PRINCIPLES OF BEHAVIORAL ECONOMICS

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Week 56

Lecture 56

Hello everyone, we are discussing the problems with classical game theory. This is lecture 56 of the course on Principles of Behavioral Economics and we are going to continue with the discussion on problems with classical game theory in this module as well. We have been talking about different problems with respect to the framing effect, in terms of to what extent people are able to go for iterative deletion of dominated strategies. And also whether mixed strategy equilibria are in reality played or not. So in a similar fashion, we will continue with discussions on cognitive processes and strategic reasoning and their influences on the outcomes of classical game theory.

Classical game theory does not explicitly model the cognitive processes that underlie players' strategic choices. However, experimental studies have shown that understanding these processes is vital for assessing the plausibility of theoretical predictions. A 2002 study examined how subjects process information in a three-round Rubinstein bargaining game, solvable by backward induction. Rather than searching backward through the rounds as the logic of backward induction would require,

most players searched forward, beginning with first-round data. So, as we also discussed in the previous module, forward induction is observed or is sometimes played or several times played by the players. This mismatch between theoretical reasoning and cognitive behavior indicates that many subjects do not naturally engage in backward-looking logic. The experimental findings reveal that forward search dominates even when backward induction is the optimal solution method.

So, basically people do not follow the optimal solution method as prescribed by the classical gain theory. Teaching subjects the logic of backward induction improved their search patterns and their conformity with the theoretical predictions. So, again the point is that the rationality does not come naturally. People are not, due to bounded rationality, they are not able to always follow the best thing, do the best thing possible.

So if they are told and they are explained about the process of backward induction, fine, they applied it. And probably then the outcome was much closer to the one that is predicted by the classical game theory. They suggest that the cognitive cost of solving games as prescribed by classical models is non-trivial. It also highlights that deviations from classical predictions may arise not from irrationality but from the complexity of the reasoning process itself. While traditionalists may argue that cognitive processes are orthogonal to theoretical outcomes,

the strength of the evidence cautions against dismissing these findings on purely a priori grounds. In the next, we talk about failures in signaling games. Signaling games involve complex equilibrium concepts and place substantial cognitive demands. I will give you an example of signaling game, but then we would be very brief on it because explaining an entire signaling game is beyond the scope of this course. Experimental studies have tested whether these equilibria are observed in practice.

Consider a job market signaling model where there are two players, a sender which is a player 1 and a receiver. So basically player 1 sends the signal, player 2 is the receiver. This is how a signaling game may look like. Now first of all nature moves first at the oval circle in the middle and chooses one of two types of player one, that is player ones could be of two types one is H the another one is L with respective probabilities two by three and one by three.

Now who is going to pay that is randomly chosen by nature that is some outside entity the chosen type is revealed only to player one whose pure strategies are given by A and B, A and B. So both players H and L have two strategies A, B, A, B. But who is going to play that is chosen by nature and that is again revealed only to player 1. So player 2 does not know which one between H and L is being chosen by nature. Player 2 has two pure strategies,

C and D. You can say C and D. Also, each of player 1's strategy, player 2 has two strategies, but does not know the type of player 1. So, it does not know between H and L which one is picked up by nature. This is indicated by two vertical dotted lines connecting the two information sets of player 2 since he does not know for sure that is why these lines are dashed lines, for instance when player 1 chooses action A player 2 does not know whether the game has proceeded to the upper or to the lower node

on the right hand side information set. So again the point is that player 1 can play A or can play B but player 2 does not know whether A or B is played by H or L. The payoffs are shown at each terminal node. There are two equilibria and one of the equilibrium strategies are shown by the bold lines here. In the figure, both types of player 1 chooses action B if they are or if it is chosen by nature, then they will be choosing. So, this is one possibility that if player 1 plays strategy B, then observing action B, player 2 does not update prior beliefs about the type of player 1

And his best reply is to play action C. Player 2 plays action C because that is the bold line, irrespective of whether it is player H or player L, because he does not have this information. The second pooling equilibrium is shown below and labeled as the unintuitive equilibrium. The previous one was actually the intuitive equilibrium. So here, basically, if player 1 chooses strategy A, then again, player 2 chooses strategy C, and these are the outcomes.

So as evidence, signaling games involve complex equilibrium concepts and place substantial cognitive demands on players. Experimental studies have tested whether these equilibria are observed in practice or not and found mixed results. While one type of sender conformed closely to the predicted equilibrium—here, sender refers to player 1—satisfying the intuitive criterion. The other type initially deviated but improved over time.

So, with repeated games, the outcome was actually closer to the predicted ones. Importantly, unintuitive equilibria were not played, and more refined equilibrium concepts received little empirical support. These findings suggest only partial and selective conformity to classical predictions. A 1997 study tested signaling in the context of limit pricing under asymmetric information. In theory, firms with private information about demand should use quantity choice to signal unfavorable conditions to deter entry.

The game admitted both separating and pooling equilibria. We are going to define them very briefly. Separating equilibria is an equilibrium in which each agent's first-period strategy is a one-to-one function of his type, so that his first-period action reveals his type completely. So, in the case of the previous signaling game, it means that if strategy A is chosen, then player 2 will get an idea about

whether it is player H or L who is being chosen by nature in the first round or when strategy B is chosen then which what is the player who is the player 1 and accordingly he can decide or take a call so the basic point is that that helps it is it is actually associated with the type of player consequently in the second period agents are essentially playing a game of complete information They update their prior beliefs based on the information they receive. On the other hand, if at least one first-period strategy is not one-to-one—that is, from the strategy, you cannot identify the player—then the equilibrium is semi-pooling.

In the extreme case of the strategies being constant functions, the equilibrium is completely pooling. That is why we call the previous game's outcomes pooling equilibrium. Experimental results showed that players initially attempted full-information strategies but gradually shifted toward pooling behavior. So they stopped updating their information base or a priori beliefs about the players. However, convergence was slow, and in some sessions, many players continued to deviate from equilibrium.

When only separating equilibria existed, subjects still tended to pool, indicating persistent difficulty in achieving equilibrium behavior. Next, we talk about testing correlated equilibrium in experiments. A correlated equilibrium is one in which the joint payoffs of the players exceed the highest payoff from any Nash equilibrium. Cason and Sharma in 2007 tested whether players would follow such recommendations using the game. So, whether they would play a recommendation of correlated equilibrium or not.

So, this is one such game. This game has two pure strategy Nash equilibria. As you can understand pretty easily, one is DL the another one is UR and one mixed strategy Nash equilibrium which again you can calculate in which the row player plays up with probability 0.6 so he plays down with probability 0.4 and the column player plays left with probability 0.6 and right with probability 0.4.

Suppose that the monetary payoffs shown in the payoff matrix also represent the respective utilities of the players. So, payoffs and utilities are the same. If the experimenter were to recommend the players to play their part of a Nash equilibrium, say through a public signal, then such a recommendation may be expected to be self-enforcing. If it turns out not to be the case, then there are two possibilities. So, first, the monetary payoffs in the payoff matrix do not represent the utilities of the players.

Basically, here the recommended strategies are the Nash equilibrium. Now, if the players are not playing it, which basically should be self-enforcing, then this implies certain things. The first such thing is that they must be perceiving the monetary payoffs as something different from the associated utilities. And how can that be? For instance, the players might have social preferences and thus may derive utility

from their own monetary payoffs as well as the monetary payoffs of others. In that case, the utilities associated with not playing the NE may give them more utility. Second, the players may doubt the rationality of other players and so believe that other players will not follow their part of the recommended strategy profile. Under these conditions, it may be optimal for a player to ignore the recommendations of the experimenter. Cason and Sharma attempted to find out which of these two or both possibilities hold.

While some subjects adhered to the suggested strategies, many did not, particularly when playing against human opponents. Interestingly, compliance was higher when participants played against robotic agents, suggesting that distrust in opponents' rationality hinders the realization of correlated equilibria. So, something which I actually discussed in the very beginning, that people do not have trust in the rationality of other individuals. which again was established by these researchers.

These results show that correlated strategies are not inherently self-enforcing unless players believe others will also follow them. Cason and Sharma concluded that our results indicate that recommendations are not sufficient to induce players to switch to any chosen equilibrium. Subjects do not switch because they believe that their opponents will not do so. Duffy and Feltovich explored a broader set of recommendations, some yielding payoffs higher, lower, or equal to Nash equilibrium outcomes. They found that such recommendations shifted behavior toward the correlated equilibrium direction.

However, the evidence showed that correlation alone was not sufficient. For recommendations to be effective, players needed assurance that others would also comply. So again and again, we are coming back to the same problem. Thus, correlated equilibrium appears necessary but not sufficient for achieving coordinated outcomes in practice.

The next thing we talk about is strategic complements, substitutes, and nominal rigidity. Strategic complements (SC) and strategic substitutes (SS) characterize how a player's action affects another's incentives. When actions are strategic complements, an increase in one player's action raises the marginal payoff of the other's action. In contrast, with strategic substitutes, such an increase lowers the marginal payoff.

So it's simply the way we understand complements and substitutes in economics. Complements tend to go together. Substitutes replace each other. So here in this case, SC can be thought of as something where coordination is possible and both improve their situations, while SS is a competitive game where if one is making a loss, the other is gaining from that and vice versa.

Experimental results by Potters and Suetens found that players showed higher level of cooperation when actions were strategic complements. It makes perfect sense because when you are in a strategically complementary situation, you would prefer to coordinate, as that is going to improve your total payoff. Surprisingly, even in strategic substitute settings, when negative correlation is expected, the player's actions remain positively correlated.

So even when they are strategic substitutes, they are probably coordinating with each other. Reciprocity may explain this behavior. When one player facilitates joint payoff maximization, the other tends to respond in kind, regardless of classical expectations. Fehr and Tyran in 2008 extended this behavioral insight to macroeconomic settings involving price adjustment. In their experiment, firms operated in a monopolistically competitive environment where payoffs depended on their price,

The general price level and the nominal money supply. They introduced two behavioral factors with good empirical support, like money illusion and anchoring, in a model that allows considerations of strategic complements and strategic substitutes. They found that the extent of behavioral biases is endogenous and depends on the type of strategic interaction that is whether it is SC or it is SS. Behavioral biases are likely in those strategic environments where they are less costly in terms of foregone payoffs. The Fehr-Tyran findings are inconsistent with the current practice in theoretical macroeconomics.

Finally, we talk about competitive equilibrium and experimental limitations. The concept of competitive equilibrium lies at the heart of economic theory. It requires that all consumers and firms act optimally and that markets clear. So, in competitive equilibrium, we have the most common example or most extensively studied idea is that perfectly competitive markets and the associated equilibrium situation,

but actually in other types of markets there is imperfect competition and accordingly the equilibrium situation varies. So, competitive equilibrium actually drives all possible situations. However, CE models depend on strong assumptions, such as no trade at non-equilibrium prices and the presence of a fictitious Walrasian auctioneer. So, what does this Walrasian auctioneer does?

The Walrasian auctioneer contemplates fictitious out-of-equilibrium trades and then arrives at equilibrium prices. Actual trading then takes place only at the equilibrium prices. One may imagine that the Walrasian auctioneer starts out with an initial price vector, then invites market participants to truthfully report their intended trades in all markets at that price. If all the excess demands are zero at the initial price, The initial price is the competitive equilibrium price vector P star.

If the excess demands in some markets are positive or negative, then the auctioneer increases or decreases the price in those markets. So, basically, if there is excess demand and that is positive excess demand, then the Walrasian auctioneer increases the price there. Similarly, if there is negative excess demand, then the prices are decreased there in order to reach the equilibrium. So, the whole point here is that there is a Walrasian auctioneer who basically ensures that the trades all take place at the equilibrium price.

So, once the equilibrium price is reached through this kind of intervention, then only trade takes place. This experimental process goes on until the auctioneer finds a price vector P star at which all excess demands are zero. This is the CE price vector or competitive equilibrium price vector. Global uniqueness of P star requires, as a sufficient condition, that all goods be gross substitutes of each other at all prices. Furthermore, we require a large number of atomistic buyers and sellers, none of whom are large enough to influence the actual market outcome.

These are typical assumptions under perfectly competitive markets where there are infinite numbers of very small buyers and sellers, which are basically written in different language here. Thus, all individuals are price takers, be they buyers or sellers. In the classical model, buyers, sellers and the Walrasian auctioneer have full information about all relevant aspects. However, because each participant has no effect on the actual outcome, none of the participants can use the information in any strategic manner. So basically, there are contradictory assumptions.

First of all, we say that all buyers and sellers are price takers; they fail to influence the market, being very small. So basically, whether they have full information or not is actually immaterial. What the market probably assumes is that all of them together tend to influence the final outcome or equilibrium outcome. But that has been replaced by the Walrasian auctioneer here.

Furthermore, we require that there be no market frictions or imperfections, no externalities, and no public goods. The assumptions behind a CE are unlikely to be met in actual practice. In experiments with a double auction format, where buyers and sellers place bids simultaneously. That is the concept of a double auction.

Researchers found support for a competitive equilibrium. Some researchers using zero-intelligence robots also confirmed the predictions of CE. So, this raises questions such as: What degree of rationality does the market require on the part of the participants? Does individual irrationality wash out at the aggregate? That is, at the aggregate level, we all basically become rational individuals.

Do behavioral biases have any bite in a competitive market equilibrium? Because if at the aggregate level people are actually behaving rationally, then we do not need any behavioral interventions at the aggregate level. Chamberlin's seminal experiments which allowed buyers and sellers to bargain freely rejected the competitive equilibrium prediction. The failure of this model to align with observed behavior led Chamberlin to question the theoretical foundations of CE itself. Surprisingly, providing players with full information

often reduced rather than enhanced convergence to competitive equilibrium. So full information actually is not required in order to attain competitive equilibrium, specifically as exemplified by Chamberlin. Moreover, when the environment was enriched to allow for endogenous product quality, the CE no longer held. These findings suggest that while certain institutions can produce CE outcomes, their success depends heavily on specific rules and simplifications.

The real-world applicability of CE remains limited unless supported by institutional mechanisms that structure and constrain behavior in particular ways. So here before closing, The discussion on problems with classical game theory. We present a summary of the key criticism. First of all, human cognitive limits restrict iterative reasoning.

Second, framing and presentation alter strategic choices. Third, mixed strategy equilibria are rarely achieved in practice. Fourth, coordination failures are widespread despite theoretical predictions. Fifth, psychological factors like assurance, fairness, reciprocity, loss, aversion, all these things matter.

Sixth, bargaining outcomes deviate from rational models. Seventh, signaling and correlated equilibria depend on trust and communication. Institutions critically shape whether equilibria emerge or not. Behavioral game theory is needed to address empirical anomalies or these observations. With this, I conclude this module on the criticism of classical game theory.

These are the references that are being used. Thank you.