Economics of Reciprocity and Temptation

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1. Behavioral Economics: A Brief Reminder

- Traditional economic models assumed that:
  - people thoroughly analyze all their options and
  - make optimal decisions based on this analysis.
- In many decision-making situations:
  - this assumption works reasonably well and
  - leads to a reasonably accurate description of an overall economic process.
- However, many research results – some of Nobel Prize quality – have shown that:
  - in many practical situations,
  - the actual people's behavior differs from the assumed ideal one.
- The analysis of such behavior and its economic consequences is known as *behavioral economics*.

2. Challenges for Behavioral Economics

- Behavioral economics provides convincing and impressive examples of people's non-optimal behavior.
- However, in many cases, it does not provide us with quantitative models predicting people's behavior.
- Coming up with such models is an important challenge for behavioral economics.
- One way to come with such predictions is:
  - to understand why people's behavior differs from the predictions of traditional economic models,
  - so that, hopefully, this understanding will lead us to the desired predictions.

3. Why People's Behavior Differs from the Traditional Economic Predictions

- There are two main reasons why people's behavior differs from the traditional economic models.
- The first reason is that people often have limited ability (and limited time) to make a decision.
- As a result, they sometimes make a sub-optimal decision.
- In such situations, it is, in general, not easy to come up with the adequate model of people's behavior.
- This requires a deep knowledge of how exactly we process limited information in our brains.
- However, there is another reason why people's behavior differs from the traditional economic models.

4. Why People's Behavior Differs (cont-d)

- Traditional models oversimplify how people gauge gains from possible actions.
- In such situations, in principle, we can come up with quantitative models of human behavior.
- For this, we need to provide more adequate, more accurate models of human utility.
- Such situations are the "low-hanging fruits" of this research areas.
- These are topics in which there is the biggest hope of reaching quantitative descriptions of human behavior.

5. What We Do in This Talk

- We provide two examples of such phenomena.
- These examples correspond to (seemingly unrelated) phenomena of reciprocity and temptation.
- From the economic viewpoint, these are two different behaviors.
- However, it turns out that they can be explained by using similar ideas and similar techniques.

6. Utility in the Traditional Economic Models

- In the traditional economic models, it is usually assumed that a decision maker maximizes his/her gain.
- This gain is numerically expressed as utility u.
- This utility value describe the effect of this decision on this person at this particular moment of time.

7. Need to Go Beyond Traditional Models

- In these models, person's decisions are not affected:
  - by gains (utilities) of others and/or
  - by gains of the same person at future moments of time.
- However, gains of others (and/or future gains of the same person) do affect our behavior.
- Hardly anyone would prefer, e.g., \$101 to \$100 if this increase is accompanied by someone's severe suffering.
- Some people spend all their money like there is no tomorrow and retire in poverty.
- However, most people do limit somewhat their current expenses to save for retirement.
- It is all a matter of degree.

8. Dependence on Others' Utilities

- Let $u_i^{(0)}$ be approximate utilities that come only from this person's consumption.
- How can we take into account other people's feelings?
- A natural way is to add, to $u_i^{(0)}$, terms proportional to other people's utilities:

$$u_i = u_i^{(0)} + \sum_{j \neq i} \alpha_{ij} \cdot u_j.$$

- Here each coefficient α_{ij} describes how the utility of the i-th person depends on the utility of the j-th person.
- This phenomenon is known by a polite term *empathy*:
  - for positive α_{ij}, this describes how people feel better if others around them are happier;
  - it is also possible to have $\alpha_{ij} < 0$, when someone's happiness makes the other person unhappy.

9. How to Describe Dependence on Utility in Different Moments of Time

- In the traditional models, we assume that:
  - a person's utility at moment t
  - is determined only by his/her consumption at t.
- In reality, the person also takes into account future utilities u_{t+1}, u_{t+2}, ..., and past utilities u_{t-1}, u_{t-2}:

$$u = u_t + \sum_{j>0} q_j \cdot u_{t+j} + \sum_{j<0} q_j \cdot u_{t+j}.$$

- This is known as *discounting*, since a person usually considers future experiences as less valuable.
- E.g., people will pay less that a dollar for a chance to get a dollar a year from now.
- We will show that this explains reciprocity and temptation.

10. What Is Reciprocity

- Usually, people have reasonably fixed attitude to others.
- They feel empathy towards members of their family, members of their tribe, usually citizens of their country.
- They may also be consistently negative towards their country's competitors.
- However, they also have widely fluctuating attitudes towards people with whom they work.
- It is difficult to predict how these attitudes will evolve – even in what direction they will evolve.
- Usually, people are nice to those who treat them nicely and negative to those who treat them badly.

11. What Is Reciprocity (cont-d)

- In terms of the coefficients α_{ij} it means that:
  - if α_{ji} is positive, then we expect α_{ij} to be positive;
  - if α_{ji} is negative, then we expect α_{ij} to be negative.
- This *reciprocity* phenomenon is intuitively clear – this is, after all, a natural human behavior.
- But how can we explain it in economic terms?

12. Let Us Formulate the Problem in Precise Terms

- Let us consider the simplest case, when we have only two people. Then:

$$u_1 = u_1^{(0)} + \alpha_{12} \cdot u_2; \quad u_2 = u_2^{(0)} + \alpha_{21} \cdot u_1.$$

- Since each person tries to maximize his/her utility, a natural question is as follows:
  - suppose that Person 1 knows the attitude α_{21} of Person 2 towards him/her;
  - what value α_{12} describing his/her attitude should Person 1 select to maximize his/her utility u_1?

13. Analysis of the Problem

- The above system of equations is easy to solve, we get

$$u_1 = \frac{u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)}}{1 - \alpha_{12} \cdot \alpha_{21}}.$$

- This expression can take infinite value – i.e., as large a value as possible – if we take $\alpha_{12} = \dfrac{1}{\alpha_{21}}$.
- We can make it positive – and as large as possible – if we take α_{12} close to the inverse $1/\alpha_{21}$.
- Then, the difference $1 - \alpha_{12} \cdot \alpha_{21}$ will not be exactly 0, but be close to 0, with the same sign as the expression

$$u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)}.$$

14. This Explains Reciprocity

- Indeed, according to the formula $\alpha_{12} = \dfrac{1}{\alpha_{21}}$:
  - if α_{21} is positive, then the selected value α_{12} is also positive, and
  - if α_{21} is negative, then the selected value α_{12} is also negative.

15. What Is Temptation

- A popular book by a Nobelist Richard H. Thaler starts the chapter on temptation with a simple example.
- A group of friends eats nuts before dinner.
- As they eat more and more nuts, they realize that:
  - if they continue,
  - they will have no appetite for the tasty dinner.
- So they decided to put away the bowl.
- All this sounds reasonable, until we start analyzing it from the economic viewpoint.
- From this viewpoint, the more options, the better.
- So how come the elimination of one of the options made everyone happier?

16. What If We Take Discounting Into Account

- Let us denote:
  - the overall amount of food that a person can eat in the evening by a (e.g., by a grams),
  - the utility for eating one gram of nuts by n, the utility of eating one gram of dinner by d,
  - the discounting coefficient from dinner to now by q_+, and
  - the amount of nuts that we eat now by x.
- The variable x can take any value from 0 ro a.
- So, when we eat x grams of nuts and $a - x$ grams of actual dinner, then the utility now is equal to

$$n \cdot x + q_+ \cdot d \cdot (a - x).$$

- According to the usual decision making idea, we want to select x for which this utility is the largest.

17. Taking Discounting Into Account (cont-d)

- But this expression is linear in x.
- So its largest value on $[0, a]$ is attained at one of the endpoints of this interval, i.e., for $x = 0$ or for $x = a$.
- In the first case, we do not eat any nuts at all, in the second case, we do not eat any dinner.
- This may be mathematically reasonable, but this is *not* how people behave!
- How can we explain how people actually behave?

18. At Different Moments of Time, People Have Different Preferences

- So far, we assumed that the only way a person takes into account future events is by discounting.
- This would make sense if the same person at different moment of time has the same preferences.
- In reality, people's preferences change.
- To some extent, the same person at different moments of time is a kind of a different person; so:
  - when a person makes decision,
  - he or she needs to find a compromise between today's and future interests.

19. People's Preferences Change (cont-d)

- This situation is similar to situation of joint decision making, when:
  - several people with somewhat different interests
  - try to come up with a group decision.
- The only difference is that:
  - different people can decide not to cooperate at all,
  - while here, "agents" (i.e., the same person at different moments of time) are "joined at the hip",
  - decisions by one of them affect another one.
- Thus, to properly describe decision making, we need to view the problem as "group" decision making.
- It is group decision making by agents representing the same person at different moments of time.

20. People's Preferences Change (cont-d)

- According to decision theory, a group decision should be maximizing the product of agents' utilities.
- This is known as *Nash's bargaining solution*.
- So, in our case, a person maximizes the product of his/her utilities at different moments of time.
- Let us show that this indeed avoids the un-realistic prediction that $x = 0$ or $x = a$.

21. How This Idea Helps

- Let's consider the simplest case of 2 moments of time:
  - the original moment when we eat nuts, and
  - the future moment when we eat dinner.
- In the original moment of time, the utility is
$$n \cdot x + q_+ \cdot d \cdot (a - x).$$
- Similarly, at the next moment of time, the utility is $q_- \cdot n \cdot x + d \cdot (a - x)$.
- Here, q_- is a discounting coefficient.
- Thus, the correct value x maximizes the product
$$(n \cdot x + q_+ \cdot d \cdot (a - x)) \cdot (q_- \cdot n \cdot x + d \cdot (a - x)).$$
- This function is quadratic.
- The maximum of a quadratic function on an interval is not necessarily attained at one of the endpoints.

22. How This Idea Helps (cont-d)

- Let us illustrate it on a simplified example where computations are easy:

$$a = 1, \quad n = 1, \quad d = 2, \quad q_+ = q_- = 0.25.$$

- In this case, we maximize the function

$$(x+0.5\cdot(1-x))\cdot(0.25\cdot x+2\cdot(1-x)) = (0.5\cdot x+0.5)\cdot(2-1.75\cdot x).$$

- Differentiating this expression with respect to x and equating the derivative to 0 leads to

$$0.5 \cdot (2 - 1.75 \cdot x) + (0.5 \cdot x + 0.5) \cdot (-1.75) = 0.$$

- So, $0.125 = 1.75 \cdot x$ and $x = \dfrac{0.125}{1.75} = \dfrac{1/8}{7/4} = \dfrac{1}{14} \approx 0.07.$
- The values a, n, etc., were kind of random.
- However, the resulting proportion of nuts snack in the food – about 7% – is quite reasonable.

23. Comment

- So why is everyone happy that the temptation was taken away?
- Because this allowed everyone not to violate their social contract.
- In this case, it is a social contract (as described by Nash's bargaining solution) between:
  - a person now and
  - the same person in the future.

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