Microfoundations of Macroeconomics
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Lecture - 12
Ricardian Equivalence I

Welcome back. As I mentioned that we are going to discuss the Ricardian equivalence. And Ricardian equivalence idea is very important in the area of public finance and also it helps understand the timing of the government and whether the government is going to increase the taxes then it is bound to happen that the government will give tax relief in the future. Individuals are also working out their consumption behaviour.

And then they smooth out the consumption given the condition of the government.

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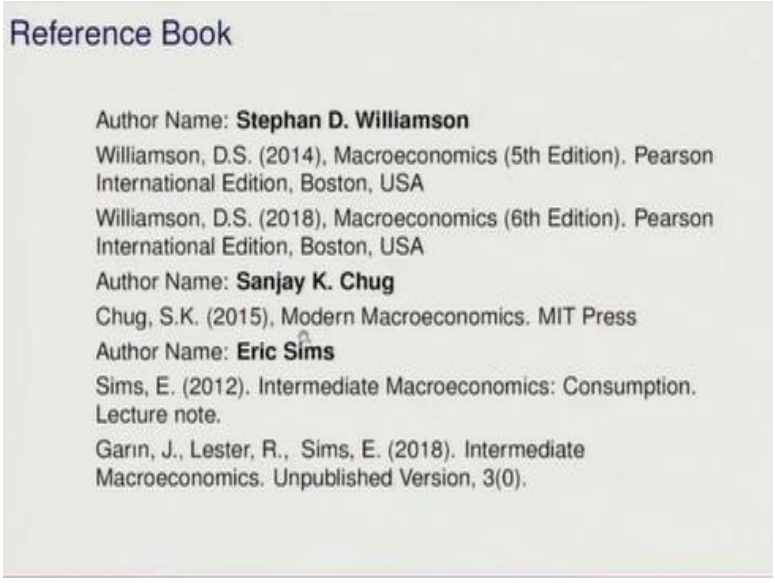

The reference book as I mentioned remains the same Stephan D Williamson and Eric Sims and the Sanjay K. Chug.

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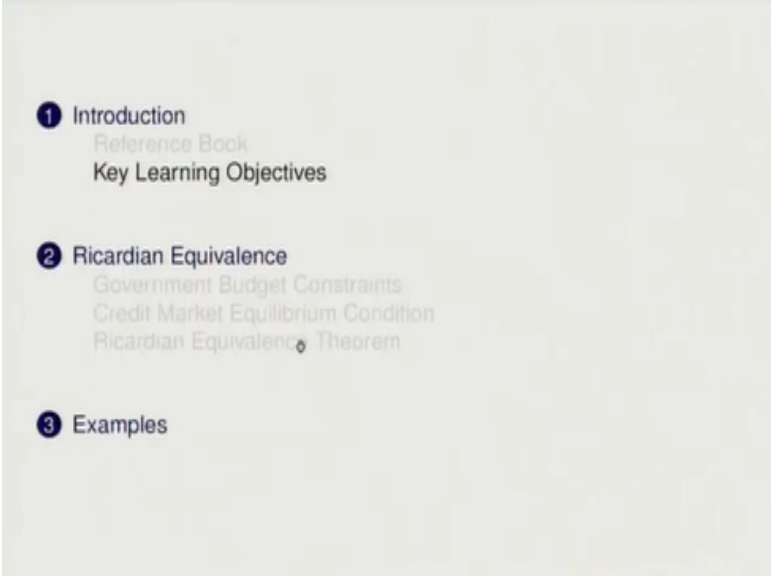

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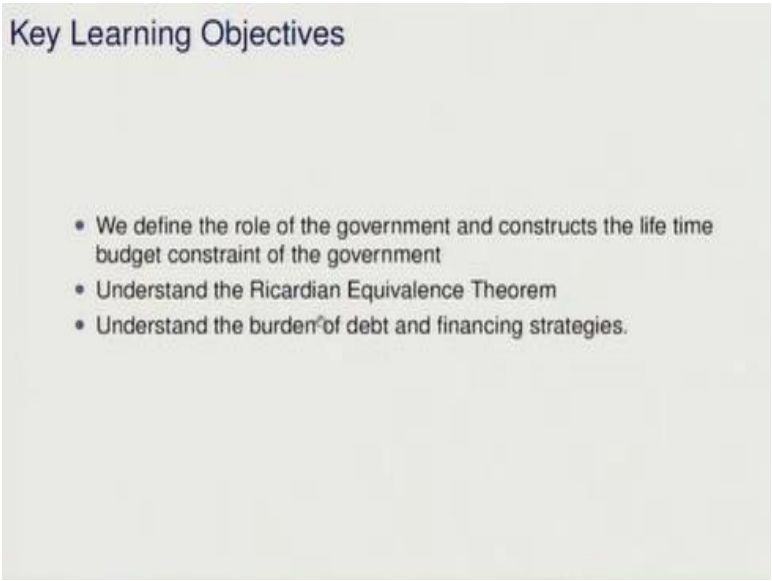

And the objective I have already mentioned.

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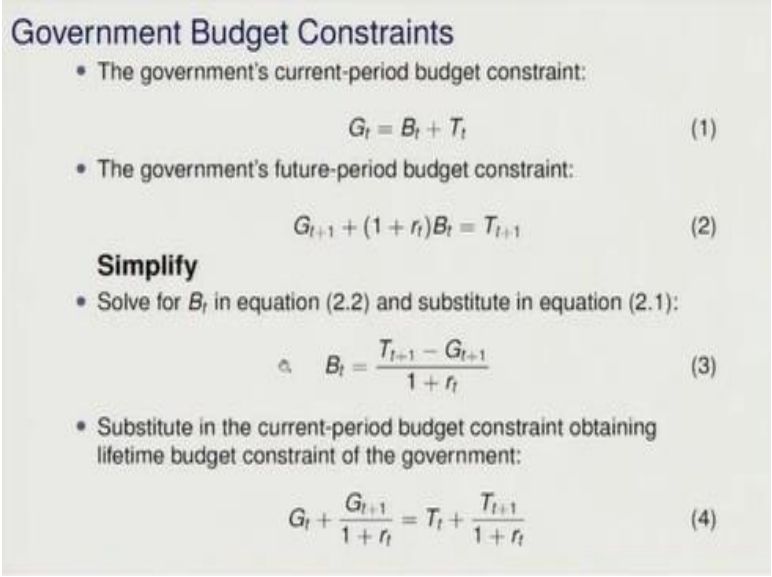

Let us start. Like before here you have the government's current period budget constraint. This particular government has two channels to go for creating income. G is the government expenditure which is equivalent to B is the bond issued by the government. It has been sold to the private parties and this T is the tax.

One is the tax revenue that the government gets other is the debt scenario where the government can borrow.

$$G_t = B_t + T_t$$

Borrowing and taxation are these two important scenarios where you have a total income of the government is equivalent to government expenditure. The government's future period by its constraint is

$$G_{t+1} + (1 + r)B_t = T_{t+1}$$

This B_t will have an increased value. The government will have to pay some kind of rate of interest. this will also bear that so the value will increase in the future period of this bond. And in the future period, the corresponding future period value of the government expenditure will be G_{t+1} and here we have the T_{t+1}. Now if you solve for B_t here and substitute back here you can easily derive the budget constraint of the government.

Solve for B_t in the equation here and substitute it in the equation here this is what.

$$B_t = \frac{T_{t+1} - G_{t+1}}{1 + r_t}$$

Once we substitute in the current period so since I got the B_t, I can substitute it here, I get this expression which is equivalent to

$$G_t + \frac{G_{t+1}}{1+r_t} = T_t + \frac{T_{t+1}}{1+r_t}$$

This is the lifetime budget constraint of the government so once I mentioned about so here is the expenditure.

Lifetime expenditure of the government is equal to lifetime income of the government which is coming from the tax sources. In the two-period setup similar to the representative consumer that we did, we had done is equal to we had gone for $C_t + S_t = Y_t$ and then we had introduced here S_t in the future period given this C_{t+1} and here we had Y_{t+1}. In the case of government, it also comes out to be the same.

Here we have G_t the only thing is that the government will have to go for borrowing in the current period and the amount that it will be bigger in future. This is how it looks like. Here we have

$$G_t + \frac{G_{t+1}}{1+r_t} = T_t + \frac{T_{t+1}}{1+r_t}$$

This is the lifetime budget constraint similar to the representative consumer that we have got.

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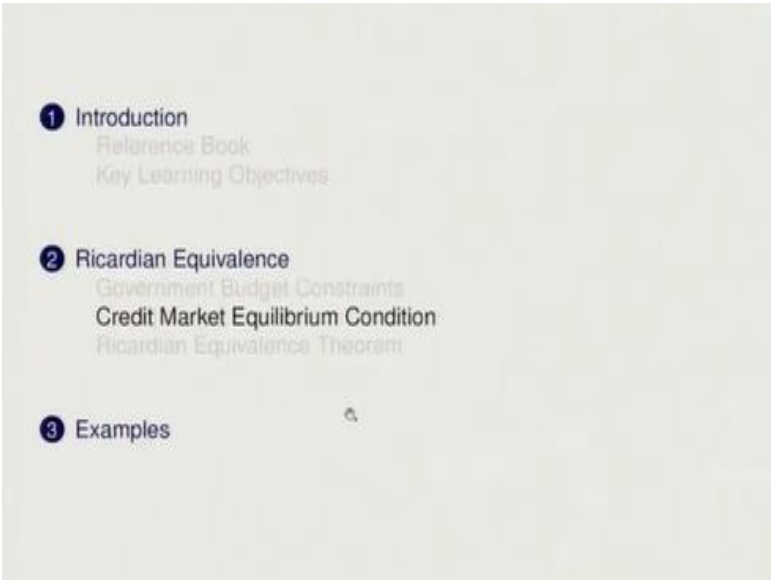

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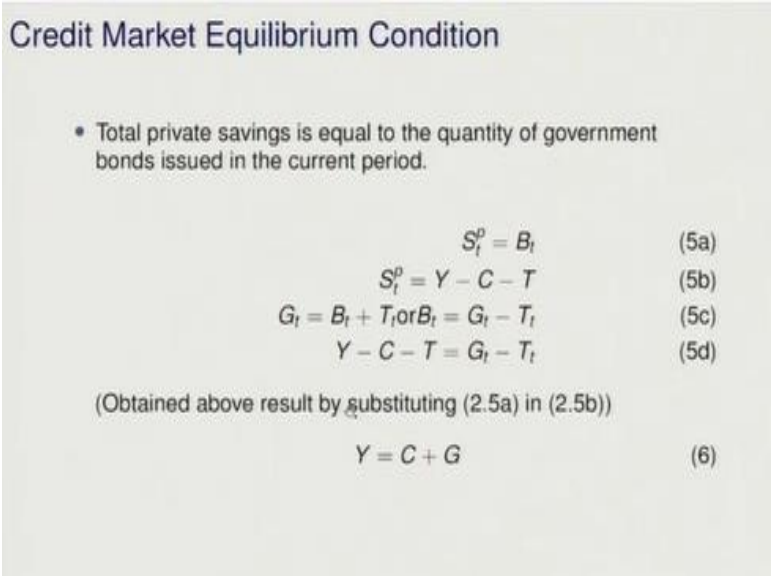

Now the credit market equilibrium conditions. So in most of the cases if you think about your private savings, what it consists of? If I am talking about the private savings so this is how the government is going to calculate. If I am saying about the private savings so private saving is nothing but you have an income minus consumption minus taxes. Government is charging some amount of taxes where saving is nothing.

But the disposable income minus consumption of the individual that you have. Now this tax is going to the government. Here we have the

$$G_t = B_t + T_t \text{ or } B_t = G_t - T_t$$

Here we have the

$$S_t^p = B_t$$

$$S_t^p = Y - C - T$$

I am getting $B_t = G_t - T_t$ so I am just putting it here. You have

$$Y - C - T = G_t - T_t$$

$$Y = C + G$$

What we get is nothing but the close economic equilibrium. We easily clear the economy with the given set of the economy you have the bond issued by government and this bond is hold by the by the individuals which is coming from saving. And this saving is nothing but Y - C - T and this bond is nothing but whatever the extra amount that government needs over the tax revenue.

Whatever government expenditure that government is making minus the T_t that whatever amount that government is using for expenditure, $G_t - T_t$ is this. Here we have a $Y - C - T = G_t - T_t$ so obtain our result. here we have Y = C + G. this is what we try to get it here.

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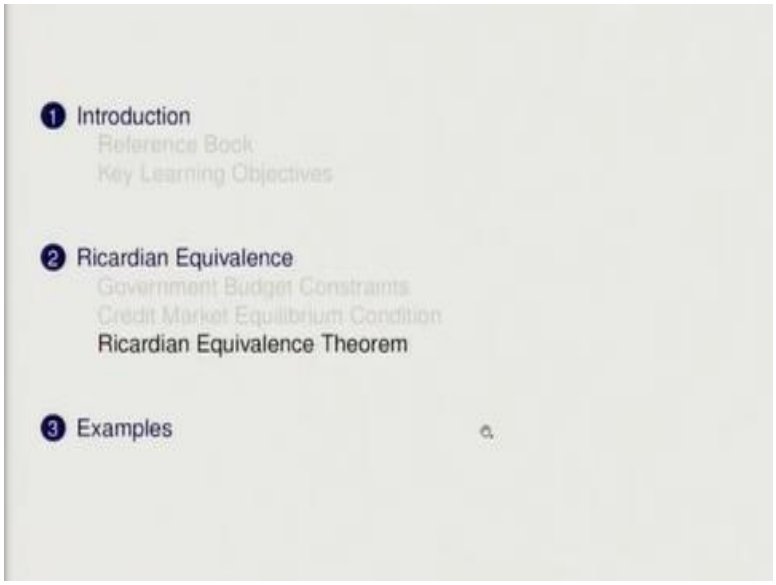

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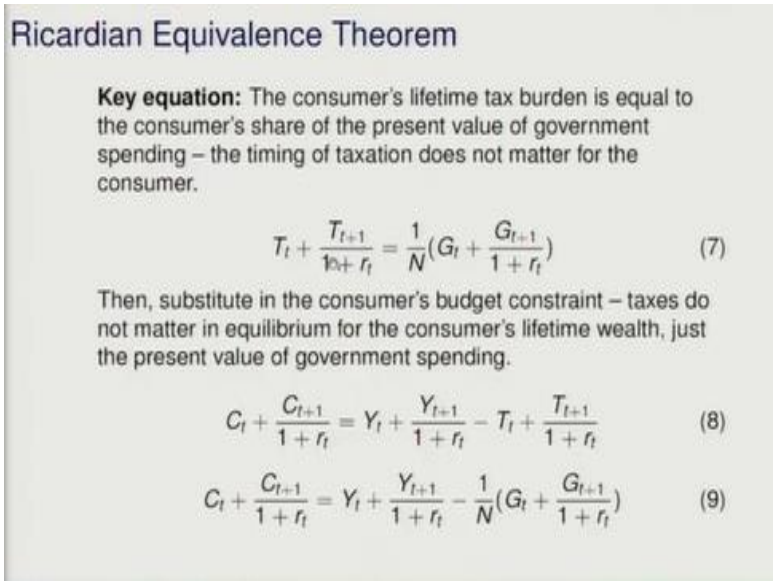

Now let us work out with the Ricardian equivalence. What is the purpose here? The purpose here is that we are trying to derive the lifetime budget constraint of the government. We have derived this particular part. Once I have derived the lifetime budget constraint of the government then this is how it looks like.

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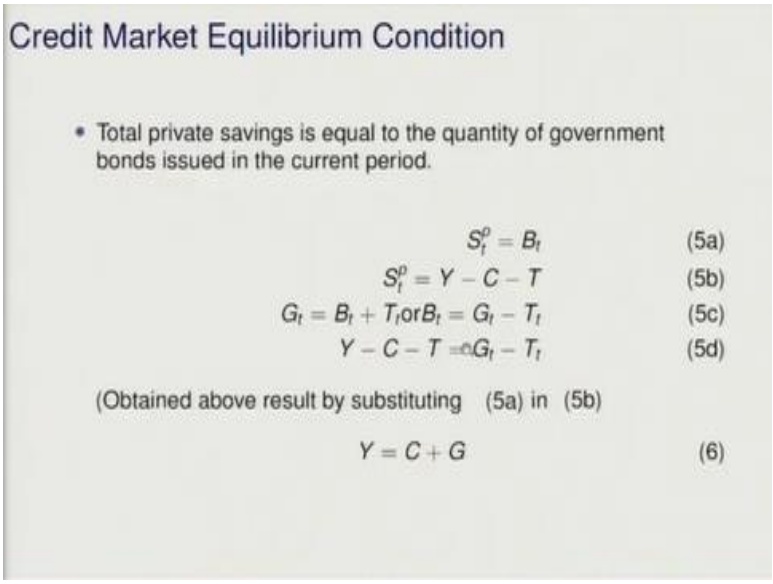

Now we want to work out that. If the government is going to introduce the bond then what is the need of introducing the bond that is the credit market equilibrium condition that given the equilibrium condition close economy equilibrium condition, we have Y = C + G given the level of tax revenue that individual the government gets. Whatever the government has the provision of making expenditure if the government does not collect enough money from the taxes.

Then the residual amount of government expenditure has to be financed by bond. This we try to find out here and finally we mention it in this form, Y = C + G. this idea we try to emphasize here. You can write Y = C + G, this is the close economy setup I am writing here $S_t^p = B_t$. here we have $S_t^p = Y - C - T$. Here, we have the $G_t = B_t + T_t$ *or* $B_t = G_t - T_t$. Here we have $Y - C - T = G_t - T_t$.

If you substitute if we just go for cancellation, then if you bring this side so this becomes positive and this gets cancelled. Here we have finally $Y = C + G$. Finally we are arriving at this, which means; that if the government places the bonds issued to the private individual then we are easily arriving at the competitive equilibrium. This is what we can easily arrive at the close economy equilibrium or compatitive equilibrium.

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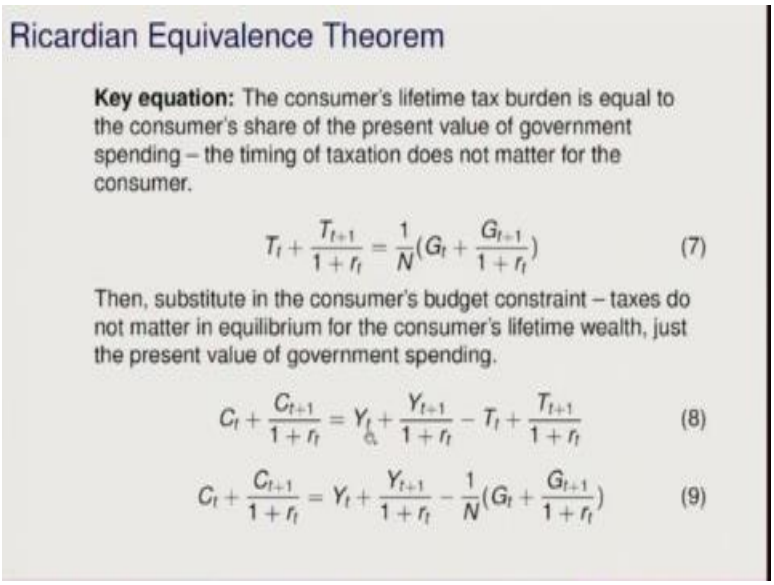

Now here we have the consumers lifetime tax burden which is equivalent to consumer share of the present value of government spending. The timing of taxation does not matter for the consumer. here we have

$$T_t + \frac{T_{t+1}}{1+r_t} = \frac{1}{N}\left(G_t + \frac{G_{t+1}}{1+r_t}\right)$$

And this individual tax is coming from where? It is coming from individuals. The government collects the taxes and then government simply uses that for expenditure.

Now government when it collects taxes it uses it for expenditure in what way? It uses it for expenditure on individual. If I am having n individuals in the economy government collects hundred then it is going to divide across all n individuals so this is how it means. Now if I substitute this back in the consumer's budget constraint so this is what we have.

There if I am going for formulation with the taxation. This is the consumer budget constraint which is looking like this with the tax imposition.

$$C_t + \frac{C_{t+1}}{1+r_t} = Y_t + \frac{Y_{t+1}}{1+r_t} - T_t + \frac{T_{t+1}}{1+r_t}$$

I am saying that we can also write the budget constraint as

$$C_t + \frac{C_{t+1}}{1+r_t} = Y_t + \frac{Y_{t+1}}{1+r_t} - \frac{1}{N}\left(G_t + \frac{G_{t+1}}{1+r_t}\right)$$

Which means that if I am just considering at this also becomes the Y = C + G scenario.

Because if the government is simply collecting from the individuals and if it is transferring the same to the individual then in that case it becomes a quite smooth kind of function and you can easily get the close economy equilibrium. Here it again represents C, it represents Y, it represents G so which means that Y = C + G. You can easily get this. This can go this side and becomes this.

One way of getting close economy equilibrium is this that whatever bond the government has issued out of $G_t - T_t$. This is the private saving here we have the $C_t + \frac{C_{t+1}}{1+r_t}$ in the inter temporal framework this is how the close economy equilibrium can be arrived.

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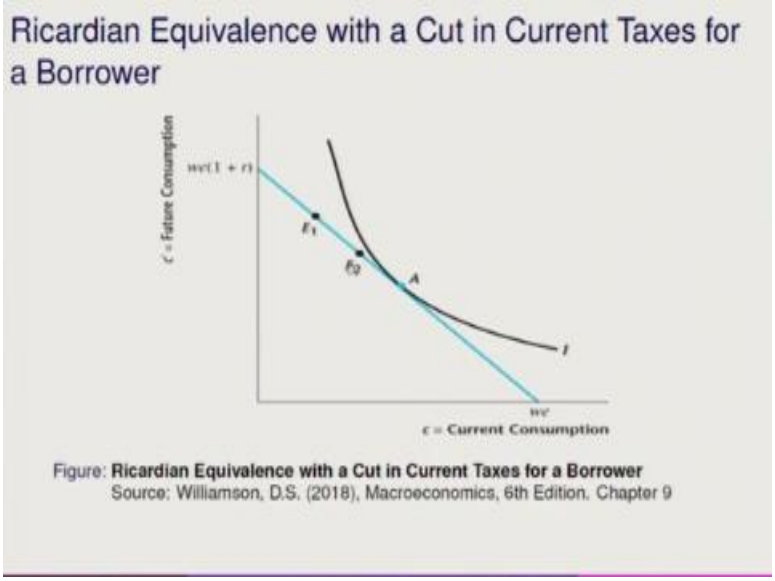

Figure: **Ricardian Equivalence with a Cut in Current Taxes for a Borrower**
Source: Williamson, D.S. (2018), Macroeconomics, 6th Edition, Chapter 9

Now let us have the comparative statics. Now here it is easier to understand one is that what happens when the government is going to cut the current taxes for a borrower. This is the budget constraint of the representative consumer. The consumer is at equilibrium at point A. He is at point A now you can think about that the endowment point of this representative consumer is at E 1. Now we are introducing the cut in current taxes.

If the government is going to cut the current tax which means that this particular individual will have a less of future consumption more of current consumption. It means that this is having at the increased income, but still you can see that the consumption pattern is not going to be impacted. here with these two points if it had it been here then it may impact. But since all these points are

above this then this representative consumer is not going to have any kind of a bad experience with the consumption.

Because the income adjustment that we are seeing because of the tax cut, this amount may be saved for the future increase in taxes. If the government is going to give a tax cut in the current period it may happen that it may increase the tax in the future period. This dividend that government is going to get in the form of tax cut.

It will be saved and this will be transferred to future period because equilibrium condition remains same it does not change at all.

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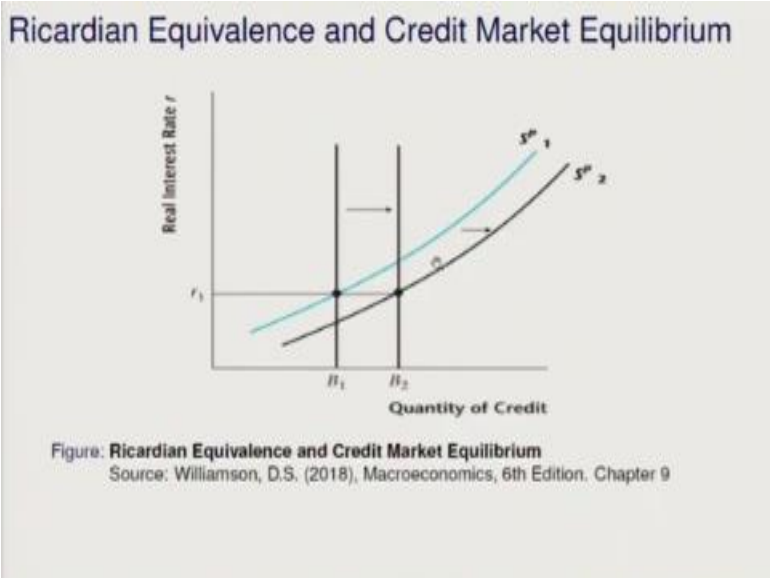

Figure: **Ricardian Equivalence and Credit Market Equilibrium**
Source: Williamson, D.S. (2018), Macroeconomics, 6th Edition. Chapter 9

Now since we have derived the credit market equilibrium in two ways. This is the credit market equilibrium with the help of bond. We can superimpose the condition here that Ricardian equivalence with credit market equilibrium. It says that if if the government is going to borrow money by issuing the bond and it sells to the commoners for the private saving it becomes part of the private savings the bond issued.

Then you can see that the government borrowing also increases. Here you have the borrowing increase you can see that the private saving also increases. Here the budget line here the upward line of the saving which is the same increasing with the bond holding, it also increases. But the

increase in private saving it is not as high as we see increase in borrowing. Maybe the government has borrowed some amount of money from individuals but individuals are also rational.

They know that the government is going to cut down or giving some incentive by issuing bond or some. If government has issued the bonds for example tax relief government wants to give. For giving the tax relief for example suppose we have the situation of Covid 19 and we have seen that government has gone for giving a special expenditure incentive to the individuals at every business level and each and every business activities has some incentive.

If that incentive is going to play very important role, then the borrowing of the government has gone up. The increase in the borrowing of the government is not directly translating into increase in the private saving, individuals are also having a limited impact here, which means that some amount of income it is going for either consumption or others but the amount of borrowing it has been translated into this.

This amount will be used in future to smooth out the consumption pattern. What is the learning here? Learning here is that as long as individuals are also saving with the incentive attached from the government then this will not impact the current consumption. This will not impact the consumption behaviour of the representative agent; representative agent will be able to smooth out the consumption in the future period also if he sees some kind of tax relief in the current period.

If you see some kind of rise in the current period expenditure, current period taxes then whatever compromise that he is going to make he will easily compensate that in future. Those kind of consumption smoothing patterns are important to note. The rate of interest here we are keeping the same not much change. But these are the conditions under which the Ricardian equivalence and the market equilibrium works.

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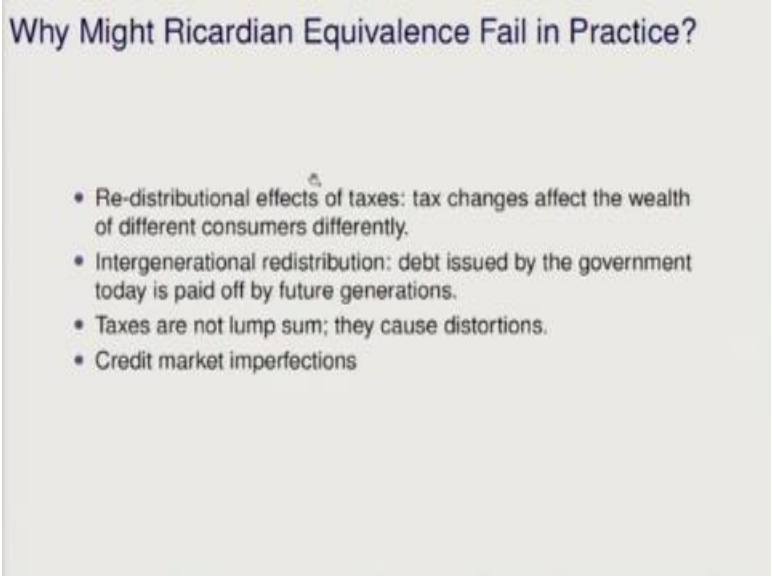

Now so far, we have seen that there has not been any problem with the model and we have been able to derive the Ricardian equivalence. But this Ricardian equivalence idea may be linked with some kind of situations where this may not be easier to make this particular theorem valid in certain scenarios. For those scenarios we will be working out with some cases. For example, re-distributional effect of taxes, tax changes affect the wealth of different consumers differently.

Rich and poor if I am saying if the government is going to increase the uniform tax. if it is going by increasing the tax by the same amount and if the government does not care about the income strata of the individuals, then the poor will have more compromise on their consumption and they will not be able to smooth out, the ricch will be easily smoothing out. In George Bush administration in case of US, he had given with certain schemes of the government incentives for the rich.

As a result the tax relief that were given to the rich in terms of investing in certain activities that created a bubble. But at the same time, it also created a situation in which the lower income strata did not have that much chance and ultimately, we saw that the middle-income class had faced difficulties and we had a full-fledged crisis in 2007-08. Second thing is that the debt which the government is has issued.

Suppose to tackle the Covid 19 government has borrowed money from the market. Now the money is spent on this current generation which is having the vaccination, which is having tax incentives, which is having businesses, having some business incentives tax relief. Whatever cost the government has borne to meet these requirements whether it is borrowed from the World Bank, which is borrowed from some other agencies.

Whatever borrowing has been done whatever adjustment we have seen with regard to the fiscal deficit that cost of borrowing should be borne by the current generation who has enjoyed the vaccination and all the tax incentive. It should not pass on to the future generation. Otherwise, what happens that if the current generation does not pay the current debt issued by the government, then this particular debt generation will have a spill over effect on the younger generation.

Younger generation; who is still in the college studying in some university, once they come back to the job, they may face at that time increase in taxes. Because government has given tax relief now. The new job market entrants will have extra burden. Inter generation transfers whenever we have, we see that Ricardian equivalence fails because those individuals will be paying the price of the older generation who had incurred extra borrowing to deal with certain situations.

Those examples are important with regard to debt also you have certain restrictions on the individuals. When taxes are not lump sum, lump sum in the sense that as a fixed amount of income is deducted from your total income, if it is in percentage term that you have a certain investment, you have certain interest earning the government is going to charge from that then that will have the impact.

Because if banks are not offering very high interest rate, the interest offered by the bank on the deposits it maybe for the rich it may not be that great but for the poor it may be a good. For poor that money matters a lot. If you have a tax imposed on the interest income of the individual then the lower income strata may not have that easy to smooth out the consumption. In that case also it matters. Then you have the credit market imperfections.

The more you have the credit market imperfection the market asymmetry, more defaults, banks are increasing the rate of interest and the borrowing rates are costlier. The difference between deposit and borrowings are much larger then in that case again this equilibrium or this extra burden will create some kind of inefficiency to the borrower and lender. And this may again have impact on different income strata and that will create again the tax paying abilities.

And that difference in tax paying abilities will further have impact on the smoothing of the consumption. Your rate of interest, your current and future period consumption will have some kind of the unbalanced adjustment and that may further create adverse scenario for fulfilling the Ricardian equivalence theorem. That it is we mention about and it matters a lot for the policy purposes.

we will be seeing with some examples that how we can understand the re-distributional effect of taxes. How we can understand that when we do not have the credit market imperfections can we understand this. Ricardian equivalence has lot of applications in real life and it is more intuitional also

Wat happens when we have overlapping across generations which means that one generation is going to retire then you have another generation ready. There is some overlap between these two. suppose you have three period scenario. individual one born in period one dies in period; two then in period two individual born. you have some kind of overlap because the period in which the first generation is dying.

You have the next generation coming up and this next generation will die again in period three beyond that we do not see. The overlapping period since you have the individuals going and coming in one particular period. In that period there will be some kind of extra care and love from the older and the younger generation. In that scenario also inter generation transfers helps a lot. If you have the individuals in the first generation; born and die in the period two.

If they transfer some amount of wealth to the younger generation then fixed asset or any kind of financial wealth. Then that if it is interest bearing then that wealth will create extra cushion for the individual to pass on the tax burden from the government.

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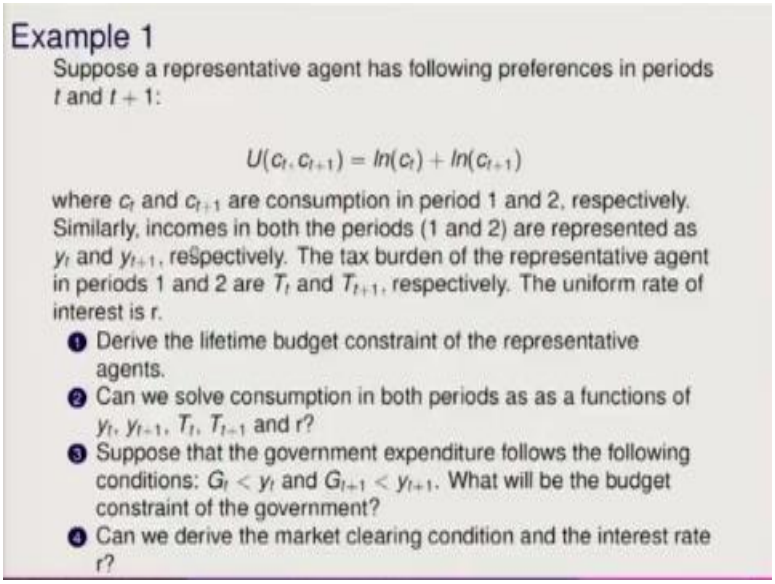

Here we have the example suppose a representative agent has following preferences in periods t and t + 1.

$$U(c_t, c_{t+1}) = ln(c_t) + ln(c_{t+1})$$

Similarly, incomes we have in periods 1 and 2 represented y_t and y_{t+1}. Now the tax burden of the representative agents in period 1 and 2 are T_t and T_{t+1} we assume the uniform rate of interest which is r.

Now can we derive the lifetime budget of the representative agents can we also solve the consumption in both periods how it looks like. Now suppose that you have the government expenditure that follows the following conditions that you have G_t which is less than y_t and G_{t+1} less than y_{t+1}. Can we derive the budget constraint of the government? Can we derive the market clearance condition and the interest rate?

if we are going to see this then can we also find some kind of insights using the two-period consumption model and we also introducing the government so will that be possible.

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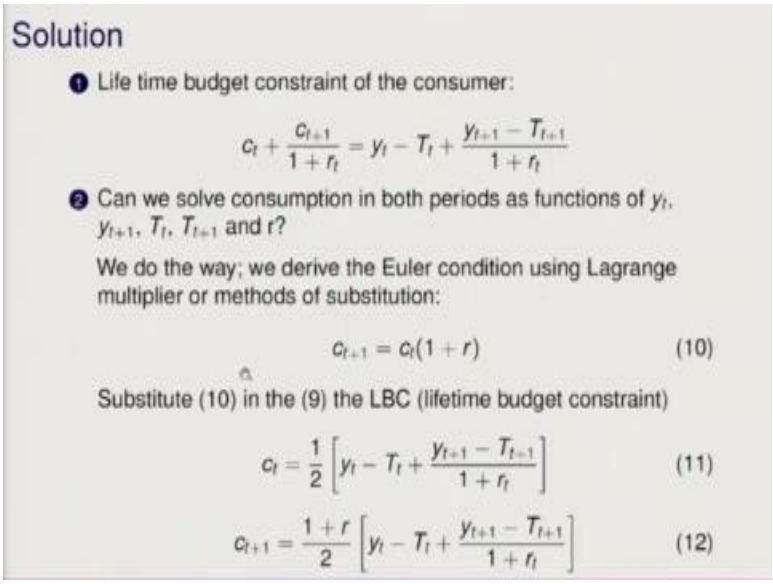

If you just refer the consumption then here it is easier that you get the budget constraint of the representative consumer will be the same like two period we have done earlier.

$$c_t + \frac{c_{t+1}}{1+r} = y_t - T_t + \frac{y_{t+1} - T_{t+1}}{1+r}$$

And then we can solve for the period as in consumption in both periods.

Just to summarize that what we have done so far, we have done with regard to two things. One thing is that we have done that how government is going to finance the expenditure. If the expenditure financing through bond goes to the private agents saving then saving brings equilibrium into the economy in the close economy set up. Then we have the budget constraint and the budget constraint. We found that the tax relief is not going to impact the consumption.

In the credit market equilibrium, we saw that the bond borrowings of the government it also had the positive effect. You have the rightward shift of borrowing lets you rightward shift. These two conditions are having lot of role to play. Ricardian equivalence I hope with this exposition it has helped you understand the concept in a much better way. We will have one example that I mentioned.

And then we will try to see that how we can see the scenario in which the Ricardian equivalence holds and in which also a scenario in Ricardian equivalence fails. I am stopping it here and we will continue in the next session from here and thank you, thank you so much for your attention.

And I hope you are having some kind of new feel about the macroeconomics apart from the conventional textbook that we read and we have a very rough idea about certain aspects.

The microfoundations I hope it is helping you to clear the clutter and you can see how in real life scenarios when we impose certain condition, it helps understand the macroeconomic concept in a much better way. Thank you once again.