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PROFESSOR: So today, we're going to be talking about today and on Thursday, we're going to be trying to answer this question. We're going to give a slightly different answer today than on Thursday. Just to give you a road map of where we are going, today is more going to be about the poverty trap in the sense that Pak Solhin described it to us in-- I think it was our first lecture together.

We started from Pak Solhin description of a poverty trap, which was really based on the immediate impact of the calories on your productivity that very day. And then that's what we're going to look at today, which is try to answer [? Daiquiri's ?] question which I've been putting off until now, which is to say well, can we really believe his story? And then on Thursday, we are going to further our inquiry into nutrition based poverty trap by looking at things a little bit more subtle than the impact of calories on your productivity the very next day by looking at things like micro nutrients and by looking at things like feeding your children or feeding pregnant mother so that the kids that they bear grow up as different people, et cetera.

So that's kind of the road map for our work today and on Thursday. At the end of last lecture, we discussed the important observation by Amartya Sen that maybe there are no famines in today's democracies, that the large big famines are gone or at least that when we observe them, they are due to some really extraordinary circumstances like a war or a civil war. So there is a paper that I didn't ask you to read because it's a little long. But the title is *Is Famine History?* And it sort of concludes that it might be outside of specific circumstances.

I should say that it's history that might come back because we have no idea what global warming is going to do to the productivity of agriculture, and it may or may

not be sufficiently bad that it might come back. But in the short term, we may be in a situation where people are not starving to death in very large number like they did in West Mongol outside of some big serious political crisis. However, malnutrition and under nutrition is not.

You can see the food and agriculture organization that's based in Rome is in charge of trying to monitor people's situation. They try to estimate how many people are, they call, hungry. So they give periodically a number of the number of hungry people in the world. And not long ago, they came up with one billion.

And that number, if you've seen, has been all about the newspaper, one billion hungry people in the world. To be completely honest, I am not fully understood how they compute the number of hungry people in the world, because I suppose you could ask them. But I don't think this is what they are doing. I think they are trying to estimate the calorie requirement that people might need to fit.

And the question is do we really know what's a calorie requirement? And the answer to that is no. We don't really exactly know what's a calorie requirement.

So maybe this notion of what's a hungry person is a little bit more hazy than we'd like it to be. But there is not really a lot of people who look very skinny. So do you know what the bodymass index? The bodymass index is your-- sorry, go ahead.

AUDIENCE: 730 times your height divided by your weight squared.

PROFESSOR: 730? I didn't know that that's 730. I think it's your weight divided by your height squared in meter. That's maybe the 730 coming from. It's your weight in kilograms divided by your height in meter squared.

So sometimes I'm trying to think that this means that we're trying to elongate the person over a square meter and see how fat that rectangle would be. So that's the BMI. Do you know what the threshold for the BMI is.

AUDIENCE: 18.5.

PROFESSOR: 18.5. So 18.5 is undernourished. And there is a large number of people we know

who are undernourished by this standard. Also there is about 2 billion people in the world who are anemic. That means they don't have enough hemoglobin in their blood.

Now all of anemia is due to poor nutrition, but it's estimated that maybe half of this is due to iron deficiency anemia. So it's a deficiency in one particular micronutrient which is iron. So that's about one billion people who are anemic due to some deficiency in iron in their diet.

Is there deficiency in iron or difficulty in absorbing the iron? A lot of these anemic people is in India. And sadly, Indians combine the fact that many of them are vegetarian and their diet is rich in rice which is rich in phytates, which is an inhibitor for the absorption of iron, which is one reason why the rate of anemia is particularly high in India, is that on the one hand, they get less iron in their diet than other people at comparable level of calorie intake just because those come less from meat. Then on the other hand, they are less good at absorbing them due to the rice.

There was a large increase in food prices in 2006. And then again, they collapsed during the crisis. And they increased again in 2010 to be almost at 2008 level.

And there are two consequences of an increase in food prices on those of the poor who are net consumer of food, that is those who produce less than they consume. Those are, for example, the urban poor. And those are on the one hand, a large proportion of the budget of the poor. A larger proportion of the budget of the poor is spent on food, so an increase in the price of food affect the poorest more than proportionally, compared to any other source of inflation.

So if the source of inflation is sort of a general increase in priced or it's driven by the price of housing, then that affects everybody the same or that might affect the rich more. But if the inflation is as it is today, driven by an increase in the price of food, then it affects more the people who are relying the most, of course, on food. And that's the first story.

That's one reason why organizations like the World Bank, the UN, they FAO are practically worried about an increase in food prices, because that's disproportionately affecting the poor. And it's also disproportionately affecting the urban poor, which may be one of the many reasons that have led to the unrest that you observe today in the Middle East. The reason why I'm mentioning that is that in 2008, at the height of the previous increase in food prices, there were food riots in Egypt that never had achieved the kind of intensity of what we saw in the last few weeks, but were clearly and very directly prompted by the price of food.

And here, the whole rhetoric of the revolt was framed around political reform, but it is not impossible that part of the reason why so many people, in particular in urban centers, were willing to spending so much time outside protesting is because they were profoundly unhappy with the increase in the price of food. The second reason why we might be worried about an increase in the price of food is if we take Pak Solhin's story seriously and we are wondering that this increase in hunger is going to lead to some vicious circle. So If you read the World Bank document about-- the World Bank's job, in a sense, is to raise money for developing countries.

So part of the World Bank's communication department job is to be slightly alarmist, so we need to take everything they say with a pinch of salt. But one of the thing that they would very frequently say is the price of food increase-- that makes the poor poorer. That makes them more difficult for them to get enough calories, which means they can't work as hard, which means they will be plunged back into poverty.

And so this is the story that Pak Solhin told us in our first lecture. And that's what I want to investigate with you today, whether we have reasons to be worried about this kind of immediate vicious circle. So I want to give us a quick refresher of what's Pak Solhin's story. So with your daily wage, it's a short term nutrition, a nutrition based poverty trap.

With your wage, you buy food. That gives you strength, and allows you to get some more wages at the end. So you buy more food, and that gives you strength. And you have more wages, et cetera. And that's how you survive maybe on a daily

basis.

So that means that it creates a relationship between how much you start from one fine evening and what is your income tomorrow. And that also means that it creates a relationship with the wage level and your ability to do any work at all. So Pak Solhin's story was that the wage had dropped because of the increase in input prices and the uncertainty that the farmer had about whether they were going to be able to raise their output prices corresponding.

That had led to a decrease in the wage at the same time as there was an increase in the food prices, so big decrease in the real wage in term of the food entitlement of a day of work as Amartya Sen would say, which means that if you took this food entitlement and you had nothing else to supplement it with, this just was not enough to give you the strength to do the work to earn that wage. So that means that someone like Pak Solhin that had no extra resources was not able to work at all. So that creates an inequality among people.

Take Pak Solhin and imagine that, in fact, he also had a little piece of land. Then what could he have done with this little piece of land once the wages had gone down? Ben?

AUDIENCE: Sell some of it.

PROFESSOR: So he could have sold some of it to get money. Or he could have rented some of it and get money. So suppose he rents some of it and gets money?

So he starts the morning with 1000 rupee he has from the rent of his field. And that can be complimented with whatever wage he's earned yesterday for his work. And that might be enough to give him the strength to do a day of work.

So if you compare Pak Solhin to his brother, for example-- he has a brother in the story, right? If you compare Pak Solhin with his brother, who had a piece of land, they might be exactly similar in term of their underlying body and their strength, et cetera. But the fact that one of them has a piece of land allow them to work, and therefore they start with a little bit more non-labor income, which gives them much

more labor income.

So the existing inequality in non-labor income is strengthened by the inequality in labor income, which is very different from what we would see in our standard models where the richer people would be less likely to work because they already have the non labor income money. So the labor market would serve to make people more similar rather than less similar.

So that's the story he told us. And as we saw last time, the necessary condition for such a poverty trap is that the capacity curve, which relates your income to that, your income tomorrow via the biology of the body, has this S shape curve that we discussed that intersects below the 45 degree line, then at some point crosses it and then comes back. So we are not going to go back to that, because we saw it in detail last time.

That was supposed to be the shape again. It doesn't want to come back. So the S shape is made of two relations.

The S shape is the relationship between income today and income tomorrow, midrow since I can't have it on the slide. So this is income today and income tomorrow. And so the S shape is actually not one function, it's the product of two functions.

One is given how much income you have, how much calories do you decide to eat? And then the calorie that you eat-- how much productive do that make you? So if we write it in math, it's like there is income, nutrition is equal to g , function g of income today. Because you get your wages and then you eat some good meal.

And then income tomorrow is a function f of nutrition. That means that income tomorrow is f of g of income today. So this is what makes this S shape.

So what we can do today is to look separately at these two relationships. What's the strength of the relationship between income tomorrow and nutrition today? And what's the relationship between nutrition today and income today?

And here, when I mean today and tomorrow, I really mean today and tomorrow. This is a short run phenomenon that we are talking about. Maybe next week, but not a matter of generations or years.

So suppose that there is indeed that this particular relationship, income tomorrow and nutrition, is indeed S shape, and suppose that you were a very poor person, so you are in a low part of the S, and suppose that you happen onto a bit of money, what would you do with this money? If this relationship between income and nutrition was S shape and you were a very poor person, but you find a pile of money on the ground, what would you do with the money?

AUDIENCE: Well, if that holds true, then you would want to eat more.

PROFESSOR: If that holds true, then I know you would want to eat more. So that means that if there is indeed an S shape between income tomorrow and nutrition, then we should see a very strong relationship between nutrition and income for the very poor, because it is like for an excellent investment. If you find yourself here, there is no better investment you can do than eating some more.

So a first thing you can do is we can see whether poor people are really trying to put all of the possible money into food. Now the question is the possible money, so that means that we would find the share of food in the budget should be very high for the poor. And the second thing it would mean is that it would increase quite fast with income.

And possibly, it would again have a form of S shape for the following reason.

Suppose that you have some unavoidable expense to solve. For example, you need a house and you need some clothes. So unless you live in a very hot country where you don't really need much clothes, you need a house, you need a piece of land to put the house on, and you need some clothes.

So someone who was a budget of 20 rupees will spend, say, five rupees on clothing and house. They can't do anything more than that. And 15 rupees on food. So that's the poorest person.

And then if there is really this S shape here, this person would be somewhere here. So they would remain quite poor. And now another person, comparable in other aspect, but has a total budget of 30 rupees, let's say because they have some non labor income or because they have a bit more weight, than they would still spend unavoidable expenses on clothing and houses, but they would not do any more.

They will still do just the minimum. And they would spend all the rest on food. That means that by how much did I increase the income of this person? Sorry?

AUDIENCE: By 10.

PROFESSOR: Yeah, 10 out of 20, and [INAUDIBLE].

AUDIENCE: 50%

PROFESSOR: 50%, and this is how much of [INAUDIBLE]?

AUDIENCE: [INAUDIBLE].

PROFESSOR: It's 25 out of 15. An increase from 15 to 25. It's 10 on the basis of 15.

AUDIENCE: [INAUDIBLE].

PROFESSOR: I trust you. You are the MA student. So whatever it is, that's going to be on video. 66? Let's go with 66. That means that when I increase your income by 50%, your expenditure on food increases by 66%.

So if I divide by one of the other, what concept is it called? An elasticity. So this means the elasticity of food expenditure with respect to overall expenditure is more than one for the extremely poor. Because you start by taking care of your essentially needs.

And after that you're putting all of the money into food because you think this is highly valuable. So this is one thing. And the second thing is now you go from someone who gets 30 rupees to someone who gets 45 rupees.

So I've rigged this so that it's nicely another increase of 50%. And now this person

who makes 45 rupees-- they're already kind of over here somewhere, so the marginal value of one more rupees into food is not that high. So they are still going to spend a bit more on food, but only five rupees more.

Going to spend a bit more to have a nicer clothing and some houses. And now they can bring in entertainment, because now they are basically just taken care of. The marginal value of extra is not that high. So they can get into doing other things.

So now the elasticity is going to be 0.25 to 30. That's out of 25. Sorry?

AUDIENCE: 20%

PROFESSOR: 20%, is that? Yes, 20%. 20% out of an increase in 50%. Now the elasticity is much less than 1. So what we would see is a group of people, the poorest people, where we have very high elasticity. And then for anybody who is somewhat richer, the elasticity of food consumption with overall budget would be less than 1, which is what people refer to as the Engel curve, which is the share of food of the budget increases less than proportionately.

So the Engel curve refers to this phenomenon, which is the share of food increases less than proportionately as you become richer, but it's worth pointing out that in an S shaped world, we would probably have and reverse Engel curve phenomenon, where the share of food of the budget first increases and then decreases. So the question is, do we see this, that the poor spend as much money as they can on food? And the second question is, do we see this, which is do we see anybody who's elasticity of food consumption with respect to budget is more than 1?

So that's kind of where I want to go next. So first, let's look at the food share in the budget around the world. And this comes from a data set that-- the World Bank collect data set in many countries called the Living Standard Measurement Surveys. And they very nicely put them on the website-- not all of their surveys, because in some case, they have agreement with governments that doesn't allow them to do that.

But a lot of their surveys are on the web. You can actually download them and play

with them. You're welcome to do that. And we did that.

So we took the overall expenditure to compute people's budget transferred into PPP dollars. So this is people who live under a dollar a day, at pressures in power poverty, so in US prices. And look at the share of their budget.

So this is what we find for a bunch of people living in the rural areas. And this is food, alcohol, tobacco, education and health. So what are your remarks when you see these numbers?

AUDIENCE: I have a question about the education percentages. Do those mean that we'd be paying for tuition or educational [INAUDIBLE]?

PROFESSOR: So this is only education expenditure. So this is tuition if the child is in a private school or if they get extra tuition, which a lot of people in developing countries do. They get extra help at home. This could be school uniform, school books, boarding school for kids who are in boarding school. Any education related expenditure would be in there. Yeah, Ben.

AUDIENCE: I guess a couple confusions, [INAUDIBLE].

PROFESSOR: So in 2.1, Mexico is spending more on alcohol and tobacco than on education. Spends very, very little on health. That doesn't mean people are totally unhealthy. But actually, Mexico has an excellent health care system, but basically is free for most people. And in all of the countries, the share on alcohol and tobacco tends to be at least comparable to what we see for education and health. Yeah.

AUDIENCE: Why don't the numbers add up to 100%?

PROFESSOR: Because there are other things you do with your money other than food, alcohol, education or health.

AUDIENCE: Got it.

PROFESSOR: Going to the movies, putting some cloth on your back, that kind of stuff. If it adds up to more than 100, we're in trouble, which is quite possible. But I hope not, I hope

not. I don't guarantee it, but I hope that that kind of mistakes would not always send scrutiny. Any other observation on this table?

Let me ask one question then. Do you think the share of the budget on food is high or low?

AUDIENCE: High.

PROFESSOR: High, you think the share of food is high? Yes. [INAUDIBLE]. Ben?

AUDIENCE: I mean, [INAUDIBLE], I don't think you'd have much wiggle room to spend your money on other [INAUDIBLE].

PROFESSOR: It's about right. Yeah, so the question is whether it's high or low. So one thing I should say is that it's kind of viability. It goes from pretty low in India, 56%, to pretty high in Timor, 77%.

Remember, this is all people who are equally poor in term of their ability to consume things, because they're all below a dollar a day at PPP. They make very different choices. They are quite viable.

Whether it's high or low, I think it's in the eye of the beholder. On the one hand, it's certainly a high part of the budget, compared to what people spend, for example, in the US. On the other hand, if you compare it with, for example, what they spent on tobacco, even on education, given that a lot of these countries have a free education system, the education expenditure they are making are extras, I'm sure surely value extras.

But that means that there seems to be actually some wiggle room, that you could do something about your food budget and increase it without sacrificing anything else that's vital for the house. Yes.

AUDIENCE: I just have a question about what you presented. The people who spend more on food, is their nutrition better? Or is it [INAUDIBLE]?

PROFESSOR: So that's an excellent question. We're going to look into that, which is when you

spend more money on food, it could be on more nutritious food or more calories. It could be on not so much more nutritious food. It could be on better tasting food. And the short answer is that the two are happening. I don't know whether it's true at the country level.

For example, India is a country that spends very little on food and which has probably the worst nutritional stages for this group of people within the world. But at the individual level, we're going to see that very soon when people increase how much money they spend on food, they both get more food and they get better food, more expensive food for the calories and the nutrition they are getting. So both things happen together.

AUDIENCE: What is the requirement for the [INAUDIBLE] children and [INAUDIBLE]?

PROFESSOR: No, this is everyone. This is everyone who lives on less than a dollar a day per capita. So if there are five of them, they are entire budget divided by 5. And if no one has any children, then they won't spend anything on education.

AUDIENCE: They might have spent quite a bit more on education.

PROFESSOR: This means that per child, they spend a fair amount on education.

AUDIENCE: [INAUDIBLE] is more expensive in South Africa or Timor, so [INAUDIBLE] basically be buying the same quantity of food to be spending more.

PROFESSOR: Right, so that's an excellent point. The point is in answer to the unstated question, which is what explains this variation across countries, our first possible explanation is the relative price of food is different. So food could be relatively more expensive in Timor Leste, which is why people are spending more money to get the same thing. What is interesting is that the opposite seems to be true, which is because India is a very large economy that is able to produce very many things in India, the relative price of things like toothbrush, even DVDs, cellphones-- that kind of things relative to food-- is lower in India.

So one of the reasons why people seem to be spending, or one possible reason--

I'm not saying this is a tirant. But this is a conjecture, let's say-- is one of the reasons why people in India spend much less on food and more on other things compared to people in Papua New Guinea, is that there is nothing to get in Papua New Guinea except food. So if you are poor, like what can you buy?

Well, in India, you can buy shampoo of this kind, and everything is produced locally, hence the relative prices are lower. So that's a possible explanation for this pattern. Yeah.

AUDIENCE: In terms of the different prices across countries for food, I thought that the one dollar a day standard was in terms of purchasing power, so [INAUDIBLE].

PROFESSOR: For your entire budget. So the one dollar a day standard takes a basket of consumption good. Of course, food is an important part o it, but there is also other things that people consume. So one dollar a day takes the basket of goods. In fact, the way it's computed here, it's 16 rupees a day, actually-- takes the basket of good that is consumed by the poor rather than your basket of good or my basket of good, and price it in the different places and adjust with that.

So good plays an important part. But other things play as well. And then within a single dollar a day, it could be that, say in India, for example, food is relatively expensive relative to other things just because the other things are so cheap and available. Yes, Eve.

AUDIENCE: Could it be that it's hotter in India than the other places, so in other places people need to eat more food to have more fat to preserve heat, whereas in India, they don't need to eat as much food because it's hot all the time?

PROFESSOR: So it could be. It's a very interesting point, and we are going to make this point. We are going to see this point coming up in another guide very soon. The point is that we don't know what's the calorie requirement for a human being, partly because it depends on the climate and it depends on what you are doing. And it depends on how much calories you are losing to illnesses and other things like that.

One piece of evidence that suggests it's not the entire story is that if it were the

case, if I looked at the size of the Indian people compared to the size of anyone else, what should I see? Sorry?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Well, in your hypothesis where the difference is due to the fact that they need less calories because it's warm, if everything was explained here by the fact that Indian people don't need that much calorie compare to-- see, all these countries are warm. But compared to South Africa, South Africa is a bit more temperate, so poor people in South Africa need to eat a lot because it's cold when it's the winter there.

Then if all the differences in calorie consumption were to be explained by these needs, we would find people whose nutrition status would be comparable. So their height would be the same and their weight would be the same. And in fact, Indian people are very, very short and they are very, very skinny. Now you might say, yes, but that's genetic. It's just, like, Indian people are short.

But that's actually not true, because the children, when Indian migrants come to the US, they start eating US food, their children are still smaller. But the children of their children-- some of you might be that-- are exactly as tall as anybody else. So it suggests that the genetic potential of Indian people in term of height and body size is no different than that of anybody else.

But it's their nutritional status that is different. And that affects them directly, and that affects their children just because of when you're in utero in someone who doesn't eat enough, you'll also be smaller. For the longest time, people said Japanese people were short. But it turns out that the height in Japan are converging to the height of everybody else in the world.

So this is more of a nutrition thing than all this cereal and maize that we are consuming, than a genetic potential probably. So going back to sort of the two punch lines here-- one is that this is moving a lot, which suggests that there is some margin of choices, at least in India, for example. Second is we have this alcohol and tobacco that we could, in principle, get rid of.

And then all of that would be extra calories. So that suggests that this is high, this is important. But there seems to be some amount of wiggle room take Ben's word. There is some amount of wiggle room here.

And to look at other form of wiggle room, so another way to look at it is to look at this question, which is what is the elasticity of calorie consumption with respect to your income? So this log per capita outlay is some fancy way of saying log per capita expenditure, which is a good measure of your wealth. And what you can see is that this is the log per capita calorie.

This is looking at Maharashtra in 1993. India has grown a lot since 1993, but Maharashtra in 1993 was a pretty poor place. And what you find is that as people become richer, they do consume more. The slope of this line is about 0.3. And the slope of this line when I run a regression of log per capita calorie on log per capita outlay, what is the slope giving me?

The elasticity. So whenever I go log log regression, I get the elasticity. Interestingly, this is not a regression. I mean, this is a regression, but not a linear regression. This is a non parametric regression, which means that if the shape had been what I told you it could be, which is very high elasticity early on, and then a lower one, so something we would expect if we were in the S shape world of the elasticity being above one for the poor and then less, the way they have estimated this regression allows for this to be the case.

But that's not what they find. They find the elasticity of 1.5 pretty much constant across the range in the data. Now no one here is very rich, so it's quite possible that it starts going down here.

But the point is that even for the very poorest, that elasticity is not above one, so even the very poorest have an Engel curve phenomenon, which is as they become richer, they don't start eating as much as possible, eating the extra calories up. They're eating, in terms of calories, if I increase your income by 10%, you increase your calorie consumption by 30%. So these two first things suggest that maybe this is somewhat unlikely that there would be this very strong S shape, because

otherwise people would be behaving in a very bizarre way.

So we've seen that. So I think we've covered this. So the calories increased with overall consumption, but not one for one. When total expenditure increased by 10%, the consumption of calorie increased by 3.5%. So we have an Engel curve. That is true for everyone.

So why is the slope of the Engel curve less than one? So what happens is what was suggested earlier, which is when people get a bit more money, they do increase the share of the budget going to other things. So the elasticity of overall food expenditure is less than one. It's about 0.7.

So if I increase your budget by 10%, you increase your food consumption by 7%. And then it means you increase something else more than proportionally. So maybe you start spending money on the movies, which you were not doing before. So that's the first thing.

So 7% is not 3, though. So what is the difference between 7 and 3? When I increase your budget by 10%, you increase your food budget by 7%. But your calories only increase by 3.5. So what happened in the meantime? [INAUDIBLE].

AUDIENCE: Maybe all your food wasn't as high in calories.

PROFESSOR: They bought more expensive food anyway. Maybe because that food was yummiier, maybe because it was more nutritious, but certainly more expensive food. So what happens is that when you spend more on food, you start buying more expensive calories and you do that in various ways.

You start eating meat instead of eating cereals, and you start eating more expensive cereals instead of the course cereals you were eating before. And even within the more expensive cereals, rice for example, you buy more expensive rice. So all of this margin happens.

And we can see it here in the table. We can see this is Maharashtra, 1983. These are the poorest 10% and the top 10%. We can see that the poorest 10% spent 46%

of their budget on cereals, and the top 10%, 31%.

And if we look at meat, meat is 8.5% for the poorest and 12% for the richest. Things like are constant, however, in terms of fraction of the budget is sugar. And the sugar actually goes down 7.425%, and oil. That remains about the same. The fraction of the budget spent on oil is 9% for both.

But you get cereal going down, and you get meat going up. And the price per calorie of cereal is much cheaper compared to the price per calorie of meat. And now within cereal, people who are poor spend 9% of their budget on the rice. And the rich are spending almost 11% of their budget on rice.

And then the price of rice is also cheaper than the price of other things. Price is more expensive, sorry, than other things like the course cereal. And even within rice, the poor are buying cheaper rice than the rich.

The poor are spending 18 paise per calorie for the rice, and one rupee per calorie for the richer people. So all of this margin happen, which again suggests that there is some amount of flexibility. Because otherwise, what you would do is to, within the same budget, continue to eat the same thing, but more of the same thing. So if you were at subsistence level, the share of your calories that comes from the staple food would remain constant.

And it's only after you've reached some level of subsistence that you would say, now I can start eating more meat. It's more expensive, but it's yummiier. And so the fact that even for these relatively poor people who see that the share of calories that comes from rice declines is an indication that they probably see themselves having some margin of choice.

So even among the very poor people, an increase in economic well being has positive, but not a huge, impact on calories consumed. So you take the poorest person here and you increase their budget by 10%, they will increase their calories by 3.5%, partly because there are other things they like to do, partly because within food, they also like to eat better food. So that brings us to this Jensen and Miller

idea, which is the idea of a Giffen good. So what's a Giffen good?

AUDIENCE: It's a good that when the price increases, there's an increase in demand.

PROFESSOR: When the price increase, there is an increase in demand. That's right. Why is that surprising?

AUDIENCE: Because generally the demand curves--

PROFESSOR: Yeah, go ahead.

AUDIENCE: Generally as the price increases, there's a decrease in the demand for the quantity.

PROFESSOR: Generally, we think of the demand curve as looking down. So if there is an increase in the price, you decrease your demand. So why is it not a violation of everything we know about economics?

AUDIENCE: Because if the price of some good increases, then you wouldn't be able to substitute out [INAUDIBLE] pretty easily. So the example of rice and meat-- if the price of rice increases, then in order to get the calories you need, you might have to buy more rice and just stop buying meat.

PROFESSOR: Right, Mr. Giffen is referred to by who for the first time? Are there some writings by Mr. Giffen?

AUDIENCE: *Indiana Jones.*

PROFESSOR: *Indiana Jones*-- but before that. So Mr. Giffen-- we have no writing from him directly, but he was referred to by Adam Smith. And Adam Smith gives the example of potatoes in Ireland. The price of potatoes goes up, but potatoes is such an important part of the budget that when the price of potatoes goes up, it does an income effect, so that is always true. When the price of a good goes up, it has an income effect and it has a substitution effect. What do we know about the substitution effect? Yeah.

AUDIENCE: Generally when the price of one good goes up, [INAUDIBLE].

PROFESSOR: Right, so when the price of a good goes up, you substitute to another good. So the substitution effect is always negative. But the income effect can be either positive or negative. So the income effect-- in what case is it positive?

So for example, if you look at iPod consumption, would that tend to have a positive income effect or a negative income effect? So the goods that are more like luxury goods, that are a bit expensive, will have positive income effect, meaning as you become richer, you will consume more of them. The goods that are cheaper and that are not particularly desirable will have negative income effect.

For example, think about your own budget. As you become richer, maybe you are going to buy more orange juice. That is a positive income effect. Maybe you are going to get fewer macaroni and cheese pre-packed. That has a negative income effect.

So the income effect could be positive or could be negative. It's positive if it's a normal good. It's negative if it's an inferior good. So now something like potato is presumably an inferior good. That's not something people love. It's something that as they become richer, they will try and substitute to another thing.

So the question is whether the income effect of an inferior good like potato is so large-- not only it's negative, but it is so large that it out does the substitution effect. So if the income effect is so large that it more than compensates for the substitution effect, then you might be getting a different good. So that is the story of the potato famine, which is possibly apocryphal, the story being the price of potato increases.

But that makes people poorer, so that actually increases their consumption of potatoes, because they stop eating meat, and they eat only potatoes because they have no money left to buy any meat. So this is a different good. So until this paper, I think there was a strong suspicion among economists that different goods-- actually, they didn't exist, but they were a nice theoretical possibility, but that in practice, you don't see a good where the income effect is so large that it outdoes the substitution effect, so that if you become richer, you eat fewer potatoes. But if the price of potatoes declines, you eat more potatoes.

So this is the story. So a staple food that constitutes a large part of the budget, like potatoes for Irish famine or the example they have in China are what?

AUDIENCE: These were two provinces in the North [INAUDIBLE].

PROFESSOR: Wheat and rice. So these are foods which are a fairly large part of the food budget and a fairly large part of the overall budget. So this is a good confident for a different good. Because for the income effect to have any chance to be large enough, it has to be something that takes a large part of your budget. So that's why they decided on this thing.

So the first thing they've done is they looked at these two provinces and they observed that, for example, in a rice consuming region, they observed that in cities where the price of rice is higher, people consume more rice. And first, they are very happy, and they said oh, we have found our Giffen good. But then they get depressed and they realize maybe it is not a Giffen good. So why do they conclude that it doesn't give them a Giffen good?

AUDIENCE: [INAUDIBLE] is it because the price is higher that people consume more rice, which would make it an incident? or is it that people consume more rice, so the price becomes higher?

PROFESSOR: Right, we don't know. We are trying to trace a demand curve. But if we only observe prices and quantity, we might be tracing the supply curve. So we don't know whether we have traced the demand curve or the supply curve. And this would be the normal shape for a supply curve.

So this is exactly the same type of problems that we were facing when we were trying to look at the effect of malaria prices on bednets, which is if we just look at the variation in the world, there is the effect that we are trying to identify, and there is a possible of a reverse causality, in this case, very clear, which is we also have a supply curve that we are trying to trace. So that's why they decided that's not working. So what did they decide to do?

AUDIENCE: They subsidized rice and wheat. [INAUDIBLE].

PROFESSOR: Exactly, what they decided to do is to run the maize experiment where they subsidized the price of rice in the rice consuming region and wheat in the wheat consuming region at various levels. I think there are three levels of subsidies. So they take a sample of households. They distribute a voucher for the reduced price of rice in Hunan and reduced price of wheat in Gangsu to a random sub sample for more than a month's supply every month.

They made sure that the household wouldn't extend them. Otherwise, what would be a problem if households started trading them?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Exactly, in particular you try to reduce the price. But if you give voucher and people start exchanging them, think of food stamps when people sell their food stamps. When they sell their food stamps, they are getting money, which is-- I mean, it's not bad. But why do we think it's an issue? And why would there be a theoretical issue in their cases?

AUDIENCE: Essentially, the price of the rice would need to be changed.

PROFESSOR: It wouldn't be changing. So the people would get their voucher, and then they would sell it to someone. So they would get money instead. And then they would, with that many, perhaps buy some rice and wheat and buy some other things as well.

So their experiment where they tried to change the price of rice or wheat would end up just changing their income without changing the price. Because the marginal price that they are facing once they have sold their voucher is the same, except they now have more money. So now all they would identify is the income effect. And of course, the income effect would be negative because that's an inferior good.

So they would be finding a Giffen good. But that would not be a real one. That would be a fake one due to the fact that their price experiment would be transformed into an income experiment. So it's very important for them to keep the

price experiment in fact. So they tried to do that and they tried to argue in the paper and in the post that you read in *Freakonomics* that they've done this properly.

And after six months, they came back, and then they asked detailed questions about the consumption of rice, wheat and other things. So what do they find? So I'm going to show you the regression table which gives us the results directly and explain to you what's in the regression table.

So it's a long table. But for now, focus on the first column. So what they regress is the percent increase in rice consumption over the percent subsidy. There are three groups of subsidies. I was looking everywhere in the paper for you to have the three prices and the three reductions so that I could plot them, but they were not there.

So this is the overall result. So basically, the way you read this graph-- it's saying that your consumption of rice reduces by 23.5% when the subsidy increases by 100%. It's directly a percentage of a percentage.

So your consumption of rice reduces in percentage about a quarter of the reduction in price. So the important thing here is, of course, that it's negative. And below the coefficient here, you get the standard error. So the coefficient is 0.235. The standard error 0.14.

If you divide by one the other, you get the familiar T statistics. This one is above 1.7, so this means this is significant at 10% level, which tells you that this is not entirely due to chance. This negative is not some fluke. It is something which is indeed significantly different from 0.

So that's what they find for Hunan. And then they find the opposite for seafood, where the elasticity of seafood consumption with respect to the price of rice is very positive. So what happened in their experiment-- this is your typical Giffen good behavior-- is the price of rice increases, but increases because rice is such an important part of your budget. It amounts to increasing your income.

And because of this increase in your income, you feel that you can now get more of your calories from shrimps and fewer from food. So that's for Hunan. So this is the

explanation.

And for Gansu, we have a positive elasticity. So it means that wheat doesn't appear to be a Giffen good in Gansu. It appears to be an inferior good. It increased less than one for one, but in fact, it's not significantly positive. But it's certainly not negative. And they explain why they find a different result in a different place. [INAUDIBLE].

AUDIENCE: What prevented them from just [INAUDIBLE] rice they got to give more money by substituting goods?

PROFESSOR: Right, so they tried to stop that. But we don't know for sure that they succeeded. What they were very worried about is the resale of the voucher. And their view then is once you had resold the voucher, then you wouldn't have resold the rice. And what they did after that is they did a survey.

So the data here doesn't come from the administrative data of what was sold in the shop. The survey comes from what people consumed at the end of the day. So to the extent that people didn't lie to them, this is the actual consumption.

So it could still be the case that they bought the rice. They sold the rice. They bought the rice with the voucher because they couldn't exchange the voucher. But then, they went to the trouble of selling the rice. And that's why it's just an income effect that we are estimating, which is why it's negative.

They tried to argue that it didn't happen, but that's, of course, a key concept. So what do they say about wheat, that why did the wheat show them a different good for the wheat, but they have one for the rice?

AUDIENCE: Because people aren't eating wheat itself. They're eating wheat products, like noodles.

PROFESSOR: Exactly, you are saying that it's not their own group, that people rice. They don't buy big packets of wheat, so that it was kind of the wrong idea. This, of course, has implication for nutrition, and in particular for a very frequent policy that we find in

developing world, which is food price's subsidy for greater nutrition.

So for example, in Indonesia, we have the ration program. If you remember, in Pak Solhin's stories, he got some free rice from the ration program. In India, India just introduced the Right to Food Act and a subsidy scheme for rice in rice consuming regions.

So India has something called a public distribution system where they distribute food to households at reduced prices, to poor households at reduced prices. Egypt spent something like 3% of its GDP on food subsidies. So food subsidies is a very important part of help to the poor in developing countries.

It's also a very important part of our-- our meaning the US-- aid to poor countries is in the form of food aid, directly food which we send to poor countries. Why are we spending a lot of our aid in terms of food aid?

AUDIENCE: [INAUDIBLE] lot of food [INAUDIBLE]. It's easier for us to just take that [INAUDIBLE].

PROFESSOR: Yes, so part of the reason why a lot of our aid is in the form of food aid is that it's also aid for our own farmers. And it's a way of kind of buying the [INAUDIBLE] and sending them out. So when the weather has been good in the US and the harvest is very big, a lot more food aid is being spent all over the world.

But with that aside, this is a policy that many countries have to try to subsidize the price of food. But if we have something like the Giffen good, what may happen if you make the price of the staple less high, if you make the price of the staple lower?

Yes.

AUDIENCE: Then they'll spend their income on other sorts of stuff, not on the [INAUDIBLE].

PROFESSOR: Yes, we might find that something like this happens, which is the price of rice has now gone down. Instead of eating more rice, you ate less rice and more shrimps and maybe also more cellphones. So if rice is indeed a Giffen good, the increase in the calories you are getting from a decline in the price of rice might actually not be very high. In fact, it might even be negative.

Because if the income effect is sufficiently large, it made outdo, again, the price effect. And we might find that as we make food cheaper, people eat less instead of eating more. And that's exactly what they found in Hunan where rice was a Giffen good. They find that as you decrease the price of rice, people eat fewer calories, not more.

So this would be the very standard poor price policy in your average developing countries, to try to subsidize the staple. And the justification of this policy will typically be in the form of we need to increase the calorie consumption because people are trapped in poverty trap like our friend, Pak Solhin. But in fact, if you look at this for this urban household in China, you find the opposite, which is subsidizing the price of rice actually leads to fewer calories consumed.

And it's not because people gain in terms of other micro nutrients, though we don't have all the other micro nutrient. But we get fewer portions being consumed as well. So this is what they find in Hunan, but they don't have it in Gansu.

So it's not to say that it happens necessarily everywhere, but it is something that might happen. So it is not a total given that a reduction in the price of food will lead to an increase in nutrition. On the bright side, it also means that it's not necessarily a given that the current increase in the food prices that we are observing will lead to people eating fewer calories. Because it might have this progress effect of making them poorer and therefore leading them to eat more of calories.

AUDIENCE: Yeah, I think one way [INAUDIBLE] food [INAUDIBLE]. Because, for example, if you eat shrimps, shrimps may not be very calorie rich. In India, people eat a lot of lentils. And the next thing that they eat to rice is durum, which is actually full of protein. So eating less rice, and if they spend more on protein, [INAUDIBLE].

PROFESSOR: Right, so this is, of course, completely dependent on what you substitute with. If you substitute rice with lentils, actually it might be more nutrition, and more iron, more nutrition, et cetera. So we might find an increase in nutrition due to subsidy in the price the rice.

So the only point here was not to say that it has to be the case. It was to say that it doesn't have to be the case that subsidizing the price the rice will lead to more rice and more calories being consumed. Now let's look at India, precisely.

So before that, there is something that should surprise you in when you put together this Jenson and Miller result and what we had before in India. We found that a household that are 10% richer eat about 3.5 more calories. But the Jenson and Miller result-- what does it suggest about the income effect?

We are finding that when the price of rice decreases, you eat less, not more. What the income effect has to be?

AUDIENCE: It's negative.

PROFESSOR: It has to be negative. So on the one hand, I showed you positive income effect-- maybe not very large, but certainly positive for India. On the other hand, I'm showing you price effect in China which suggest that the income effect has to be negative, and in fact, very negative. So how can this be? How can we have the two things together?

So the first thing is that in India, we were comparing different households. We were not comparing the same household to which I give more money. And different households are different.

Maybe they're households that are a bit richer. They are also more educated and they understand the value of nutrition, and that's why they eat more. So the idea in experiment would be to give people a little bit more money, really literally do that and see whether they spend this money on food or not.

And that would allow us to estimate the income effect. To my knowledge, no one has done that. It's a little bit difficult to parachute [INAUDIBLE] drops of money on people-- not impossible, but it's not been done, I don't think. So what we have when we looked at the India curve, we find that people who have more money eat more. But it may be because they have different tastes or it might be because they eat more, and therefore they're more productive, therefore they have more money, so

the opposite relationship.

So that may be an underestimate. That positive estimate, which was already not that high of the income effect, might have been an over estimate. And one thing that's suggested-- and it goes back to [? Swati's ?] point earlier-- is when we plug the Engel curve over time in India, we see two interesting things. Number one, all of the Engel curve for the rural areas are above the Engel curve for the urban areas. Why do you think that would be the case?

AUDIENCE: The work in the rural area is much more labor intensive, so you need to eat more to have physical strength.

PROFESSOR: Exactly, the work in rural area is more intensive, and so they need more calories. So this is interesting that you are making this point, because this is the point you were making earlier about maybe the needs of calorie in South Africa are bigger because it's colder. So that's the first things we notice. So this we can explain.

And what's the other interesting trend in this picture is that over time, the Engel curves are falling down. People are eating less, and less, and less for the same level of income. So what happened in India over time is that, of course, people got richer. So if the Engel curves had been stable, they would have eaten more.

But because the Engel curves are also falling down at the same time, what happened over time is that people are moving first across to another Engel curve and then up along an Engel curve. So take someone who would be at a log income of 5. 15 years later, they have a log income maybe of 5.5, but the Engel curve have also moved.

Take someone who is at 5, and then 15 years later, they would be, let's say, at 6. But now we need to find the 6 on the much lower Engel curve. So instead of eating more, as they would have if the Engel curve had become stable, we find that people in India eat less and less. So over time, the poor in India are eating less and less instead of eating more and more, which does suggest some negative income elasticity for the country as a whole.

The country is becoming richer and those people are becoming richer, but they are eating less and less. So this now starts to make sense with the two results, where maybe the income elasticity of food consumption-- not only it's not above one, which is what we would have in a poverty trap kind of a world, but it might be negative, which is as people become richer, they-- a funny thing-- eat fewer calories.

So if we look at nutrition in India, we have a pretty interesting phenomenon, which is this is the share of people who are eating below 2,100 in urban areas and 2,400 in rural areas. This is the number of calories they consume per head. Why are these interesting thresholds? Yeah. You had a question or you were just moving?

AUDIENCE: Yeah, I was going to ask [INAUDIBLE].

PROFESSOR: Go ahead, go ahead.

AUDIENCE: I was wondering if that couldn't just be explained because of inflation and not necessarily for a negative effect.

PROFESSOR: Very good, I could be that the price of food has changed. People have become richer, but food is now more expensive. Remember, it has to be relative prices, because people have become richer in real term. Even corrected for inflation, India is richer now. And there are also fewer poor people.

But it could be that food prices increase relative to other things. And that's actually not the case until 2005. And then it became very much the case after 2005. But these results are until 2005, where the relative price of food were relatively stable. That's a very good point. 2,100, 2,400. Yeah.

AUDIENCE: So I was just wondering the calculation that was done for people who are doing sort of intensive labor, how many calories they would need as a bare minimum to be able to succeed in that?

PROFESSOR: Again, we don't really know how many calories we need, but this is what the Indian government says you need. And maybe they get it a bit wrong, because this is the fraction of people in rural area who are getting less than they need. So it's very

high.

Yet these people are still all alive. But what is striking is that this is increasing both in rural area and in urban area, but even more in rural area. So one first explanation was yours, is maybe it's the relative price of food. That would be true after 2005, but not until 2005. What could be other explanation?

AUDIENCE: Maybe a lot of poor people have come from rural areas, and very poor [INAUDIBLE] rural areas and then sort of broke up into rural areas [INAUDIBLE].

PROFESSOR: So that's a very good suggestion. Maybe that the people who are in rural area now are the very, very poor, so they are relatively poorer, so we get more of them who are eating less. And the urban area also getting poorer, because the people from the rural area move to them. That's a very good suggestion, a composition effect.

That probably doesn't explain it, because if you look at that overall consumption per capita of these people, are the function of people who live below a dollar a day, that is going down here and down here. So that's probably not--

AUDIENCE: There has been more technology. They're going to spend other money on other stuff.

PROFESSOR: Right, so this would be another explanation, which is the similar explanation from what we are seeing on the wall, which is there are more and more things available. In particular, one thing that has clearly happened is the advent of cell phone. And so now cell phones weren't there, and now they are there. In India, you can get a cell phone and airtime everywhere. And so that's one thing. So more things become available, very good. Yeah.

AUDIENCE: I think this might be what you meant, but technology that might make the work easier, so you require fewer calories because the work is not as difficult.

PROFESSOR: Right, this is not what she meant just now, but that's what she meant earlier. So I was surprised she is not making this point again. But that's exactly a very good point, which is maybe these are what the Indian government says, but who knows

what they know. And maybe the calorie requirements have changed.

One of the reasons would be that you're less likely to do back breaking work, or maybe because there is more irrigation, there is more mechanisation of agriculture. People are less likely to be in agriculture, even in rural areas. What would be another reason why the calorie requirement would have gone down?

So one is clearly, you are less likely to work. What competes with calories with you?

AUDIENCE: Are you talking about worms and health?

PROFESSOR: Worms, and health and diarrhea, and other nice things like that. Generally being sick consumes a lot of calories. And so one thing that has happened in India is drinking water has become more available and cleaner, so people are much less likely to be sick. Another thing that uses a lot of calories is being pregnant, and you have many fewer children being born. So that's also compete less for calories.

So one possible reason for all of these, for these changes, is that the calorie requirements have just changed and people are staying at the same level as before. They spend less. And they are used to a particular level, so they just stay there, and it costs them less money than before.

So this leads us to a possibility for why people are not easy more generally. Maybe they're not eating because that's not such a great investment. And so when we went through out little theory section here, we said that if you happen to be right here in the capacity curve, it's very valuable for you to eat. But if, in the real world, the effect of calories on productivity is not that loud, then you might as well do something else with your money.

And in fact, what we find when we look at the effect is that this is the effect of calories consumed on your productivity if you're a farmer in Sierra Leone. And it's hard to find a job that requires less strength than being a farmer in Sierra Leone. And what you find is that while it is increasing, certainly, people who eat more-- this is your calorie consumption, and this is how productive you are-- people are more productive when they eat more.

But what's the shape of the curve?

AUDIENCE: [INAUDIBLE].

PROFESSOR: It's our inverted L shape, and it's not greater than one. So now we finally can answer the question that you asked ages ago. There is no real sign. This is probably the most favorable case, which is why I put it on the board. There is no real sign that this phenomenon that you need to eat enough calories, otherwise you can't be productive enough to do anything is really there.

So in the very short run, everything starts to fit, which is people don't really need the extra calories that much, because the extra calories makes them productive, but not that much more productive. Hence, they are not eating them. And in fact, we see over time that they are eating less and less of the calories because they need less and less of them. And they have a level of strength that allows them to do their day to day work, and with the rest of their money, they do other things, and that makes now perfect sense.

So in terms of policies, what does it mean? Well in term of policies, it means that policies that are going to insist that the big problem is starvation in terms of not eating enough grain are probably going to be misleading, and are probably going to lead to a fair amount of waste. So in summary, at the maximum when your income today increases by 10%, your calorie consumption increase by 3.5%.

That's what we saw in India, and that's almost surely a wild over estimate. But let's say that it's a maximum possible. And then your productivity-- you multiply that by another 4%, so when your income increases by 10%, your income increases by 1.4% tomorrow. That would be the S shape, except it's not S, because there is no point where it would cause the 45 degree line from below, because the elasticity is much, much less than one instead of being above one.

So we don't have a place where the curve is crossing the 45 degree line from below. The curve is just not steep enough to create a poverty trap from this phenomenon. Just to be sure that you don't go away thinking everything is well, this

may be very different from other things than calories, for example iron. And this may be very different for children, because the investment in a child, the investment you're making at one specific time is going to help them for their entire life instead of just for tomorrow.

So what we are going to do on Thursday is look at what I call the hidden trap, which is that there might be a nutrition productivity poverty trap, but it's not in the usual sense where we were looking for. It's in these more subtle things, nutrients, micronutrients, children's nutrition, pregnant women's nutrition.