Introduction to Economic Growth- I

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Lecture-17

So, continuing with the growth accounting exercise, what we saw previously was this one, and very quickly, these are all growth rates, right? So, if we would like to interpret them in percentage terms, we just have to multiply it by 100. For instance, Canada between the years 1947 and 1973 should be read as 1.8%. So, if we compare along the same time block for different countries, then as we can see that the highest was for Japan here for 4% TFP growth. So, this is how it is to be interpreted. Similarly, here continuing with the same table, this is for the Latin American countries for a span of 50 years between 1940 and 1990, as we can see here.

And the TFP growth rate in the case of Peru, as we can see, is negative. Although if we just round it off maybe to the first decimal point, it will be around 0% itself. So, what is this telling us? This is telling us that TFP growth rate is not necessarily always positive. There might be instances where there has been a drop in productivity.

In fact, for all the countries that we mostly see here, as we can see, even Colombia is 0.008, so that will be almost about 0%; these numbers have been fairly low. Now if we compare it with East Asian, what are known as the East Asian miracle countries between the years 1966 and 1990, what we note is that productivity growth is again not uniformly high though, as we can see for Singapore that it has been low. So clearly, then, at least, it tells us that maybe for Singapore, although the GDP growth rate has been very high, the source of this growth has not necessarily been productivity growth. So this is the interpretation and this is what we meant when we said that it gives a good, you know, starting picture about an economy, okay.

So if we were to think that for all the countries that are a part of the East Asian miracle, you know, a country that blocks, so if we were to think that for all of them, productivity growth has been the main factor that is not the case, okay. So, this is how we interpret this kind of data. So, as we said that we can concentrate on the columns, or we can go row-wise and we can make our interpretations. So, what is important here is the values between 1973 and 1989, they reflect the well known what is known as productivity slowdown. So, if we just go back here, between the years 1973 and 1989.

So, this is the last column that we are looking at. So, if we look at this column, even if we go country by country or if we compare across countries, the observation is TFP growth rate had slowed down. Okay, across all these nations that we see, especially for the US as we can see, and this has been a matter of great concern, in fact. Okay, so this is how we interpret these numbers and this is how we get at least some starting information about the sources of economic growth. Similarly, we have already covered this, but you know we can go as we said country by country or we can just take up one particular time period and compare across countries and we will find these comparisons there, okay.

So, the last point that we also saw here. In fact, that is what is mentioned in the last bullet point here. Because of the stellar growth performances of these East Asian countries, many economists were actually surprised by the low TFP numbers because generally the belief is that high growth is driven by high productivity. So, for the East Asian countries that the numbers were low, following this methodology, this actually came as a surprise to many economists. This is a point that we have already mentioned before: how is the Solow residual computed? continuing with that, I just thought maybe it is apt to give an example here.

So this is a paper that uses the growth accounting methodology comparing China and India. So a lot has been said about the growth stories of both you know India and China. And this paper by Bosworth and Collins which was published in the year 2008, this does a growth accounting exercise. So I am just showing the cover page of this particular paper. So if you are interested you can go through the paper.

But I am just showing the most important results that we get to see from this particular research. So, for instance, this table that is taken from the Bosworth Collins paper, as we can see this talks about the sources of growth for India, China, and East Asian countries between the years 1978 and 2004. So, what they actually do, they do the growth accounting exercise that we had earlier seen and talked about. So, here for instance, we can see that between the years 1978 and 2004, India and China they have been compared and contribution to output per worker. As we can see here is the last 3 columns, the contribution towards this by physical capital.

Okay, that is mentioned by education that is mentioned and by total factor productivity. Okay, so if we compared the numbers here, we will see that if you are comparing India and China the total productivity factor has been higher for China compared to India. The same time period has been divided into two blocks or what we call two subsamples because as we know that 1991 is a watershed year for India. So that is also evident because if we look at the numbers, we will see that for the period between 1993 and 2004, the contribution of total factor productivity for India increased to 2.3, earlier it was 1.

1, okay. So, again, this is another way of looking at the same thing for the same countries; we are doing the same thing. But if we divide it into subsamples, then we can get a clearer picture as to what has been the contribution of different factors over a period of time. In the last panel of this table again the East Asian you know example comes back but this time excluding China. And here also as we can see what we had seen earlier also for an earlier time period that the contribution of TFP very surprisingly the growth in TFP has been actually quite moderate. So, this actually took economists by surprise because the belief was that these Asian miracle countries, they were mostly driven by productivity growth.

So, what these numbers then tell us is as at least as far as you know the Asian miracle countries are concerned, there has to be the contribution of some other factor other than productivity growth. And if we are comparing India and China, what we see is that the contribution of total factor productivity growth has been higher for China compared to India all throughout. And for India, post-1991, this TFP growth in TFP factor has definitely increased okay. So, as we wrap up the growth accounting exercise part, what we would like to summarize very quickly is that, as we had mentioned earlier that this is an indicative exercise okay because we would not arrive at too many answers based on the growth accounting exercise, but it's a good starting point clearly it is a good starting point because you see if we go back to numbers like this. So clearly we are talking of the East Asian miracle countries.

Now if this exercise is telling us that well it is not TFP growth that has driven the economic growth of these countries then surely we know where to look. Then we know definitely there has to be some other factor. But what is that other factor that as we can see that is not evident from here? That part of the story is not uncovered by the growth accounting exercise. That is why we said that it gives a starting picture. It also gives a big picture.

The big picture in the sense it will definitely tell us whether the source has been total factor productivity growth or the source has been factor accumulation. But anything beyond that, for that we have to switch to some other kind of exercise or to some other kind of model. So staying on with productivity because productivity or rather growth in TFP is a very important factor and again we would like to recall what we had learned from the Solow growth model that sustained growth can only be brought about by growth in TFP. That is why a lot of emphasis is put on TFP. Now, after completing the growth accounting exercise, we would quickly take a look at something known as development accounting.

Okay. Now what is development accounting? Development accounting helps us to do cross country comparison in terms of differences in income at any given point in time, okay. So, what is the difference, the fundamental difference between growth accounting and development accounting? For growth accounting, as we saw in case of India, China and other countries, you know a certain time period is considered. During that time period,

one looks at economic growth and tries to decompose that economic growth based on whether it has come from growth in productivity or has come from growth in the factors. So, the starting point is actually a time series. And then what did we see? We saw that either we can consider any one country and look at its pattern over time.

Or we can consider a bunch of countries, but then we have to do this exercise separately for each country, like India and China, as we had seen here for the Bosworth Collins paper. So, they did the same exercise once for India and once for China and then they compiled the results together. But if we take a look at this exercise here once again, we will see that this was growth rate was considered over a period of time. So, that is why it is a growth accounting exercise. Whereas, when we talk of development accounting also, the terms are different, right? So, there has to be more than this kind of a difference that we are talking about.

Here rather the question is not really about growth, the question is why do we see cross country differences in per capita income at any given point in time? Say for instance in the year so say 2023, all different countries have different levels of per capita GDP. This we have seen in the different maps so far. So this exercise, development accounting, is trying to uncover that what are the cross-country sources of differences in income at any given point in time. I hope the distinction is clear at least in terms of the timeframe, okay. And what might be the sources of differences in per capita income across different countries? Well, a part of this disparity or difference in income can be due to differences in productivity.

And the other part might be explained by differences in factor accumulation, okay. So, again, fundamentally, those two factors come back once again. So, what we had mentioned earlier as well is that one part of the contribution comes from productivity for income or growth, and the other part comes from factor accumulation, okay? The similarity between the two exercises is for both the exercises, we start from a production function. So, that is the important point of similarity, that is why we have noted it separately. This is a graph that is taken from the Weil, which is one of the textbooks that I had mentioned that demonstrates what are the possible sources of differences in per-worker output.

So, again, let us just remind ourselves of what we are looking at and what we have been looking at. You know, right from the start of this course, we saw that there is a huge amount of disparity in terms of per capita income across different nations of the world. So, with the help of this exercise, we are trying to ascertain whether this difference is due to or rather how much of this difference in per capita income is due to differences in productivity and differences in factor accumulation. This is what we are trying to do. This graph from Weil just kind of makes that point even clearer.

Say for instance, if we are looking at panel A, it shows us how there can be differences in output due to factor accumulation. So, maybe both countries have the same production function, but if the two countries are in terms of factors of production, which is measured on the x-axis while doing the Solow growth model, we will remember we had plotted a small k there. So, something similar. So, if two countries have two different levels of a factor of production that is considered, then even though their production function is the same, both countries have exactly the same production function, then both countries will end up having two different levels of output. Is this clear? So here, the difference in income across the two countries is attributable to the difference in factor accumulation or the factors of production.

In panel B of the same graph, what we see is differences in output due to productivity. So, here the two countries can have two different production functions as it is evident from this figure here. There is a production function for country 1. And there is a production function for country 2. So, 2 countries having 2 different production functions.

But both countries have the same level of input or factor of production. Do we see that? It is at the same level. This is marked on the x-axis. Now, because there are two different production functions, what it implies is that given the same level of input, the output level will differ. So, what is the message here? The message here is that two countries might be employing the same level of input.

However, because the production function varies across the two countries, hence productivity varies as we can see here, the productivity also varies. And that is why there is a variance in output. Perhaps the most common case is what is represented in panel C as we see here. Why is that? Because here again productivity variation is there which is evident from the two production functions that we see here. And at the same time, two countries have two different level of inputs, which is evident from the x axis.

And as a result of that, we have two different levels of output. So, this is what this figure from wheel is demonstrating. Now, when we look at the data, this is what is the explanation part of it, to show how differences in income between two countries can arise. So, differences in income can arise when they have two different levels of factors, whereas having the same production function, or it can be the case that they have two different production functions but have the same level of input. Or perhaps the most common case is where production functions are also different and the level of input that is also different.

Now, when we look at the data, this is how it appears to be like, right. So, the two points that we see here in each panel, it represents the data points. So, we have to infer from these data points about productivity, that is the thing that is mentioned here. So, for instance in panel A, what we see is that two countries they have equal factor accumulation, but country

1 has higher output. In panel B, what we see is the countries they have equal output, but country 1 has higher factor accumulation.

So, 2 countries producing the same amount of output, but they are not using the same amount of input; country 2 is using less amount of input compared to country 1 and still the output is the same. So, when is that possible? By using lesser input when can we have similar level of output when comparing with another country then definitely productivity has to be higher, right. So, this is how we infer by looking at the data points. And in the third case that is panel C as we see here, country 1 has higher output and higher factor of accumulation. And of course higher you know level of output as well which tells us that this might be due to both differences in factor accumulation and productivity at the same time.

So, this is the reasoning that is generally given for as far as data is concerned. So, this is what we get to see, but how do we then break it up as to how much of this difference is due to a difference in productivity and how much of this difference is due to a difference in factor accumulation? So, there are, again, you know, two components to this. So, what development accounting helps us to do is to break down the differences in output across nations into these two components. So, this is the objective of this particular exercise. What do we see here? Again, all these are taken from the textbook by Weil.

So, output is productivity times factors of accumulation. This is clear to us; this is what, say, you know, the production function actually tells us, and suppose the starting point is a Cobb-Douglas production function. So, we are familiar with the Cobb-Douglas production function that we see here as well. So, A here measures productivity as we are familiar with it and, K is physical capital, N stands for labor here. So, K, N these are all the factors of production as we call them.

So, two countries will have two production functions, and all these parameters here and the variables can be different from each other. So, this is how we write it: y1/y2 is equal to the production function of country one divided by the production function of the second country. Now, if we just separate out the productivity terms from the factor terms, this is how it looks like. And from there, ultimately, we can call y1/y2 as Q. A1/A2 as P, productivity term and the rest of the term we can call it as F which stands for factor accumulation.

So, Q is equal to P times F, and everything is in ratio terms here. We can rearrange, and we can write then P is equal to Q over F. Why do we write it like this? Because, as we had discussed this before, we have data on output that is GDP data. We have data on capital, so we have data on K.

We have data on labour, so we know N. Generally, α is taken as 0.3 or any other value can be taken as long as $\alpha + \beta = 1$ here. So, do we have data, or do we know the values of all

the variables and the parameters we see here, except for what? We do not have any data on A1. That is why we bring this term A1/A2 to the left-hand side, because now, what we have on the right-hand side, we have data or values for all of them. So, in other words, we are going to compute something like this.

So, this is an example, and I would very strongly encourage you to please work out this example to see how they have arrived at these numbers. So, country 1 and country 2, 2 countries, have been considered, and country 2 is like a benchmark. That is why every value for country two has been taken as 1. And country 1, the numbers are also given to us. So, if these numbers are given to us, question is can we do the development accounting exercise, right? And the value of alpha is considered as one-third.

So, naturally, we know what is the value of 1-α and as we had said earlier, then we can pretty much whatever we have on the right-hand side here, okay, which is the last part of this slide? Do we see this? So, we actually have data on all of them here. Where is the data? The data is here for the two countries. Once we plug that in, then what we are left with is A1/A2, and if we simplify this, what we get is (A1/A2) = 2. So, what it means is that the productivity of country 1 is twice the productivity of country 2. So, again this is an exercise on productivity as we had said earlier that productivity and productivity growth, these are very important factors.

In fact, the most important factor for, you know, driving growth or propelling economic growth. But since we do not have data on this kind of variable, we use methodologies like this: either the growth accounting exercise from where we know about growth in productivity or an exercise like this where we look at relative productivity. So, from here at least we can infer. Which country has higher productivity? For instance, here, country 1 has higher productivity because its productivity is twice that of the productivity of the second country.

So, this is how we make use of development accounting. And let us look at some more data and let us see whether these numbers have changed across economies.