[SQUEAKING] [RUSTLING] [CLICKING]

**ESTHER DUFLO:** So I hope you enjoyed Frank's lecture on behavioral economics. We have put them early in the semester this year because the insight are going to keep coming back because, of course, they apply to any topic.

But in some sense, today is going to be a bit of a fall back to much more neoclassical territory because I do want some time talking about the model that, in a sense, was the workhorse model, still is the workhorse model of how to think about human capital investment decision. And then once we know that model, we can think about what everything is wrong about it. But it's a good place to start.

So I'm going to take one embodiment of that model, which is from a paper by Abhijit, which is sort of a review paper. But it's a very classical and commonly-used model. So you could call it the Barro-Becker human capital investment model.

And the question it's trying to ask is how human capital investment decisions are made. Does the fact that the decisions are made within families, and therefore, by parents, potentially on behalf of their children, who might potentially be credit-constrained or not-- might that contribute to the persistence of poverty and inequality?

What's the role for public policy in this world? And how it depends on various assumption? So most development economics have used, implicitly or explicitly, that framework in the back of their mind, the framework of the poor but efficient of Schultz, which is let's think about people, they have no money. But otherwise, they are making the best decision they can within their limited resources.

To the Schultz framework, we're thinking about the farmer maximizing the use of inputs on their plot. But that framework in particular, in the human capital model, has been the way that people have been framing the decision, people like Duncan Thomas, like John Strauss, and have used as a framework to look at the empirical evidence.

So if you read papers by Thomas, by Strauss, by Foster or Rosensweig, they will all have some version of that model, either on the page or on the back of their mind.

So the idea there is that parents treat investment in human capital of themselves and their children as economic decisions exclusively, which have costs and returns. We'll write down a version of this model.

We'll write it down at the beginning in a very general way, so where we'll allow for the education decision to respond to other thing then cost in return, and see how we need to narrow it and specialize it in order to get to the classical Barro-Becker framework.

So let's start with a production technology, which is very standard, so none of the shenanigans we had in our [INAUDIBLE] scale relationship. There is a final good that's produced with two kind of human inputs-- skills and unskilled labor. So it's a very standard production function.

You need these two inputs. The more inputs, more skills is better, more labor is better, but in a concave way. So there is no non-convexity in here. The labor supply is such that each person has one unit of unskilled labor and some skills. They supply them. Labor has no disutility. So we don't enter into that.

And people leave for three periods. In the first period, they acquire skill. Their parents invest in them. They acquire skill. They don't need to work. In the second period is when they work. They earn an income. They have one child. And in the third period, they are retired, but they consume. There are markets. So there is a labor market. The price of labor is wtL. And the price of skill is wtH.

Now, how is human capital produced? Human capital is produced using a combination of human capital. You need teachers, who are themselves educated, and unskilled labor. So they need some time. So to get each unit of human capital, you need gamma s h of s of h and h minus, where h minus is the human capital of your parents.

So the idea is that if your parents are themselves educated, then it becomes cheaper to educate the child. If some parents are themselves educated, it becomes cheaper for them to educate their child because they can help out or something, although that's at a declining rate. So the family environment helps.

And then in order to avoid create non-convexity there, this is the return to the human capital of the parents in the human capital production of the child is also positive, but decreasing over time.

So this is our functions. It costs money to acquire education. What does that translate as in plain language? It's d2s as d2. Yeah?

**STUDENT:** That the cost of education [INAUDIBLE].

**ESTHER DUFLO:** Yeah, the cost of education is convex. So it becomes more and more expensive to acquire subsequent skill, a subsequent unit as it goes. So that's avoid the source of non-convexity as well. It's probably realistic also.

If your parents are more educated, it's cheaper to educate your kid, although that's at a declining rate. And then in steady state, so it's when all of the generations have the same human capital, it still costs money to educate people. It doesn't go to 0.

So what this already rules out, and we are not going to play with the tool in this, is sources of non-convexity similar to the one that we saw in the Dasgupta and Ray model.

We have seen that if fHH is less than 0, so there is no non-convexity in skill production at any point. And the cost of acquiring education is increasing with further units. So there is no gains here from-- so this is a very standard.

So what this holds out, for example, is the Galor-Zeira model, which is one of the early, mid-1990 model introducing dynamic of inequality and growth in a non-representative agent model, where the fundamental assumption that makes everything tick is that there are non-convexity.

So for example, the return to primary education is 0. And then there is a fixed cost. And you start getting a return once you get at least to middle school or at least to college. So that's something that is happening here, which we don't have here.

We are just going to not have that. One reason why we don't have that is we already know how that works. And we know that works if you have a shape somewhere in a production function, you can generate a bow at the top. OK.

So we're going to rule that out and start from a very well-behaved production function. What we also going to rule out is s12, the cost partial being negative. So the cost partial being negative means that if you are yourself more educated, it is cheaper to acquire a higher unit of human capital.

So there, again, that might generate complementarity. Like if you have sufficiently strong complementarity between the human capital of the parents and educated the kid at higher level, you can also get spread out into two. You can get to two steady states, whereas the dynasties which start with a lot of human capital find it cheaper to move above a certain level. And the people who start with little human capital don't.

So that's also a gain of people that get [INAUDIBLE]. So we are also ruling that out for the moment. We basically do nothing funny with the production function, either in the economy or human capital, because we already know. Not to say that this can't be realistic, but we've already-- this is behind us. We already played with them.

So given that the cost of education is that S function, so if you yourself have Ht unit of human capital and you would like your kid to get Ht plus 1, you need to pay this is H function multiplied by gamma wH. That's your unit of skills plus 1 minus gamma wT. That's your units of non-skilled. OK? So that's a functional form we'll use.

Now, we are going to start with very, very general utility functions, both in the static and in the link across generation. And then we are going to simplify them and see how Barro-Becker simplified.

So starting with a very general utility function of what people might care about, they might care about what they consume, obviously. So this is your material consumption. And they might care about symbolic consumption, deriving for example, from how much education they have, or in fact, how much consumption they have, their kids have, how much money they've spent on their education, and so on, and so forth. So we'll start with that.

Then the material consumption is pretty simple. You get money. While you're working, you will consume ct. In retirement, you're going to consume some amount. We are calling it p, both in terms of the final good. And let's start with writing the symbolic consumption with a very generic term.

So you might be very proud that you go to MIT, just independently of any value that there is in going to MIT. You might very well be very proud if your child goes to MIT. So that's ht plus 1.

So you like to consume yourself. But you might also be proud if your children have a Ferrari. So that's another part, potentially, of your symbolic utility function.

So this is separate from the fact that you might just derive utility from their utility. This is just your direct utility from their consumption, so from the warm glow of their consumption.

And irrespective of where you go, you might be happy to brag to your friends that you're going to this super expensive preschool. And there, it costs you $50,000 a year. And you are very proud to say that. So this could be all sorts of things that might enter in the symbolic consumption of someone. OK?

So the reason why that's going to turn out to be important is that that creates a motive for educating your children, which goes over and above the return from doing so in terms of either their own earnings or their ability to educate their kids in the future.

And if you did derive utility from it, then assuming that this is a normal good to some extent, or it might even be a luxury good, then richer people are going to want more of it-- not for its functional value, just because they like it better.

Likewise, we can start from a very generic utility function for how we link the generation. So the family-level outcome is going to be the utility of all of the future dynasties, discounted at some rate.

And it's defined recursively as well, and then the utility, your own valuation of the family value of all of the future generations. So in any period, someone is looking about. Someone is thinking, what's the what's the family-level utility that I'm observing today?

Well, it's the discounted sum of all the older utility in the future, all of the instantaneous utility in the future, plus the fact that they take into account the utility of the entire family in the future. So that's recursive. So that's a complicated object. And then your own utility is the sum of your personal utility plus however you end up valuing the utility of your entire family at this point.

So this seems like much more heavy notation that you are used to. And why is that the case? Because we are very used to work with the Barro-Becker preferences. And how does Barro-Becker simplify it? Do you know that? How do we go from this? You might value the future utility of the others. Then you might value the utility of the family in the future, with some different discount rate, and so on, and so forth.

How do we simplify these intergenerational things? So this says, when you thinking about the utility to value your own utility, you value your own utility plus some discounted value of your family. And the family, in turn, is the discounted sum of their own utility plus the discounted sum of the utility values of the family in the future.

So from that potentially very generic things, how does Barro-Becker think? What are the Barro preferences, if anyone knows? You would have seen them maybe in second-year macro or first-year macro at some point maybe. But then I haven't taken macro in a long time. So maybe. I'm sure you noticed. Yeah.

**STUDENT:** Is it when you want to take [INAUDIBLE] solutions, so you would just have the sum of [INAUDIBLE]?

**ESTHER DUFLO:** Exactly. So the first thing is that you only care one generation above. So delta 1 is some number delta, which is the same as this one. You value the utility of the next generation and the family in the next generation 1 delta, the same delta. So it's your same.

And then that delta also happens to be your discount rate. So you value the utility, the consumption of your child tomorrow at some discounted rate, which is the same as you apply to yourself for your retirement.

So there is only one discount rate. There is no extra thing that comes from the fact that this is your children, this is not you, which would introduce some kind of beta delta if you care differently about other generation than yourself. You just have one discount rate, which applies to anything in the future. And you care only one generation below.

So you care about the utility, not the consumption, the utility of the future generation. In turn, they care about the utility of the future generation, discounted delta. And in turn, the future generation care about the utility of the future generation, and so on, and so forth.

And then there is another thing that the Barro-Becker preferences does, which is going to simplify our life. They remove symbolic consumption, so utilities is material consumption. So all of that very kindly simplifies the preferences in this recursive way.

From here, you can just rewrite with-- you now have just UCt as delta Ut plus 1, p plus delta Ut plus 1C. And then you replace the plus 1C by t plus 2C, et cetera. And you have a sum of discounted utility with the discounted-- it should be a superscript, this guy.

And then if we got rid of material consumption as well, we are just discounted. We are just getting a discounted sum of material consumption over time. So that makes an object that we are very used to play with because now, it is like one individual, the same type of things that we play with in the [? Ransom ?] model of one individual investing, and deciding how much to save and consume, and maximizing a discounted sum of utility to infinity.

But that comes from drastically simplifying the model of how you care about the other generation. You just care about your children. You care one. The other thing that we are going to add is that anybody can borrow or lend at growth rate rt. There is no imperfect credit market. And there is no contracting between generations.

So the parent can choose their own consumption, the middle age, and the old-- their own consumption in middle age and while they are older, the investment in their children, and that's it.

They cannot dictate to them how they should invest in their own grandchildren. All they can do is doing the investment. And the child, in turn, will make the investment in the future. So there is no commitment problem because there is no decision that is made over the long run, no contracting possible.

With Frank, you haven't done hyperbolic discounting and inconsistent time preferences for the individual, the very famous Beta Delta model. But we're going to see it when we study savings. But once we have studied it, you can see that none of these complexities are there in the Barro-Becker model because of this simplification.

And if we didn't have this simplification, we would find ourselves in a world, in a sense, of commitment problem, contracting problem, which are very similar to the type of issues that we think about when an individual is trying to deal with a lot of impatience in the short run, for example, or an attempt to commit their future selves to behave in such and such way.

So the same issues will appear within the family as soon as you have. And you can see even more easily, in a sense, that you don't have to have any funky preferences like we need to have at the individual level. It is just like if you care about your grandchildren, everything's messed up in this model.

By the way, similarly in political economy, we have these models of how a country might decide to take a debt that will apply to the future citizens of that country and how you make the commitment in the policy space.

It's, again, the same issues of what contracting is possible between generations. And how do we take into account our caring for the future? And it's only in this very simplified model where that things work out analytically.

So you can borrow. Credit and loan can be bequeathed. So that simplifies our life a lot. So we start that set that gives us a very standard credit constraint, where defined in terms of wealth, how much financial assets someone has, which could be positive assets or negative assets.

So the wealth that you're going to have in the future is r, which is the gross interest rate. So suppose if you have any assets after the end of this operation, you put it in the bank. And next period, they'll give you that multiplied by the gross interest rate, so 1 plus something.

And what do you put in the bank? Or what do you borrow? Well, you start with some wealth. You consume. You feed the generation before. They've made a commitment. You earn some money. That is your unit for your unit of unskilled and for however you need of skills you happen to have, ht multiplied by the rate of return to education.

And then you spend some money to educate your kid. So if you want your kid to have ht plus 1, you're going to have to spend phi of ht plus 1ht, which, well, this phi is just a shortcut for the equation we wrote before. So that's how much you're going to have in the next period.

So now, we have our utility function. We have our budget constraint. How do we go about solving this problem? What are the three equations that are going to help us solve this issue, this maximization problem? So this, I know you have seen in macro, even in today's times. Yeah?

**STUDENT:** Maybe it's the [INAUDIBLE].

**ESTHER DUFLO:** Exactly. So we get to Euler equation, one with respect to ct, one with respect to pt plus 1. And then we are going to take the first-order condition on the budget constraint.

I'm not going to write the ct and the Euler equation for the two consumption levels. They are what they are. And they are not interesting. I mean, they are. They would be interesting in another world.

But the reason I'm not going to write them up is that if you did write them up, you would notice that the human capital doesn't appear in them anywhere. The Euler equation is defined in terms of consumption, and the interest rate, and your discount rate.

So depending how impatient you are, you're going to spend more on consumption or less for this, while you're working, and also for next year. Meanwhile, the only place where the human capital decision is going to enter is in the budget constraint.

So to figure out the level of the human capital investment, it's ht plus 1 we are trying to determine because ht is what we already have. What do we do? Sure.

**STUDENT:** Is it just

**ESTHER DUFLO:** Yeah, so we're going to take the derivative on both sides. And basically, what it says in plane 1 is that we want to equalize the marginal return of investing in one more unit of ht plus 1 to its cost.

And just before we even do the calculation, why is it interesting to invest? What is the value to invest in ht plus 1? Where are we going to get bang for our buck when we invest in ht plus 1? Tyler.

**STUDENT:** Child's consumption.

**ESTHER DUFLO:** Yes. The child's wage is going to be higher, and therefore, later, their consumption. But in the budget constraints, it's going to show up at their wage. And then what else? Yeah.

**STUDENT:** Ht plus 1.

**ESTHER DUFLO:** Yes. So again, so to their wage, then that's going to give them money too. But first, the value of investing in human capital is that they'll earn more. And what's the second value investing human capital, coming straight out of the budget constraint?

**STUDENT:** Would it be cheaper?

**ESTHER DUFLO:** Sorry?

**STUDENT:** Would it be cheaper for their children?

**ESTHER DUFLO:** Exactly. It will be cheaper for them to educate their own children. So these are the two places we are going to see a value investing human capital. And that, in turn, is going to translate into their higher wage, going to translate into more consumption for them and more return. But we are not going to see it later.

So what you can do is to take the derivative of this, and then the derivative of this, and then rearrange the terms a little bit. And you get exactly what we were discussing. So you get-- it costs some amount of money to get.

This is the marginal cost of getting ht plus 1. This is the first s1, meaning d of the first derivative, the derivative with respect to this first term. So that's the marginal cost of one more unit of human capital for your kid is equal to the marginal return, which you're getting in the next period.

So it's divided by the interest rate. Extra wage for them, plus reduction and the minus in the marginal cost of educating their own children. So it's now s2 of ht plus 1.

So you can, straight from here, take the derivative of this bit and that bit with respect to ht plus 1 and rearrange the term. And you'll get this. But this is the intuition that you want to keep in mind is that that's how you're going to define. That's how you're going to decide how much to spend in your own human capital.

So what is interesting is what's not in there at all. So this equation, we can rearrange a little bit. If we are in steady state we can replace 1 over r by delta because that's what's going to determine the interest rate in steady state. We can replace the ht plus 1, ht plus 2 by hs. But even in this particular equation, what is not there? Yeah.

**STUDENT:** [INAUDIBLE]

**ESTHER DUFLO:** Yeah, or what else? Yes?

**STUDENT:** And I don't know, like, all the other things that were in utility.

**ESTHER DUFLO:** It is nothing about the utility function. There's nothing about the utility function of the parents. It's got nothing to do with their taste. It's got nothing to do even with how patient or impatient they are. There is a 1 minus there.

But from the individual point of view of the parent, this is given by whatever happens to be the interest rate in society. So any individual parent, however impatient, or nasty, or whatever, is going to spend the same amount in educating their children.

And where does this come from? Why is that result? Why is it 2, irrespective of the math? What's the intuition that makes this true? This is quite powerful. You would think that doesn't really completely fit with our--

**STUDENT:** I think you were assuming that it's a steady state so with that it's short.

**ESTHER DUFLO:** Right. This is not steady state. It's full of h plus 1. It's the individual-level decision today. There is no steady state yet. We're going to get there. But in this model, in the first instance, another thing that's striking, everyone will-- yeah. Yes?

**STUDENT:** My guess is that it's because the returns are all the same across all people?

**ESTHER DUFLO:** The returns-- the function is the same. But potentially, they have a different level of human capital themselves. Yeah?

**STUDENT:** Is it because the insurance on savings and [INAUDIBLE]?

**ESTHER DUFLO:** Exactly. There is this other thing they could do at any point. They can save. And they can borrow. They can borrow against the earning of their children. Or they can save the earning of their children. Therefore, the utility function is going to determine how much they want to save.

But then how this is separated between human capital and debt or assets, there is no choice involved. Therefore, the only thing that matters is how productive it is.

So you have the return to education in terms of their earning of their kid as well as in terms of how cheaper it is to invest your future kids. But the only thing that matters is the returns to education, and how that compares to the cost, and nothing else because a more patient parent will invest less.

But that will all go through how much they put in assets. There is no reason to not do the efficient thing with respect to education. So that's a pretty striking result. There is no parental preference effect. There is also no income effect.

In fact, in this particular model, in one shot, everybody invest the same thing. And in steady state, r is equal to the inverted of the discount rate and the two human capital levels. All the human capital become constant.

And that gives you an expression for the human capital that's chosen in a generation. And there, you have delta. So you have a preference effect in steady state. But the delta comes from because it's saying how patient is society is, and therefore, how much they want to save overall in the form of either human capital or physical capital.

So at the level of society, more patient society will save more, both in physical form and in the form of human capital. And otherwise, all you have in here is how expensive it is to educate someone in terms of educated and uneducated labor and what are the returns to education, which enters here.

So if the returns to education are higher, people are going to invest more. If it's going to become more expensive, they'll invest less. There's also no inequality in this model. Everyone will converge to the same thing, in fact, in one generation, because they're all going to pick the same ht plus 1.

And that breaks down. One way in which this breaks down is if s12 is very negative, where, if you start from a very different level of human capital, your cost of education might be quite different. And then you might end up with two different statistics. So that's, again, just to repeat the Galor-Zeira model. But otherwise, if you don't have this extreme complementarity, you're good.

There is unique steady state. So there is no longer an effect of a large shock to human capital. So we are discussing with David Atkin about COVID and saying, oh, all these kids who are not going to school this year. Oh, it's a disaster.

In this model, it's just going to be sorted very quickly because the return to human capital assets-- that investment will take place when schools become open again, at least as a level of society. And interestingly, that was his immediate-- I guess that part was kind of his instinctive reaction, showing how powerful this model is for us.

So in this case, you can think very quickly in the framework of this very simple model about your policy instrument. So you could have an education subsidy. For example, if you spend E, you get some amount.

Say, primary education is free, so even if you spend 0, you'll get e0. And then you get tuition subsidies, tuition discount, depending where you go. And then you might have a tax, which it could be a progressive income taxation. So it's a tax on human capital.

If we take this, it's very easy to put in the steady state. The steady state become this one. So your return to education is now smaller. The direct return to education is smaller because of the tax on human capital.

But the cost of education is also smaller because you now don't have to-- you're getting this subsidy every time you educate more. And then this stays the same as before. So what's the first observation? Where do you see an e0 here and tau 0 in this formula? Yeah?

**STUDENT:** These are a lump sum as taxes.

**ESTHER DUFLO:** Yeah. They are a lump sum. They don't bear out there. So in this model, subsidizing primary of education is irrelevant. This is lump sum, doesn't matter to the choice.

And then a second thing is this one. What does enter is the marginal subsidy and the marginal cost. So it would not make sense in this model to pay a tax in order to finance education. That's just going to be distorting people.

But you might want to have a subsidy if you need a tax for some other reason. So the idea is that if you want a tax on education because you want to have progressive taxation to do something on the other, then it might make sense to have a subsidy for education that is going to, to some extent, outweigh the cost of education.

So the proportional tax and subsidies have the predicted effect. Ideally, you are going to put the optimal. You go back to optimal if you have the subsidies the same as the tax. So in the absence of any other reason to tax, you want laissez faire. So education subsidy might be a way to contract on tax on human capital. That's there because of the necessity to have progressive.

Now, something that is true here as well is that these are the return to education in a way because that's the ratio of the unskilled to the skilled labor. The higher return to human capital means more investment. So that's the best education policy.

And if you listen to Mark Rosensweig, he says that very explicitly. The best education policy is no education policy. The best education policy is one which is in the labor market, where it becomes more valuable to get an education.

So in terms of things that we want to look at empirically, one, we want to look at whether people are sensitive to the cost of education. Direct or other subsidies to education. One is we want to see whether people are sensitive to the returns to education.

Is there, as they see it, the real return or the passive return to education? Those are kind of the main prediction of this model in term of how should decision-- that we should see how so being responsive to.

So to summarize this model, and then we can start discussing it, this Barro-Becker world is great. There is no inequality in the steady state. Wealth, income, even preferences don't matter in the short run. And the only thing that determines education in this world is the return on the cost. So why might education be different in different countries? Yeah?

**STUDENT:** Returns can be very different.

**ESTHER DUFLO:** Yeah. The return could be very different. So that's one. What's another one? Yeah?

**STUDENT:** So with this, it seems like you might prefer your education split there, but there might be [INAUDIBLE].

**ESTHER DUFLO:** So I heard the beginning, this assume that the market for education is perfect.

**STUDENT:** Right. That there might be frictions.

**ESTHER DUFLO:** Yes, that there might be, in the delivery of education itself. So we'll go back to that in a minute. And then within this model, with the context of this assumption, the other thing that's going to determine education level, potentially, is the discount rate.

So the technologies is going to determine the education level, both the technology in the labor market and the technology of providing education, and then the discount rate. And those are the things that should determine education and not education subsidies and education policies.

However, there is scope to improve the production function of education potentially. So if you make education more productive, cheaper, that is, for example, you increase the quality of education so you get more unit of capital per amount of money that you're spending, you might get more education as a result of it.

So even though the Rosensweig conclusion is don't bother with education, just improve the technology outside of the school system such that people find it valuable to be educated, one could also say, well, even in your model, I still have a reason to make education cheaper by making it more effective, more productive, et cetera.

So for a long time, development economists had no interest in the economics of education, unlike the World Bank, who would spend a lot of time and effort trying to push investment in education.

And to some extent, many people still hold this view and don't have much time for any of the work that exists on the economics of education and the technology of education that we are going to spend some time discussing in the next few weeks. And to some extent, many still hold this view that all of that is secondary relative to the return to education.

So now, what I want to do for the rest of today is to discuss the different assumption that live inside this model and try to have you think, too, whether or not they break the fundamental logic of the model or not. Yeah?

**STUDENT:** I guess, maybe, this is a big assumption. But is the core intuition in this that we should think of education as an asset just like the many other assets that people decide to invest in or not?

**ESTHER DUFLO:** Exactly.

**STUDENT:** So then in portfolio theory, we should think of it in that lens?

**ESTHER DUFLO:** Exactly. So this is exactly what it's doing. So where this is buried, or maybe not buried, but we are where this took place is when we remove the symbolic consumption from the utility function so that there is no consumption value in education, either direct, via the fact that people like to spend on education or like to be educated, or indirect, via the fact that you enjoy the fact that your child is educated or consume more.

**STUDENT:** So education has big externalities in terms of it could even help shift the curve. Is that a big part of the literature of the discussion?

**ESTHER DUFLO:** Yes. So here, education has no externality. And you're absolutely right that, for example, the World Bank argument of subsidizing education has long been around this idea that there are huge externalities to subsidize education, so to have more educated people.

So here, if you change this world, so where that is buried, where is that buried no externality? Where does it live? In which assumption does it live?

So early, quite early in the production function, so there is no externality in the production function. Just it doesn't have an A in front of it, which could be a product of h.

So the way that externalities show up in models like the Lucas model is by having the entire production function multiplied by a term, which is itself a function of human capital. So that's pulled out by the production function that we wrote.

Another place where we have ruled out, we have actually limited the externalities, is by saying that educating your children is cheaper when you are yourself educated. But this is decreasing.

If, instead, we had-- and that's another way to write the Lucas model-- that education became cheaper as you yourself are more educated in a way that is linear, for example, then it would again give us externality of education, and potentially, very different steady state level of growth from that externalities. And that could happen either within family or via the education production function.

So another place where the education production function is located is we don't have an A in front of it, which again, we have the unit of human capital times the little s plus unit of regular labor times the little s, which is all individual. We don't have an A that could be collective, which is if everybody is more educated, that's going to make the production function more educated.

So that's the two places where the externalities are missing. And this idea that there are these huge externalities of education was kind of a big World Bank justification for investing in education, with or without much empirical evidence behind it. But we'll discuss it later. Yeah, [? Shawn? ?]

**STUDENT:** This one also seems that parents are freely normalizing the [INAUDIBLE] they have on their children's education by--

**ESTHER DUFLO:** Do you mind holding your [INAUDIBLE]?

**STUDENT:** So the second, also, it seems that parents are freely normalizing the [INAUDIBLE] that their [INAUDIBLE] has on children's education. It's like that [INAUDIBLE] function is different from theirs. Parents value their children's education less than the [INAUDIBLE], then the results may spill forward.

**ESTHER DUFLO:** Yes. So that's very important. So this is, in a sense, what we are discussing now is the form of the utility function. So the form of the utility function is restrictive in two places. And the one you call attention to is the idea that the discount rate for future generation is the same discount rate that applies from period to period.

So this beautiful trick of the Barro-Becker preferences, where I care about the next generation only, and with effect on delta, which is similar to my own discount rate over the period. And that absolutely means that there is no contracting difficulty between parents and children and means that the planner is going to have the same objective as the family.

If the parents don't care about the children at all or they care about them less, then we find ourselves in a world that is going to have a time inconsistent utility preferences.

So we are going to find ourselves where the entire future-- so suppose that this is the same model, but I modify it just a little bit, which is I like the consumption of my child just a little less than mine.

Then we have two discount rates. Just this change leaves us with two discount rate that we have to play with. On the one hand, we have the over time, my own consumption over time. Let's call that delta. And on the other hand, we have the future generation. Let's call that beta.

And rewriting now the utility function, we have one discount rate beta, which applies to the entire future, and then within that, the delta. So we are in a beta delta world, time inconsistent. Therefore, the decision of the individual today in the absence of commitment is going to look different than the decision of someone who cares not about any individual generation, but about all the generation in the future.

So that's what you were saying about the planners potentially having a different objective. So here, we could say, well, the planner just is going to maximize the welfare of all of the future generation. So he is going to have exactly those preferences without the beta, whereas the individual is going to look like they are more impatient.

So they are going to favor their own consumption to the expense of the investment in future of their children, educational investment or savings investment. And that creates a wedge there.

But not that it creates a wedge in term of all the investment. They are going to overconsume. It's not that they are going to invest less in education relative to other financial assets. So that's one thing.

And then once we have that, then we enter this delicate things about what can you commit? What can you commit your future generation to do? Because the person who cares about their children, but a little less than they care about themselves, they would like to commit their children to invest a lot in their own children's education because viewed from this generation perspective, the children, the grandchildren, et cetera, they are all equally valuable because we all value them at beta.

So they would like to convince their children to invest a lot, to invest more in their own children's education. But of course, when the time comes for the children to take the education decision, they are not going to do that.

So that's when we are going to have a wedge. And that's when we can have a planner, who is going to take a different decision. And he might, for example-- or she might-- decide to subsidize education to counteract this tendency overspend today. Yeah?

**STUDENT:** [INAUDIBLE] But in realistic settings, in settings where the governments do not provide institutional or good support, parents probably also invest in children because children are going to earn money and then give them back in order to support them.

**ESTHER DUFLO:** Yes.

**STUDENT:** So I wonder if that's useful to capture that investment model too or [INAUDIBLE].

**ESTHER DUFLO:** No. So you're thinking of another place where this might break down, which I was hoping we would get, is that what's the assumption that you are taking away from me here. Not the contract.

Here, let's stay to this world where there is no contract. All you can do is invest in your kid's education. That's it. But I have one assumption, one assumption here, which you removed when you were talking about pension and stuff like that.

So what did you have in mind? Actually, don't have pensions here. There is no pension system. But what can people do? Usually, it's kind of the first thing people note along with the externality. I'll look for it. Now, it's pretty obvious.

Well, the assumption you removed from me is that anyone can borrow or lend that growth rate r. And in fact, credit and loans can be requested. So you had in mind a pension system. We don't need a pension system here because people are able to save.

So what the pension system does is that it helps us save. So here, there is no-- people are able to make their decisions perfectly. And they are able to put money in the bank account or to borrow. So they are able to transfer money in the future. So they don't need their children as a vessel to transfer money.

So that's why that motive that we could find in the real world of investing in your children human capital in order for your children to pay you in the future doesn't have to be there. So the only reason why you invest in your children is because you care about them. Otherwise, you would have no reason to do it.

So now, since we are on that slide, what happens if I say, well, you cannot borrow, or save, to remove whichever way you want, or both of them. Maybe let's start with borrowing in the first place. What implication is going to have in the short run and in steady state?

**STUDENT:** [INAUDIBLE]

**ESTHER DUFLO:** Sorry?

**STUDENT:** There are going to be no hikes in the wages.

**ESTHER DUFLO:** Yes. So in the short run, you're going to have an income effect because in the short run, you are going to see that some people are going to be constrained. Again, that's like the standard [INAUDIBLE] consumption level.

Some people would like to consume more today than they get to. Here, some people are going to want to consume today more than they would like to. And then if those constraints are strong enough, then they might not-- they might not be able to pay for the level of education that they would like to get.

Now, so that's going to change. That's potentially going to introduce income effect in this equation. This equation might not be satisfied anymore. We might be able to find cases where poor people invest less. Is that going to lead to multiple steady state?

So two questions for you. The first one is that is it a big deal or not? Is that going to lead to multiple steady state, to persistence of inequality, and so on, and so forth if I leave everything else the same?

I'm making you do a lot of gymnastics with standard models. I'm going to try someone else. I trust you know the answer. Heather.

**STUDENT:** Hazel.

**ESTHER DUFLO:** Hazel, sorry.

**STUDENT:** And I don't think you would lead off the steady states. This is still no long capacity.

**ESTHER DUFLO:** Yes, exactly. So what's going to happen if we have this credit constraint? What's going to happen over multiple generations?

**STUDENT:** So we'll just take on to get the steady state because you can't built up human capital realistically because you're going to try--

**ESTHER DUFLO:** Exactly. So in the simple model, it's in one period, boom. Everyone invest the same thing. We're all in the same place. In this model, it might not be possible. So people are going to invest a little. But those who are poor, what are they going to enjoy that is going to help?

Since they invest a little, their return to human capital is very high. So their return to human capital is very high. So that gives them some money that their kids are going to be able to invest. Their kids are still going to feel constrained, maybe.

But over a few generations, it's going to all work out. So there is still only one steady state. That's another thing that is important to note is. In and of themselves, credit constraints are not a big deal in this model over time. Now, in the long run, as Keynes said, we'd all be dead. So this still sucks for the generation that doesn't get their own education. But that's relevant.

So the way, for example, that Galor-Zeira make multiple steady state and inequality emerging equilibrium is to combine credit constraint with the non-convexity that they have, which is the return. There is some jump return to education at 0 and then become higher after some level. And then you could get stuck in the ways that we discussed in our first lecture. Very good.

So that's the first thing I wanted to note. So that in and of themselves, credit constraint is not really the thing that is going to make the massive difference in this model, unless it's combined with non-convexity. So that is something that you get. That's one of the tropes that you keep hearing in policy circles, which are good to keep in mind to re-examine a little bit.

The other one is that it's just in terms of empirical observation. So you rightly observed that in the short run, there might be income effect that would be absent otherwise. So people who are richer will invest more.

So going the other way, in general, that is shown as a proof or as a sign that there might be credit constraint. But what else would make income effect appear? What other assumption we could relax that would make income effect appear, even in the absence of credit constraint? I'll find it.

It's that one. As soon as we introduce another motive to educate your kid, other than the altruism via material consumption, then you're going to have a potential income effect on consumption.

So the fact that we find the income effect on education-- sorry, on education, the fact that we find income effect on education is not a proof that there are credit constraints on education. And the fact that there are credit constraints on education is not in itself an indication that there might be differentiable statistics, and therefore, the model will break down. Yeah, OK.

**STUDENT:** So I just want to know why we're having the extra debate on the utility function.

**ESTHER DUFLO:** Oh, why? So think on it. We now have a term of the utility function which has a human capital directly of your kids, as well as potentially even what you spend on it as being directly some argument of the utility function.

So just think about that. Your parents are probably delighted that you're here. And therefore, they are deriving some utility out of it. So potentially, they gave you the school that you needed, and the tuition that you needed, and so on, and so forth.

But if they had been starving, then they wouldn't have, not just because they couldn't borrow for it, but they wouldn't even have borrowed for it because therefore, this is a luxury that we can't afford. So education becomes a thing that is valued for the sake of it.

But then it's valued like a normal good or even a luxury good, that the richer we are, the more we like it. So then if that's the case, then people spend on education, both for investment purposes and because they enjoy it.

And then now, you have an asset that's not your regular asset anymore. You have an asset that's at the same time an asset and a consumption good. And that creates havoc because rich people invest more. And therefore, their kids are more productive. And that makes them richer, which therefore, wants them to invest even more. And that makes them productive, and so on, and so forth.

So you can see how you could have, without even credit constraint, with the education or education expenses entering in the utility function, you can generate multiple statistics on inequality. Yeah?

**STUDENT:** So on a similar line of analysis, I noticed one thing that we haven't touched on in this model is it's kind of assumed that there's maybe just one child in a household.

So could, in this same symbolic consumption framework, let's say you have two children. And maybe there's birth order preference. Or you just invest more in quality between children as some form of smaller consumption. So there could also be effects in terms of equalizing the level of education between children.

**ESTHER DUFLO:** Yes. So we haven't introduced family dynamics. But we'll get there in a while. Well, we have a little bit introduced in term of intergenerational conflict.

And then as soon as you introduce that people just don't care about the consumption of their kids, the generation later, they have to start thinking about how is it possible to contract? What can you contract on? Can you force them to do everything? And can you force them to do nothing? And there is something in between? So that's the first set of family issues.

And then the second set of family issue is even within a generation, different parents might have different views about what to do with their children. And the same parents might have different views about their two children.

So they might value the consumption of sons differently than the consumption of daughters. They might derive different symbolic joys from an educated son versus an educated daughter, and so on, and so forth. So that's also going to generate differences within the family, and potentially, gender dynamics as well.

And then once the two are integrated-- and I want you to hold this thought because in a couple of lectures, we'll look about our paper on Ghana, where we have boys and girls. And the girls are much less educated than boys. But it looked at the return to educating girls is much higher. Or at least, the marginal girl, the return to educate the marginal girl is higher than the return to educate the marginal boy.

And that wouldn't exist in that model. That was not possible. You could have two different types of agent with different return. But they should both be equalized. They could have different level if girls happens to be less productive than boys for whatever reason, for example, because they don't get to work or something like that.

But in this setting, we returned to educating the marginal girls is higher than the return to educating the marginal boys. That doesn't fit with that model. Because they need to all be equalized and be equalize to the interest rate. So that's something like a utility would have to enter.

So now, I think we have kind of gotten over quite systematically over each of the different departures of the simple model. The last exercise I would like to do before we break is to think about the return to education.

So remember, in the basic model, I told you that the return to education in steady state have to be positively related to how much education is being provided. All right. We can see it here, if the return to education is higher-- this is the return to education, that's the inverse of the return to education. If the return to education is higher, then people are going to invest in more schooling.

Now, in a world where education potentially has these income effects, there is this income effect in education coming from preferences for more educated kids that behave like a normal or like a luxury good, is it always going to be true that the return to education are positively correlated with education in a country?

So think about the two forces that are at play. So when I increase the return to education, I increase this. Yeah? You look like you're ready to speak.

**STUDENT:** No, I'm just still thinking now.

**ESTHER DUFLO:** Go for it. It is not obvious. So I don't expect you to deliver the answer. But I would like to just think through the pieces for why that's kind of what seems to be an automatic recipe of oh, just increase the rate to education. You're going to increase education might or might not apply.

I'll give you a hint. So what is education provided with? By who? By whom? Who is education provided by?

**STUDENT:** Schools? Governments? Parents?

**ESTHER DUFLO:** Yeah, school, government. But who is in the school?

**STUDENT:** Are workers.

**ESTHER DUFLO:** Yes. Who have what characteristics?

**STUDENT:** They're educated.

**ESTHER DUFLO:** They're educated themselves. So if you remember, if we go back to the education production function, the education is being provided by a combination of uneducated workers and educated workers.

So when we return to education increase, what happens to the cost of education?

**STUDENT:** It also increases?

**ESTHER DUFLO:** It also increases because now, you need to pay more those educated people. So unless you manage to change the technology at the same time, you need more educated people. So think about who is going to teach them while they're in school?

So now, you have two forces that can potentially compete with each other. On the one hand, you have the return to education have increased. So people find it more valuable to educate their own kids. But remember, they wanted to educate their kids anyways, that they like to educate their kids irrespective of the return, just because it's a consumption good.

At the same time, the cost of education is now going up because the education system is competing with the rest of the economy. So it could well be it doesn't have to happen. And it depends on exactly how things shake out with the parameters.

But it could well be that the effect of the increase in the cost of education more than outweigh the effect of the increase in the return. For example, take the mother in mind, where a big driver of education was just that you like to have your educated kids. Then as it becomes more expensive, then you like it a little less. You're going to buy other things for them that will also make you happy.

So you might find yourself in a situation where if a country starts going really fast, they actually, even though the return to education increases, and they find themselves having difficulty staffing the schools, and therefore, educating kids because of the wages they have to pay to the teachers.

So you might find yourself where, in fact, the return to education increases decreases education level that a country attains. And again, you don't need any credit constraint for that. You just need this. This is just a consequence of introducing a utility value to the education expenditure or the education level themselves.

So that looks like a much more-- I don't know, maybe it looks to me like a smaller departure from our traditional model. But in fact, it kind of breaks down a lot of things as soon as-- and I think [INAUDIBLE] summarized it the best-- is that if education is not like your regular old assets, everything can go south.

So for example, in India, during the growth of the '80s and '90s led to an increase in the demand for educated workers, including in the software industry and then in the call centers that could take people with secondary education or the beginning of college. And then it becomes very, very difficult to staff the schools.

So here, it doesn't necessarily translate into increasing costs for families, which in principle, can go to secondary school. But it leads, in a way, to increasing the effective cost, because that leads to a decrease in the education and quality. And you're basically getting less you need of human capital for time spent in the school. Hence the tension between the two.

So that's what I wanted to do for today. Unless you have any more questions or remark, that's it. Yeah.

**STUDENT:** I was wondering what would happen if you introduced risky returns into this model, if things would break down as a result of that as well?

**ESTHER DUFLO:** Yeah, that's a great point. So you mean on education, for example?

**STUDENT:** Yeah, like if I invest in my child's education, maybe there's like some distribution of wages that they can get. And I don't necessarily know if they're actually going to get a really good job out of it.

**ESTHER DUFLO:** Yes. So I think it's a great point. So again, everything else constant, it's going to depend. So the net return to education is going to be weighted down by your risk aversion. But the other assets might themselves be risky as well.

So I don't know how to think about how the two compare when we need to write them down. But basically, again, you're going to do the same thing. But you're going to-- so I don't think it fundamentally changes the logic, except that instead of having a simple budget constraint where everything is certain, you're going to have an expected budget constraint.

And then it's going to depend whether the expected budget constraint needs to be satisfied with equality every time. And so that might generate a little wiggle here and there, but probably doesn't change the fundamental logic of the problem in particular, since if you introduce uncertainty in return distribution, probably, you need to introduce uncertainty in the return to other kind of investments as well.

**STUDENT:** Can I [INAUDIBLE]?

**ESTHER DUFLO:** Oh, we didn't finish your point, because we move the to borrowing constraint. But with saving constraint, you're going to have the same thing. And again, Hazel's point continues to apply, which is it might lead to the opposite of people overinvesting in their kids because they are trying to get money back later in the form of the kids paying for them. But in the absence of other things, that also should eventually even itself out.

Great, thank you. So next time, we are going to start-- basically, we're going to go back with this model in the back of our mind, or sometimes explicitly, on the slides. We're going to go back to thinking about all these things. Do people pay attention to it?

That's going to be our framework to think about do people pay attention to the cost of education? Do people pay attention to the return to education? How do we even think about the return to education? And then so next week, on Wednesday, it's still going to be within that kind of neoclassical world. And then we can start breaking the things one by one, adding externalities, adding credit constraint. And Thanks.