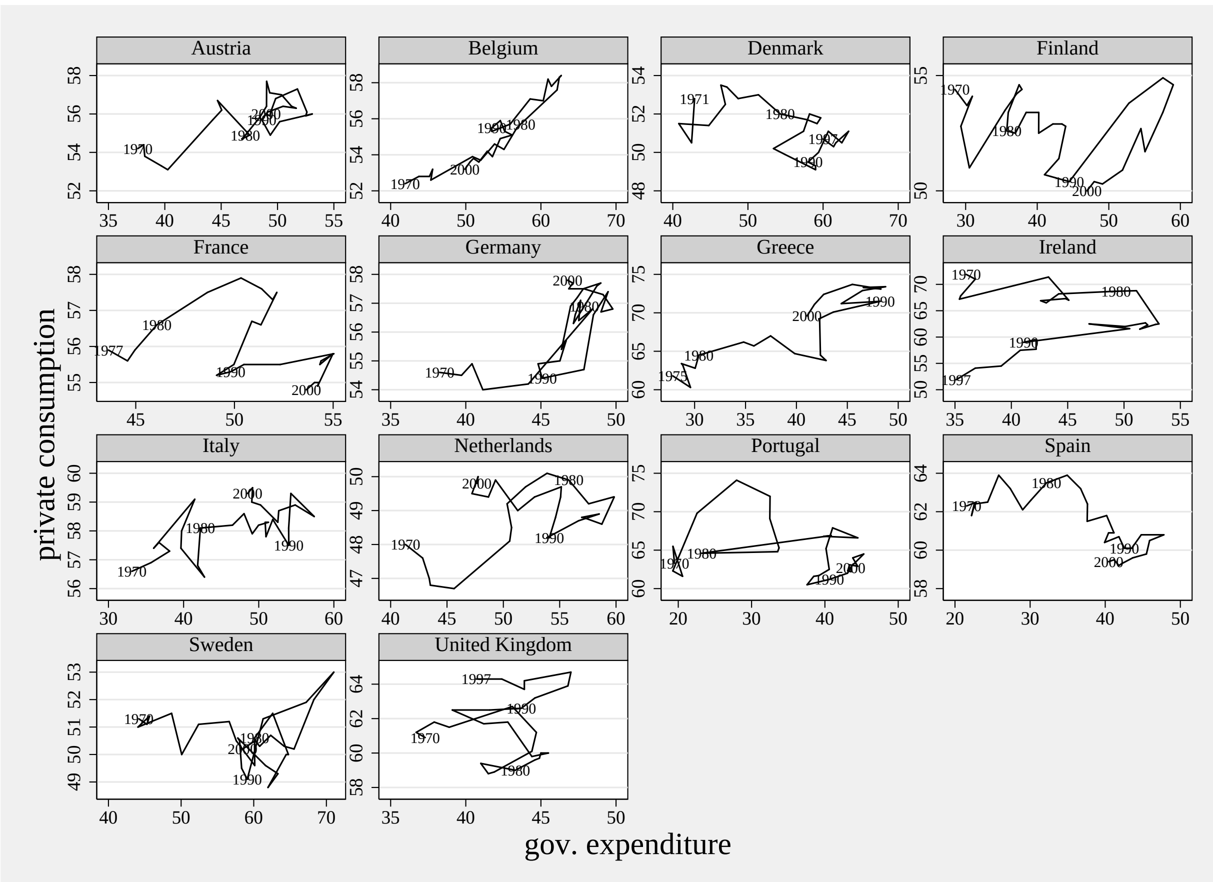


Figure 8.5: C/G in the field

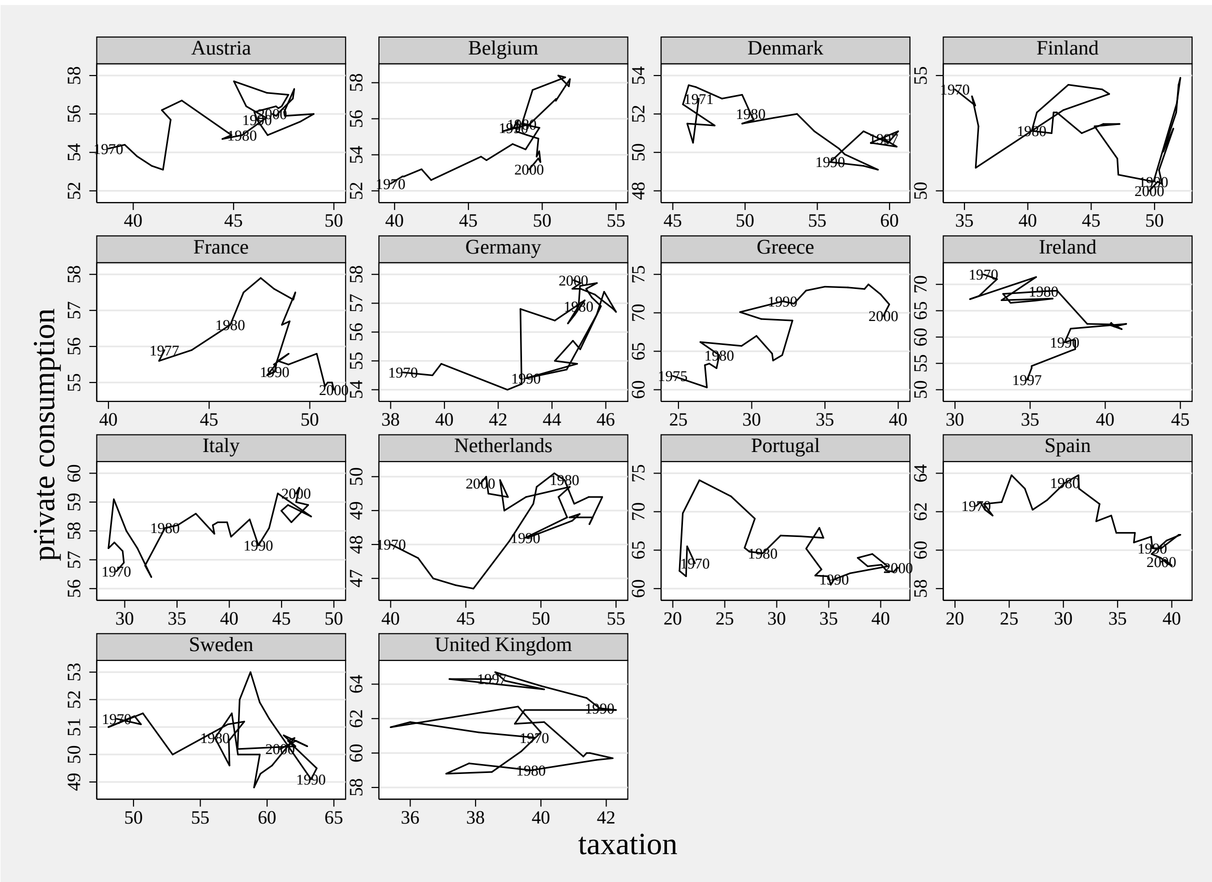


Figure 8.6: C/T in the field

- **tax-and-spend** hypothesis government as **Leviathan**, Friedman (78) Policy Review Buchanan and Wagner (78) JME
- bidirectional government trades off marginal cost and marginal benefits of public services Meltzer and Scott (81) Journal of Political Economy

8.2 Fiscal policy and consumption?

- fit models with a given causality with field data
  $\rightarrow$ Problem: true parameters are unknown. Any model can be fitted
- model with sparse structure $\rightarrow$ VAR

$$\begin{aligned}\Delta T_t &= f_1(&& \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \\ &&& \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t1}) \\ \Delta G_t &= f_2(&& \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \\ &&& \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t2})\end{aligned}$$

  - linear relationship
  - VAR model (few assumptions)
  - short run / long run causality

  $\rightarrow$ Problem: results are unclear / not significant

  $\rightarrow$ why should one be interested in the causality in the field anyhow?

Table 8.1: What is the impact of fiscal policy? why should we be interested in the field causality anyhow?

Model of the world:

$$\begin{aligned}\Delta T_t &= f_1(\Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t1}) \\ \Delta G_t &= f_2(\Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t2})\end{aligned}$$

- Consumers with rational expectations estimate this model and react accordingly ($\rightarrow C$)

$\rightarrow$ Do our consumers have rational expectations?

Austria	$T \leftrightarrow G$
Belgium	$T \leftarrow G$
Denmark	
Finland	$T \leftarrow G$
France	$T \leftarrow G$
Germany	
Greece	
Ireland	
Italy	
Netherlands	
Norway	$T \rightarrow G$
Portugal	$T \leftrightarrow G$
Spain	
Sweden	$T \rightarrow G$
UK	

Table 8.1: Causality in the field

How react consumers with general expectations on fiscal policy?

$$\begin{aligned}
\Delta T_t &= f_1(&& \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t1}) \\
\Delta G_t &= f_2(&& \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon_{t2}) \\
\Delta T^E_t &= f_1(&& \Delta T^E_{t-1}, \Delta T^E_{t-2}, \Delta T^E_{t-3}, \ldots, \Delta G^E_{t-1}, \Delta G^E_{t-2}, \Delta G^E_{t-3}, \ldots, \\
& && \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon^E_{t1}) \\
\Delta G^E_t &= f_2(&& \Delta T^E_{t-1}, \Delta T^E_{t-2}, \Delta T^E_{t-3}, \ldots, \Delta G^E_{t-1}, \Delta G^E_{t-2}, \Delta G^E_{t-3}, \ldots, \\
& && \Delta T_{t-1}, \Delta T_{t-2}, \Delta T_{t-3}, \ldots, \Delta G_{t-1}, \Delta G_{t-2}, \Delta G_{t-3}, \ldots, \epsilon^E_{t2})
\end{aligned}$$

How to get $\Delta T^E_t, \Delta G^E_t$?

- canonical answer: $\rightarrow$ with the help of rational expectations from field data?
- if the type of expectations is unknown $\rightarrow$ experiments?

experimental control

- in the field? $\rightarrow$ impossible

Participants are exposed to time series for for various european countries (values are % of GDP): $B, \Delta B, T$ and G

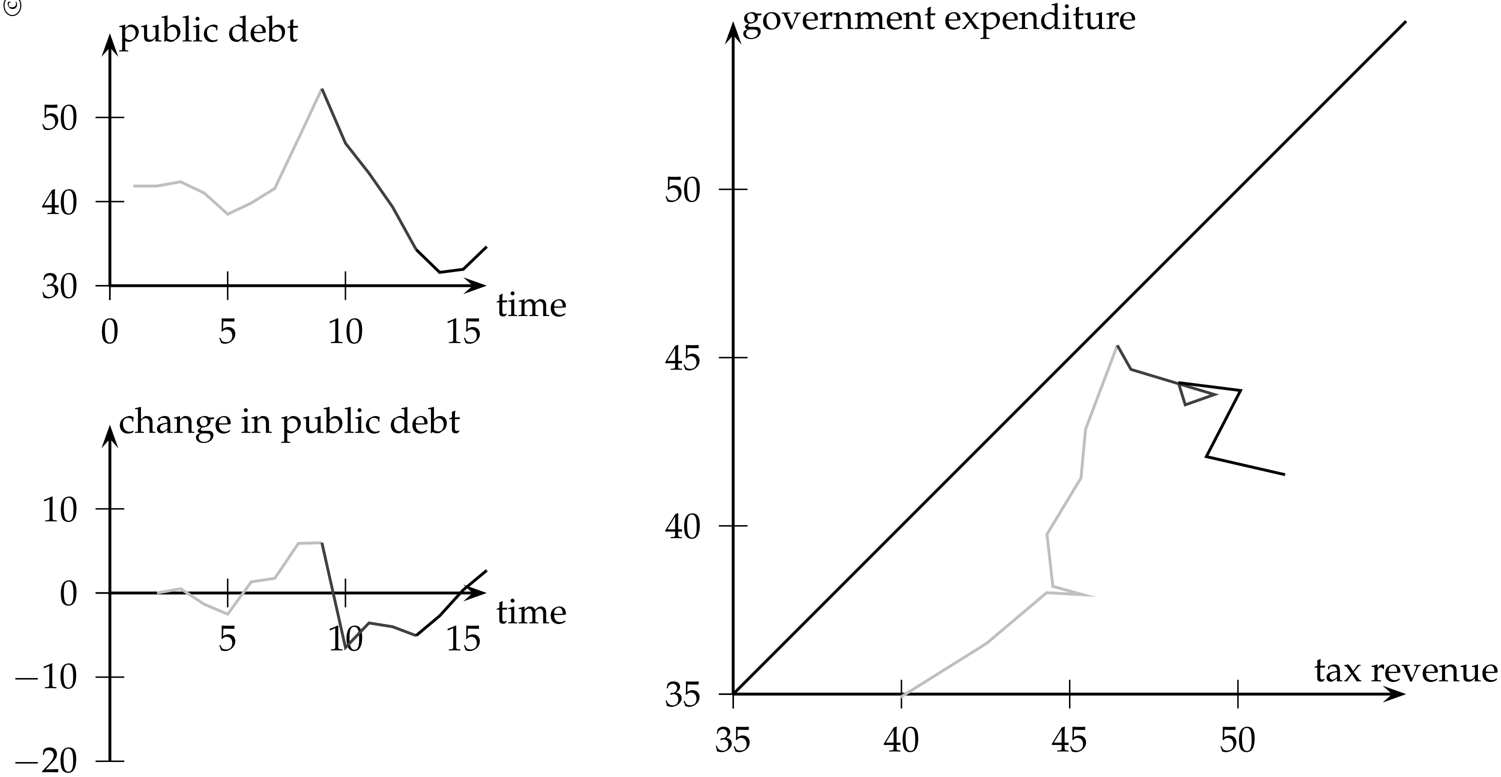


Figure 8.7: Interface in the experiment

- model economy with endogeneous T, G, T^E, G^E in the lab $\rightarrow$ rather demanding
- 1/2 model economy with exogeneous T, G, endogeneous T^E, G^E
  $\rightarrow$ use the following tool...

Participants derive utility from consumption in two subsequent periods:

$$u = (\gamma C_0 + (1-\gamma)G_0) \cdot (\gamma C_1 + (1-\gamma)G_1) \text{ (U)}$$

budget constraint:

$$(1 - C_0 - T_0)(1 + r) + 1 - T_1 = C_1 \qquad \text{with } r = 0.1 \text{(B)}$$

$i = 0$: forecast for $(\hat{T}_1, \hat{G}_1) \overset{(U,B)}{\longrightarrow}$ computer determines and implements the optimal C_0.

Participants are exposed to time series for for various european countries (values are % of GDP): $B, \Delta B, T$ and G

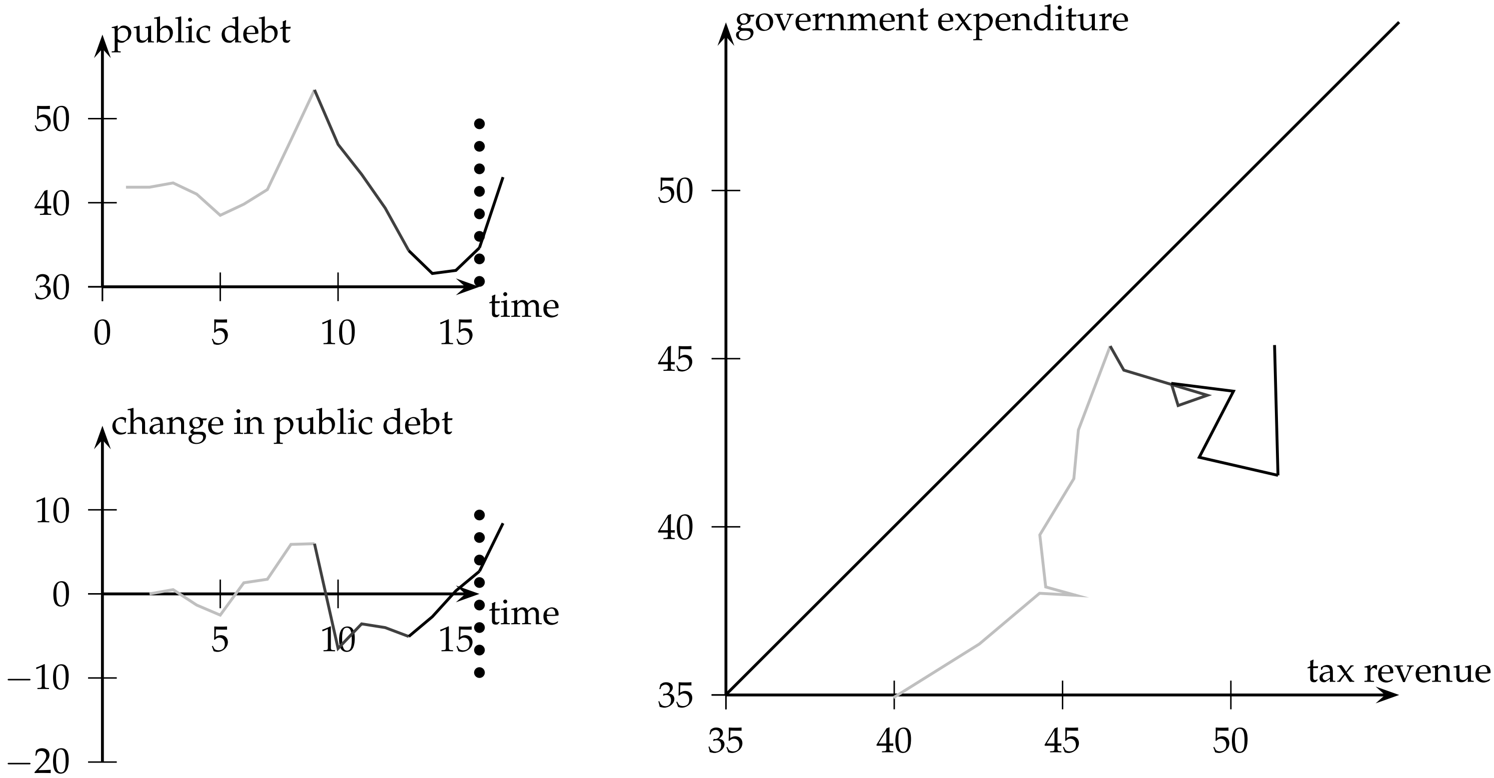


Figure 8.8: Interface in the experiment

Participants are exposed to time series for for various european countries (values are % of GDP): $B, \Delta B, T$ and G

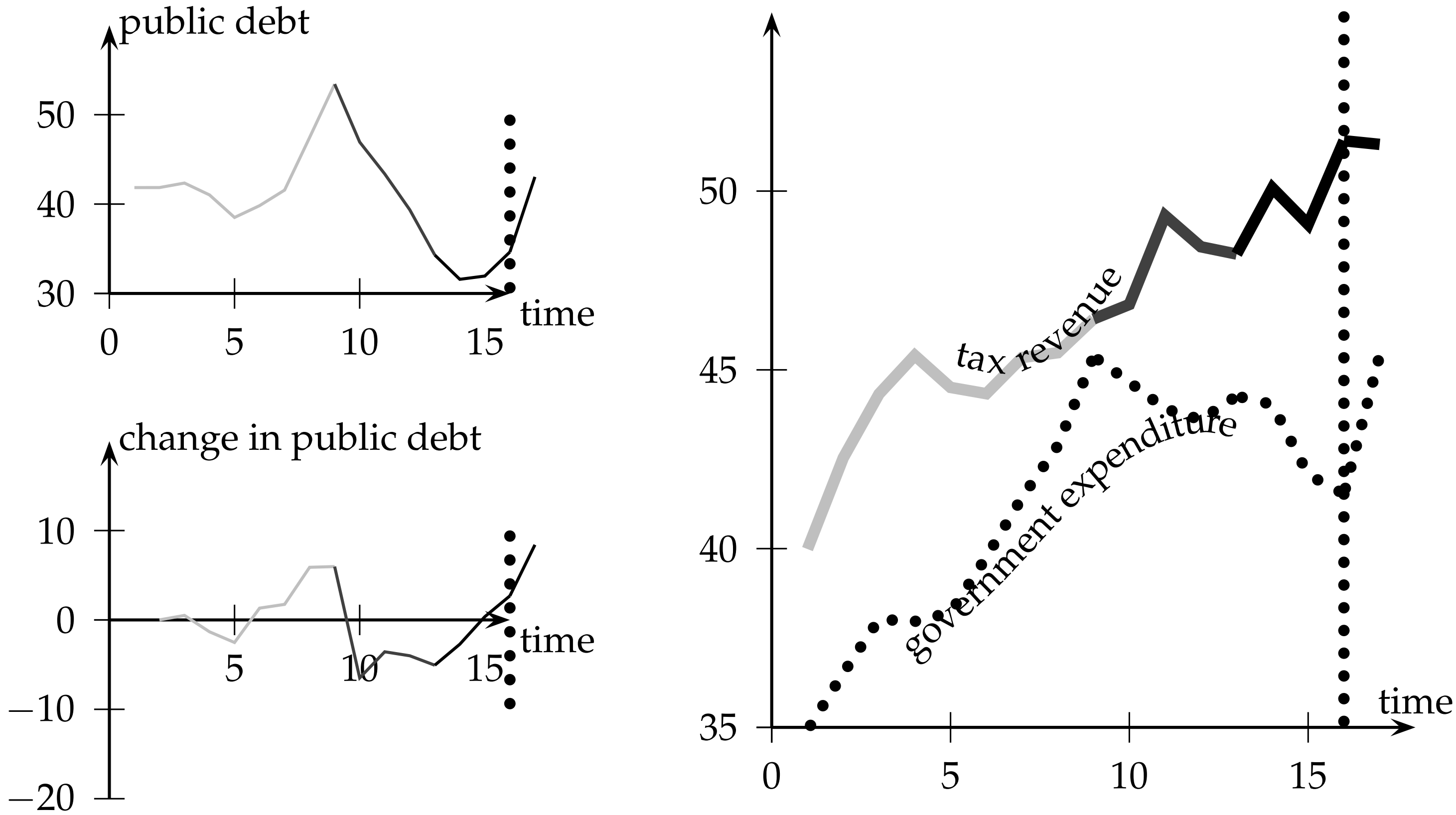


Figure 8.9: Interface in the experiment

Participants are exposed to time series for “variables, which are from a scientific context, which is measured at regular intervals”

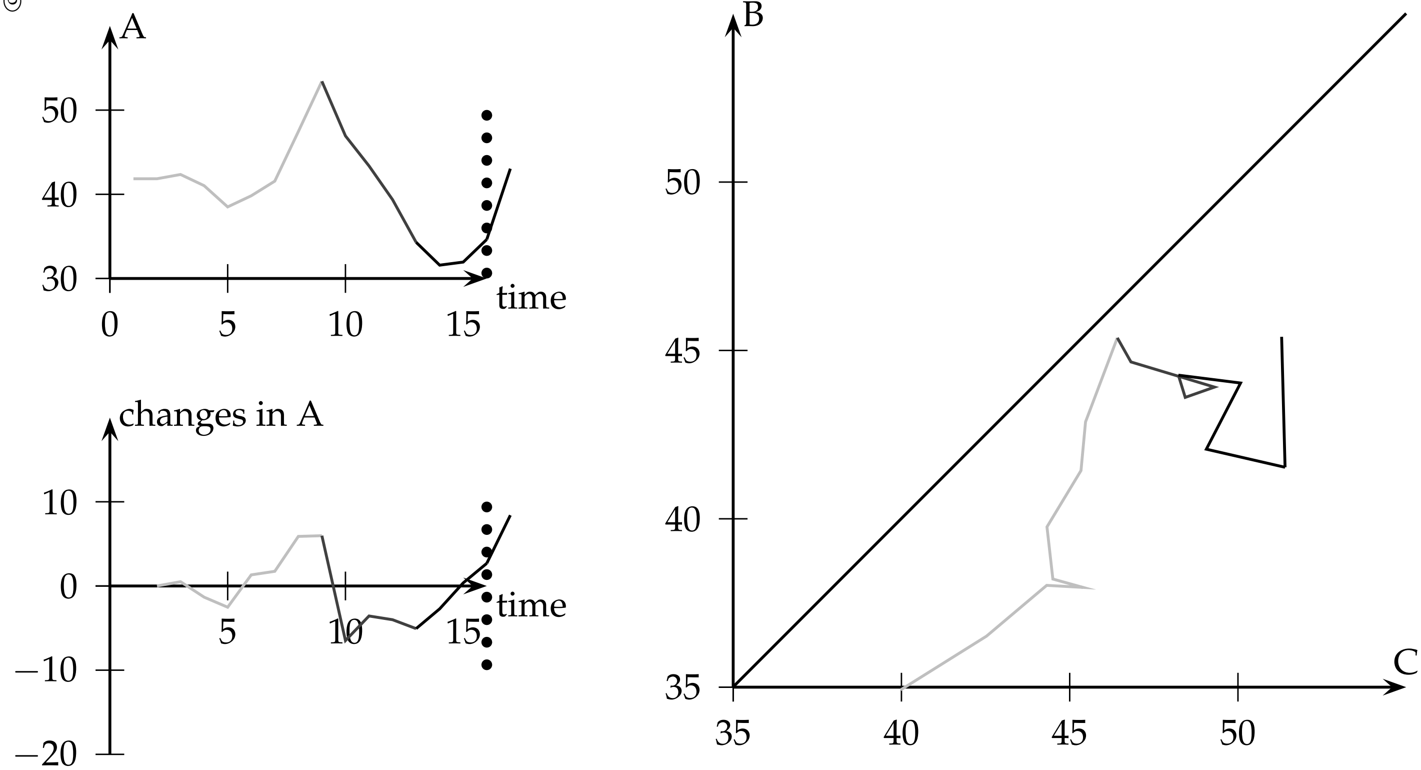


Figure 8.10: Interface in the experiment

$i = 1$**:** T_1, G_1 realise $\stackrel{(B)}{\longrightarrow} C_1 \stackrel{(U)}{\longrightarrow} u$

wage per minute $w = 0.3 \cdot (u/u^*)^\eta$ € with $\eta = 15000$ (T) or 12000 (T/G)

Internal validity? Internal validity?

- start with the field model, estimate a VAR with 5 lags
- eliminate non-significant lags
- Johansen procedure determines rank and cointegrating vector

⇓ Field data: mixed evidence ⇓

- Garcia and Henin (99) Economic Modelling
- Payne (98) Public Choice

	fiscal	neutral
other	23	26
economists	53	43

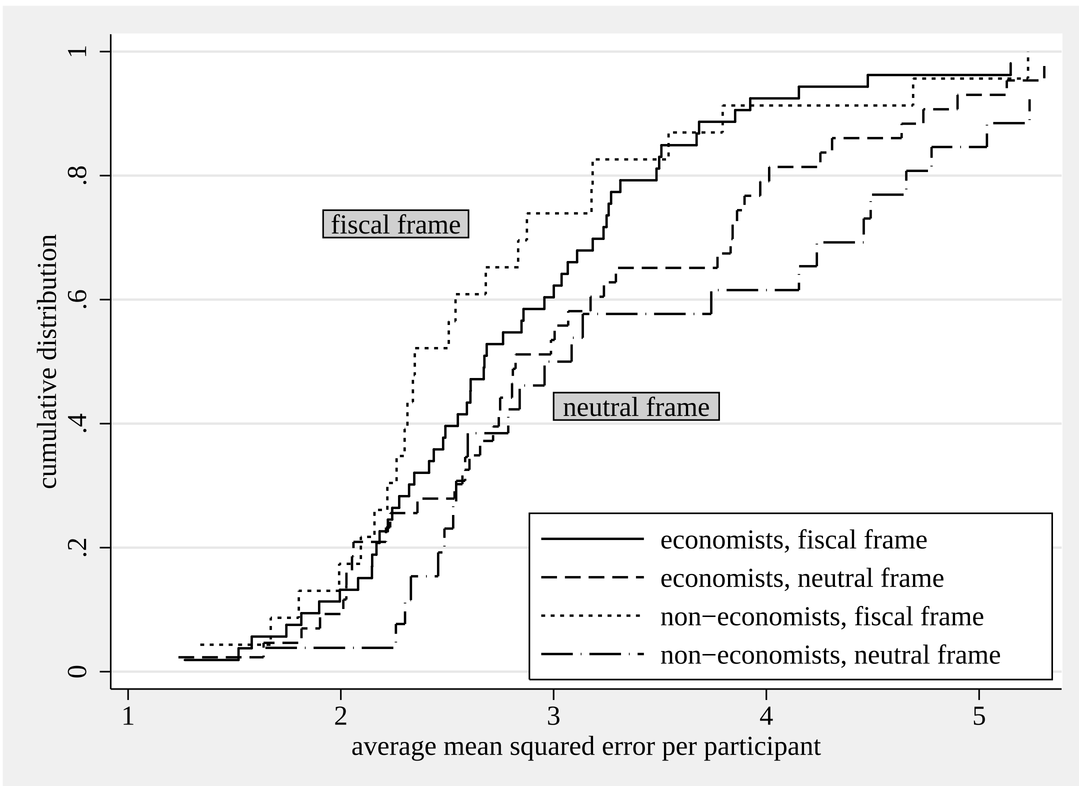


Figure 8.11: Internal validity?

	VAR order	$H_0(r_2 = 0)$ $H_1(r_2 = 1)$	Rang	cointegrating vector	test for stationary budget
Austria	$k = 3$	42.5^{***}	$r = 1$	$(1; -0.739; -10.385)$	-13.23^{***}
Belgium	$k = 2$	9.05	$r = 0$		
Denmark	$k = 2$	15.92	$r = 0$		
Finland	$k = 5$	27.99^{***}	$r = 1$	$(1; -0.565; -21.436)$	-28.29^{***}
France	$k = 2$	15.92	$r = 0$		
Germany	$k = 2$	19.40^{*}	$r = 1$	$(1; -0.572; -17.863)$	-4.32^{**}
Greece	$k = 2$	14.37	$r = 0$		
Ireland	$k = 2$	16.67	$r = 0$		
Italy	$k = 4$	18.19^{*}	$r = 1$	$(1; -0.892; 0)$	-1.72
Netherlands	$k = 2$	20.47^{**}	$r = 1$	$(1; -0.606; -17.630)$	-13.51^{***}
Norway	$k = 2$	18.42^{*}	$r = 1$	$(1; -1.051; 0)$	-3.52^{**}
Portugal	$k = 3$	49.12^{***}	$r = 1$	$(1; -1.177; 13.667)$	-2.09^{*}
Spain	$k = 2$	16.10	$r = 0$		
Sweden	$k = 2$	18.18^{*}	$r = 1$	$(1 : -0.950; 0)$	-2.13^{*}
UK	$k = 2$	23.42^{**}	$r = 1$	$(1; -0.922; 0)$	-9.18^{***}

Legend: *, **, *** denote rejection at, in the order, 10%, 5%, 1% significance level.

Table 8.2: causality field / lab, see table 8.3

	long run			short run		
	field	T_t, G_t	T_t	field	T_t, G_t	T_t
Austria	$T \rightarrow G$			$T \leftrightarrow G$	$T \leftarrow G$	$T \leftarrow G$
Belgium				$T \leftarrow G$	$T \leftarrow G$	$T \leftarrow G$
Denmark					$T \leftarrow G$	$T \leftarrow G$
Finland	$T \leftarrow G$		$T \leftarrow G$	$T \leftarrow G$	$T \leftrightarrow G$	$T \leftarrow G$
France				$T \leftarrow G$	$T \leftarrow G$	$T \leftarrow G$
Germany	$T \leftarrow G$				$T \leftarrow G$	$T \leftarrow G$
Greece						$T \leftarrow G$
Ireland					$T \leftarrow G$	$T \leftarrow G$
Italy	$T \leftarrow G$	$T \leftarrow G$			$T \leftarrow G$	$T \leftarrow G$
Netherlands	$T \leftarrow G$					$T \leftarrow G$
Norway	$T \rightarrow G$	$T \rightarrow G$		$T \rightarrow G$	$T \rightarrow G$	$T \leftarrow G$
Portugal	$T \leftrightarrow G$	$T \rightarrow G$		$T \leftrightarrow G$	$T \leftarrow G$	$T \leftarrow G$
Spain					$T \leftarrow G$	$T \leftarrow G$
Sweden	$T \rightarrow G$	$T \rightarrow G$		$T \rightarrow G$		$T \leftarrow G$
UK	$T \rightarrow G$	$T \leftarrow G$	$T \leftarrow G$		$T \rightarrow G$	$T \leftarrow G$

Table 8.3: causality field / lab

- long run causality:
  - no rational expectations
  - ambiguous even in the lab
- short run causality:
  - clear in the lab
  - ambiguous in the field

8.2.1 Antikeynesian regimes

- Sachverständigenrat (council of economic experts) (1981)
- Hellwig and Neumann (1987) Economic Policy
- Giavazzi and Pagano (1990) NBER Macroeconomics Annual

Persistent long run fiscal expansions and contractions have an Antikeynesian effect

What is a persistent long run contraction?

- McDermott and Wescott (1996) IMF Staff Papers
- Giavazzi, Jappelli, and Pagano (2000) European Economic Review

$\rightarrow$ reduction of the budget deficit for at least 2 years and for at least 1.5% of GDP.

8.2.2 Summary

- Method (field- and lab-data) + VAR in $\Delta T, \Delta G$
  - internal validity
- long run causality $T, G \rightarrow$ expectations:
  - no rational expectations
  - ambiguous in the lab and in the field
- short run causality:

	Fiscal Expansions			Fiscal Contractions		
		T_t, G_t	T_t		T_t, G_t	T_t
Belgium	'80-81	·	·			
Denmark	'80-82	−	·	'83-86	+	·
Finland	'91-93	·	·	'88-89	·	·
France	'92-93	·	·			
Greece	'88-90	·	·	'96-97	·	·
Ireland	'78-80	−	·	'83-84 '88-87	·	·
Norway	'91-92	·	·	'94-96	·	·
Spain	'81-82	·	·	'97-96	·	·
Sweden	'78-79 '91-93	·	·	'83-84 '86-87 94-96	·	+
UK	'92-93	−	·			

Table 8.4: Antikeynesian effect

  - ambiguous in the field
  - clear in the field $G \to T$

- Antikeynesian expectations

$x_t = (T_t, G_t)', y_{i,t} = (T_t^{E_i}, G_t^{E_i})',$

8.A Exercises

1. Fiscal Policy

   - What are the goals and tasks of fiscal policy?
   - Which instruments can be used to reach these goals?
   - How can experiments on fiscal policy help to achieve these goals?
   - What are the advantage of experiments on fiscal policy compared to other methods?

Chapter 9

Neuronomics

So far we have studied black-box models

- Behaviour can (sometimes) be approximated quite well.
- Mechanisms behind this behaviour remain abstract.

Idee

- Relate structures of the brain to economic concepts.
- Perhaps this gives us an idea how to structure economic concepts.
- Bilateral anterior insula, anterior cingulate cortex
  - emotions
  - Insula: disgust, anger
- Dorsolateral prefrontal cortex (DLPFC)
  - understanding, control, aims

Injuries

- Uncontrolled injuries
  - Phineas Gage

    * Change of behaviour after an accident
  - Language
  - Amygdala: Significance of emotions
  - Hippocampus: Long term memory

- Controlled injuries
  - remove the Amygdala in rats:
    * rat becomes docile, sexually inactive, not scared of enemies
  - Measurement of the potential of single neurons with primates

Brain activity and electricity

- Luigi Galvani (1783): Tissue of (dead) frogs
- Eduard Hitzig, Gustav Fritsch (1870): brains of (living) dogs (scull was removed without anesthetics, brains of wunded soldiers
- Electroencephalography (EEG)
  - good temporal resolution
  - bad spatial resulution

Magnetoencephalography (MEG)

- Measure the magnetic field of neural activity
  - good spatial resolution
  - measurement only at the surface of the brain, no access to deeper parts of the brain

Positron Emission Tomography (PET)

- Inject participants with a radioactive substance
- Measure radioactivity in the brain
  - More radioactivity—more blood—more activity
- temporal resolution in the order of magnitude of minutes and more.

fMRI (Functional Magnetic Resonance Imaging)

- neural activity needs oxygen
- magnetic properties of hemoglobin depend on oxygen level
- attach a strong magnetic field, this shifts protons in hemoglobin out of equilibrium
- when protons return to equilibrium they generate a tiny magnetic field

→ measure oxygen levels in the blood, temporal resolution of about 1 second

- apply an electromagnetic field to induce (weak) electric currents at a spefic location
- → neurons discharge an action potential
- may (rarely) cause seizures (abnormal neuronal activity in the brain)

Methods

- Impact of traumas
- EEG Electro-encephalogram
- MEG Magnetoencephalography
- PET (Positron Emission Tomography)
- fMRI (Functional Magnetic Resonance Imaging)
- TMS Transcranial Magnetic Stimulation

9.A Exercises

1. Neuroeconomic research
   - What are advantages and disadvantages of neuroeconomic research?
   - What criticism against neuroeconomics can you think of?
2. Neuroeconomic experiment

- Find a research question that can be answered with a neuroeconomic experiment.
- Find an experimental design to answer this research question.
- Describe how you would conduct this experiment.

Chapter 10

Using experiments

10.1 Ethics

Purpose of ethic committees

- IRB - institutional review board
- IEC - independent ethics committee
- ERB - ethical review board
- REC - research ethics committee
- NRES - national research ethics service
- HSC - human subjects committee

Ethical principles guide "human subjects research".

Research = systematic investigation with the aim to obtain generalisable knowledge.

Human subjects = living individuals of which the investigator obtains data through intervention or interaction or other identifiable private information.

- trade off between scientific merit versus harm to participants
- protection of the subject of research
- protection of the researcher

Ethic committees are common in. . .

- Medicine
- Biology
- Psychology

Examples from pharmaceutical science

Studies with sexually transmitted diseases PHS wanted to know whether penicillin could prevent infection with sexually transmitted diseases.

- 1944: injection of prisoners at the Terre Haute Federal Penitentiary in the U.S.A. with gonorrhea → gonorrhea is really a sexually transmitted disease, injections do not work well.
- 1946-48: Syphilis inoculation project in Guatemala.
  - 696 subjects (men in the Guatemala National Penitentiary, army barracks, men and women in the National Mental Health Hospital).
  - Prostitutes with the disease were used to infect subjects, but also direct inoculation.
  - Subjects then received penicillin.
  - → deception about infection

  (Susan M. Reverby, Journal of Policy History, 2010)
- 1932-72: "Tuskegee" Syphilis Study
  - 427 subjects (African American men) with late stage syphilis (assumed to be not contagious) plus 185 non-infected were not treated but observed.
  - → deception about non-treatment

  (Susan M. Reverby, Examining Tuskegee: The Infamous Syphilis Study and its Legacy, 2009)

TGN1412

- 2005/06: TeGenero (meanwhile bankrupt) develops and patents an antiinflammatory drug TGN1412 (rheumartoid artritis, multiple sclerosis, leukemia).
- clinical tests with animals and with human blood are promising
- 13. March 2006: phase I clinical trials with 14 healthy humans at Parexel (blind test, experimenter does not know, which drug is administered, 8 participants obtained placebo, 6 participants obtained 1/500 of the highest dose used before safely with crab-eating macaques, participants obtained £2000)
- $\rightarrow$ unexpected adverse reaction with all six participants: multiple organ dysfunction syndrome

Clinical trials with humans:

- Phase I: few (20-80) and healthy participants. Measure side effects, start with safe dosage
- Phase II: 100-300 participants, measure treatment effect, safety
- Phase III: 1000-3000 measure treatment effect, compare with other drugs, side effects, safety
- Phase IV: after market release: observe risks and side effects, optimal application

Thalidomide

- 1953: Grünenthal develops and patents Thalidomide.
- Experiments with animals show: not toxic.
- Experiments with humans abroad show that it is an effective tranquiliser and painkiller.
- 1957: Sold as a sleeping drug (no risk of suicide), in particular for pregnant women to prevent morning sickness.
- 1961 teratogenicity is realised in Germany.

$\rightarrow$ 8000–12000 children with birth defects

Examples from social psychology

Milgram Experiment in social psychology (Obedience to Authority Study, Stanley Milgram, 1963), experiments began 1961 at Yale University, one year after Adolf Eichmann trial in Jerusalem.

Coverstory:

- Investigate learning behaviour with positive and negative feedback, depending on the type of the teacher.
- participants are "randomly" allocated the role of a learner/teacher.
- participant believes that 'learner' is another participant
- participant believes that 'learner' receives actual electro-shocks
- participant believes that each of the four verbal encouragements to continue are spontaneous

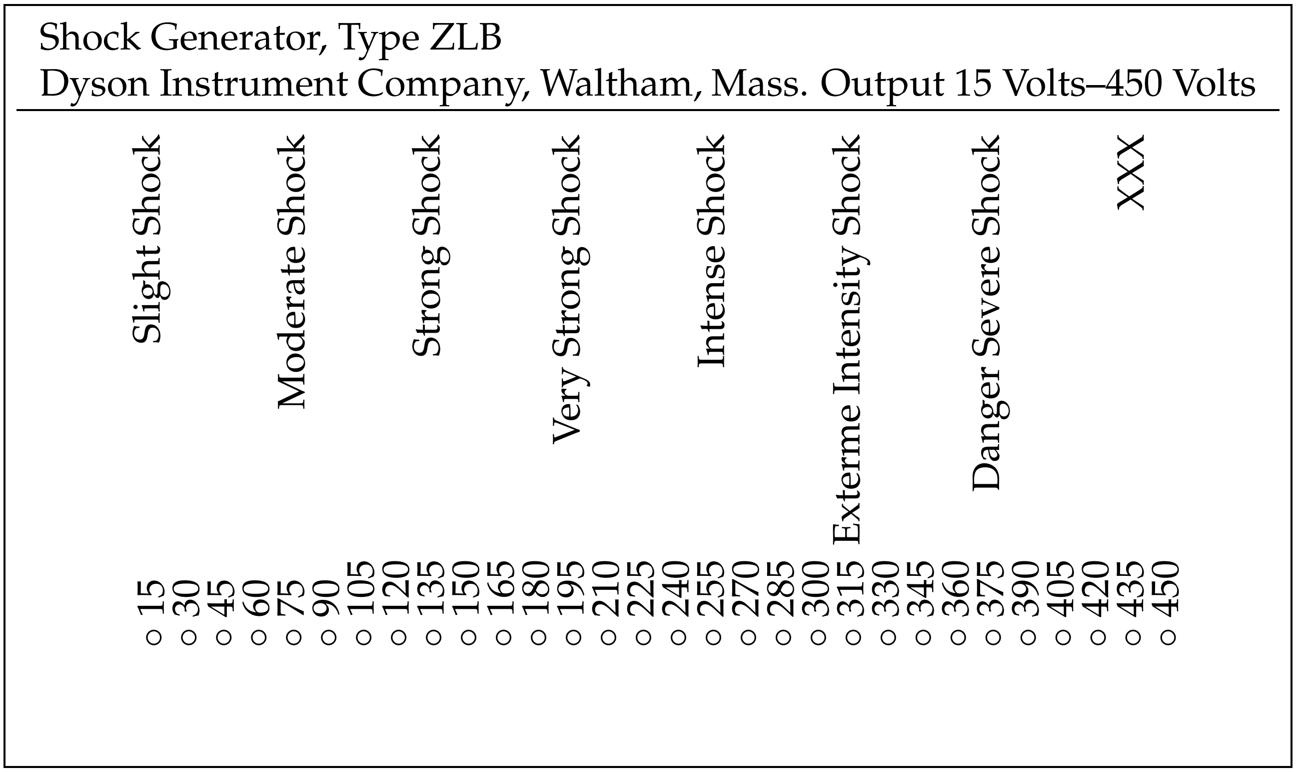
1. Please continue / please go on
2. The experiment requires that you continue
3. Is is absolutely essential that you continue
4. You have no other choice, you must go on

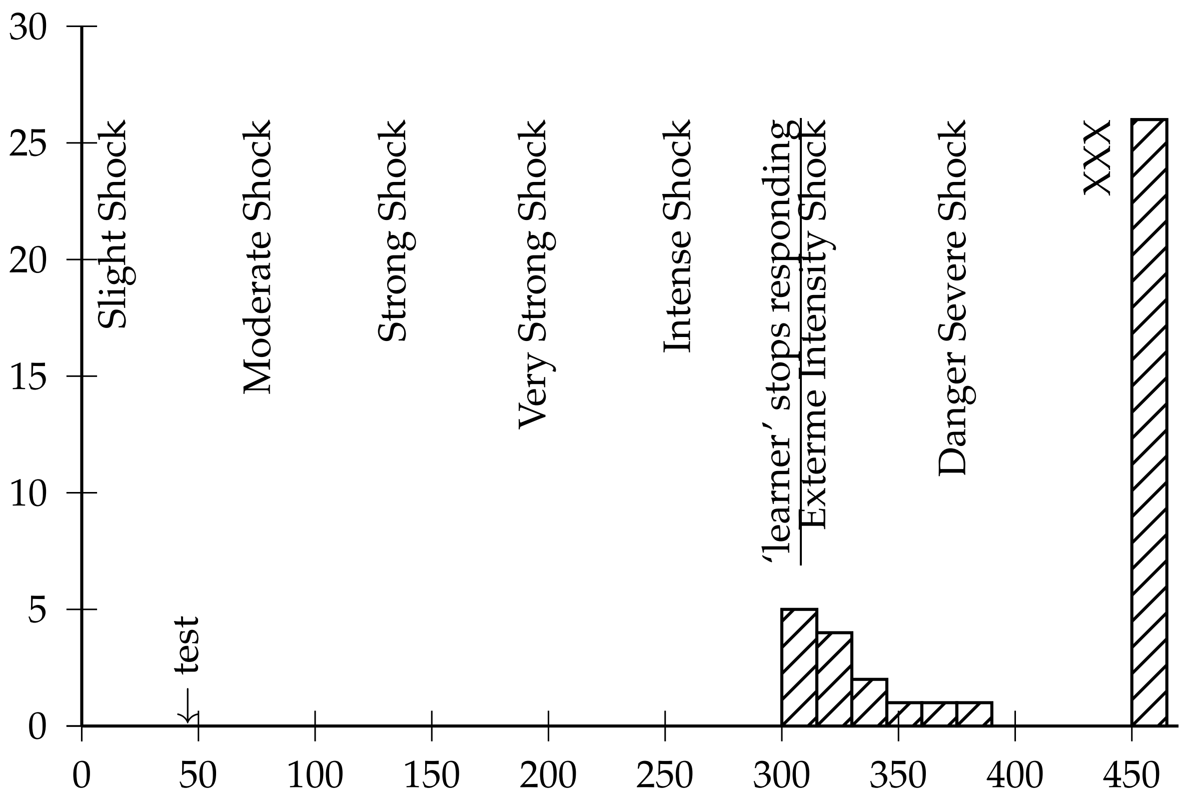
If participants ask whether shocks are damaging:

> "although the shocks may be painful, there is no permanent tissue damage, so please go on."

If participants wonder whether learner might prefer to stop learning:

> "whether the learner likes it or not, you must go on until he has learned all the word pairs correctly. So please go on."





- → between 61%-66% of participants go to 450V level.
- → participants suffer extreme emotional stress

Stanford prison experiment Philip Zimbardo (1971), to test whether prison guards and convicts are self-selecting, which lead to poor conditions in prison → no.

Asch conformity experiment Solomon Asch (1951), vision test, judgement of length of several lines.

- participants did not know that other participants where confederates of the experimenter.

Rosenhan experiment Validity of psychiatric diagnosis (David Rosenhan, 1972)

- 8 pseudopatients: healthy people gained admittance to 12 psychiatric hospitals, acted normally, and were not identified as impostors. All were discharged with schizophrenia "in remission"
  - participants did not even know they were participating in an experiment.
- non-existent impostors: During 3 months among 193 patients 41 were diagnosed impostors, and 42 suspect (there was not a single impostor).
  - participants were led to believe that there was an impostor.

- Milgram experiment
- Stanford prison experiment
- Asch conformity experiment
- Rosenhan experiment

What harm can be done to participants in economic experiments?

- Grading as payment device — may or not measure learning objectives
- Classroom experiments — may not be in line with teaching objectives
- Experiments with high stakes
- False information / decption (is this an ethical or a pragmatic concern?)
  - about the purpose of the experiment / about the game being played
  - omitting information / giving false information

  * playing against computers (e.g. what do real participants do if they face a particularly generous / selfish opponent)
  * false feedback (e.g. entitlement before bargaining experiments to motivate specific demands)
- Debriefing

→ distrust any instructions given in further settings, loose internal validity in future experiments

→ Rules of the game must be known — otherwise the experimenter could save a lot of money (e.g. trust game)

10.2 Implementation of experiments

Terms

- Experiment: several treatments, several sessions
- Treatment: Experiment + specific parameters
- Session: Experiment at a given date with a given group of participants
- Round: short (repeating) part of a session

date	participants	monetary policy
9.5.1997	12	dynamic, constant, dynamic
15.5.1997	6	constant, dynamic, constant
12.12.1997	17	dynamic, constant, dynamic
⋮	⋮	⋮

10.2.1 Types of experiments

Where

- classroom-experiments
- laboratory
- field

How

- paper-and-pencil experiments
- computerised experiments
  - expensive (you need to maintain a lab, you need skills to program software)
  - less contamination of subjects, more experimental control, more speed (in particular in markets), more accuracy.
  - Sharing a lab with a computer pool may be difficult, since lab experiments tend to be planned on short notice, need all computers, . . . they are very disruptive.

10.2.2 Experimental control

1. internal validity
   (a) simple experimental structure
   (b) simple instructions
   (c) "neutral" instructions (Strategies A+B)
   (d) anonymity
   (e) honesty, no deception
   (f) incentives
   - monotonic
   - salient (in contrast to questionnaires, hypothetical questions)
   - dominant

   (g) Script
   - welcoming the subjects
   - assigning to seats
   - assigning to roles in the experiment
   - presentation of instructions by outside
   - how to deal with questions

   Hawthorne Effect (1920th, 1930th: General Electric: how does lighting, rest period, workroom layout, length of workday,. . . affect productivity? Test at Hawthorne plant: whatever you do, productivity is increased).

e.g.: ultimatum game

1. is the structure simple, are the instructions simple?
2. framing as a trade $\leftrightarrow$ framing as splitting a pie
3. payoff in money
4. subject with low opportunity cost
5. subject with high learning ability

Direct / indirect control Direct control of neighbouring parameters, e.g. full factorial design

Indirect control of unobservable parameters: randomisation (random allocation of participants to treatments, seats, etc.)

e.g. sellers and buyers in a market experiment should not get their roles according to their arrival time at the lab.

Within-subject design / accross subject design

- shoe-leather test (left/right different leather),
- not trivial if sequence effect is possible
- Within subject: ABA treatment, sequence effects, BAB treatment is necessary
- Accross subjects: more noise

10.2.3 Workplace for participants

- Enough space
- Temperature, etc.
- Anonymity
- but also credibility (other participants are visible, random draws or market prices are publicly visible)

10.2.4 Conducting an experiment

- Lab log
- Pilot experiments
  - to scale payoffs
  - to check software, instructions, coordination, timing
- recruitment (computerised, paper+pencil), punishment for non-shows
- conductors
- monitors (to ensure credibility)
- instructions: written / oral (demand effect, but more clear)
- dealing with questions
- dry-run periods
- termination of infinite-period experiments
- debriefing
- payment in cash
- bankruptcy
- emergency plan

10.3 Data analysis

- descriptive analysis
  - to make other people familiar with your data
  - to find anomalies
- hypothesis testing
  - hypotheses developed before running the experiment
  - hypotheses developed after running the experiment

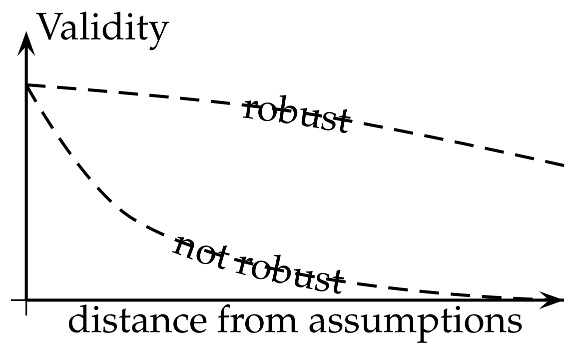
- units of observation
  - measurement error
  - sampling error (we always have a subsample of the population)
    - random samples
    - balanced samples
    - selection biases among participants (cash rewards)
  - learning effects: correlations within a group — splitting groups
- non-parametric tests
- parametric tests

10.4 Testing theories — parallelism

students who play for small amounts of money in the lab ↔ traders at stock exchange

how can we generalise from our experiments?

- induction
  - theory has the same problem, sometimes even worse:
    - why should the theory hold in the field?
- if a theory (which claims to be general) holds in the lab, that is already a good sign
- if a theory does not even hold in the lab (where we can control most assumptions), why should the theory then hold in the field?
- if somebody comes with a second theory to explain why the lab experiment has different properties than the field, then we can test this with another experiment.



10.4.1 Summary

- Testing **robustness** of economic theories
- developing new economic theories
- theory-free what-if studies

10.A Exercises

1. Deception
   - Deception is usually not used in economic experiments. Why? What could happen if one used deception?
2. Incentives
   - Economic experiments are usually incentivized. Why?
   - Why do researchers usually use money to incentivize experiments?
3. Framing
   - What is framing in an experimental context?
   - Most experiments are unframed. Can you think of experiments where you expect framing to play a role? Name a few.
4. Types of experiments
   - Experiments can, for example, be conducted in the class room, in a laboratory, or in the field. Explain which of the methods is useful for which kind of experiment.

- Experiments can, for example, be conducted with paper and pen or with computers. Can you think of situations where one of the methods is more practical than the other and the other way around?

5. Exam 2005, exercise 1a

   In order to integrate long-term unemployed back into work life the unemployed are asked to participate in a qualification program. Before introducing this costly qualification program on a national level the unemployment agency would like to conduct a field experiment to check how effective the program really is.

   Discuss the following suggestion: The unemployment agency in Jena will ask all unemployed in Jena and proposes them to participate in a 6-month qualification program. Participation will be free of charge. The researchers expect that some, but not all long-term unemployed will participate in the program. The researchers plan to compare the salary of the people that were asked to participate and actually did so and the people who were asked to participate but did not make use of the offer after one year. If the participants of the program receive a significantly higher salary the unemployment agency will assume that the program is successful and introduce the program nationwide.

   - Which assumptions have to be made to justify these conclusions? What are advantages and disadvantages of this experimental design?

6. Subjects

   - In many experiments students are used as subjects. What are advantages of this kind of subject pool? Can you think of any disadvantages?

7. Cross-cultural experiments

   - Experiments can be conducted in different countries. What kind of questions can be answered with cross-cultural experiments?
   - What do you have to take into account when conducting cross-cultural experiments?