Econometric Modelling
Professor. Sujata Kar
Department of Management Studies
Indian Institute of Technology, Roorkee
Lecture No. 01
Econometric Modelling: An Overview

Hello, and welcome to the course on econometric modeling. This course is actually designed to introduce you to the concepts of econometrics, econometrics methodology, why econometrics is applicable, and how the methods of econometrics are applied in the fields of primarily economics. As we will discuss later that the methods of econometrics are used in many other fields, fields other than economics, the name itself suggests that econometrics must be having its major applications in the area of economics only.

So, to begin with, we will first introduce the subject, econometrics. So, the first module actually deals with what is econometrics? What are its types? What are the applications of econometrics and etc?

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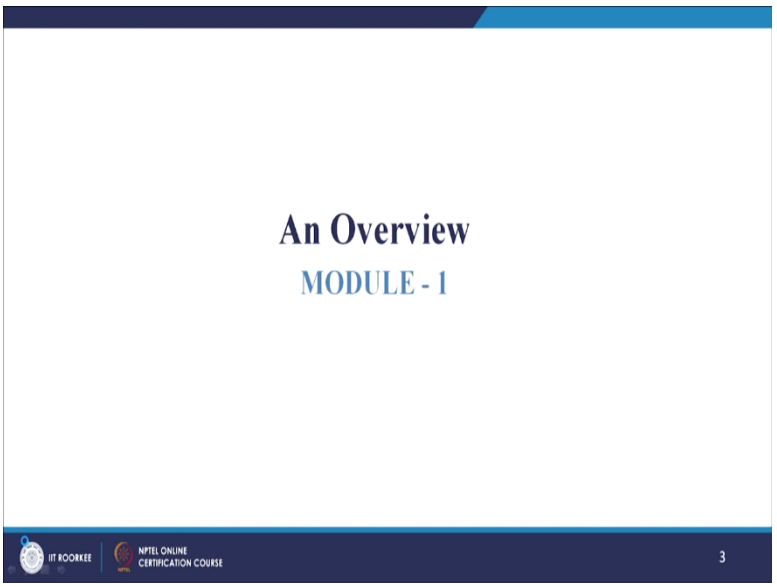

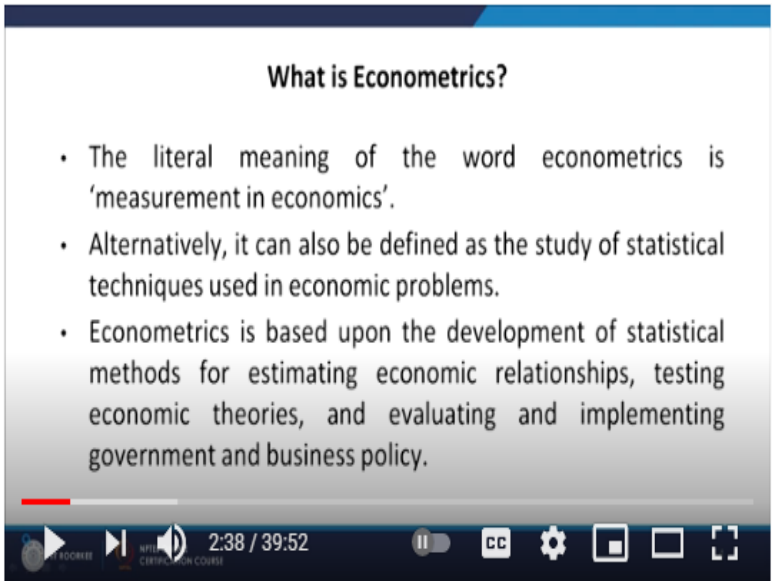

So, to begin with, I present an overview of the subject. We have module 1 on an overview. So, first of all, what is "econometrics"? The literal meaning of econometrics or the word econometrics is a measurement in economics. So, as we know that econ has a relation to economics, and metrics are associated with measurement. So, measurement in economics is known as econometrics.

Alternatively, it can also be defined as the study of statistical techniques used in economic problems. So, econometrics heavily draws from statistical techniques or methodologies and then applies them to economic problems. Econometrics is based upon the development of statistical methods for estimating economic relationships, testing economic theories, and evaluating and implementing government and business policies.

So, basically, this briefly talks about the aspects or dimensions on which econometrics is based on. First of all, it takes basic statistical methodologies, then it makes some further developments in it on the basis of the requirement.

We will discuss later that sometimes the problems in economics are slightly different from what is handled by statisticians, mathematicians, or researchers from other scientific domains.

So, we probably have very special cases and that is why certain modifications in the methodologies are required, and that is why econometrics is further developed from the basic discipline of statistics. Now, why do we apply them? We apply them in order to understand various economic relationships either suggested by established economic theories or things, the things that we are interested to estimate understand and further develop.

And then once we have this understanding of various theories and relationships, we test for the validity of theories and the expected relationships between different economic variables, we can think of further evaluating them and then their purposes. Their purposes are basically implementation in terms of business strategies and policies.

So, policies could be of course, at the private level or at the government level. For example, private firms may need information on consumer preferences. So, what kind of consumers prefer what kind of products or possibly, one may try to understand the purchase behavior of individuals belonging to different social and economic strata or classes. That is the aspect of business entities, whereas, when it comes to government entities, they also have certain interests.

First of all, people are interested in understanding how the economy is doing, where the economy is heading to and how further improvements can be done. For example, as we can see in recent times, because of the COVID-19 pandemic, all the major economies in the world are heavily affected. So, when these economies are impacted, how are they impacted? What are the sectors that are being worst affected due to this pandemic? And what are the way out of this situation?

They are basically topics of interest for the government policymakers, so there also, they would need the help of econometrics in understanding or in analyzing data collected over a period of time, and then that may give us further direction regarding how this situation can be improved, what are the measures that need to be taken. So, econometrics is based on the

development of statistical methods, which are actually also important or useful for evaluating and implementing government and business policies as well.

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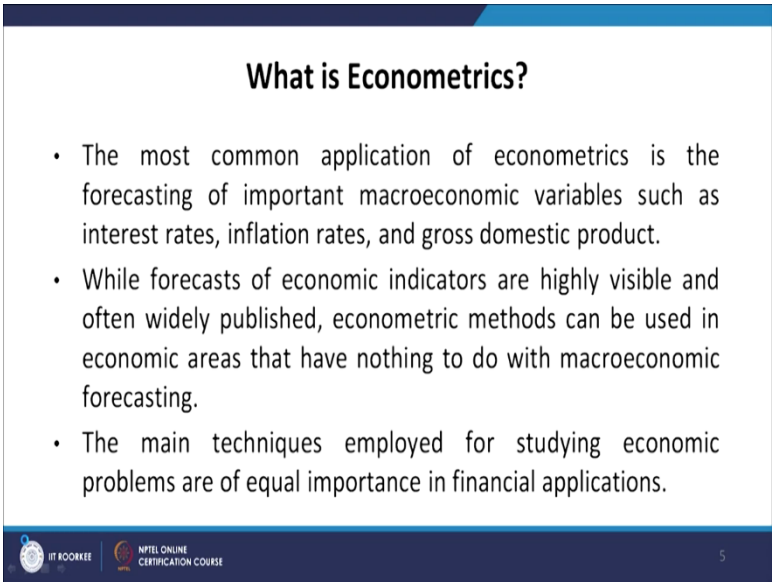

The most common application of econometrics is the forecasting of important macroeconomic variables, such as interest rates, inflation rates, and gross domestic product to name a few. We can have a very long list of variables that can be predicted using macroeconomic data. So, as I was talking about the impact of the COVID-19 pandemic, then very recently or probably throughout the 2020s when the pandemic impacted many countries in the world we could see or we have seen that IMF has on a regular basis come up with projected growth for various countries, so it has also predicted or projected growth rates for India.

And similarly, there are Indian agencies also including the government sector, which also come up with projections for future growth rates, that is GDP growth rates. So, these predictions are certainly based on methodologies, which are part of econometrics. So, that is the most common application of econometrics we can actually think of. Econometrics probably provides us with the very basic tools of forecasting important macroeconomic variables.

But while forecasts of economic indicators are highly visible and often widely published, econometric methods can be used in economic areas that have nothing to do with macroeconomic forecasting. So, that is an example probably I was trying to give that we

always do not need to forecast things or probably there could be forecasts besides macroeconomic forecasting.

For example, I am going to launch a new product, that product could be anything starting from say a detergent powder. So, I want to launch it at the local level, first of all, what happens is that, I need to understand what is the consumption pattern of a detergent powder among the consumers in that locality. So, for that, I would need to collect data. And on that basis, I can find out the future projected growth rate of this particular sector?

Now, of course, in order to launch a product like detergent powder, probably no one does any kind of analysis. So this is more important when we launch a product nationwide or when we are planning to launch a completely new product. In that case, having an understanding about consumer preferences is very helpful. So, that could be done using consumer survey data when the product is completely new. Consumers are not at all even aware of it, nobody has used it.

So, we can ask them that if such a product is made available to you, whether you are going to use it or not, whether you would like to use it or not, what kind of prices you would like to pay for that kind of a product, etc. So, these are the questions one can generate from a consumer survey, and we can do some basic analysis using econometric tools to understand what would be the possible demand for such a product.

Now, the thing is that if a product already exists in the market then what is its current growth rate. So, every year the consumption of any product mostly increases, because the population is increasing, people's income is increasing, lifestyles are changing, so consumption pattern also changes. So, based on such projected growths of consumption patterns one can understand that, if a new product or a competitive product is launched in the market, then what market share it can capture, what are the prices that should be charged on that particular product, and things like that.

So, business forecasting is also there, but then there are purposes that are beyond simple forecast things. For example, we want to understand that, what is the status of female employment in the Indian economy. So, female employment level is much less compared to male employment level. What are the reasons behind that? Is it some, has it something to do with education level, has it something to do with marital status, location, etc. So, there could be many factors.

Family income, the job prospects, a particular the development of the job market, etc. They are actually very important factors in determining whether a female gets employed or not. Also, other factors include Social Security. The security system in a particular city in the cities or places where women do not feel insecure, they may feel like going out for work more compared to places or cities where possibly, security is not that much. So, given all these things, they are also examples where econometrics methods can be applied.

The main techniques employed for studying economic problems are of equal importance in financial applications. So, finance is another area, which though not exclusively use econometric methods, but also uses econometric methods heavily. So, finance and economics are the major areas where econometrics is used.

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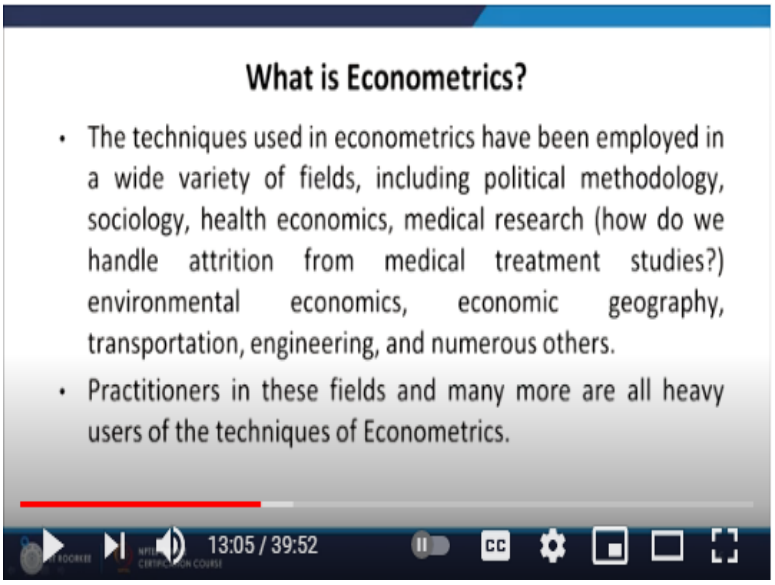

But it is used in a wide variety of other fields as well including political methodology, sociology, health economics, medical research, environmental economics, economic geography, transportation, engineering, and numerous other fields. Practitioners in these fields and many more are all heavy users of techniques of econometrics.

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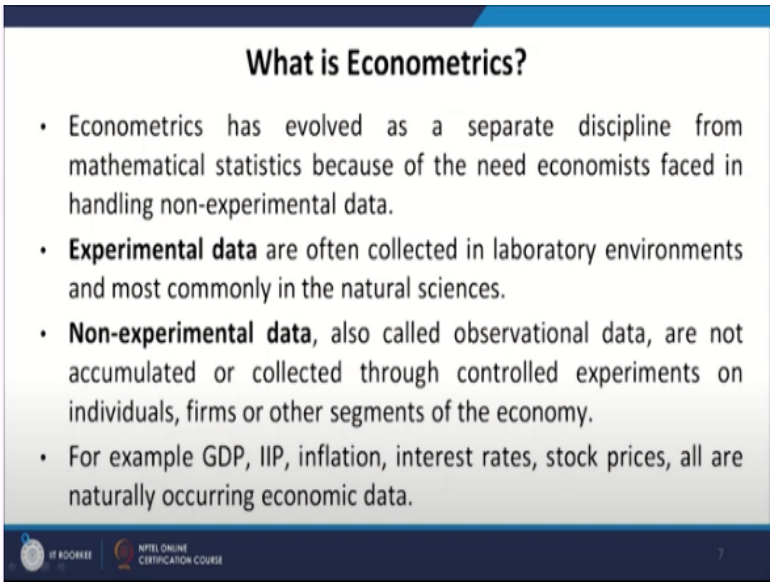

Econometrics has evolved, as a separate discipline from mathematical statistics, because of the need economists faced in handling non-experimental data. As I have told in the beginning, that these are simply statistical methods or rather we have borrowed from mathematical statistics to apply them to economic problems. So, basically, what are these peculiarities, because of which we needed to borrow and modify according to our requirement.

So, first of all, we need to define experimental and non-experimental data. Experimental data are basically data that are collected through experiments and experiments are often conducted in controlled laboratory environments and most commonly, they are used and observed in natural sciences. So, as we all know that physics, chemistry all these natural sciences, conduct experiments, generate data, and then apply statistical methods on those data in order to analyze them.

But in economics, we tend to have non-experimental data, which are also called observational data. They are not accumulated or collected through controlled experiments on individuals, firms, or other segments of the economy. Now, there is something extremely important or interesting about this non-experimental data or observational data, because they are naturally occurring data.

For example, if I consider macroeconomic data, then we can say that starting from, say 1947 we have recorded data of gross domestic product for India. Now, for each and every year, we have one gross domestic product data, and this basically cannot be changed, modified, altered

or repeated. So, it is not possible that I did not like the 1991 GDP figures, so I can have another GDP figure for 1991 for India. So, once that has happened, that is being observed, that has happened and there is no way we can change it. So, these are naturally occurring data, and we call them non-experimental data seminars.

Similarly, we can also think of other kinds of data, say, if I try to understand what are the factors that impact the income of an individual. So, the income of an individual may depend on, of course, his level of education, his years of experience, maybe his area of specialization. It may also depend on the gender, whether it is a female or male, it can depend on the location that person is residing.

So, given all these things, maybe I want to understand that what are factors that impact the income of an individual. So, I collect data from 100 individuals, but there is also one thing, these are also non-experimental data because when I pick the first individual he or she has a certain amount of income, a certain amount of experience education, and so on, which cannot be altered. I can increase my sample size from 100 to 200 to 500 to 1000, but then, these are not experiments because I cannot change an individual's income and other individual-specific data.

So, these data are observational data, they do not actually change and that is why possibly economists need to have modified or specially developed techniques compared to what the mainstream statisticians or mathematical statisticians develop and use. So, for example, GDP, IIP inflation, interest rates, stock prices all are naturally occurring economic data. And these are macroeconomic data when we talk about an individual’s income and then associated characteristics then they are possibly microdata, data collected from at the micro level from individuals.

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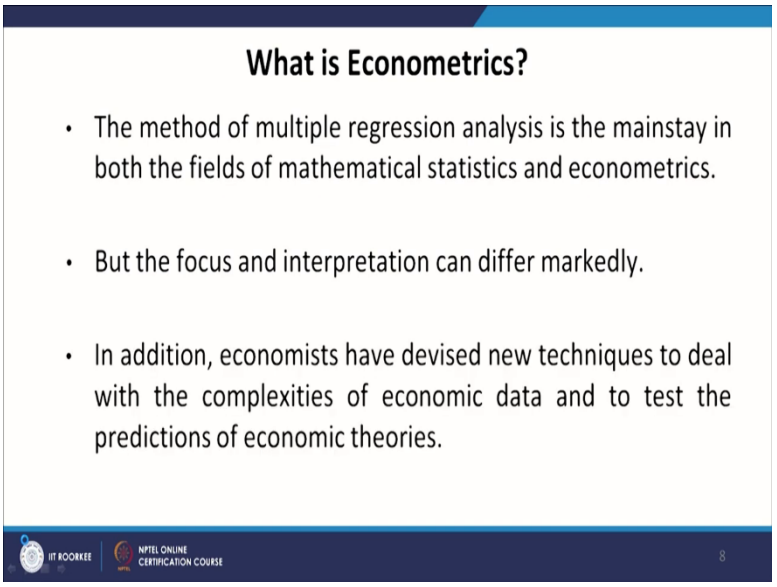

So, the method of multiple regression analysis is the mainstay in both the fields of mathematical statistics and econometrics. Both of these subject areas heavily rely on multiple regression analysis, but the focus and interpretation can differ markedly. That is, the way we look at a particular problem and try to address it, could be very much different from the way it is handled by a mathematical mathematician or a statistician.

In addition, economists have devised new techniques to deal with the complexities of economic data and to test the predictions of economic theories.

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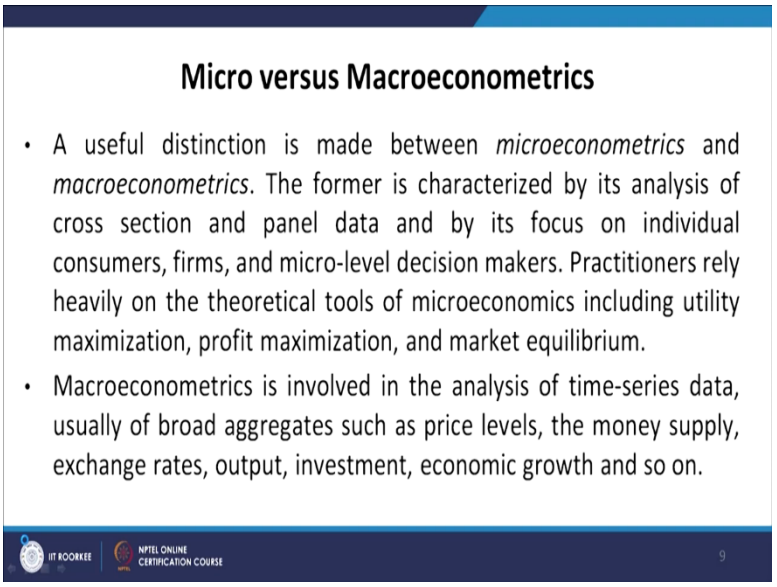

Now, what are those data and what are those specifications that we will definitely learn along the course, but for the time being, we just need to mention that there are basic differences

because of which we need tend to have or we need to have a separate subject area that is econometrics, other than what the statisticians have been doing.

Now, we can differentiate econometrics or categorize econometrics into two subfields though, the differences actually are not very sharp, neither they are actually useful while applying these methodologies, but still, these are important for understanding so we can have micro versus macroeconometrics.

The former is characterized by its analysis of cross-section and panel data and by its focus on individual consumers, firms, and micro-level decision-makers. Practitioners rely heavily on the theoretical tools of microeconomics including utility maximization, profit maximization, and market equilibrium.

So, here I have used certain terminologies like cross-section and panel data. You might not be familiar as of now with this kind of data type, but then we will be soon learning in future modules, what are these types of data. But what is more important is that it basically focuses on the individual consumers. So, if you have studied economics you would know that we have two broad fields of study, one is microeconomics another is macroeconomics.

So, microeconomics deals with micro-level entities, micro means small. So smaller entities like we individuals, individual firms, and individual firms coming together forming individual types of markets are basically part of microeconomics, and macroeconomics actually is the field where we go for aggregation.

So, aggregation here implies when all the individuals of an economy are considered together, we have macroeconomic data. Similarly, all the firms taken together, their production gives us an index of industrial production. All the agricultural products produced by the farmers of a nation give us agricultural production of the country. Similarly, we have a nationwide wholesale price index that is a price index that is a general price index.

Similarly, we can have a consumer price index, all these basically are measured at the aggregate level or the national level and that is why they are called macroeconomics or macroeconomic data. Macro here means large, so when we are going for aggregation then we end up at macroeconomics. Microeconomics deals with micro-level or small entities. It includes individual consumers, firms, and micro-level decision-makers. And that is how practitioners rely heavily on theoretical tools of microeconomics.

So, while we deal with supply and demand, we try to measure the demand elasticities of an individual product. They are basically part of microeconomics. And when we try to estimate elasticity demand, elasticity supply, elasticities of individual commodities for a particular market, then they are part of micro econometrics.

Macroeconometrics involved in the analysis of time series data usually have broad aggregates such as price levels, the money supply, exchange rates, output, investment, economic growth, and so on. So, as I have already defined macroeconomics, these are basically concepts that are studied and covered under macroeconomics, and consequently, you can say that when we use econometrics in order to analyze these kinds of data then they are called macroeconomic data. So, things that are measured and studied at the aggregate level and the methods applied to understand those data is macroeconometrics.

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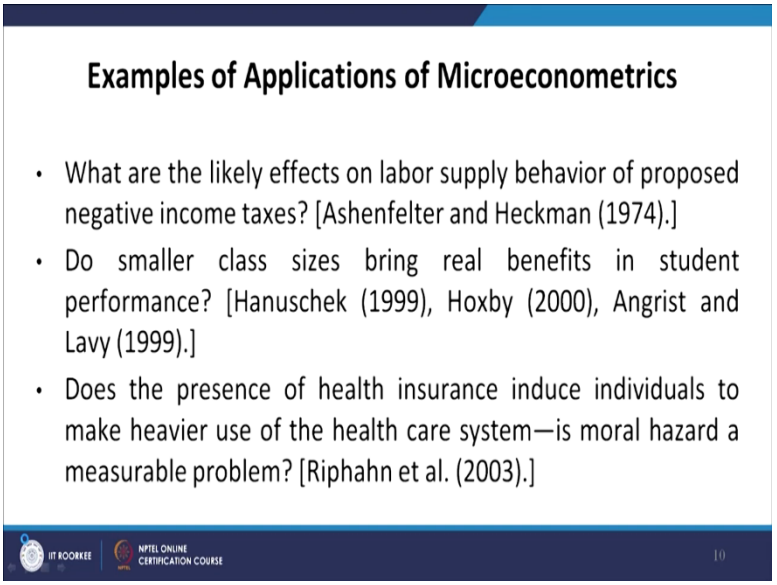

Now, we come to examples of applications of microeconometrics. Now, here I actually have quoted some of the studies. These are basically very well-known or popular studies and that's why they have been referred to, so interested students can also get back to the original studies and understand what are the problems that have been handled there and what are the methodologies that are being used there.

For example, one study by Ashenfelter and Hackman in 1974, which tries to understand what are the likely effects on labor supply behavior of proposed negative income taxes. So, when income taxes are imposed then how the labor supply or the laborers are going to react by changing labor supply or availability of labor in the labor market.

So, a similar study is or maybe not similar rather microeconometric studies are, for example, Hanuschek in 1999 Hoxby 2000 Angra Angrist and Lavy 1999, while they try to understand do smaller class sizes bring real benefits in student performance. So, here one is trying to find out the impact of class size on students' performance. Is it really the fact that if the class size is small then students' performance improves?

Then another example is from Ripahn et al, 2003 where he examines the presence of health insurance induces individuals to make heavier use of the healthcare system, is moral hazard a measurable problem. So, now, the thing is that one is probably checking the problem associated with health insurance. How individuals can try to exploit health insurance policies provided by insurers, so whether there are moral hazards or not.

Moral hazard here actually refers to a situation where possibly two parties involved in a transaction do not provide an equal amount of information or sufficient amount of information, positive information to each other. So, both the parties involved in the transaction do not have equal information. One has more information, the other one has less information. So, the one who has more information is always in an advantageous position and can manipulate the deal or the trade.

So, when the trade or the deal is manipulated, then the person who is having less information may be at a disadvantageous position. If that disadvantageous position leads to some further economic costs associated with possible problems coming up, then that is called moral hazard.

Anyway, these concepts are actually beyond the scope of this course, but very briefly, what it implies is that, suppose I am taking insurance from a company but I am not providing complete details of my health status or other information, maybe I am hiding some, I am being dishonest in providing certain information, then the insurer does not have actually complete knowledge of my health condition.

This may lead to basic exploitation of the health insurer that I may make future claims very frequently or I claim probably every year.

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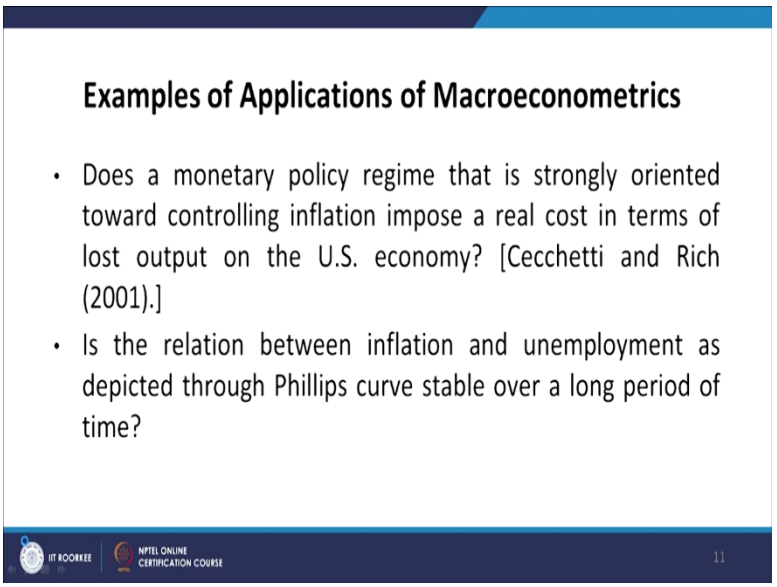

Now, examples of applications of macroeconometrics includes; Does a monetary policy regime that is strongly oriented toward controlling inflation impose a real cost in terms of lost output on the U.S. economy? This problem was addressed by Cecchetti and Rich in 2001. It basically deals with the monetary policy regime, and what kind of impact it has on output when the regime actually tries to control inflation.

People from economic background know that when you go for a very tight monetary policy regime that impacts the growth negatively, that impacts the inflationary situation positively. So, inflation comes down, but growth falls. So, what kind of trade-offs are there? Are these trade-offs actually considerable and things like that.

Is the relation between inflation and unemployment as depicted through the Phillips Curve stable over a long period of time? So, Phillips Curve is again another very well celebrated concept in economics, which gives an inverse relationship or a negative relationship between wages and inflation in an economy.

So, it has been observed that Phillips Curve in the context of some countries that Phillips Curves are actually not stable, so Phillips Curve keeps on moving upwards or downwards. And this kind of instability, whether it is applicable in all other countries or not, what kind of behavior we can expect in terms of movements, can also be studied, and they would form part of macroeconometrics, concepts.

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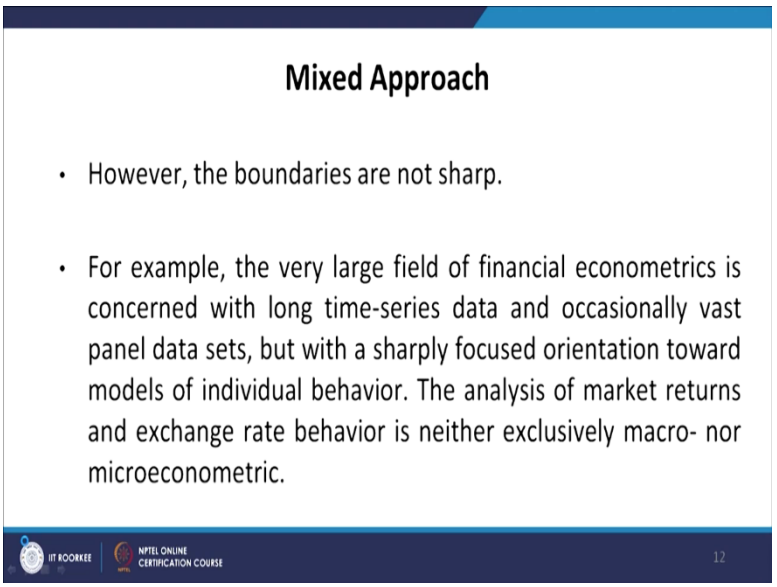

But as I was trying to tell you in the beginning, that the boundaries are actually not very sharp or not at all sharp. For example, the very large field of financial econometrics is concerned with long time series data and occasionally vast panel data sets, but with a sharply focused orientation towards models of individual behavior. The analysis of market returns and exchange rate behavior is neither exclusively macro nor microeconometrics.

The reason is that it has components of micro-level analysis. When we are considering market returns and exchange rate behavior, then at the aggregate level, they are certainly macroeconometrics, but when we concern ourselves with individual stock prices and returns associated with them, then they are specifically micro problems, but then individual stock prices and market returns, they are basically a mix of micro and macro approaches.

So, that is how one can think of a mixed approach. Other than that, these days we also have the trend of working with micro-level data at the aggregate level. So, I consider all the individuals of an economy, but then I am working with microdata. So, all the individuals' income, employment, gender, location, marital status, religion, etc., are demographic factors. There could be other economic factors and other socioeconomic cultural factors.

I can pick up a particular segment and work on them. So, that is again a mixed approach where I am working at the aggregate level, but working with the micro-level data. So, that is how the approach to econometrics is actually not very sharp. They many times blur or probably mix with each other. Then we talk about theoretical versus applied econometrics.

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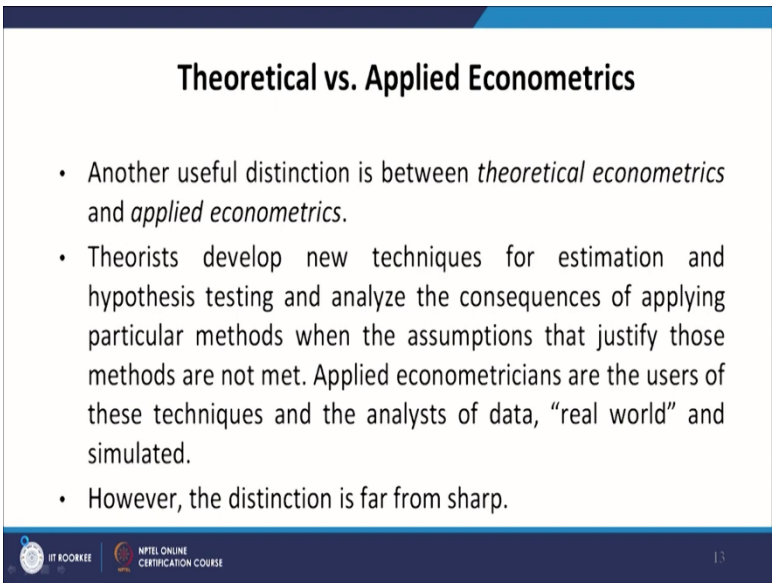

So, this is another useful distinction between theoretical econometrics and applied econometrics. Theorists develop new techniques for estimation and hypothesis testing and analyze the consequences of applying particular methods when the assumption that justifies those methods are not met. Applied econometricians are the users of these techniques and the analysis of data, both, real-world and simulated.

So, basically, theoretical econometrics focus on the development of econometric methods, that is, setting aside any economic problems. They are rather into the model building itself, and the data generated could be experimental data. So, data generated is basically through simulation, and using that simulated data they try to establish the theory that they are actually propagating. That is theoretical econometrics.

Empirical econometrics is the application of those methods that are being developed by theoreticians on real-time economic problems.

So, that is the difference between theoretical and applied econometrics. However, again, the distinction is far from sharp, because there are many instances wherein a real-time problem, the existing methods do not appear sufficient, then further methodologies are developed and then applied on the real time data.

So, while dealing with real-time data, one may feel the need to further modify or develop the existing methodologies. So, here we have a combination of theoretical and applied econometrics. Now, we talk about empirical economic analysis, so basically, the field where econometrics is used or specifically the field of applied econometrics.

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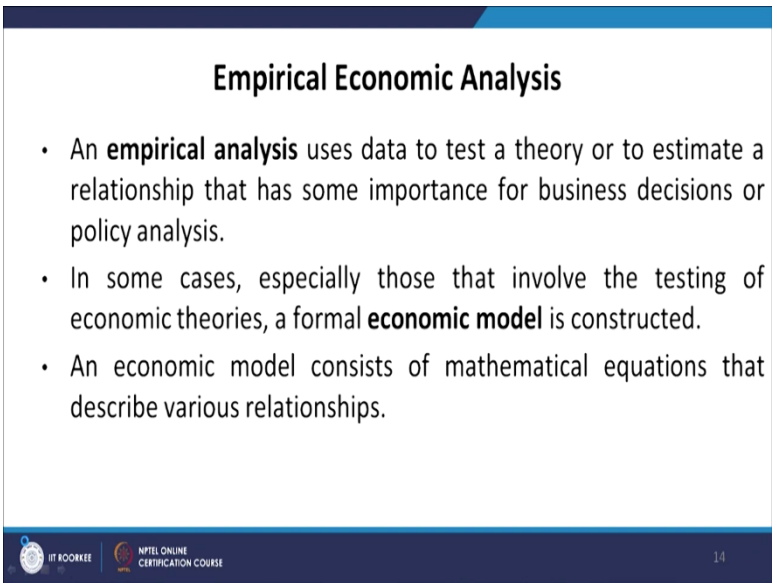

An empirical analysis uses data to test a theory or to estimate a relationship that has some importance for business decisions or policy analysis. So, this is actually an application of empirical econometrics. We are using the methodology to test a theory or estimate a relationship.

In some cases, especially those that involve the testing of economic theories a formal economic model is constructed. An economic model consists of mathematical equations that describe various relationships. Right now, I will explain this with an example.

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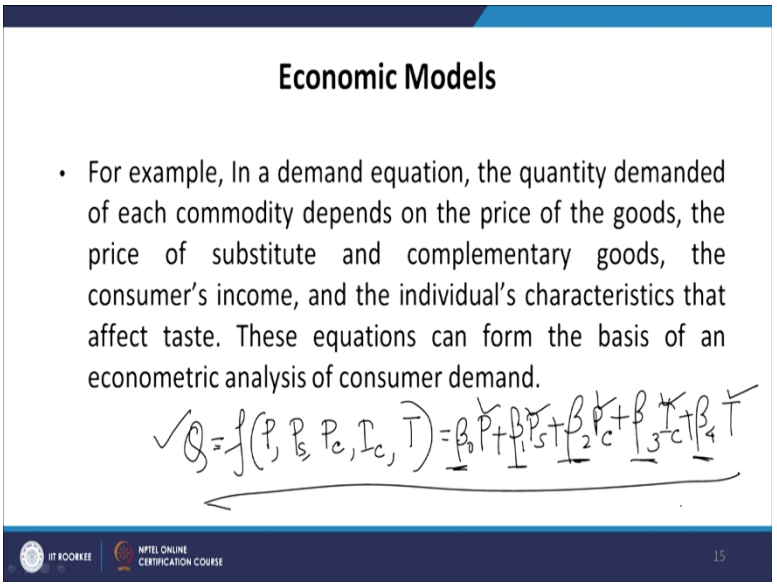

We will take the example of a demand equation. The quantity demanded of each commodity depends on the price of goods, the price of substitutes and complementary goods, the consumers' income, and individuals' characteristics that affect the tastes and preferences of individuals. These equations can form the basis of an econometric analysis of consumer demand.

So, suppose in the previous case, we can basically write the econometric model as we are measuring demand for a particular product. We denote the demand by Q, then it becomes a function of the price of that product, the prices of its substitute commodities, the prices of its complementary goods, the consumers' income, so, consumers' income and other individual characteristics that affect the tastes and preferences.

This is a generalized functional form (refer to the above slide on economic models), which can be further expanded as a linear or nonlinear form. So, for simplicity, if I expand it in a nonlinear form, I can write it as demand for a particular product depends on the price of its own, the price of its substitute commodity, the price of its complimentary good, then the income of the consumer and finally the tastes and preferences.

So, once I have a specific form, then what happens is that it becomes a measurable concept. And given the demand for the product and given information on these variables, I can always try to find out what are these parameter estimates, which will tell us which one of these is more important and which actually is impacting which is not impacting, and so on and so

forth. So, this is an example of an economic model, which is estimable or can be rendered estimable using econometric methods.

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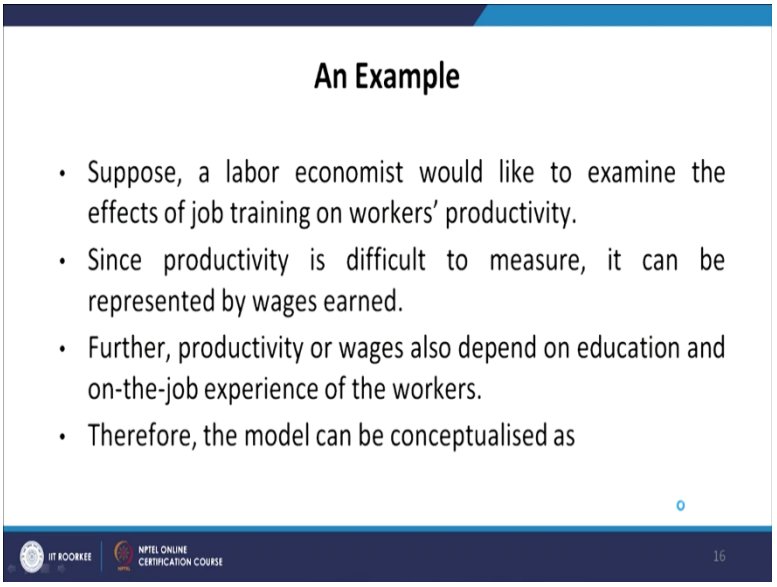

We can take another example. Suppose a labor economist would like to examine the effects of job training on workers' productivity. Since productivity is difficult to measure it can be represented by wages earned. So, a more productive individual or labor would be actually given a higher wage. So, further productivity or wages also depend on the education and on the job experience of the workers.

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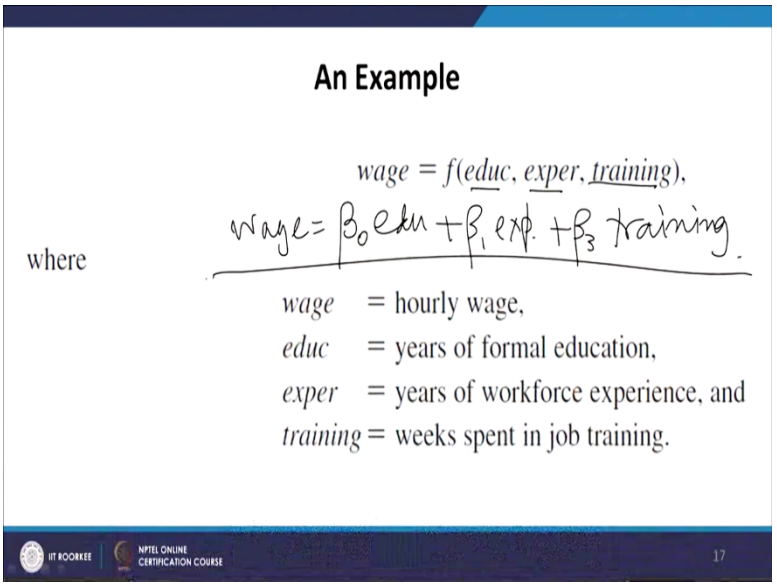

Therefore, the model can be conceptualized as something like this, wage is a function of education, experience and on-the-job training. So, this is how I have a generalized functional

form. Now, again this generalized functional form can be converted into a linear functional form where I write that it depends on first of all education, then it depends on experiment and then it depends on the training of the individual.

Once I have a linearized form, then this is again an estimable concept. So, how do we estimate these ideas or relationships that is what we are probably going to learn here, but for the time being, these are the economic models where we can apply econometrics.

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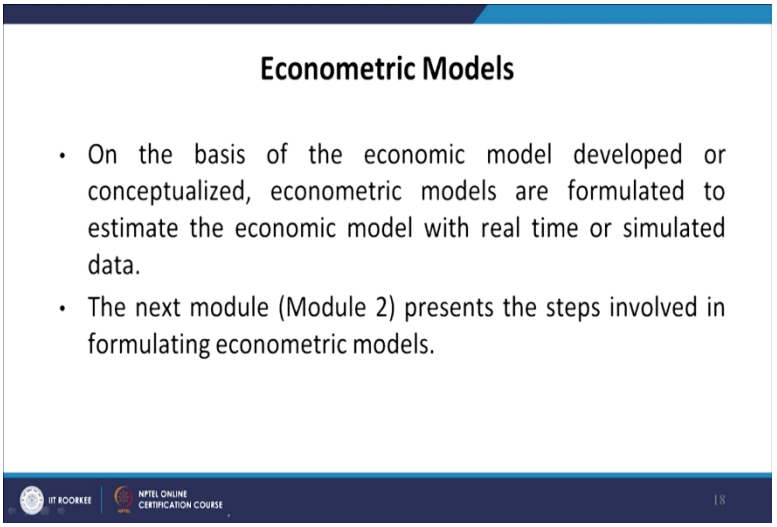

On the basis of the economic model developed or conceptualized, econometric models are formulated to estimate the economic model with real-time or simulated data. The next module presents the steps involved in formulating economic models. So, in this module what we have learned is, what is primarily econometrics, what are the types, and what are the applications and then we move on to the next module where we talk about the formulation of econometric models.

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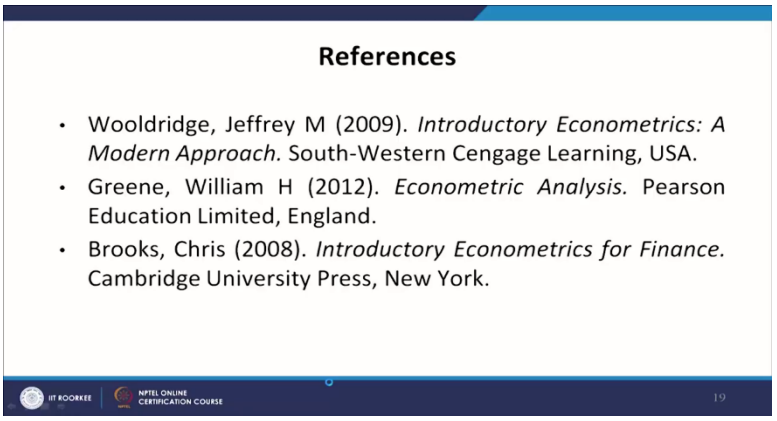

These are the references. Thank you.