Microeconomics: Theory & Applications

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Lecture – 21
Intertemporal Choice (Part – 1)

Hello! Welcome back to the lecture series on Microeconomics. Now, let us see how we can utilize our learnings from indifference curve analysis to an exciting applied area namely finance and investment. Finance is a vast growing area and there is a different discipline or sub branch of economics called financial economics to analyze financial matters. We are not going to take a detour from microeconomic theory to financial economics, but let us discuss some basic concepts and models which are pretty useful in analyzing financial economic matters.

When there is borrowing and lending market or capital market, then the consumer's consumption is not constraint by the money income that he or she has in a particular time period. Earlier we have seen that there is a budget constraint and the budget constraint has fixed money income, but if borrowing and lending is permitted, then if the consumer is money constraint or budget constraint in a particular time period, he or she can go to the capital market and borrow some money and then consume more than that is permitted by his or her current income level. So, if that is the case, then basically we are talking about consumers decision how much to consume in a particular period. Consumption over time periods is known as inter temporal choice problem.

So, basically in essence this is a consumptions savings problem which is alternatively known as inter temporal consumption plan. So, in this lecture we are going to look at a very simple modeling framework through which we can find optimal consumption plan of a consumer for two time periods. Let us look at the agenda items first.

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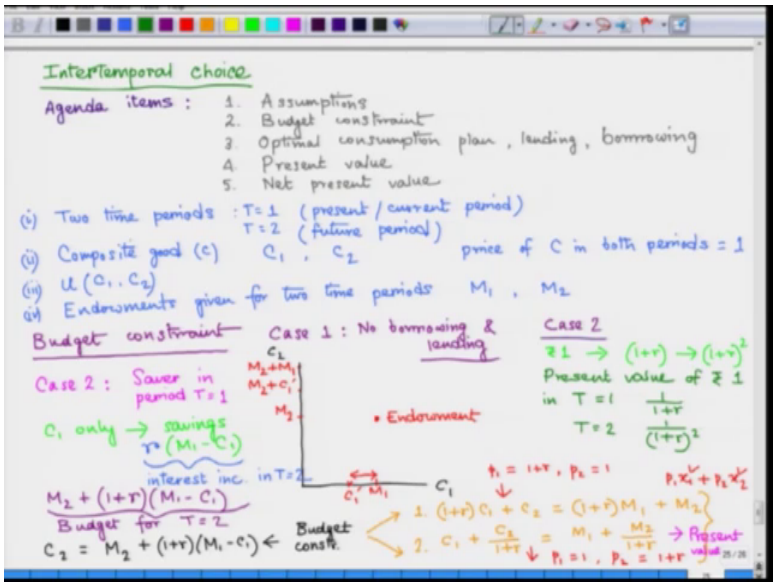

So, first we are going to talk about the budget constraint that a consumer faces, well. So, first we are going to look at the assumptions, then with the assumptions we will develop the budget constraint of the consumer and then, we are going to find out Optimal consumption plan and lending and borrowing.

We are also going to look at a very useful concept known as Present value and then we are going to see the application of net present value. So, now, let us start with the modeling assumptions. Let us assume that our consumer leaves for 2 time periods. Of course, this can be generalized later on. So, there is a present period and there is a future period. We denote the present period by 1. So, T equals 1 is the present or current period and T equal to 2 is future period. So, this is our assumption number 1; assumption number 2 is that earlier we have spoken about at least two commodities that the consumer used to consume.

Now, we are going to assume that there is a composite good which is basically a combination of all goods denoted by C that is to be consumed in two periods. So, we can say that C1 is basically the current consumption level and C 2 is basically the future consumption level and we assume that price of this consumption good is 1 in both the periods. So, no inflation, basically that is what is the implication then the third assumption is on the utility function. The consumer has an utility function defined over the current consumption and the future consumption levels.

The fourth assumption is this. The consumer has endowments. So, you can assume that this is the money income level given for two time periods and these are M 1. So, that is the money income given in period one and then there is M 2 that is money income level given for period 2. Now, let us first construct the budget constraint. Having stated the assumptions of the model, now let us look at the budget constraint of a consumer. We are going to consider two different cases; case number one would be a case of no existence of capital market. In that case, basically the consumer our consumer is not allowed to do borrowing and lending.

And in case number 2, we are going to assume that loan market or a capital market exist. So, the farmer can do some borrowing and lending. Let us have a look at these two cases individually. So, first we are going to consider the case of no borrowing and lending. So, now, we are going to draw the budget line in the consumption plane where the current consumption C 1 is measured along the horizontal axis and the future consumption c 2 is measured along the vertical axis. Now the consumer starts with an endowment right. So, the endowment is basically M 1 and M 2 the income levels into different periods.

If no borrowing and lending is permitted then the maximum consumption that that the consumer can have in period one is constraint by his or her income M 1. And of course, the maximum that he or she can consume in period 2 is given by the money income M 2, the income in second period. So, we observed there is a dot in the consumption plane. So, that is basically the endowment point right. Now, if at least saving is permitted in this model, then there can be some transfer of money income from one period to the other.

Let us assume that our consumer decides to consume a consumption level at c 1 and then if that is the case then basically he or she is saving money by this gap between M 1 and C 1, we can call it C 1 prime ok. Now, this much money will be transferred from period 1 to period 2 for the future consumption. So, basically the intercept along the vertical axis is now going to rise and we are going to have M 2 plus C 1 prime as the intercept and this will be the maximum that the consumer is going to consume in the future or period 2 because he or she has saved some amount in period 1. Now, one can also assume that the entire money income M 1 in period 1 could be saved and this income could be used for consumption in period 2. So, if that happens, then basically we get even higher intercept along the future consumption axis. So, if the consumer transfers the entire amount of money income M 1 from period 1 to period 2, he or she will consume

M 2 plus M units of consumption good in period 2. So, if I now join these two points, my initial endowment and my future consumption, then I get a straight line that is my budget constraint and this budget constant will have a slope of minus 1.

It is quite obvious that the slope of the budget constraint in this case will be minus 1. Now, let us discuss case number 2 where we allow our consumer to borrow and lend let us also assume that the consumer needs to save in period 1 so that he or she can consume more in the future period or period 2 and let us see how the budget constraint is going to be written in this case. So, we are going to assume that our consumer is a saver in period 1. So, if that is the case, then let us assume that the consumer our consumer decides to consume only c 1 units of consumption good in period 1.

And then, there will be a saving right. So, if he or she consume c 1 only in period 1 that will lead to a savings M 1 minus c 1 right. Now, this savings he or she can keep with the bank and that bank will give him or her, a rate of interest in return for this amount of savings the. So, basically the consumer is lending the money to the bank. So, that will be his or her interest income in period 2. So, if that is the case, then not only the interest you will earn but he will also earn the principal back right. So, basically the consumer will have this much amount of money in period 2.

So, M 2 that is the endowment of period 2, then he will or she will get this much from bank as he or she saved M 1 minus c 1 amount of money in previous period. So, this is going to be his new budget for period T equal to 2, right. So, we can write down the budget constraint as C 2 that is the consumption in period 2 equals this much of income M 2 plus 1 plus r M 1 minus C 1. So, that is basically going to be the budget constraint in this case. Now, we can rewrite our desired budget constraint in two forms and each of these forms we have very interesting economic interpretations.

So, let us have a look at them one by one and one of these rearrangements of the existing budget equation will give us the concept of present value. So, from this budget constraint, we can now have two different forms that can be generated and one will be this is number 1. So, that will be 1 plus r times C 1 equals C 2 equals 1 plus r times M 1 plus M 2. Note that you know I have only rearranged it. Now, there will be a second form of the rearrangement done can be done and that would give us C 1 plus C 2 divided by 1 plus r equals M 1 plus M 2 into divided by 1 plus r.

Note that both of this rearrangement is surprisingly very similar to the expression that we have seen before right. We have earlier seen the budget constraint as p 1 x 1 plus p 2 x 2 right and then basically what you can see that if x 1 and x 2 are the consumptions in two different time periods, then p 1 and p 2 will be the prices. So, basically these two expressions give different prices for the present consumption and the future period consumption. So, I talking about equation 1 here p equal 1 plus r right and p 2 equals 1 and when we are in the second equation, then we get what, we get p 1 equals 1 and p 2 equals to 1 plus r.

Now, the second expression is very important in economics as it leads to the concept of present value. So, how much does a rupee value next period in terms of rupee value today, ok. So, that is basically in a nutshell the concept of present value is. Now, to elaborate suppose, you start with rupee 1 in period 1. You save the money with bank and you get 1 plus r at the end of period 1, then you do not stop, you again re invest the money with the bank you save the money with the bank and then at the end of period 2 you get 1 plus r square back.

So, the present value of rupee 1 in period 1 will be 1 over 1 plus r and in period t equal to 2 it will be 1 over 1 plus r square. After introducing two variations of the budget constraint of a consumer and the related concepts of future value and present value let us have a look at the formal definition of these 2 concepts and let us understand these two concepts through some illustrations.

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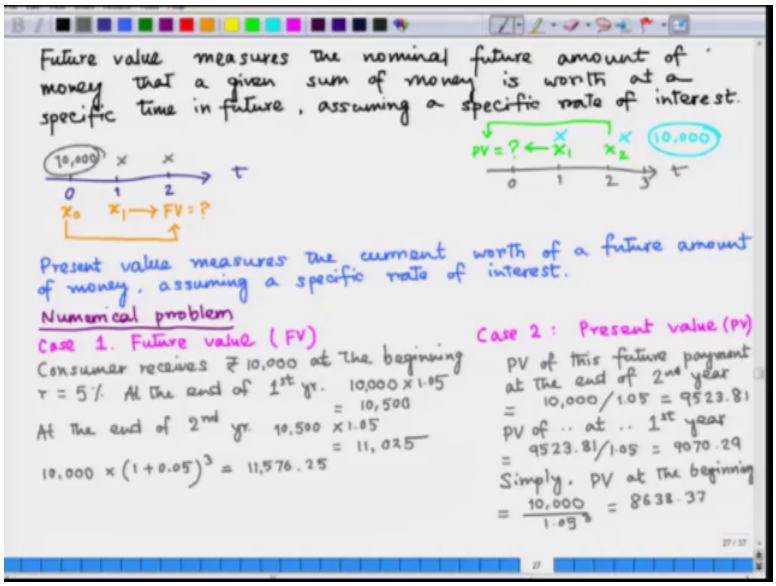

So, we will start with future value. Future value measures the nominal future amount of money that a given some of money is worth at a specific time in future.

Of course, assuming a specific rate of interest or return, now we are going to have a graphical illustration of the concept. So, let us draw a timeline. So, this is T and we are talking about three different time periods say 0, 1 and 2. Now at period 0, suppose the consumer gets x naught amount of money and in period 1, the consumer receives x one units of money. So, then we will be interested to know what will be the future value of these two payments in period 2. So, basically in the future value computation x naught will come and x 1 will come as well but through some mathematical procedure.

Now, we are going to look at the definition of the present value. So, present value measures the current worth of a future amount of money again assuming a specific rate of return or interest. Having spelled out the definition of present value, now let us look at a graph to understand the concept better. So, again we are going to draw a timeline, this horizontal line measures time and let us again assume three different time periods 0, 1 and 2 and now if the consumer is about to receive x 1 units in period 1 and x 2 units in period 2, then the pertinent question that can be asked is what is the present value of these income streams to the consumer in period 0.

So, again what will happen these x 2 and x 1 will contribute to the value of P V through the method of discounting ok. Now let us look at a numerical problem. Case 1 will talk

about the future value and case 2 will talk about present value. Let us introduce the abbreviations F V and P V.

So, now, let us going to assume that a consumer receives rupees 10000 at the time period 0, it means you know at the beginning of the story and let us assume that there are three time periods. So, the consumer actually receives rupees 10000. Let me write this figure here. So, 10000, but he does not receive anything in period 1 or period 2. That is an assumption let us make that assumption and then the consumer is interested to find the future value of these income rupees 10000 that he or she has got in period 0. So, what will happen? The person can put this money in bank and earn a rate of interest; we assume a rate of interest 5 percent for this example. So, at the end of first year, how much does the consumer receives from the bank, principal amount times interest payment at 5 percent. So, the consumer receives 10500, right.

Now, this money he can reinvest with the bank in that case. At the end of second year, he will receive and the amount is. So, simply if this continues then we can add on more years or time periods. So, say for time period 3, he or she will receive right and the amount will be. Now, we are going to talk about the case of present value. So, now, here to make it little bit more interesting, let us introduce another time period say time period 3 and we assume that our consumer receives a sum of 10000 at the end of period 3.

But he does not receive anything at the end of period 2 or period 1. So, here the pertinent question is that what is the present value of his income rupees 10000 which is about to come at the end of period 3. So, we have to start with the present value of this future payment at the end of second year to start with and that would be 10000 divided by 1.05 and the amount would be 9523.8 approximately 1.

Now, following a similar strategy, we can find out P V of this future payment at the end of first year as well and the amount would be around 907029, right. So, we can follow similar step for the period 3 or simply we can use mathematics to write P V at the beginning. It implies time equal to 0 would be cube and that would be 863837 approximately, right. So, we have derived budget constraint of the consumer when the consumer chooses between future consumption and current consumption.

We have also introduced the concepts of present value and future value. In the next lecture, we are going to find a consumer's equilibrium and we are going to find some useful applications of these concepts in financial markets.