Johannes-Gutenberg University Mainz
Bachelor of Science in Wirtschaftswissenschaften

Macroeconomics II: Behavioural Macro

Summer 2017

Klaus Wälde (lecture) and Jean Roch Donsimoni (tutorials)

www.macro.economics.uni-mainz.de
February 22, 2017

Contents

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1 The idea of this lecture

1.1 Some background on behavioural macro

- The state of affairs of behavioural macro
- Some articles (no textbook) but very few
- Akerlof (2002) "Behavioral Macroeconomics and Macroeconomic Behavior"
- Why behavioural macro is very important
  - bring more psychology into economics (Rabin, 2013)
  - bring more of economic methods into psychology

1.2 The structure of the lecture

1. Emotional economics
    (a) The role of emotions in economic research (historical background)
    (b) Modern emotion research in economics
    (c) Why emotions matter (going beyond economics)
2. Behavioural economics
    (a) Bounded willpower and automatic behaviour
    (b) Time (in) consistency
3. How behavioural macro could look like
    (a) Unemployment and time-inconsistency
    (b) Growth, cues and automatic behaviour
    (c) Business cycles and anxiety

4. Wealth distributions and redistribution

   (a) How wealth distributions look like in the real world

   (b) How we can understand wealth distributions (using also behavioural features)

   (c) How the inequality of wealth can be reduced

Part I
Emotional Economics

2 Introduction

We ask three questions

1. Which role do emotions play in economic research?
2. How do economists model emotions?
3. Why care about emotions at all? A bold conjecture

- Which role do emotions play in economic research?
  - What did classical economists think about emotions (e.g. in the form of utility)?
  - How does neoclassical economics think about emotions?
  - Utility and emotions in behavioural economics

- How do economists model emotions?
  - Economists work on a long list of emotions (elation, surprise, fear, guilt, envy ...)
  - Some take psychological emotion research into account, some are motivated by economic findings
  - We go through central emotion models from economics to see who does what

- Why care about emotions at all?
  - Psychologists: obvious human trait
  - Economists: obvious human trait?
  - Emotion are key to solving three most pressing human problems
  - These are: stress, divorce and global warming
  - See below for further details

Some background from the literature

- Psychological literature: what is an emotion?
  - Kleinginna and Kleinginna (1981) present and discuss a list of 92 definitions of emotions
  - Discrete emotion terms: Shaver et al. (1987) → see their table
  - More recent list is in Sacharain et al. (2012) → see their figure
  - Various surveys by George Loewenstein on emotions and decisions (Rick and Loewenstein, 2008, Loewenstein and Lerner 2003)
  - Wälde and Moors (2016) provide a survey on 'emotion research in economics'

- The valence-arousal view

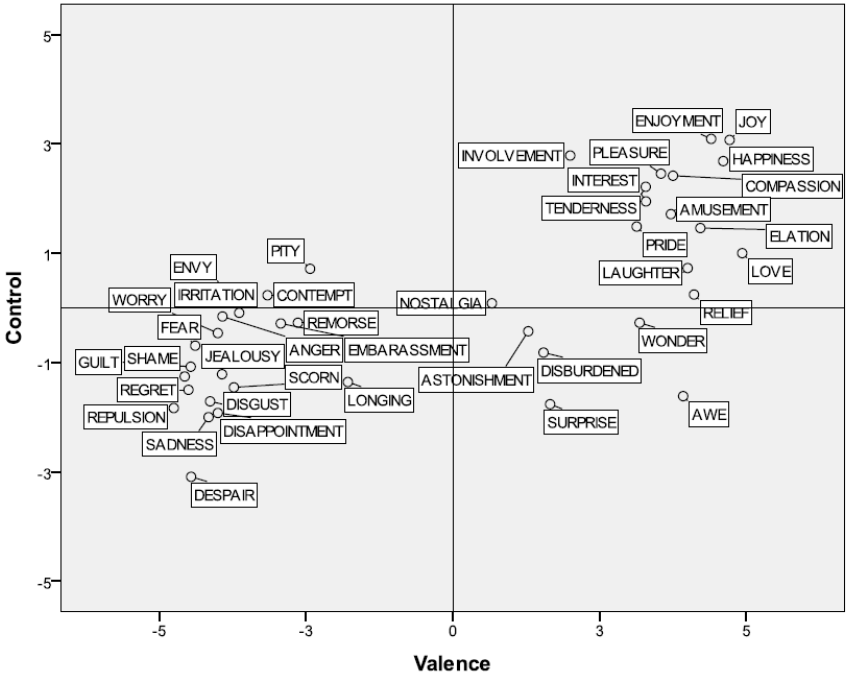

Figure 1 *Valence vs control of emotions (Sacharin et al. 2012)*

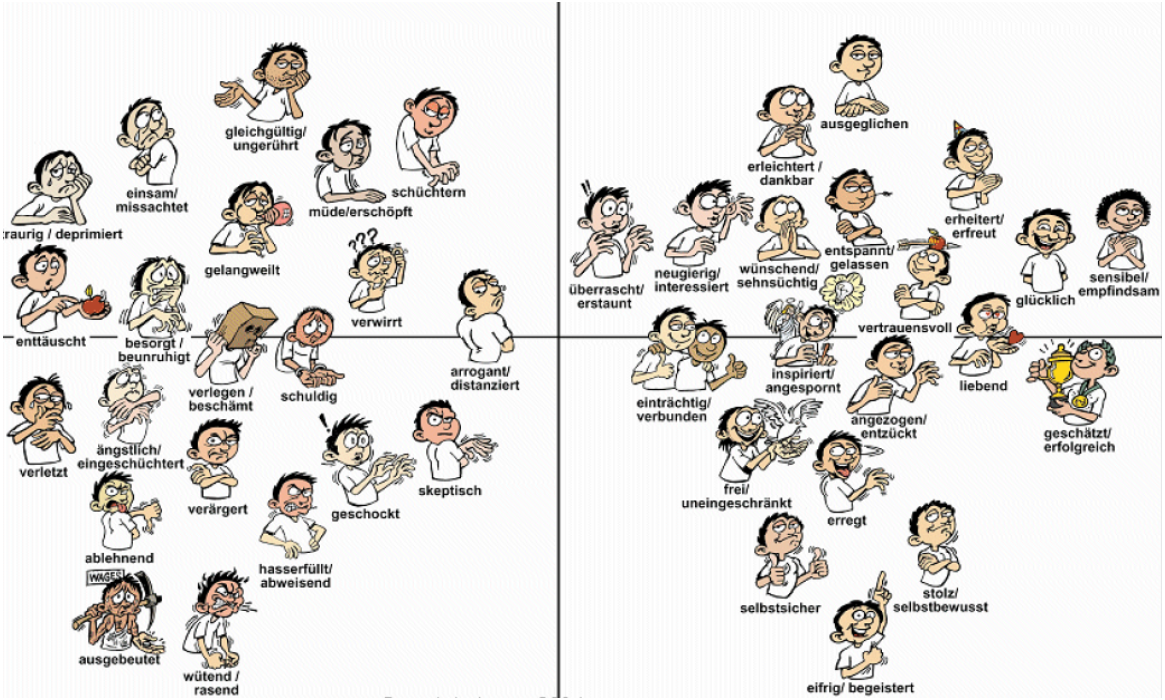

Figure 2 *Valence vs arousal (http://www.absatzwirtschaft.de/images/emotion.gif)*

Some background from the literature

- Economic literature (surveys)
  - Elster (1998 JEL, philosopher, political scientist) "Emotions and Economic Theory"
  - "economists mainly try to explain behavior, emotion theorists try to explain emotions" (p. 47)
  - His central question: "How can emotions help us explain behavior for which good explanations seem to be lacking?" (p. 48)

Classification of emotions (generalizing Elster)

- Emotions directed towards oneself or other, towards behaviour, characteristic and possession and positive or negative (2x3x2)

positive			negative		
	oneself	other	oneself	other	
behaviour	*pride*	*admiration*	*guilt*	*anger*	behaviour
characteristic	*pridefulness*	*liking*	*shame*	*hatred*	characteristic
possession	*pridefulness*	*altruism* $u\left(c^A, c^B\right)$	*shame*	*envy* $u\left(c^A, c^B\right)$	possession

- Emotion directed towards possession of others: envy (also: malice, indignation, jealosy) requires $\frac{\partial u\left(c^A, c^B\right)}{\partial c^B} < 0$, altruism requires $\frac{\partial u\left(c^A, c^B\right)}{\partial c^B} > 0$
- More or less unclear cases: contempt, disgust, romantic love, boredom/stress, interest, sexual desire

- Classification of emotions by time structure
  - Anticipatory emotions: fear, hope, suspense
  - Ex post emotion
    - General: joy and grief
    - Counterfactual emotions (relative to expectation): regret, rejoicing, disappointment, elation
  - Immediate emotions and visceral factors: excitement, arousal, hunger, thirst, tiredness, pain

- The economic literature
  - Elster (1998) again
    → ignores specific emotion analyses (Regret theory by Loomes and Sugden, 1982, 1986, disappointment aversion by Gul, 1991) but most emotion papers come after 1998
    → talks a lot about emotions in books by Gary Becker (to be covered)
  - Loewenstein (2000) "Emotions in Economic Theory and Economic Behavior"
    → Economists (at that time) looked at anticipated emotions (regret, disappointment) which are *not* felt at the moment of the decision making (and are only cognitively perceived)
    → Psychologists focus more on immediate emotions (which are an example of visceral factors) which *are felt* at the moment of decision making (anger, fear, hunger, thirst ...)
    → Visceral factors can be dealt with as state-dependent preferences

- The economic literature (cont'd)
  - DellaVigna (2009, JEL) "Economics and psychology: evidence from the field"
    → looks at emotions in section 4.5: "two examples of emotions, mood and arousal, for which field evidence is available"
    → no conceptual analysis
  - Sobel (2005, JEL)
    → inquires into the nature of reciprocal behaviour (intrinsic vs instrumental)
    → probably strongly related to feelings about another person, but no mention of feelings ...
  - Mindless and mindful economics (Gul and Pesendorfer vs. Camerer in Caplin and Schotter, eds., 2008)
    → should we use non-choice data?
    → or should we allow for brain-data (or questionaire data)?
  - Wälde (2016) surveys emotion research in economics (background for this part of the lecture)

3 Which role do emotions play in economic research?

We look at the following economic fields

- Classical economics
- Neoclassical economics
- The current view/ behavioural economics

3.1 Emotions in classical economics

- The natural place to look for emotions in economic thinking is the field of 'utility theory'
- Adam Smith in his "The Wealth of Nations" (1776) used the term 'utility' to denote the "value in use" of a certain good (as opposed to the "value in exchange" (Stigler, 1950, p. 307)
- The hedonic concept of utility was then made popular by Jeremy Bentham in 1789 with his "Introduction to the Principles of Morals and Legislation"
- He suggested to measure utility by measuring "pleasure and pain". He also talked about "happiness" when discussing the effect of wealth on a person
- Jevons strongly denied that utility could be measured stating that "we can hardly form the conception of a unit of pleasure or pain" and that the idea of "quantities of feelings" is out of question (Stigler, 1950a, p. 317)
- Yet, he cleary perceived utility resulting from an object as a feeling
- Utility theory in economics, initially, was all about feelings

3.2 Absence of emotions in neoclassical decision making?

- Two approaches in economics to decision making (see Mas-Colell et al., 1995, ch 1)
  - Preference-based approach
  - Choice-based approach
- In both cases, an individual chooses among a set X of alternatives. Examples include
  - $X_1 = \{\text{become an economist, engineer, philosopher}\}$
  - $X_2 = \{(4,1), (1,4), (2,3)\}$ where the first pair stands for (study $4h$, see friends for $1h$)

- Preference-based approach
  - Traditional approach in economics
  - The fundamentals ("below which" there is no theory) of this approach are preferences of a decision maker
  - These preferences represent the decision maker's tastes
  - Rationality axioms are imposed on these preferences and the implied choice behaviour is then studied
- Choice-based approach
  - Primitives of decision making is the choice behaviour
  - Consistency axioms are imposed on these decisions and the implied decision process is studied

3.2.1 Preference-based approach

- Starting point is the set X of alternatives with an element x and another element y
- Tastes of decision maker are described by "preference relationships"
- Preference relationships are denoted by the symbol $\succsim$
- $x \succsim y$ means "x is at least as good as y"
  - becoming an economist (x) is at least as good as becoming a philosopher (y)
  - (study $4h$, see friends for $1h$) is at least as good as (study $3h$, see friends for $2h$)

- Definition of rationality of a preference relationship (see Exercise 3.4.1)
  - A preference relationship $\succsim$ is rational if it possesses the following two properties:
    (a) Completeness: for any x and y, either $x \succsim y$ or $y \succsim x$ or both hold
    (b) Transitivity: for any x, y and z, if $x \succsim y$ and $y \succsim z$ then $x \succsim z$
  - (Compare this to "rational" in everyday language)
- Completeness sounds obvious but not so clear in practice
  - Think of any tough choice with lots of trade-offs
  - become an economist (x) or become a philosopher (y)?
  - Have children or not? Have 1, 2 or 3?
  - Go on wonderful sunny-beach holiday in winter but pollute the environment?
- Transitivity is at least as strong an axiom as completeness
  - If you prefer macro over micro and micro over econometrics, do you still prefer macro over econometrics?
  - In theory, it is simple, with real-world examples, there are always very many dimensions to be considered, some of which are more present (salient) than others

- What is a utility function?
  - A utility function $u(x)$ that represents a preference relation $\succsim$ is a function for which

$$x \succsim y \Leftrightarrow u(x) \geq u(y)$$

- A first result
  - Given a choice set X, a preference relationship $\succsim$ and a definition of rationality, we find:
  - A preference relationship can be represented by a utility function only if it is rational
- In other words
  - When we work with a utility function that represents a preference relationship, then the latter must be rational
  - We assume completeness and transitivity in all of our economic models as soon as we write down a utility function (in most cases)

3.2.2 Choice-based approach

- Starting point (here as well) is the set X of alternatives
- Budget set $\mathcal{B}$ is a set of subsets of X – in words: Budget set is exhaustive list of feasible choices
- As an example, consider a consumption-leisure choice

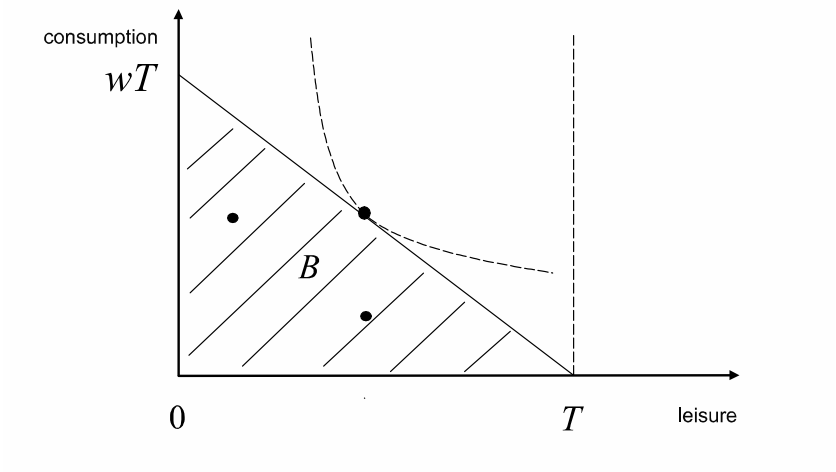

Figure 3 *Consumption-leisure choice (see next slide for background)*

- The consumption-leisure choice (formal description)
  - Budget constraint
    $$c = w\,[T - l]$$
    where c is consumption, w is the real wage, T is time endowment and l is leisure
  - Budget set $\mathcal{B}$ is the shaded area including the budget constraint
  - subsets of X are e.g. the three dots (can be on the budget line or below)
- Choice rule $C(\mathcal{B})$
  - assigns a set of chosen elements for the budget set $\mathcal{B}$
  - (example from Micro I: tangency point between indifference curve and budget line)
  - note that we have not yet introduced any notion of utility function or other

- Now impose some "reasonable" restrictions on budget set $\mathcal{B}$ and choice rule $C(\mathcal{B})$
  - originally proposed by Samuelson (1947, Foundations of Economic Analysis)
  - Weak axiom of revealed preferences implies: if $C(\{x, y\}) = x$, then $C(\{x, y, z\}) = y$ is excluded (see Exercise 3.4.1)
- Definition of "revealed preference relation $\succsim^*$"
  - Formal statement
$$x \succsim^* y \Leftrightarrow \text{if } x, y \in \mathcal{B} \text{ then } x \in C(\mathcal{B})$$
  - In words: x is revealed preferred to y if x is chosen whenever both x and y are feasible (i.e. are in the budget set, i.e. can be afforded)
- Interesting feature of this approach
  - Individual choice is analysed with fundamentals that can be observed
  - We do not need unobservable "preference relationships" but we can work with observable "revealed preference relations"

- What do approaches share?
  - In both cases, the objective is to understand decision *making*
  - This suggests that this is a process that requires some e.g. thinking
  - Approaches might also allow to capture automatisms
- What is the difference between these two approaches?
  - Preference-based approach works with objects (preferences) which can *not* be observed (in some objective sense)
  - Choice-based approach works with objects (choices) which can be observed
  - A theory of decision making (even though decisions take place in some "black box") can be built on observables only
- Choice-based approach very much in line with "positivism"
  - Philosophy of science (Carnap, Schlick, Wittgenstein) which states that
  - all knowledge either comes from logical derivations (like in mathematics) or is based on objective observations
  - Introspection (pleasure and pain, questionaire answers) and intuitive knowledge are rejected

3.2.3 Emotions in neoclassical decision making or not?

- Mainstream view
  - Emotions do not play a role in preference-based or choice-based approach to decision making
  - Mas-Colell et al. (1995) write (about the choice-based approach) "theory of individual decision making need not be based on a process of introspection but can be given an entirely behavioral foundation"
  - Varian (1992) writes (about preference-based approach) "A utility function is often a very convenient way to describe preferences, but it should not be given any psychological interpretation"
- My reading of the choice-based approach
  - clearly "observation-only" structure
  - behaviouristic approach (in the psychological sense), positivists (in philosophical sense) should be happy
  - no emotions around, simply not needed, all based on objectively observable quantities

- My reading of the preference-based approach
  - As always with economic methods: open for any extension, extremely flexible setup
  - What are preference relationships? Tastes! (Mas-Colell et al., 1995)
  - I prefer x to y means (can be understood as) I have a more positive feeling when I own x as compared to y
  - Preference-based approach is perfect to put emotions into economic model building
  - Economics is open for a "cognitive revolution" (cmp. Brandstätter et al., 2010) as it took place in psychology

- Are there emotions in neoclassical decision making or not?
  - There are not, at least in standard interpretation of textbook decision models
  - There are in alternative interpretations (preference relationships describe feelings)
  - There is room for allowing for emotions in textbook setups
- We can use economic tools
  - to understand emotions
  - to understand the effect of emotions on decisions
- (This could even be 'standard economics' as defined by Gul and Pesendorfer, 2008, see also Camerer, 2008)

3.3 Emotions in behavioural economics – the current view

- Behavioural economics goes further than state-dependend preferences
- Among the many departures, one big departure consists in making a distinction between
  - decision utility and
  - experienced (or true) utility
- People phrase this distinction in different ways
  - "What makes individuals happy ('true utility') differs from what they choose. Economic welfare analysis should use true utility rather than the utilities governing choice ('choice utility')" (Gul and Pesendorfer, 2008)
  - An example (from Kahneman et al., 1997): A person suffering from amnesia has two toasters in his kitchen. The toaster on the right functions normally. The toaster on the left delivers a painful electric shock when the toast is removed. Because of the amnesia, the person is always indifferent between the toasters, her decision utility for using the two toasters is equal. Experienced utilities are quite different
  - Maximizing decision utility will not maximize experienced utility
  - This example raises "doubts about a methodology in which observed choices provide the only measure of the utility of outcomes" (Kahneman et al., 1997, p. 376)

3.3.1 Back to Bentham

- Building blocks of Kahneman, Wakker and Sarin (1997): four building blocks
  - two notions of experienced utility
    - instant utility as "a measure of hedonic and affective experience" based on immediate subjective reports
    - remembered utility is based on subjective "reports of the total pleasure or displeasure associated with past outcomes"
  - total utility: normative concept based on instant utility "according to a set of normative rules"
  - decision utility: inferred from choices
- Basic idea
  - instant utility is how the individual feels at a certain moment
  - remembered utility is a biased account of instant utility
  - decisions are biased and do not maximize instant (or total) utility

- Character of this paper
  - suggests a research programm – does not answer all questions that are raised
  - "The relations among the various utility concepts define a complex agenda for research"
- Can we measure all of this?
  - instant utility: Experience sampling (instantaneous report at random point in time of various preprogrammed questions)
  - remembered utility: questionaires
  - decision utility: observe choices

- Summary
  - Feelings are at the center of understanding human behaviour
  - Decision does not necessarily maximize well-being
  - Individuals do not necessarily do what is best for them ("therapeutic approach" of behavioural economics)
  - BIG difference to neoclassical approach: utility maximization and decision are the same (by construction)

3.3.2 Happiness literature

- A by now well established (empirical) literature studies the determinants of "happiness"
  - Happiness is measured by self-reports of subjective well-being
  - Typical question read (from Benjamin et al., 2012, p. 2083)
  - "All things considered, how satisfied are you with your life as a whole these days?"
  - "Taken all together, how would you say things are these days—would you say that you are very happy, pretty happy, or not too happy?"

- A short history of happiness research (see Frey and Stutzer, 2002, p. 403 onwards and references therein)
  - Easterlin (1974) – does happiness rise when countries become richer over time? (No → Easterlin paradox)
  - Clark and Oswald (1994), Di Tella, MacCulloch, and Oswald (2001), Ohtake (2012)
    * unemployed workers are less happy than employed workers (at otherwise identical characteristics - see Exercise 3.4.2)
    * but see Gielen and van Ours (2014): activation policies still needed despite unhappy unemployed workers

– argue that self-reports of subjective well-being are a good measure of utility of an individual

- The link between happiness research/ subjective well-being and (utility) theory
  - There is no link between choice-based approach ("objective well-being", Frey and Stutzer, 2002) and measures of subjective well-being ("subjective well-being")
  - Frey and Stutzer (2002) see measures of subjective well-being as "complementary path to study the world"
  - Aghion et al. (2016) undertake a remarkable (empirical and theoretical) study of the effect of turnover on life-satisfaction
    - In this paper, "(l)ife satisfaction is captured by the average present value of an individual employee" (p. 3874), i.e. by the value function from dynamic programming (intertemporal utility under optimal behaviour)
    - This is the return of Bentham again, the utility function is seen as representing *experienced* utility
- Conclusion
  - Happiness research in economics is all about emotions
  - Integration into theoretical structures of economics still needed (beyond Aghion et al., 2016)

- Some interesting empirical questionnaire findings come from Benjamin et al. (2012)
  → choices are determined by their effect on (expected) subjective well-being
  → choices are also influenced by "sense of purpose", "control over life", "family happiness" and "social status"
- Many ideas and "stylized facts" for explanations available, explanations (theory) still missing

3.3.3 Experienced utility vs decision utility in theory

- Regret theory
  - Loomes and Sugden (1982) explicitly put themselves in the tradition of Bernoulli and Marshall
  - They understand the choiceless utility function they employ as "the psychological experience of pleasure that is associated with the satisfaction of desire"
  - They write about "the utility being experienced" in choiceless situations
- Disappointment (vs. elation) theory
  - Loomes and Sugden (1986) follow the same approach
  - Experienced utility depends on utility from outcome and on some reference point
  - Reference point is prior expectation (see below for details)
- Evolutionary efficiency and happiness
  - Rayo and Becker (2007) model happiness as a tool to rank alternatives
  - Happiness is a decision making device

- Explains why measures of happiness return to their mean in the long run (see Easterlin paradox)
- Another example of hedonic view of utility

3.4 Exercises

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3.4.1 Decision-making: preference- and choice-based approaches

1. *Weak axiom of revealed preferences* – Imagine you discuss with your friend what to do on the weekend. The choice is between *cinema* and *theatre*. You leave the choice to your friend and s/he chooses *theatre*. Next weekend comes and a big *pop concert* takes place. You leave the choice again to your friend and s/he chooses *cinema* this time. You recall the weak axiom of revealed preferences and you feel puzzled. Why?

2. *Rationality* – Given that the choices of your friend puzzled you, you now say, next weekend I decide. You tell your friend I always prefer *cinema* to *theatre* and I always prefer *theatre* to *pop concert*. Next weekend, you have the choice between *cinema* and *pop concert* and you suggest to go to the *pop concert*. Now your friend tells you that you are not rational. You recall the definition of rationality, What do you reply to your friend?

3.4.2 Happiness and unemployment (Clark & Oswald, 1994)

1. Why are the findings by Clark & Oswald (1994) so surprising to economists compare them to the standard life-cycle model of labour supply by Heckman (1974)?

2. How can we interpret the regression table (Table 3 in Clark & Oswald (1994))?

4 How do economists model emotions?

4.1 Background: Expected utility maximization

- Before we go deeper into models of emotions, we need some background related to uncertainty
  - How does homo oeconomicus treat risk?
  - Answer: s/he maximizes expected utility
- We take a standard example from business cycle analysis as motivation
  - This extends business cycle analysis from Macro I to allow for uncertainty
  - Will be used later in this lecture when looking at business cycles and anxiety
  - A textbook treatment is in Wälde (2012, ch. 8.1.4)

- Budget constraints
  - An individual lives for two periods
  - [We could allow for uncertainty in one-period setup or in many periods as well]
  - Budget constraint in the first period (period t)

$$w_t = c_t + s_t$$

    where w_t is the wage, c_t consumption and s_t stands for savings in t
  - Budget constraint in the second period (imagine individual is retired) reads

$$(1 + r_{t+1})\, s_t = c_{t+1}$$

    where left-hand side is income in period $t+1$ (savings plus interest r_{t+1} on savings) and right-hand side is consumption expenditure
  - [Identical to setup in Makroökonomik I]
  - Now assume that the interest rate r_{t+1} is uncertain, i.e. its value is not known in the first period t

- Describing uncertainty
  - How do we model this uncertainty technically? We make r_{t+1} a random variable
  - We assume that r_{t+1} is a *discrete* random variable with realisations $r_{i,t+1}$ and probabilities p_i with $i = 1...n$ such that $\Sigma_{i=1}^{n} p_i = 1$
  - As a consequence, the individual in period t does not know the consumption level c_{t+1}
  - A random variable is an example of what decision theorists call a lottery: A collection of outcomes and their probabilities
  - For our example, the lottery (without the time index) is $(r_1, p_1, r_2, p_2, ..., r_n, p_n)$
  - Some authors define a lottery as the collection of probabilities only $(p_1, p_2, ..., p_n)$

- Preferences
  - Individual consumes in both periods
  - Instead of the "Makro I" utility function $U_t = \gamma \ln c_t^y + (1-\gamma) \ln c_{t+1}^o$, we write

$$U_t = u(c_t) + \beta u(c_{t+1})$$

    (i.e. we generalize the utility function from ln to some concave $u(.)$)
  - We also need to take uncertainty into acount: The individual needs to form expectations as consumption c_{t+1} is uncertain

$$U_t = u(c_t) + \beta E_t u(c_{t+1})$$

  - E_t is the expectations operator saying that individual forms expectations in t and takes all knowledge in t into account
  - We talk about a *expected utility maximizer*, when the utility function is of the Neumann-Morgenstern form, i.e. when we write

$$E_t u(c_{t+1}) = \Sigma_{i=1}^n p_i u(c_{i,t+1})$$

  - In words: there are utility levels $u(c_{i,t+1})$ for each outcome $c_{i,t+1}$ and p_i is the probability of this outcome

- Solving the maximization problem
  - First, replace consumption levels by expressions from budget constraints
  - This gives nice trade-off for choosing s_t

$$U_t = \{u(w_t - s_t) + \beta E_t u((1 + r_{t+1}) s_t)\}$$

  - Next, let us be clear, what this expectations operator is
  - Then, assuming that the individual forms *rational expectations*, we write

$$E_t u((1 + r_{t+1}) s_t) = \Sigma_{i=1}^{n} p_i u((1 + r_{i,t+1}) s_t)$$

  - Forming rational expectations means that the individual uses (i) the correct model and (ii) probability distributions to form expectations (e.g. Sargent, 2008)
  - The individual knows how (i) utility is related to savings and interest rates and (ii) correctly applies probabilities to realizations of utility

- Solving the maximization problem (cont'd)
  - Finally, we compute the first order condition

$$\begin{aligned}\frac{dU_t}{ds_t} &= \frac{d}{ds_t}\left\{u\left(w_t - s_t\right) + \beta\Sigma_{i=1}^{n} p_i u\left(\left(1 + r_{i,t+1}\right) s_t\right)\right\} \\ &= -u'\left(w_t - s_t\right) + \beta\Sigma_{i=1}^{n} p_i u'\left(\left(1 + r_{i,t+1}\right) s_t\right)\left(1 + r_{i,t+1}\right) = 0\end{aligned}$$

  - We rewrite this as

$$\begin{aligned}u'\left(w_t - s_t\right) &= \beta\Sigma_{i=1}^{n} p_i u'\left(\left(1 + r_{i,t+1}\right) s_t\right)\left(1 + r_{i,t+1}\right) \\ &= \beta E_t\left\{u'\left(\left(1 + r_{t+1}\right) s_t\right)\left(1 + r_{t+1}\right)\right\}\end{aligned}$$

  - Using the budget constraints again, we get

$$u'\left(c_t\right) = \beta E_t\left\{u'\left(c_{t+1}\right)\left(1 + r_{t+1}\right)\right\}$$

- Understanding the first-order condition
  - First-order condition again

$$u'(c_t) = \beta E_t \{u'(c_{t+1})(1 + r_{t+1})\}$$

  - Optimal behaviour from the perspective of t compares marginal utilities – just as in deterministic worlds where the optimality rule would read

$$u'(c_t) = \beta u'(c_{t+1})(1 + r_{t+1})$$

    (only expectations operator is missing)
  - There are many possible marginal utilities in $t+1$ depending on the value the interest rate will take (i.e. on its realization)
  - The individual therefore looks at some average marginal utility (taking the term $1 + r_{t+1}$ also into account) where the weights for each realization is the probability p_i
  - The role of the discount factor β and the interest rate $(1 + r_{t+1})$ is the same as in the deterministic world

- An example
  - Let us use a Cobb-Douglas utility function

$$U_t = \gamma \ln c_t + (1-\gamma)\, E_t \ln c_{t+1}$$

  - We get simple rules for optimal behaviour

$$\begin{aligned} c_t &= \gamma w_t \\ s_t &= (1-\gamma)\, w_t \\ c_{t+1} &= (1+r_{t+1})\,(1-\gamma)\, w_t \end{aligned}$$

- Is there any uncertainty left?
  - Yes, r_{t+1} is unknown in t and so is c_{t+1}
  - This implies that realized consumption in $t+1$ differs from expected consumption

4.2 Ex-post emotions

- Models that analyse regret and elation
  - Disappointment theory of Bell (1985)
  - Regret theory by Loomes and Sugden (1982, 1986)
  - See Bleichrodt and Wakker (2015) for an appraisal of regret theory
  - Disappointment aversion by Gul (1991)
  - Comparison of various approaches by Grant, Kajii, Polak (2001)

4.2.1 Loomes and Sugden (1982) – regret and rejoicing

- Fundamental aspect: individuals compare the outcome of their choices to certain alternatives
- Experienced utility includes (standard) utility from the choice per se but also regret or rejoicing relative to the alternative
- An example
  - Imagine an individual can spend holidays at the beach in Italy (option 1) or in France (option 2)
  - She decides to go to Italy ...
  - ... but there is less sun than in France → she would regret
  - ... and there is more sun than in France → she would rejoice

- The utility function
  - (modified) utility of the individual is given by

$$u\left(c_{1j}, c_{2j}\right) = c_{1j} + R\left(c_{1j} - c_{2j}\right)$$

    where c_{1j} is utility from the choice of option 1 in state j, c_{2j} is utility from choice 2 in state j and $R\left(.\right)$ measures regret or rejoicing
  - Individual compares utility when choosing action 1 to utility from action 2
  - This comparison leads to regret (when $c_{1j} - c_{2j} < 0$) or rejoicing (for $c_{1j} - c_{2j} > 0$)
  - When comparison reveals a difference of zero, then there is neither regret, nor rejoicing, $R\left(0\right) = 0$
- Uncertainty
  - When the decision between 1 and 2 is to be made, the state of the world j is unknown. The individual forms expectations about utility from option 1,

$$U_1^2 = \Sigma_{j=1}^n p_j u\left(c_{1j}, c_{2j}\right)$$

    and expected utility from option 2,

$$U_2^1 = \Sigma_{j=1}^n p_j u\left(c_{2j}, c_{1j}\right)$$

– Obviously, an individual prefers choice 1 to choice 2 when $U_1^2 > U_2^1$ (see Exercise 4.7.1).

4.2.2 Loomes' and Sugden's motivation

- What is the basic motivation for regret theory?
- The most cited paper (according to Kim et al., 2006) in economic theory is the paper on 'prospect theory' by Kahneman and Tversky (1979)
- Kahneman and Tversky provide a fundamental critique of expected utility theory by
  - presenting a series of simple experiments where (hypothetical) behaviour of participants violated various assumptions of EU theory
  - providing an alternative theory – baptized prospect theory
- What are the (most important) violations of EU theory?
  - certainty effect: overweigh outcomes that are certain
  - reference point: individuals focus on gains and losses, not on absolute values
  - concavity: individuals are risk-averse and risk-loving

- What does the alternative theory look like?
  - There is a weighting function $\pi(p)$ that takes certainty effect into account
  - Utility of an individual depends on changes, i.e. a reference point is introduced
  - Individuals are risk-averse to gains but risk-loving to losses

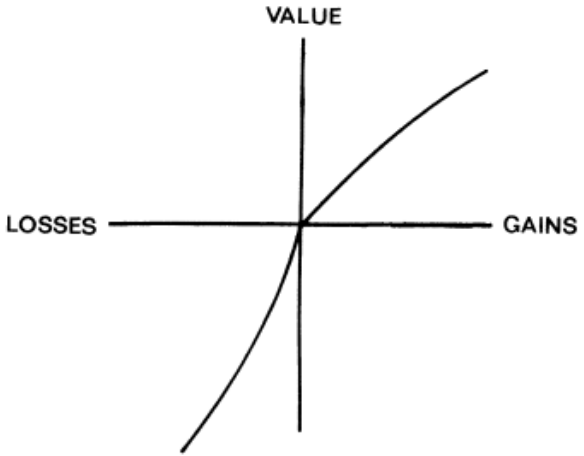


Figure 4 *The value function (fig. 3 from Kahneman and Tversky, 1979)*

- What is the new notation?
  - What is a lottery in EU theory is a prospect in prospect theory
  - Instead of utility function, the term value function is used (not to be confused with value function from dynamic programming)
  - Expected utility is denoted by V and reads (compare e.g. with eq. (1) in Kahneman and Tversky, 1979)

    $$V = \Sigma_{i=1}^{n} \pi\left(p_i\right) u\left(x_{i,t+1}\right)$$

    where the outcome in state i is defined relative to a reference point c^{ref}

    $$x_{i,t+1} \equiv c_{i,t+1} - c^{\text{ref}}$$

- Reminder EU theory (for comparison purposes): $E_t u\left(c_{t+1}\right) = \Sigma_{i=1}^{n} p_i u\left(c_{i,t+1}\right)$ with $u\left(.\right)$ concave

4.2.3 Loomes and Sugden (1986) – disappointment and elation

- Their interest: feelings resulting from the difference between the outcome of a choice and some reference point
- Reference point is not another choice (there is no Italy vs France) but the average consequence of this choice (i.e. utility from being on the beach at various sun intensities). Formally, the reference point for an action 1 is

$$\bar{c}_1 = \Sigma_{j=1}^{n} p_j c_{1j}.$$

Expected utility from option 1 is now

$$U_1 = \Sigma_{j=1}^{n} p_j \left[c_{1j} + D\left(c_{1j} - \bar{c}_1 \right) \right].$$

This option 1 (the beach) is then chosen relative to option 2 (the mountains) if $U_1 > U_2$.

4.2.4 Gul (1991)

- Offers an axiomatic approach (preference based) to understanding disappointment aversion
- Strong alternative to Loomes and Sugden (1982, 1986)
- Motivation is Allais (1979) paradox (which is nicely explained in the paper and which violates the so-called independence axiom)
- Offers a nice overview of how researchers respond to this paradox
  - need for descriptive theory (Kahnemann and Tversky, 1979, Loomes and Sugden, 1982, 1986) that ignores "basic desiderata of choice under uncertainty" (p. 669) (inter alia transitivity or stochastic dominance)
  - rejecting the normative appeal of the independence axiom
  - modifying the independence axiom (his approach)
- Offers a one-parameter extension of the von Neumann-Morgenstern expected utility model
- Details are very technical and beyond the scope of this paper (but good for Master thesis for MSc Mathematics)

- General aspect raised by his introduction: Do we want to model behaviour of individuals in any way which is descriptively acceptable or should we impose various consistency axioms (see above on preference-based approach)
- (At least) two different "research programmes" (Lakatos) active at the same time
- (unlike "paradigm" (Kuhn) where a scientific revolution replaces one paradigm by another)

4.3 Ex-ante emotions - anxiety, worry and fear

4.3.1 The setup

- Ex-ante or anticipatory emotions (fear, anxiety, positive anticipation, suspense ...) are studied by Caplin and Leahy (2001)
- Applications include Caplin and Leahy (2004) and Kőszegi (2006)
- The setup
  - Two-period decision problem (as seen further above in sect. 4.1)
  - anticipatory emotions as in Caplin Leahy (2001)

- Reminder of two-period decision problem
  - constraint in the first period (period t)

$$w_t = c_t + s_t$$

    where s_t is savings in t
  - constraint in the second period (individual is retired)

$$(1 + r_{t+1})\, s_t = c_{t+1}$$

    where returns r_{t+1} are uncertain
  - Preferences

$$U_t = E_t \left\{ \gamma u\left(c_t\right) + (1 - \gamma)\, u\left(c_{t+1}\right) \right\}$$

    where γ is the weight on first-period utility relative to second-period utility

- Now we add (anticipatory) feelings
  - Extended utility function

$$U_t = E_t \left\{ \gamma u \left(c_t, a_t \right) + \left(1 - \gamma \right) u \left(c_{t+1} \right) \right\}$$

    where a_t is anticipatory feeling
  - Following Caplin and Leahy (2001), we model feeling as a function of the variance and of the mean of consumption in $t+1$

$$a_t = a \left(var_t c_{t+1}, E_t c_{t+1} \right) \tag{1}$$

  - The anticipatory feeling is assumed to rise in the variance and fall in the mean

$$\frac{\partial a_t}{\partial var_t c_{t+1}} > 0$$
$$\frac{\partial a_t}{\partial E_t c_{t+1}} < 0$$

  - The feeling is therefore a negative feeling like anxiety

- To obtain tractable results, we need a more specific utility and anxiety function
  - We assume a Cobb-Douglas structure for anxiety

$$a_t = (var_t c_{t+1})^{\zeta} (E_t c_{t+1})^{-(1-\zeta)}$$

  - The "personality parameter" ζ captures the weight of the variance as opposed to the mean
  - Applying the log, we get

$$\ln a_t = \zeta \ln (var_t c_{t+1}) - (1-\zeta) \ln (E_t c_{t+1}) \tag{2}$$

  - (Log of) Anxiety can take positive or negative values, depending on the variance and mean
  - In the case of a negative (log) anxiety, we would rather talk about 'pleasant anticipation' ("Vorfreude")
  - Why all these functional forms? To capture some intuition and make properties of anxiety plausible

- The overall utility function
  - We choose a Cobb-Douglas utility function as well and apply logs

$$u\left(c_{t+1}\right) = \gamma\left[\ln c_t - \phi \ln a_t\right] + \left(1-\gamma\right) E_t \ln c_{t+1} \tag{3}$$

  - Consumption enters utility in the usual logarithmic way
  - Log-anxiety decreases utility in period t in a linear way due to parameter $\phi > 0$ and minus sign (which translates strong anxiety into negative utility)
  - Parameter γ captures impatience, with $\phi = 0$, we are back to emotion-free individual
  - Expectations E_t need to be formed about $\ln c_{t+1}$ only

4.3.2 Optimal behaviour and comparative statics

- Optimization
  - Computing the mean and variance of consumption for (1) and defining

$$\mu \equiv E_t \left[1 + r_{t+1}\right],$$
$$\sigma^2 \equiv \text{var}\left[1 + r_{t+1}\right],$$

    we can write the objective function as

$$U_t = \gamma \left[\ln \left[w_t - s_t\right] - \phi \left[\zeta \ln \left\{s_t^2 \sigma^2\right\} - (1-\zeta) \ln \left\{s_t \mu\right\}\right]\right] + (1-\gamma) \left[E_t \ln \left(1 + r_{t+1}\right) + \ln s_t\right]$$

  - Let us try to recognize the individual components in this explicit and distinguish utility in t from utility in $t+1$, (sub-) utility from consumption in t from anxiety in t and the different components of anxiety

- Optimization ...
  - ... now works (as without emotions) by choosing savings s_t
  - ... takes the effects of savings on emotions into account

- Comparativ statics: Optimal behaviour with "scaring variance" only, i.e. for $\zeta = 1$ (see Exercise 4.7.2)

$$s_t = \frac{1 - \gamma - 2\gamma\phi}{1 - 2\gamma\phi} w_t$$

  - In the absence of anxiety a rational individual would save $s_t^* = (1 - \gamma) w_t$
  - In the presence of anxiety (only variance matters), the individual would save less, $s_t < s_t^*$
  - Why? To avoid anxiety due to consumption variance, the individual would save less as this reduces the consumption level in $t + 1$ and therefore its variance

- Optimal behaviour with pleasant anticipation, i.e. for $\zeta = 0$ (see Exercise 4.7.2)

$$s_t = \frac{1 - \gamma + \gamma\phi}{1 + \gamma\phi} w_t$$

  - We can now make two comparisons
    - Compared to the absence of any emotions ($\phi = 0$), the individual would now save more, $s_t > s_t^*$: The individual experiences positive anticipation only and higher savings lead to higher mean consumption in $t + 1$
    - Compared to the case when (s)he only cares about the variance ($\zeta = 1$), the individual saves more now for two reasons: With $\xi = 1$, she saves less than for $\phi = 0$ (see previous slide), and with $\zeta = 0$, she saves more than with $\phi = 0$
  - For a formal derivative, see the solution to Exercise 4.7.2

- Optimal solution for the general case
  - For some general ζ, we get

$$s_t = \frac{1-\gamma-(3\zeta-1)\gamma\phi}{1-(3\zeta-1)\gamma\phi} w_t \tag{4}$$

  - Allows us to analyse the effect of a more emotional person (ϕ rises) and of a more negative focus (ζ rises, "glasses are always half-empty")
  - We find (see Exercise 4.7.2)

$$\begin{aligned}
\frac{ds_t}{d\phi} > 0 &\Leftrightarrow -(3\zeta-1)\gamma\left[1-(3\zeta-1)\gamma\phi\right] > -\left[1-\gamma-(3\zeta-1)\gamma\phi\right](3\zeta-1)\gamma \\
&\Leftrightarrow -\left[1-(3\zeta-1)\gamma\phi\right]\left\{\begin{array}{c}>\\<\end{array}\right\} -\left[1-\gamma-(3\zeta-1)\gamma\phi\right] \text{ iff } \zeta\left\{\begin{array}{c}>\\<\end{array}\right\}\frac{1}{3} \\
&\Leftrightarrow 0\left\{\begin{array}{c}>\\<\end{array}\right\}\gamma \text{ iff } \zeta\left\{\begin{array}{c}>\\<\end{array}\right\}\frac{1}{3} \\
\frac{ds_t}{d\zeta} &< 0
\end{aligned}$$

4.4 Immediate emotions

4.4.1 Hunger, thirst, pain, desire

- 'Emotions that are the result of a bodily state'
- State-dependent preferences - an example (see Exercise 4.7.3)
  - Individuals are hungry and thirsty

$$u\left(c_{Food}, c_{Drink}\right) = \left(c_{Food} - h\right)^{\alpha}\left(c_{Drink} - t\right)^{1-\alpha}$$

  - Marginal utility from food $\alpha\left[\frac{c_{Drink}-t}{c_{Food}-h}\right]^{1-\alpha}$ rises, when hunger h rises
  - Same is true for drinks and thirst t
  - One could call marginal utility from food or drink a 'desire' – this would be an example how standard neoclassical analysis would allow the modelling of feelings
  - Tip for life: never go shopping when hungry, you buy way too much

- State-dependent preferences a la Loewenstein (2000)
  - General formulation by Loewenstein (2000)

$$U_t = \Sigma_{t=0}^{T} u\left(c_t, s_t\right)$$

  - This is more general in the sense of (i) there is some state s_t (with no specification of whether this is hunger or thirst or other), (ii) it captures many periods and (iii) c_t and s_t can be vectors, capturing many consumption goods and many states (angry at one person, happy about some big personal achievement and excited about holidays coming soon)

- Caveat: People generally do not remember well emotions in past visceral states, leading to projection bias (Loewenstein, O'Donoghue and Rabin, 2003)

4.4.2 Laibson (2001) - Cue theory of consumption

- 'Emotions that are the result of an external stimulus'
- The idea
  - Preferences of individuals are not stable and invariant over time and contexts
  - Preferences rather depend on the environment a person is in and on the cues present in this environment
  - There are clinical examples (think of addicts of alcohol or other drugs) but there are also everyday examples
  - "Consider cues like the smell of cookies baking, smell of perfume/cologne, sound of ice falling into a whiskey tumbler, sight of a bowl of ice cream, and sight of a pack of cigarettes" (Laibson, 2001, p. 82)
  - The economically revolutionary statement: "preferences are sensitive to cues like these" (p. 82)
  - Analysis builds on and combines earlier work by Becker and Murphy (1988, 1993)

- Evidence from psychological conditioning
  - Classic conditioning pairs a neutral stimulus (conditional stimulus, CS, in psychologists' terms) with a nonneutral stimulus (unconditional stimulus, UC)
  - Pavlov's dog heard a bell ring (CS) joint with injection of meat-powder in the dog's mouth (UC)
  - The meat-powder leads to salivation, to physiologically prepare the dog for food ingestion
  - When the two stimuli were presented jointly sufficiently often, the ring of a bell would also lead to salivation
- The idea in more detail
  - Central "translation" of psychological findings into economics: "Cue-triggered preparatory <...> responses tend to raise the marginal utility of consumption" (p. 85)
  - What is generally called a "craving", "strong desire", "lust", "greed" or other is, in economic terms, "higher marginal utility"
  - The cue triggers a "preparatory process" (like salivation) which in affects marginal utilities and makes preferences conditional on cues

- The individual's environment
  - Individual lives in discrete time $t = 1, 2, 3, ...$
  - At each point in time t, the world can be in two states i: either the cue can be RED or GREEN
  - We denote these states by $i \in \{R, G\}$ that occur with a certain probability

$$i_t = \left\{ \begin{array}{c} R \\ G \end{array} \right\} \text{with probability} \left\{ \begin{array}{c} \mu^R \\ 1 - \mu^R \equiv \mu^G \end{array} \right. .$$

  - (This seems not very intuitive. When we talk about a "bad cue" (like alcohol, tobacco or other adds), maybe one should think of RED as "cue is present" and GREEN = "not present")

- Preparatory process
  - (simplified version as compared to the paper)
  - Bodily state x_t is a function of the cue

$$x_t = x\left(i_t\right)$$

  - We assume that $x\left(R\right) > x\left(G\right)$, i.e. the body is better prepared for e.g. food when the cue is RED (i.e. present)

- Preferences
  - (simplified version as compared to paper)
  - In state i, the utility function of our consumer is given by

$$u\left(c_t^{\text{sweets}}, c_t^{\text{fruit}}\right) = \left(c_t^{\text{sweets}} - x_t\right)^{\alpha} \left(c_t^{\text{fruit}}\right)^{1-\alpha}$$

  - Preferences are clearly "cue-contingent"
  - As the cue is a state variable (it describes the state of the world/ environment of the individual), preferences are (again) state-dependent
  - Laibson writes "the functional form of this meta-utility function is not chosen by the consumer but is instead biologically predetermined"
  - In other words, α and functional structure is stable, but x_t changes

- Constraint
  - There are prices p^s and p^f and endowment E
  - This gives a standard budget constraint

$$p^s c_t^{\text{sweets}} + p^f c_t^{\text{fruit}} = E$$

- Optimal behaviour
  - Optimal behaviour similar to hunger and thirst setup: Marginal utility from sweets rises in x_t
  - As x_t is higher in the presence of the RED cue (adds for chocolates or ice cream), cues induced individuals to change their consumption choices
  - see figure on next slide

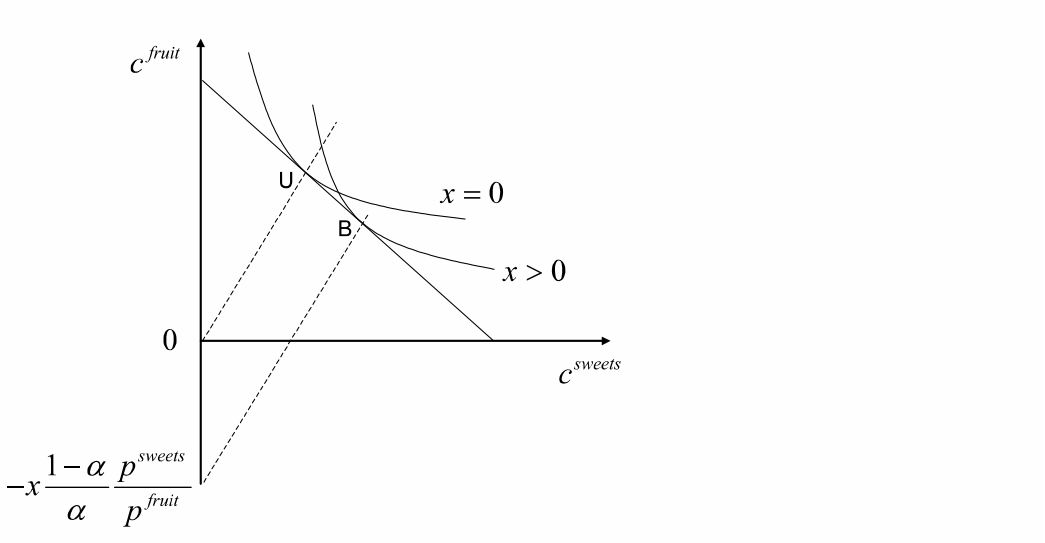


Figure 5 *Optimal consumption of sweets and fruit in the absence ($x = 0$ implies Unbiased consumption) and in the presence of cues ($x = 1$ implies Biased consumption)*

- Optimal consumption ratios satisfy (see Exercise 4.7.4)

$$\frac{c_t^{\text{fruit}}}{c_t^{\text{sweets}} - x} = \frac{1-\alpha}{\alpha}\frac{p^{\text{sweets}}}{p^{\text{fruit}}} \Leftrightarrow c_t^{\text{fruit}} = \frac{1-\alpha}{\alpha}\frac{p^{\text{sweets}}}{p^{\text{fruit}}}\left(c_t^{\text{sweets}} - x\right)$$

- What is the difference to hunger or thirst?
  - We have a formal theory of how external (non-chosen) cues affect human behaviour
  - Hunger and thirst can be seen as natural determinants of consumption behaviour
  - With advertisements (or cues, more generally), individual behaviour can be influenced from the outside
  - Individuals might experience certain desires only because of this influence
  - Individuals still behave optimal, but only subject to the exogenously given cues
  - If individuals were able to choose cues, they would experience higher utility
- Any real-world relevance?
  - The latter is to some extend the idea behind self-control and official control of advertisements
  - no ads for baby food in British maternity wards (Geburtsstationen in Kliniken)
  - no ads for sweets in kindergartens/ nurseries
  - no ads for tobacco and alcohol close to schools and kindergartens (only being discussed?)
  - for self-control, see e.g. www.werberat.de

4.4.3 Stress (Wälde, 2015)

- **Definition:** Stress occurs when demands exceed resources (Lazarus and Folkman, 1984, Stress, Appraisal and Coping)
- Psychological background
  - A standard view in psychology on stressful episodes can be illustrated as follows

$$\text{Stressor} \rightarrow \text{appraisal} \rightarrow \text{(change in) stress} \rightarrow \text{coping}$$

  - Two sources of stressors: daily hassles (e.g. 'losing keys'), rare events (e.g. 'getting married')
  - Appraisal process: Evaluation of a stressor with respect to one's objectives
  - Outcome of appraisal leads to more (or less) stress
  - Coping: behaviour targeted at controlling stress level
  - Coping can be controlled vs. automatic, problem-focused vs. emotion focused and functional vs. dysfunctional

- What is captured in model?
  - Two sources of stressors
  - A (simple) appraisal process capturing personality of a person
  - Two coping styles: controlled and automatic ('emotional outburst')
  - Emotion-focused approach of coping (not problem-focused)
- Why care and what to do about stress?
  - Individual (experienced) utility $u\left(c\left(t\right), W\left(t\right)\right)$ falls in stress $W\left(t\right)$
  - Stress also reduces labour effort (cognitive load argument)
  - Stress (=distress) is bad here (think about distress vs eustress)
  - Individual maximizes utility by choosing controlled coping $m\left(t\right)$ in an optimal way anticipating the outbursts

- A sketch of the economic modelling of stress
  - Stress is a (subjective) state variable and changes as a function of daily hassles and rare events
  - Looking only at daily hassles, stress $W(t)$ follows an ordinary differential equation

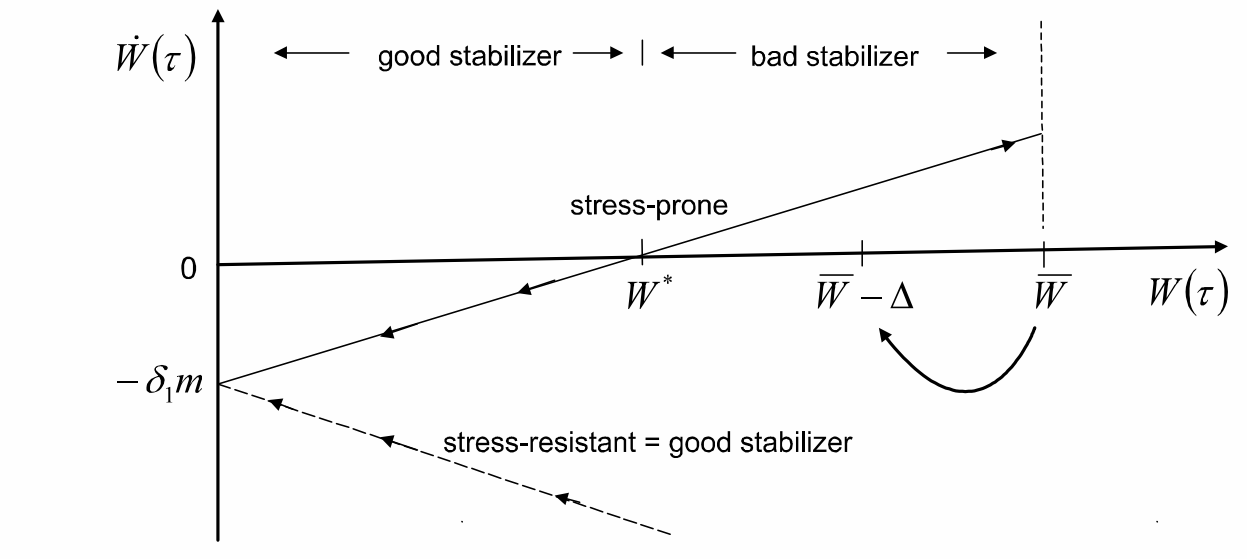
$$\dot{W}(t) = \Phi W(t) - \delta_1 m$$

  - the parameter Φ is the growth rate of stress

$$\Phi \equiv \phi \frac{p}{a} - \delta_0$$

  - daily hassles (the number of emails p relative to ability a) is the intensity of the stressors
  - controlled stress reduction methods m (talking to a friend, doing sports) is coping
  - the optimal amount (measured e.g. in hours per day) is constant (see paper, but not for exam)
  - the appraisal of the stressors is captured by the parameter $\phi > 0$
  - the effect of coping on stress reduction is described by δ_1
  - the parameter δ_0 describes an 'autonomous stress reduction potential'

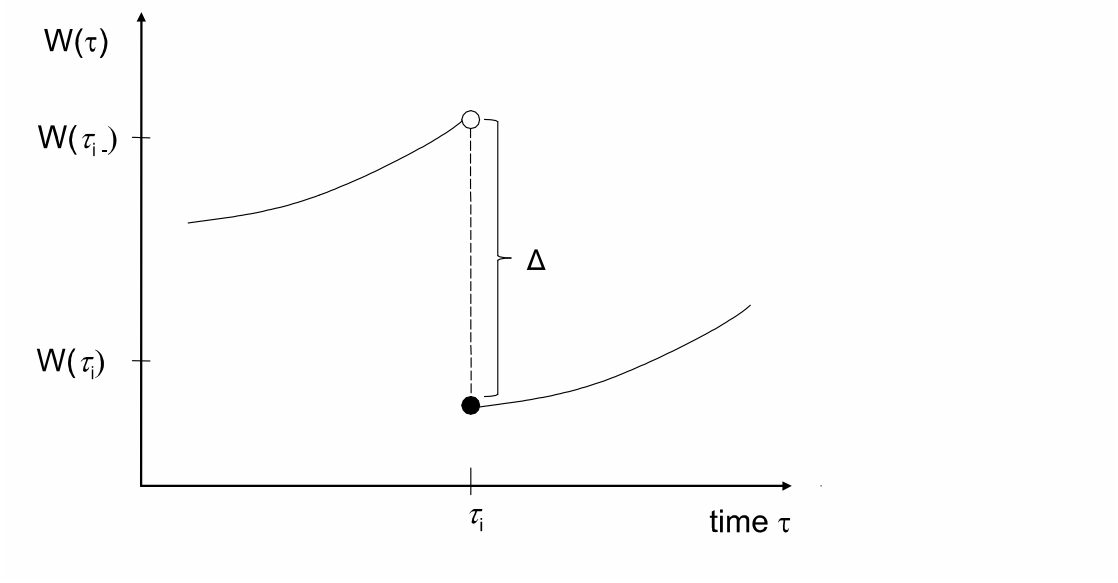
- A phase diagram illustration (see Exercise 4.7.5)



- The outburst level $\bar{W}$
  - Whenever the stress level rises too much, i.e. whenever it hits $\bar{W}$, the individual is 'overwhelmed', loses control over behaviour and experiences an emotional outburst
  - An emotional outburst can be anything from 'shouting at friends' to 'drinking excessively' (see the 'conflict tactic scale', e.g. Straus et al., 1996)
  - This is the uncontrolled (not rational expectations, behavioural) part of coping (behaviour)

- The good side of outbursts
  - Stress falls following an emotional outburst

$$W(\tau_i) = W(\tau_{i-}) - \Delta$$

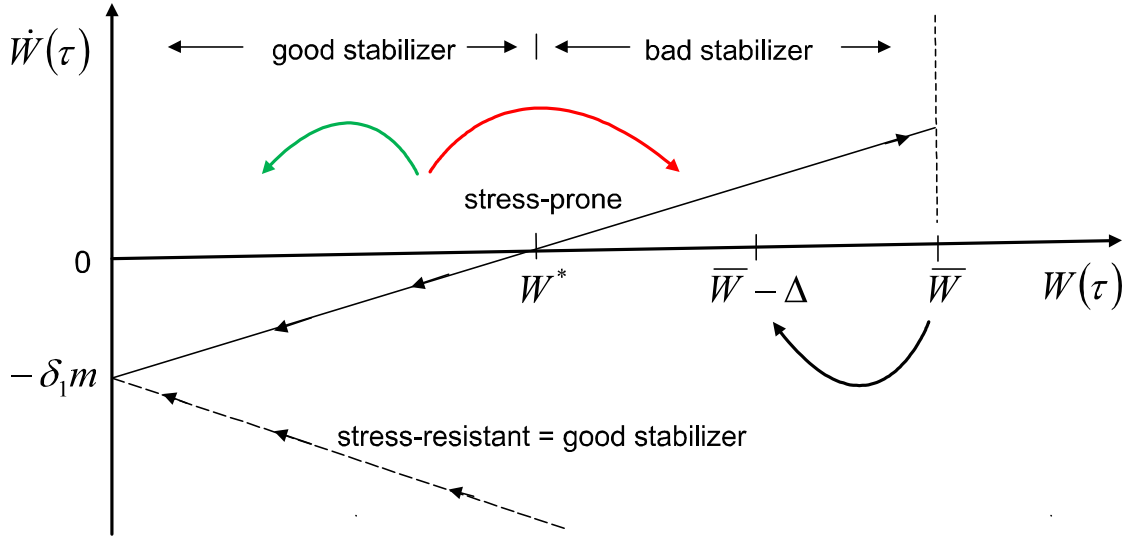


- The role of surprises
  - Coming back to rare events (like 'getting married', 'losing a job', 'publishing a paper' and other), they are modelled as surprises
  - Surprises $g(t)$ can be positive or negative
  - Random variable $h(t)$ and subjective expectation μ yield surprise

    $$g(t) = h(t) - \mu$$

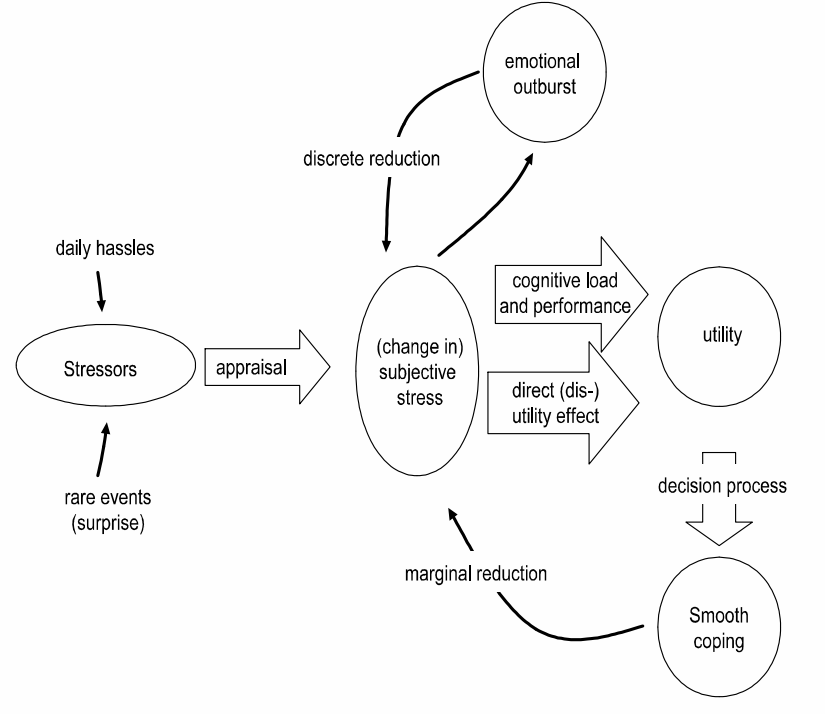
    (Bell, 1985, Loomes and Sugden, 1982, 1986)
  - surprises occur at a certain arrival rate
  - (dynamic continuous time model with Poisson uncertainty)

- Another (more complete) phase diagram illustration ...



- ... that also shows surprises and outbursts

- A graphical illustration of the model



- Results
  - Theory-consistent personality definitions: *stress-resistant* individuals never display outburst, *stress-prone* individuals do if stress level is too high
  - Outburst theorem: any individual will turn from stress-resistant to stress prone if e.g. work-load rises
  - For a given work-load, (endogenous) coping measures can make outbursts disappear
  - Outbursts should not be suppressed
  - Temporary stressors can have permanent effects, but only for stress-prone individuals
  - Structural estimation of personality parameters possible
  - Analysis of therapy shows: being emotional and pessimistic maximizes subjective well-being

4.5 Belief-based emotions

4.5.1 Psychological game theory

- There is a general framework in economics that does *not* focus on one specific emotion but that proposes a general setup that can cover *classes* of emotions
- Geanakoplos, Pearce and Stacchetti (1989) model emotions that are based on *beliefs*
- Battigalli and Dufwenberg (2009) provide a generalization
- Downside of generality: they do not focus on one specific emotion and thereby can not cover all the specific aspects of this one specific emotion
- Why is this of interest?
  - First, it allows us to understand emotions and their role in decision making
  - Second, models with beliefs are very common in economics
  - Third, game theory is also very useful tool
- Are belief-based emotions immediate, ex-ante or ex-post? Let's see ...

4.5.2 Game theory: Background and extensive form games

- Background → see slides Mikroökonomik I by Prof. Bannier
- To understand insights on emotions, we only need "common sense"

4.5.3 Psychological game theory: The bravery game

Geanakoplos, Pearce and Stacchetti (1989, p. 66)

- The idea (first part)
  - Imagine there are two individuals, called player 1 and player 2
  - Player 1 must take a decision and is concerned what his friends (player 2) think about him
  - His strategy space is $A = \{\text{bold,timid}\}$, player 2 does not make any decision
  - Player 1 can choose pure strategies or attach a probability p to being bold when playing mixed strategies
  - Payoffs are (for the time being) given by 2 and 3 as shown in the figure

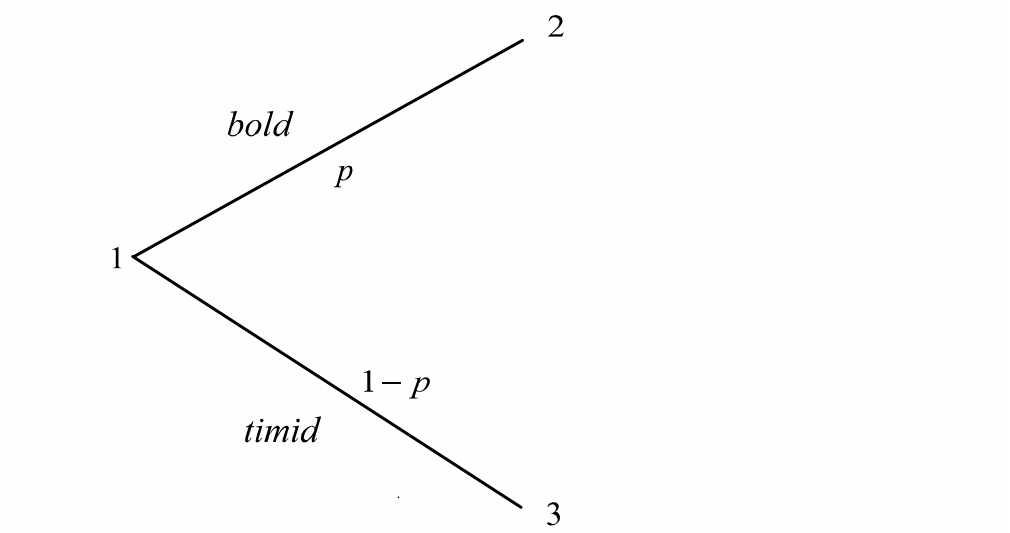


Figure 6 *A (not so hard) decision to be made by player 1 with standard payoffs*

- Player 1 will optimally decide to be timid as payoffs are highest with this pure strategy $(3 > 2)$

- The idea (second part)
  - While player 2 does not make a decision, it is good for player 2 if player 1 is actually bold
  - This is what we see in the extended figure with payoffs for both players depending on the decision of player 1

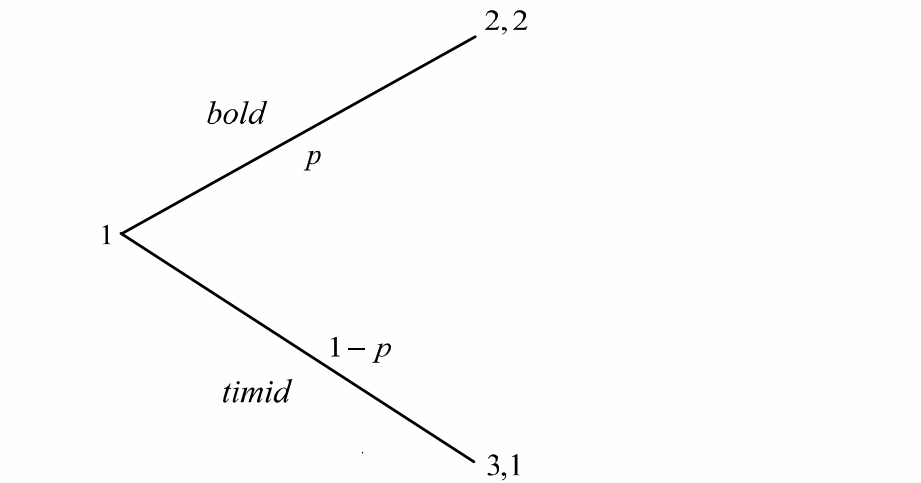


Figure 7 *A decision to be made by player 1 with standard payoffs for both players*

- Choice of player 1 would now depend on the weight he attaches to payoff of player 2
  - focus only on own payoff: be timid
  - focus only on other payoff: be bold

- The idea (interesting and final part – which makes this a psychological game)
  - Beliefs of player 2
    - Player 2 prefers to think of his friend as bold
    - This "materializes" in payoffs of player 2 to depend on his belief q about the probability p that player 1 acts bold (formally, q is the mean of p: $q = Ep$)
    - As player 2 *prefers* to think that player 1 is bold, the payoff of 2 rises in q when 1 *acts* bold and falls in q when 1 *acts* timid (big disappointment)
    - [$\rightarrow$ is this minus sign in $1 - q$ convincing?]
  - Beliefs of player 1
    - As player 1 is also concerned about what his friend thinks about him (see above), player 1's payoff also depends on what he believes about what player 2 believes
    - This belief is denoted by $\tilde{q} = Eq$
    - We assume that player 1 does not want to disappoint player 2 (who wants to think of player 1 as bold). As a consequence, the payoff of player 1 falls in $\tilde{q}$
  - Psychological game theory: games where payoffs depend on beliefs and not only on actual real outcomes

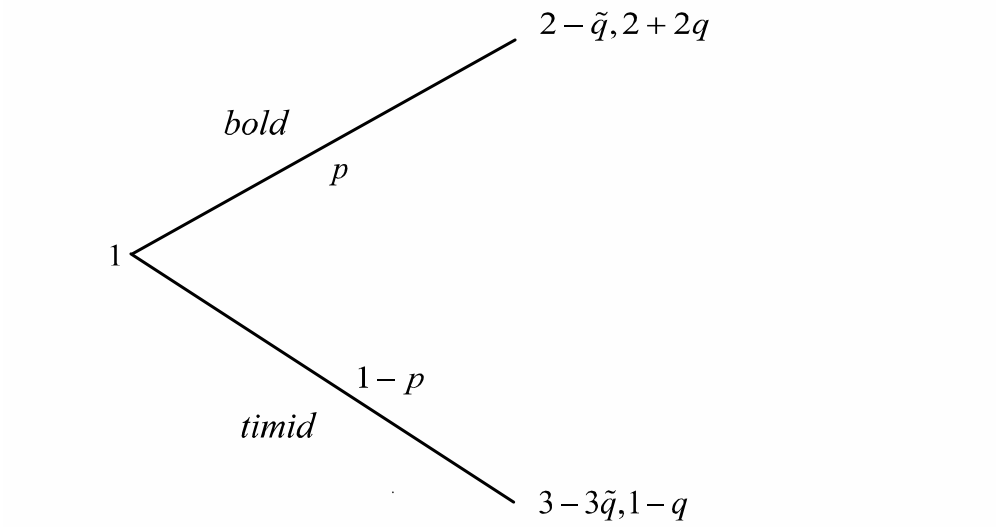


Figure 8 *The full structure of the bravery game*

- Who wants what?
  - Beliefs obviously play a central role in this game

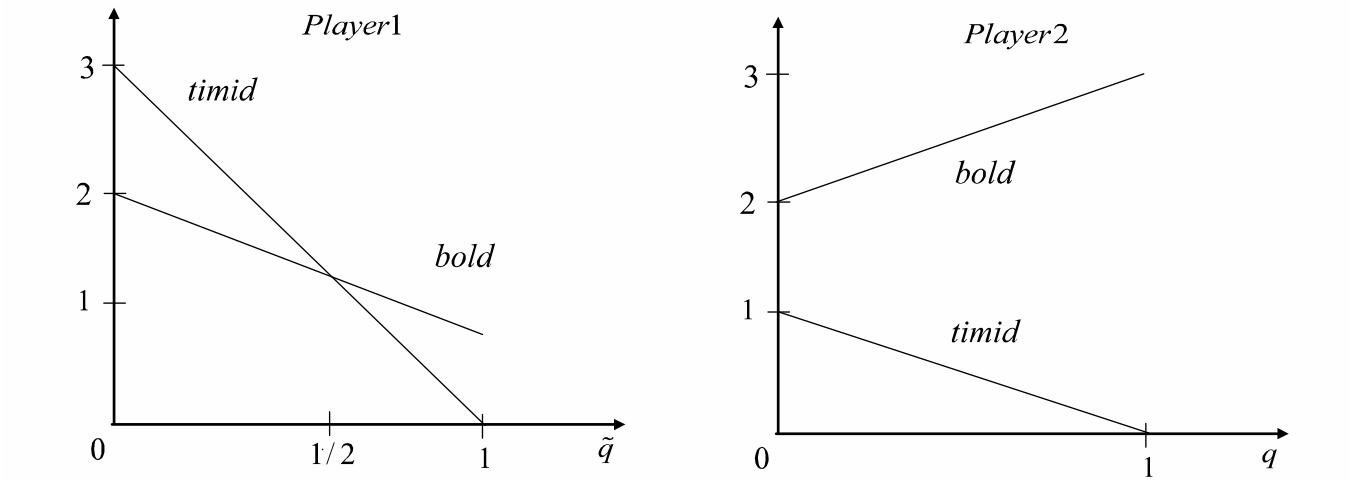


Figure 9 *Payoffs as a function the behaviour of player 1 and of beliefs*

- What is equilibrium behaviour?
  - Big question: How does player 1 behave?
  - What if there were no beliefs (i.e. if this was not a psychological game)?
    - Then we would be back to fig. 6 and player 1 would act timid
    - There would be a unique equilibrium
  - If there are beliefs, various equilibrium assumptions are imposed: Equilibrium requires (by definition of equilibrium) that
    - beliefs are consistent with behaviour: an outcome would *not* be called an equilibrium if e.g. player 2 believes that player 1 is bold but player 1 acts timid
    - beliefs are shared among players: $p = q = \tilde{q}$
  - How does player 1 behave under these assumptions?
  - We will now see that the introduction of beliefs introduces more equilibria than in the absence of beliefs

- Equilibrium behaviour (see Exercise 4.7.6)
  - Let us try: Can $p = 1$ (and thereby $q = \tilde{q} = 1$ as well) be an equilibrium?
    - In this case, payoffs are $(1, 4)$ for bold and $(0, 0)$ for timid
    - Player 1 would choose bold
    - ... which is consistent with the belief of player 2 that player 1 is bold
    - One equilibrium found
  - Can $p = q = \tilde{q} = 0$ be an equilibrium?
    - In this case, payoffs are $(2, 2)$ for bold and $(3, 1)$ for timid
    - Player 1 would choose timid
    - ... which is consistent with the belief of player 2 that player 1 is timid
    - Another equilibrium found
  - Any other equilibrium on offer? Looking at fig. 9 suggests $p = q = \tilde{q} = 1/2$
    - In this case, payoffs are $(1.5, 3)$ for bold and $(1.5, .5)$ for timid
    - Payoffs for mixed strategy are $(1.5, 1.75)$
    - Player 1 would be indifferent
    - ... which is consistent with the belief of player 2 that player 1 is indifferent
    - Another equilibrium found

- What do we learn about emotions?
  - Maybe not so much?
  - Emotion words are used (timid, bold), but they can be replaced by anything (red-green, up-down, left-right, ...)
  - Beliefs are very important and obviously play a huge role in determining behaviour of individuals
  - But why do beliefs stand for emotions? Is there any surprise (as in regret theory) or any anticipation, any tension between demands and resources (as in stress theory)?
  - Maybe emotion words are only colourful and bloomy words for an important but simple concept: expectations
- Let us see whether applications of this theory bring us closer to understanding emotions (see next section)

4.5.4 Guilt

- Psychological background
  - Baumeister et al. (1993) document that a person who rejects a relationship partner often suffers from guilt
  - Baumeister et al. (1994, 1995, p. 174) report that: "the prototypical cause of guilt is inflicting harm or distress on a relationship partner"
- Economic models
  - Dufwenberg (2002) guilt in marriage seems to be the paper where guilt is first introduced
  - Charness and Dufwenberg (2006) "promises and partnership" models guilt and guilt aversion joint with communication
  - They stresses that this is important more generally – analysis of guilt in trust games (Battagalli Dufwenberg 2007)
  - Battagalli Dufwenberg (2007) have two concepts of guilt aversion - "simple guilt" means that "a player cares about the extent to which he lets another player down" and "guilt from blame"
  - Charness and Dufwenberg (2011) is application to experiments

- The simplest model (Dufwenberg, 2002, on marriage)

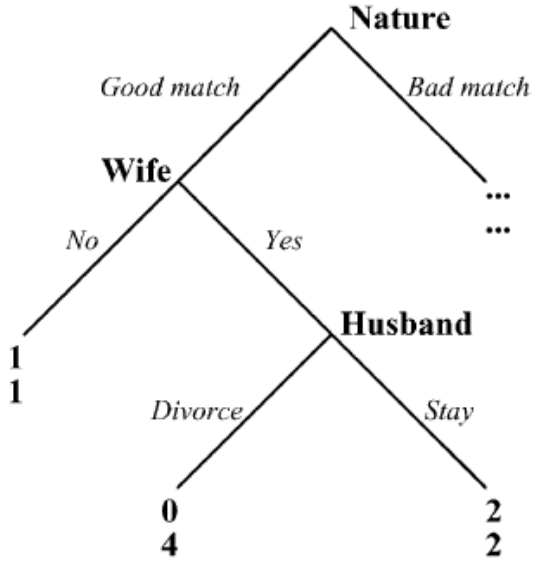


Figure 10 *The marital investment game (Dufwenberg, 2002, fig. 1)*

- The idea of the game
  - A man and a woman meet – and nature determines whether it is a good or bad match
  - If nature leads to a good match, the wife can support her husband and take care of the kids or not
  - (or the other way round as well, given that we live in modern times)
  - If she does not support the husband, they both earn some income leading to a payoff of (1,1)
  - If she does support the husband, he can study and get a rewarding job
  - The husband can now be opportunistic and divorce. His payoff would be 4, the wife's payoff would be zero
  - If the husband stays, he would share his income and payoffs are (2,2)

- Equilibrium
  - How do husband and wife behave optimally in this setup?
  - First, none of the two prefers a no by the wife to a yes-stay
  - Both prefer a stable marriage with the husband earning money and splitting at home to the wife and husband both earning a bit of money
  - But, once wife has said yes, it is optimal for husband to quit ("dominant strategy")
- Solution concept
  - subgame perfect equilibrium: A strategy profile is a subgame perfect equilibrium if it represents a Nash equilibrium of every subgame of the original game
  - Unique strategy profile is (no, divorce)
  - Husband cannot credibly promise to stay when wife makes support/no-support decision
  - This strategy profile is inefficient

- Remark on a personal note
  - Looking at partnerships in this way is scary, weird, simply "gruselig"
  - Emotional aspect is missing – affection to wife and kids
  - Let us see how Dufwenberg makes the analysis more emotional

- Adding guilt to the marital investment game

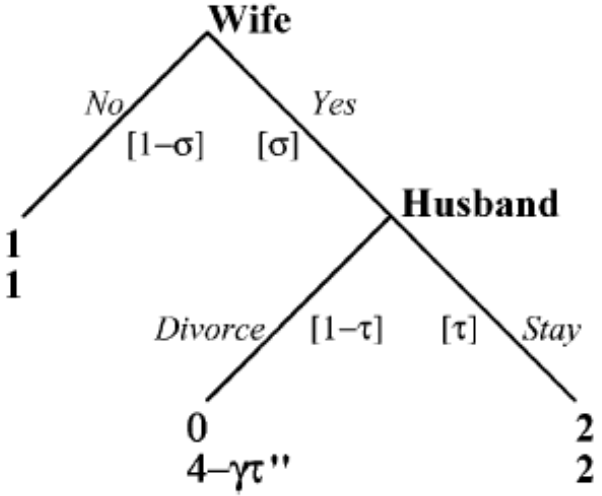


Figure 11 *The psychological marital investment game with guilt τ'' and guilt sensitivity γ of the husband (Dufwenberg, 2002, fig. 1)*

- The idea of the game
  - Individuals might not necessarily play only pure strategies – we therefore add probabilities σ and τ to capture mixed strategies
  - Individuals form beliefs about probabilities (as in psychological game theory above)
    - Belief τ' of wife about husband's probability τ to stay, called her trust (first feeling in game): $\tau' = E\tau$
    - Belief τ'' of husband about wife's belief τ': $\tau'' = E\tau'$
  - In case the husband divorces, he experiences a loss in his utility the more he believes his wife trusts him
  - The loss in utility is given by $\gamma\tau''$ and consists of γ, his "guilt sensitivity", and his guilt τ'' (second emotion in this game)

- Equilibrium definition
  - Equilibrium is defined in analogy to equilibrium definitions in psychological games
  - **Definition (**Dufwenberg, 2002, p. 65**):** A profile (σ, τ) is a marital equilibrium if
    (i) (σ, τ) is a subgame perfect equilibrium for a given τ''
    (ii) $\tau'' = \tau' = \tau$ and
    (iii) If $4 - \gamma/2 < 2$ then $\tau = 1$
- What does this mean?
  - If we know τ'', then we have a normal (aka non-psychological game) game where equilibrium is found by imposing subgame perfection
  - Beliefs must be consistent across individuals
  - If γ satisfies this condition, then the husband must choose 'stay'. Why
    * Condition requires $\gamma > 4$. Why should husband stay with $\gamma > 4$?
    * Wife knows that γ equals, say, 4.00001. Assume she plays 'yes'. She would do so only if she believes that $\tau = 1/2$ or larger as only then her expected payoff from 'yes' ($\frac{1}{2} * 0 + \frac{1}{2} * 2 = 1$) exceeds the payoff from 'no' (which equals 1)
    * When the husband beliefs that $\tau' = 1/2$ or larger, his guilt implies a payoff of $4 - \gamma\tau'' = 4 - 2.000005 < 2$ for divorce and therefore he stays. Hence $\tau = 1$

- Equilibrium behaviour for $0 \leq \gamma < 2$
  - In words, the husband does not care a lot about guilt (guilt sensitivity γ is low)
  - Even if $\tau'' = 1$, the payoff from divorce, $4 - \gamma$ is larger than the payoff from staying, 2
  - When the wife knows the husband will divorce ($\tau = 0$), she will say 'no'
  - Equilibrium beliefs are $\tau'' = \tau' = 0$
  - Unique equilibrium strategies are (no,divorce) and equilibrium payoff is $(1, 1)$
- Equilibrium behaviour for $\gamma > 4$
  - In this case, the husband cares a lot about guilt
  - Equilibrium beliefs are $\tau'' = \tau' = 1$
  - Unique strategies are (yes, stay) and payoffs are (2,2)
  - Idea as for equilibrium property (iii) from above

- Equilibrium behaviour for $2 \leq \gamma \leq 4$
  - Three equilibria exist, belief of the wife selects which one is implemented
  - If she believes he will divorce, i.e. if $\tau\prime = 0$, she will say 'no' and payoff is (1,1)
  - If she believes he will stay, i.e. if $\tau\prime = 1$, she will say 'yes' and payoffs are (2,2)
  - Third equilibrium has $\tau = \tau' = \tau'' = 2/\gamma > 1/2$. Then strategies are (yes,sty) and payoffs are (2,2)
- (Note that divorce is never observed in equilibrium)
- What have we learned
  - A lot about (psychological) game theory
  - About applications of feelings written into payoffs
  - In the present case, feelings of
    - husband, guilt, seem to be ex-post feelings as they occur after the decision to divorce
    - wife, trust, seem to be ex-ante feelings

4.6 Fairness and altruism

- Rabin (1993) "Incorporating fairness into game theory and economics"
  - Builds on and extends psychological game theory
  - Explains why people reward and punish other people at own costs
- Fehr and Schmidt (1999) "A theory of fairness, competition, and cooperation"
  - study preference for equality
  - economic environment determines whether fair or selfish types dominate equilibrium
- More traditional approaches (e.g. Baumol, 1986, but also macroeconomics literature)
- utiliy function of person A reads $u\left(c^A, c^B\right)$ or $u\left(c^A, c^{\text{average}}\right)$
- envy and altruism are determined by derivatives

$$\left.\begin{matrix}\text{envy}\\ \text{altruism}\end{matrix}\right\} \text{ if } \frac{\partial u\left(c^A, c^B\right)}{\partial c^B} \lesseqgtr 0$$

4.7 Exercises

Macroeconomics II: Behavioural Macro

Summer 2017 – www.macro.economics.uni-mainz.de

4.7.1 Regret theory (Loomes and Sugden, 1982) [in *Matlab* session]

Imagine that you have to choose between France and Italy to go on a beach holiday. Having this decision to make you know that there are three possible states you can find yourself in, let us write these states as follows, where s_{12} is the value of option 1 (vacationing in France) in state 2 (more sun in Italy):

$$\begin{aligned} s_1 &= \{s_{11}, s_{21}\} = \{8, 5\}\,, \text{ more sun in France} \\ s_2 &= \{s_{12}, s_{22}\} = \{5, 8\}\,, \text{ more sun in Italy} \\ s_3 &= \{s_{13}, s_{23}\} = \{5, 5\}\,, \text{ equal amount of sunlight} \end{aligned}$$

You do not know, a priori what the realisation of those states will be, so you have to weigh the probabilities of each, and decide which option yields the best expected utility (where U_1^2

represents the utility of choosing option 1 over option 2), given by

$$U_1^2 = \sum_{j=1}^{3} p_j u\left(c_{1j}, c_{2j}\right) \quad ; \quad U_2^1 = \sum_{j=1}^{3} p_j u\left(c_{2j}, c_{1j}\right)$$

with

$$u\left(c_{1j}, c_{2j}\right) = c_{1j} + R\left(c_{1j} - c_{2j}\right),$$

where c_{1j} is the consumption for option 1 in state $j \in \{1, 2, 3\}$. Assume the following functional forms and probabilities for the states of the world (i.e. *Case* 1 and *Case* 2)

$$c_{1j} = \ln s_{1j} \quad ; \quad R\left(c_{1j} - c_{2j}\right) = \left(\ln s_{1j} - \ln s_{2j}\right)^3.$$

Case 1	*Case* 2
$p_1 = 0.2$	$p_1 = 0.45$
$p_2 = 0.5$	$p_2 = 0.40$
$p_3 = 0.3$	$p_3 = 0.15$

1. Which destination will actually be chosen in Case 1? (See "*RegretTheory.m*" file in JGU Reader)

2. Which destination will actually be chosen in Case 2? (See "*RegretTheory.m*" file in JGU Reader)

4.7.2 Anticipatory emotions and anxiety (Caplin and Leahy, 2001)

Consider the following two-period setup where individuals exhibit anticipatory feelings about the outcome of a future event:

$$U\left(c_t, c_{t+1}, a_t\right) = E_t\left[\gamma u\left(a_t, c_t\right) + \left(1-\gamma\right) u\left(c_{t+1}\right)\right] \tag{5}$$

where $\gamma \in (0,1)$ represents the individual's relative preference for period t utility and a_t is the anticipatory feeling in t. The budget constraint in t reads:

$$w_t = c_t + s_t \tag{6}$$

where w_t is the wage and s_t is savings at time t. In $t+1$, the individual faces the following constraint, where consumption equals savings plus interests:

$$\left(1 + r_{t+1}\right) s_t = c_{t+1} \tag{7}$$

where r_{t+1} is unknown at t and is assumed to have constant mean and variance given by:

$$\mu \equiv E_t\left[1 + r_{t+1}\right], \tag{8}$$

$$\sigma^2 \equiv var_t\left[1 + r_{t+1}\right]. \tag{9}$$

We model anticipatory feelings as falling in the mean and rising in the variance of next period consumption, c_{t+1}:

$$a_t = var_t\left[c_{t+1}\right]^{\zeta} E_t\left[c_{t+1}\right]^{-(1-\zeta)} \equiv a\left(c_{t+1}\right) \tag{10}$$

where $\zeta \in (0,1)$ captures the relative importance of the variance of future consumption for anticipation.

1. Compute the first-order condition for this problem, and determine the corresponding Euler equation, provide an economic interpretation. Begin by using (6), (7), (10), (8) and (9) to rewrite (5) in terms of s_t only.

2. Now consider the following objective function:

$$U(c_t, c_{t+1}, a_t) = E_t\left[\gamma\left[\ln c_t - \phi \ln a_t\right] + (1-\gamma)\ln c_{t+1}\right] \tag{11}$$

   where $\phi \geq 0$ represents the individual's sensitivity to anticipatory emotions, note that if $\phi = 0$, we are back to emotion-free individuals.

   Following the same steps as above, compute the first-order condition for this problem, and determine optimal savings as a function of the wage, w_t, and parameters only. What is the marginal effect of ζ?

3. Imagine the individual does not care about the mean (i.e. set ζ equal to 1 in the FOC). Compute optimal savings and provide an economic interpretation. How does it compare to the standard case, when $\phi = 0$? [in *Matlab* session]

4. Imagine the individual is not worried about the variance (set ζ equal to 0 in the FOC). Compute optimal savings and provide an economic interpretation. How does it compare

to the standard case, when $\phi = 0$? How does it compare to the case above when $\zeta = 1$? [in *Matlab* session]

4.7.3 Immediate emotions and state-dependent preferences [in *Matlab* session]

Assume the following functional form for preferences (as an example for Loewenstein, 2000)

$$u(c_x, c_y) = c_x^{\alpha} c_y^{1-\alpha},$$

where $\alpha = f(\text{mood})$. Let mood stand for the emotional state of the individual such that α captures state-dependent preferences. The budget constraint for this problem is given by

$$e = p_y c_y + p_x c_x,$$

where e is the endowment, and p_y and p_x are the price of goods y and x, respectively.

1. Draw the indifference curve and budget constraint, and derive the optimal consumption ratio as a function of the mood (see "*ImmediateEmotionsAndStateDependentPreferences.m*" file in JGU Reader).

2. We now model state-dependence as Laibson (2001), talking about endogenous preferences and stable meta-preferences. To this end, assume a utility function that reads

$$u(c_x, cy) = (c_x - h)^{\alpha} (c_y - t)^{1-\alpha}$$

and call x food and y drink such that individuals eat more when they are hungry and drink more when they are not. The states are described by h for hunger (an immediate emotion, a visceral factor) and t for thirst. Using the same budget constraint as in (a) above, draw the indifference curve and derive the optimal consumption ratio as a function of h and t (see "*ImmediateEmotionsAndStateDependentPreferences.m*" file in JGU Reader).

4.7.4 Cue theory of consumption (Laibson, 2001)

Consider the following setup described in the lecture:

$$\begin{aligned} &\max_{\left\{c_t^s, c_t^f\right\}} u\left(c_t^s, c_t^f\right) = \left(c_t^s - x_t\right)^{\alpha} \left(c_t^f\right)^{1-\alpha} \\ &\text{s.t.} \quad p^s c_t^s + p^f c_t^f = E \end{aligned}$$

In this context we have instantaneous utility that depends on consumption of two different goods (namely, $f \equiv fruits$ and $s \equiv sweets$). However, the utility from s depends also on the bodily state x_t, call it a craving in this case, which is defined below as a function of the state

of the world (or cues):

$$x_t = x\left(i_t\right), \text{ where } i_t = \left\{ \begin{array}{c} P \\ A \end{array} \right\} \text{ with probability } \left\{ \begin{array}{c} \mu^P \\ 1-\mu^P \equiv \mu^A \end{array} \right\}$$
$$\text{and } x\left(P\right) > x\left(A\right)$$

Where P represents a cue that is present, and A a cue that is absent. In other words, when the individual faces a cue for s, his craving, x_t, increases, relative to when the cue is absent.

1. Derive the optimal consumption ratio, then determine the demand function for c_t^f and for c_t^s. What happens when $x_t = 0$?

2. Describe how the cues evolving over time affect the individual's optimal demand functions, i.e. what is their marginal effect on the demand functions derived above. Explain your result.

3. Working from the demand function for c_t^f, what is the effect of an increase in α? What does it imply for the individual?

4.7.5 Stress (Wälde, 2016) [in *Matlab* session]

1. (General phase diagram) How can we find the steady-state of a first-order autonomous differential equation of the form: $\dot{x} = f\left(x\left(t\right)\right)$? Under which conditions is a steady-state

stable/unstable? Illustrate with a graphical example.

2. (Stress phase diagram) Using the following equation: $\dot{W}(t) = \Phi W(t) - \delta_1 m$, where $\Phi \equiv \phi \frac{p}{a} - \delta_0$, with $\phi > 0$, explain the corresponding phase diagram from the lecture notes.

4.7.6 Psychological Game Theory: The Bravery Game

Consider the Bravery Game from the lecture, where payoffs are now given by the table below:

Normal-Form game

P1 strategy	*Payoffs (P1,P2)*
bold	$3 - \tilde{q}$, $\frac{2}{3} + q$
timid	$4 - 4\tilde{q}$, $2 - 2q$

1. Are there any pure-strategy equilibria?

2. Is there a mixed-strategy equilibrium, where P1 is indifferent between either strategy, if so for what value of $\tilde{q}$?

5 Conclusion

We asked two questions

- What is the role of emotions in expected utility maximization?
- How do economists model emotions?

Expected utility maximization theory comes in two guises

- Preference-based approach
- Choice-based approach
- Choice-based approach is purely behaviouristic/ positivistic approach – no place for emotions
- Preference-based approach leaves a lot of room for emotions

How do economists model emotions?

- Allow for experienced-utility as opposed to decision-utility (anticipatory emotions, ex-post emotions)
- Let payoffs (utility) depend on beliefs (psychological games)
- Make preferences state-dependent (immediate emotions, cue theory)
- Model emotions as state variables (stress)

Why care about emotions? (not covered in lecture - general remark)

- Economists outside their office would all agree that emotions matter for decisions
- Emotions in decision models allow to understand deviations from predictions of expected utility theory
- Many individuals are not aware of their true preferences
  - Understanding one's true preferences can lead to a personally more fulfilling life
  - Many problems of society can be overcome only if individuals change their attitudes (preferences)
  - Learning one's own preferences is emotionally (and other) very costly
  - Emotions need to be understood better, individuals should be more aware (and open) about their emotions, we need a better understanding of emotional processes