PRINCIPLES OF BEHAVIORAL ECONOMICS

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Week 41

Lecture 41

Hello everyone, today with this lecture 41 of the course on principles of behavioral economics, we are going to start discussion on intertemporal choice models, that is basically how we make choices across time. So, a major workhorse of intertemporal choice models that came from neoclassical or traditional economics is the discounted utility model. So, we are going to begin our discussion with a basic exposure to the discounted utility model.

Intertemporal choice, a core concept in behavioral economics, examines how individuals make decisions involving trade-offs between costs and benefits occurring at different points in time. So, the concept of intertemporal choice has become more popular with the introduction of behavioral economics, but intertemporal choice-making existed even before behavioral economics came into existence. And when you talk about the discounted utility model or exponential discounted utility, they refer to the intertemporal choice models of traditional or neoclassical economics, as I just mentioned in the beginning.

It refers to the decisions individuals make about allocating resources across different time periods, such as saving, investing, and consuming. These decisions have long-term consequences, impacting future consumption levels and overall well-being. Governments, firms, and individuals all face such decisions frequently and on an ongoing basis. For example, investing in roads, schools, and hospitals; building a new factory or launching a new product; buying a new car; spending on vacation; or joining a health club. So, all these, which are not one-time consumption, would definitely involve some kind of

intertemporal choices. Economists have been interested in such decisions since at least the days of Adam Smith but the current model that is generally used by most economists as well as by governments and firms is the Discounted Utility Model originally proposed by Samuelson in 1937. The widespread use of this model seems strange to many practitioners

in behavioral economics in view of the fact that Samuelson himself had significant reservations regarding both

the normative and the descriptive aspects of this model and that many anomalies have been observed over the last few decades. So, like most of the neoclassical or classical traditions, we have observed anomalies. So, this is also no exception. We will talk about anomalies later in some module. Although Adam Smith was the first economist to discuss the importance of intertemporal choice as far as the wealth of nations was concerned,

it was Rae who essentially provided a psychological foundation for a theory of intertemporal choice. So, what was John Rae's concept of—or psychological components behind—the Discounted Utility Model? So, he talked about the desire for accumulation. In the early 19th century, Rae identified the effective desire for accumulation as being the key psychological factor determining a society's decisions to save and invest. So, as you understand, this is specifically with respect to saving and investment, which in turn determines a country's rate of economic productivity and growth.

Rae also identified four psychological factors that either promoted or inhibited this desire and which varied across different societies. The two promoting factors identified by Rae were, first of all, the bequest motive - to accumulate resources for one's descendants. We are all familiar with the concept of inheritance or bequest. So, people used to—or what he claims is that—people save also in order to leave something for the generations to come. So, that is the bequest motive.

And the second thing is the propensity to exercise self-restraint. This involves the intellectual capacity to foresee probable future outcomes of decisions and the willpower to put long-term interests ahead of short-term ones. So here, basically, if I wish, I can of course spend all the money that I earn in a particular month or year. But we go for—or we exercise—certain self-restraint primarily because we understand that in the future, there might be some exigencies, some emergencies, some rainy days when I would need to utilize my saved-up money.

So, this is the purpose behind our saving tendency. So, one could be that I want to leave something for my next generations. The second one is that there could be some time when I need some additional funds. Of course, old age is one situation where everybody's productivity and ability to work decrease, as a result of which we need to consider how I am going to survive during those periods of time. So, that is a big responsibility that rests on ourselves, and for that, exercising self-restraint is extremely important.

So, keeping in mind all those long-term interests, we need to exercise or have some willpower in order to exercise self-restraint. The two inhibiting factors that were identified by John Rae were first of all there is uncertainty of human life. What it tries to say is that why we might not save. So inhibiting factors are factors that stop us from saving. So uncertainty of human life is one thing because there is no point in saving for the future if it is unlikely that we will have much of one.

Rae summed this up by saying when engaged in safe occupations and living in healthy countries men are much more apt to be frugal than in unhealthy or hazardous occupations and in climates pernicious to human life. So basically if the situation is that I am not very sure whether tomorrow I am going to survive or not. then I will have definitely very little incentive to save for tomorrow. So if the surroundings in which I am living does not guarantee a very long life, suppose a country is not much really developed, its average life expectancy is say some 60 years or so.

Generally people retire at the age of or around the age of 60. So if it is so as an average individual I would expect that I am also going to die by the time I am 60. So what is the need for me to save much because till the time I will be working, I expect to survive and maybe I will not survive long after that. So, I really do not need to bother much about the post-retirement period and it is also highly likely that is an average life expectancy at 60.

So, many people are dying much before that, some are of course surviving after that. So, it is also quite possible that I would be dying before that. In those situations, individuals will not have much incentive to save for the retirement period. So as a result of which that's an inhibiting factor. It inhibits human beings to save for future and in a similar fashion If not only the environment, but my work involves a lot of hazards, which also reduces life expectancy, then I will not have much incentive.

So broadly, across countries where the living conditions are very good, the medical facilities and health facilities are also excellent, so life expectancies are very high. You can see that in a large number of developed economies, life expectancies are increasing, and people are surviving beyond 85, 90, or 95 years, and they are also living a healthy life. Many of them are actively engaged in some kind of profession or other. Then, of course, they need to bother about their post-retirement life or when they will not be able to work much or earn much. But in countries where there is hardly any likelihood that I will survive for long, I might not have the incentive to save much.

The second inhibiting factors described by Rae was the urge for instant gratification exacerbated by the prospect of immediate consumption. So, primarily this is what is referred to as impatience. We want instant gratification, or we want to bring forward the consumption. Rae again expresses this in vivid terms as the actual presence of the immediate object of desire in the mind by exciting the attention seems to rouse all the faculties, it were, to fix their view on it and lead them to a very lively conception

of the enjoyments which it offers to the instant possession, all it tries to say is that we definitely get much more excitement, pleasure and satisfaction if consumptions are immediate as opposed to when it comes at a later date, which might not be true for everyone or all the time. But nevertheless, that is a broad understanding as presented by Rae and mostly understood also by the classical economists. So here, what we try to say is: if I am asked, 'Would you like to have a great meal today or tomorrow?' So somebody is trying to host me and then why should I say tomorrow?

Unless I am too occupied today, I definitely want to have it today. And whatever my occupation or engagement may be, I'm definitely going to have some meal at some time or devote some time on a particular day. So, I would definitely say that I can manage some time and would like to have it today itself. Most often, we would like to. bring our consumption forward to the present time, and that is basically the second inhibiting factor—that we may not save sufficiently for tomorrow or we always keep discounting the future more.

Later theorists developed two different view of time preference stemming from Rae's work. One view took the approach that the default situation was that people weighted the present and future equally, but the discomfort of delaying gratification caused people to weigh future outcomes less heavily than present ones. The second view took the opposite approach proposing that people generally only considered immediate utility but the anticipation of future utility might on occasion more than offset any loss of current utility

causing them to delay gratification. So, it basically talks about both possibilities—delaying gratification or immediate gratification. Both approaches emphasize the importance of current feelings but explain variations in time preference between people in different ways. According to the first approach, people vary in terms of the discomfort they experience in delaying gratification. According to the second approach, variations in time preference arise because people have different abilities to anticipate the future.

The next major development in the theory of intertemporal choice came from Eugen von Böhm-Bawerk, an Austrian economist. Böhm-Bawerk and later Pigou introduced the notion that people generally underestimate future outcomes, leading to a time preference bias towards the present. So, you see, the neoclassicals gradually moved towards the present bias, that is, The broad understanding is that I would prefer to bring forward consumption to the present time. So the first approach—that we favor present gratification—is actually more acceptable or found to be more favorable by a large number of economists.

It should be noted at this stage that this notion does not involve discounting future outcomes. Instead, it is the utility of these outcomes that is underestimated. So, in a way, the outcome remains the same. What we are discounting is the pleasure or the satisfaction associated with it. So, for instance, if I am asked whether I would like to have 100 rupees today or tomorrow,

Somebody wants to give me 100 rupees. So I have two options: getting it today or getting it tomorrow. Now, you can see that, understandably, the outcomes are the same. But I may need it today just because my satisfaction from these 100 rupees is greater compared to getting it tomorrow. Böhm-Bawerk introduced another important innovation in the theory of intertemporal choice.

Such choices were seen as trade-offs in terms of allocating resources to oneself in different periods of time, similar to trade-offs in allocating resources between consuming different current goods. The final development before the introduction of the discounted utility model came from Irving Fisher. He formalized much of the work outlined above extending the Böhm-Bawerk framework of analysis in terms of using different curves to illustrate the relevant trade-offs. So, all these concepts that we have discussed so far may be formally brought under the umbrella of the discounted utility model or some concept of indifference curve analysis. offered by Irving Fisher.

But one thing to be noted here is that this indifference curve analysis is pretty much similar to the one that we generally go for involving two commodities. But here it actually involves two time periods. Current consumption was plotted on the horizontal axis and future consumption usually for the following year but it is actually the next period. The next period could be the next day, the next week, the next month or the next year was plotted on the vertical axis. The concept of the marginal rate of substitution between current and future consumption was also applied.

This depended both on time preference and diminishing marginal utility. So, those who are already familiar with the concept of marginal rate of substitution understand that when there are two goods X and Y, then marginal rate of substitution essentially tells us that the rate at which we need to substitute X by Y or Y for X in order to maintain the same level of utility. Here, in this context, the marginal rate of substitution—or, in short, MRS—is applied to current and future consumption.

So, this is basically the same concept: the rate at which we need to substitute current consumption for future consumption or future consumption for current consumption. In order to maintain the same level of utility, it was applied. It should also be emphasized that Fisher discussed at length the psychological factors affecting time preference. Thus, he not only took account of future wealth and risk, he also referred to the four factors described by Rae and to foresight, which is the other side of the coin of Bohm-Bawerk's notion of the underestimation of future wants.

Now, we consider, first of all, under Fisher's analysis, a two-period model's budget constraint. First, consider a simple model in which a consumer lives for two periods: period 0 and period 1. Assume that labor income is exogenously given as Y0 in period 0 and Y1 in period 1. The interest rate is denoted by r. So, income, these are income, this is interest rate. Consumption in period 0 is denoted by C0.

Consumption in period 1 is denoted by C1. The utility function depends on both periods' consumption. In period 0, the consumer can save. Saving is defined by the difference between income and consumption. So, basically, you are earning Y0, you are consuming C0.

And whatever remains is saved by you. Now, S is greater than 0 only if Y0 is greater than C0. If Y naught is equal to C naught, you understand S will be equal to 0. And if you actually consume more than Y naught, more than you have earned, then S will be less than 0.

If C naught is greater than Y naught and if S is negative, then we consider that the consumer has borrowed money because otherwise, from where is the money coming? You have—this is basically negative saving. You have borrowed money from the market. In the two-period model, the consumer cannot borrow in the last period, period 1, and it is necessary that consumption in period 1 is smaller than or equal to the sum of saving, the interest income, rS, and labor income, Y1.

So, what we write is that the consumption in period 1 is, first of all, less than or equal to the income that you earn plus 1 plus r multiplied by S. So basically if I break it I will be having Y1 plus 1 plus rS. So if you have saved some money, then this is the income generated or the interest income that you receive. You can draw down your entire savings, and the income that you have earned.

$$C_1 \leq Y_1 + (1 + r)S$$

So, taken together, this is the maximum possible consumption that can be. But if S has been negative that in the previous period you have consumed more, then this rS is also negative, which is basically the interest that you would be paying on the borrowed amount. S is also negative. So you have already drawn. So this refers to the principal amount.

So S plus rS is the principal amount that you are supposed to return, which would be subtracted from Y1, and then that would be equal to your consumption in period 1. When we combine equation 1 and equation 2, we obtain that this is the consumption in period 0. The current period, this is consumption in period 1, must be less than or equal to income in period 0 plus 1 plus 1 upon 1 plus r y1, that is income in period 1. Now, what does it imply? This is basically the present value of future consumption.

$$C_0 + \frac{1}{1+r} C_1 \leq Y_0 + \frac{1}{1+r} Y_1$$

And present value of future income. Why is this so? Let us consider, I have, this is pretty simple, maybe some 10th-12th standard mathematics, that I have 100 rupees, I lend it to someone at an interest rate of 10%. For, say, one period, it could be one day, one month, one week, whatever. So, after one month, say, it becomes 110 rupees.

So this is period 1, this is time period 1, and this is time period 2. So what we say is that we have 100 multiplied by 1.1, 1 plus 0.1 which is 1.1, equals to 110. Alternatively, 100 equals to 110 divided by 1.1. which is 100 divided by 1 plus r. Now you can see that, sorry, 110 divided by 1 plus r. So now you can see this is pretty similar to these expressions. What does it imply?

It implies that what is 100 rupees today is equivalent to 110 divided by 1 plus r. Or alternatively, if you are expecting 110 tomorrow, then 110 divided by 1 plus r is the value that you would consider as the present value of 110. The reason is that since this is tomorrow, you can alternatively look at it like 100 rupees you had, which you did not consume; rather, you gave it to someone. So which implies that you basically let go of your consumption; you sacrificed your consumption. So for that, you need some reward.

What is that reward? That reward is the interest income. So either you have 100 rupees today for your consumption. If you are not having it today, then you want it to be a higher amount, and that is 110 tomorrow. So that is why tomorrow's 110 is equivalent to today's 100.

This is the intertemporal budget constraint basically when the future period is also brought down to the current period. If we compare this with the budget constraint for different goods in the same period such as apples and oranges and if we view the same good in different periods as different goods then we see that 1 upon 1 plus r is the relative price between C1 and C0. If you remember when we had—if you know that, at least those who are initiated—when we had a two-commodity scenario. So, we have the total income, say M, equal to PXX plus PYY, which can also be written as M upon PY equals PX upon PY.

P y plus y. So, this is basically a process of normalization that if I hold the price of or make the price of 1, price of y equals to 1, then this is my real income in terms of the price of commodity y and this is basically the relative price of commodity x to commodity y. So, that is how in a similar fashion 1 upon 1 plus r would be considered as the relative price between period 1 consumption C1 and period 0 consumption C0. On the left-hand side, so this is the left-hand side of this budget constraint, we are discounting future consumption by 1 plus R to make it measured by the same unit as present consumption.

So, this is the concept of present value calculations. Therefore, the left-hand side of equation 3 (this is equation 3) is called the discounted present value of current and future consumption. Similarly, the right-hand side is the discounted present value of current and

future labor income. For example, the labor income in period 0 is 9000. Suppose this is 9000.

The labor income in period 1 is 10,500. And the interest rate is 5%. Then, the present discounted value of labor income in period 1 is 10,500 divided by 1 plus 0.05. So, which is 1.05. That will be equal to 10,000.

Adding this to the labor income in period 0, the present discounted value of income in 2 periods is 10,000 plus 9,000, making it 19,000. Otherwise, if we do not calculate the present discounted value, then this would be 19,500. The intertemporal budget constraint is that the discounted present value of current and future consumption must not exceed the present discounted value of current and future labor income. Borrowing and lending allow us to rearrange our capacity to buy goods and services across time. Borrowing allows us to buy more now but constrains us to buy less later.

To see how this works, think about an individual named Julia who needs to consume now but has no money today. She knows that in the next period, she will have a hundred dollars from her paycheck. Maybe you are just starting to work, so this month you do not have any money. At the end of this month, you will get a hundred rupees, and with that hundred rupees, you have to spend for two months—this month as well as the next month. This is how we would be drawing Julia's budget constraint.

This is Julia's endowment of 100 rupees. This is consumption in the second period—consumption later. This is the current period consumption—consumption now. So Julia's situation is shown in this figure. Each point in the figure shows a combination of Julia's capacity to consume things now and later.

So what we are assuming is that there is an interest rate of, say, 10%. Now Julia doesn't have anything today. If she does not consume anything today or in this month, then she would be consuming the entire 100 rupees in the next month. Alternatively, if she decides not to consume anything in the next month or she is too impatient, she basically expects 100 rupees and borrows heavily from the market. What is the maximum amount she can borrow from the market?

Roughly 91 rupees because a 10% interest rate on 91 would make it 9.1. So, which is close to 100 rupees. So, basically, if she consumes, borrows the entire amount, and consumes, then she will have a maximum consumption of 91 in this month, with nothing left for the

next month; the next month is 0. And then we basically connect these two points to arrive at the budget constraint for Julia.

Now, this budget constraint, as it is mentioned here, represents various combinations. So, for example, Julia borrows only 30 rupees this month and pays an interest rate of 10%. So, basically, 3 rupees, which means that in the next month she would be left with 67 rupees. Again, on the other hand, if she chooses to borrow 70 rupees, then she has to pay 70 plus 7 rupees in interest. 77 should be left with only 23 rupees for next month's consumption.

We assume that she spends everything that she has. So basically, this assumption ensures that she would be on the budget line and not below the budget line. She cannot be above the budget line because she cannot afford. But then she won't be below the budget line. She would be spending the entire amount on consumption in both periods.

To consume now, Julia is considering taking out a payday loan. For example, borrow 91 now at an interest rate of 10% and promise to pay the lender the whole 100 rupees that she will have later. We can think of the interest rate as the price of bringing some buying power forward in time. So, since I am bringing it forward, I have to pay a price for that, and that price is the interest rate.

At the same interest rate, she could also borrow 70 rupees to spend now and repay 77 rupees once the paycheck is received and consume 23 rupees. All of the possible combinations of consumption now and consumption later generate the feasible frontier shown in this figure, which is the boundary of the feasible set when the interest rate is 10%. So this is the line we have already mentioned. With an interest rate of r equals to 10%, the opportunity cost of spending 1 rupee now is that Julia have to spend 1.1 that is 1 plus r rupee later, r rupee less later. 1 plus r is the marginal rate of transformation of goods from the future to the present because

To have one unit of good now, you have to give up 1 plus r goods in the future. So, the budget line basically represents the rate at which you are transforming present consumption into future consumption or future consumption into present consumption. Suppose instead of 10%, the interest rate is now 80%. If the interest rate is as high as 80%, then at this interest rate, Julia can now only borrow a maximum of 55.5 rupees because at 80%, the interest on a loan of 55.5 is 44.4, using up all 100 rupees of her future income.

So, see when the interest rate was 10%, she could spend up to 91. When it is as high as 80 percent, she can only spend up to 55.5 rupees and done nothing to consume in the future.

The feasible frontier therefore pivots inward, and the feasible set becomes smaller. So this is pivoting inward, and this was the initial feasible set. Now this is the feasible set, so this is much smaller because the price of bringing buying power forward in time has increased the capacity to consume in the present has fallen.

Now, considering the intertemporal budget constraint—that is, this expression that we have already derived—we see that here, in the context of Julia, Y0 equals 0 and Y1 equals 100. Therefore, the equation can be rewritten as, since Y equals 0, I have dropped Y, and then 1 plus r is multiplied or taken to the other side. So, I have C0 into 1 plus r plus C1 less than or equal to Y1. So, for r equals 10 percent, you can see that C0 could be approximately equal to 91, where C1 would be 0—the case when Julia consumes everything in the first period.

$$C_0 + \frac{1}{1+r} C_1 \leq Y_0 + \frac{1}{1+r} Y_1$$

So, with this, I conclude this discussion on the very introduction of intertemporal choice models. We have talked about theories that were developed even before the introduction of the discounted utility model.