Security Analysis & Portfolio Management
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Department of Management Studies
Indian Institute of Technology, Roorkee
Lecture 56
Arbitrage Pricing Model III, Portfolio Performance Evaluation

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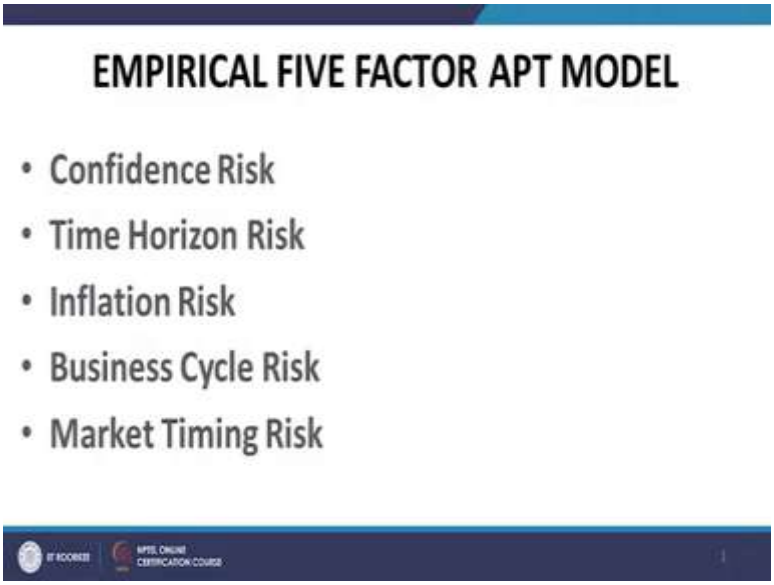

Welcome back. So, before the break started introducing an empirically tested and vindicated a bit APT model. It comprises of the following risk factor it is a five factor model, it comprises of the following risk factors the confidence risk, the time horizon risk, inflation risk, business cycle risk and market timing risk. Let us now look at investigate what are these various risks and how they are measured.

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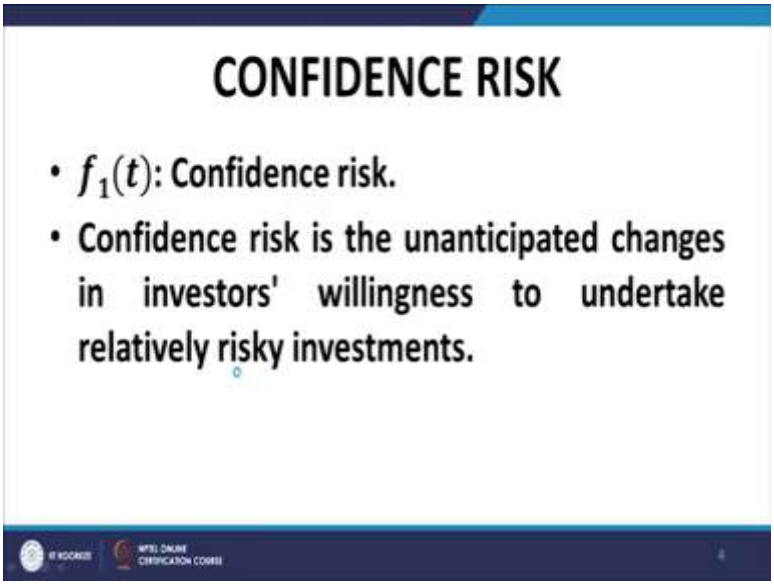

f1 t is taken as the confidence risk, confidence risk is the unanticipated changes in investors willingness to undertake relatively risky investments, a measure of confidence risk will give you more light more feel about what exactly we mean by confidence risk. So, let us talk about the measure of confidence risk.

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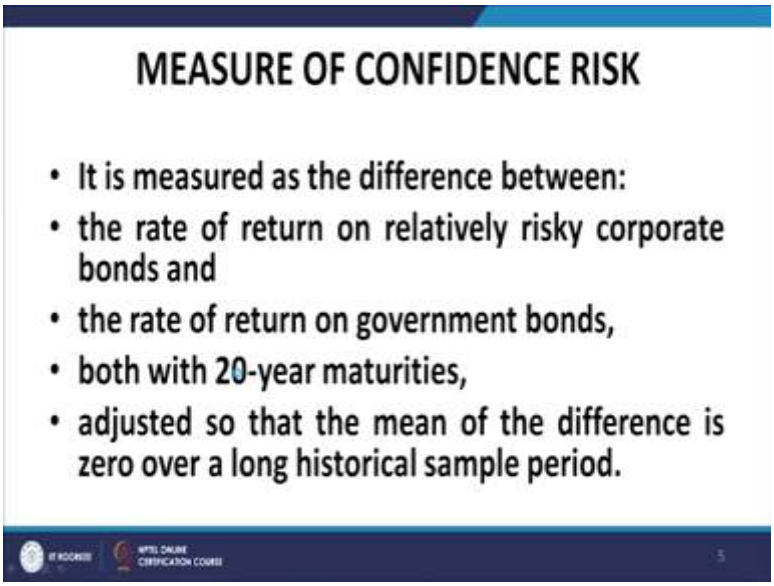

Confidence risk is measured as the difference between the rate of return on relatively risky corporate bonds and the rate of return on government bonds, both with 20 year maturity So, we are keeping the maturities constant. It is a difference in the rates of returns on the risky corporate

bonds and safe government bonds. The return is so adjusted that the mean of the difference is zero over a long historical sample period.

So, I repeat, the confidence risk is measured by the difference between the rate of return on relatively risky corporate bonds and the rate of return on government bonds both with maturities of 20 years, the rate of, the difference is so adjusted that the mean of the difference is 0 over a long historical sample period, the returns are so I just said that the mean of the difference is 0 over a long historical sample period. What are the inferences?

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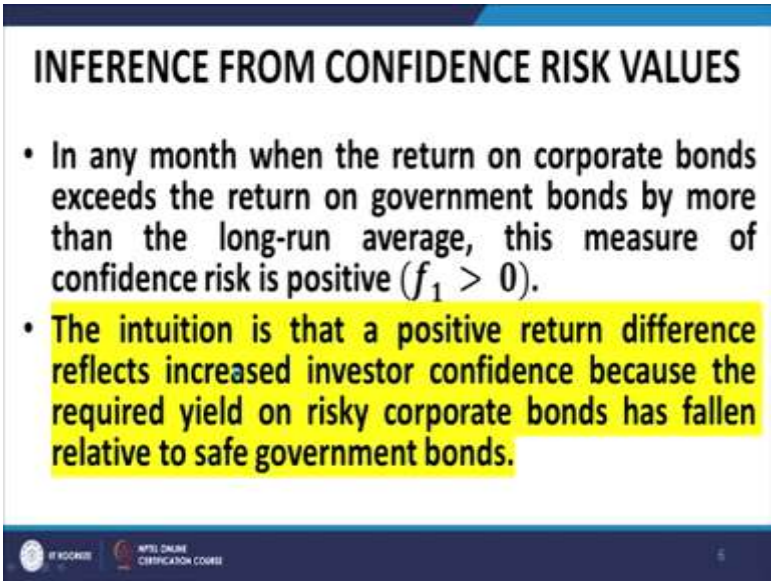

In any month when the return on corporate bonds exceeds the return on government bonds by more than the long term average this measure of confidence risk is positive, f1 is greater than 0. The intuition is that a positive return difference reflects increased investor confidence because the required yield on risky corporate bonds has fallen, its yield and price are inversely related please notice.

So, if the return has increased that means the prices have increased and if the prices have increased, increased, that would mean that the yield has decreased. So, if the returns on corporate bond exceeds the return on government bonds by more than the long term average, this measure of confidence risk is positive. And what does it reflect? It reflects that increased positive, investor confidence is there because the required return on risky corporate bonds has fallen,

required yield I am sorry, the required yield on corporate bonds has fallen relative to government bonds.

Let me repeat the return that you earn over a period is inversely related to the yield because if the yield falls, the price increases and if the price increases, now, your holding period yield increases. So if the return increases, that is the appreciation of the accretion in price increases that means the price at the end is more that means the yield has fallen. So, that is the rationale behind this.

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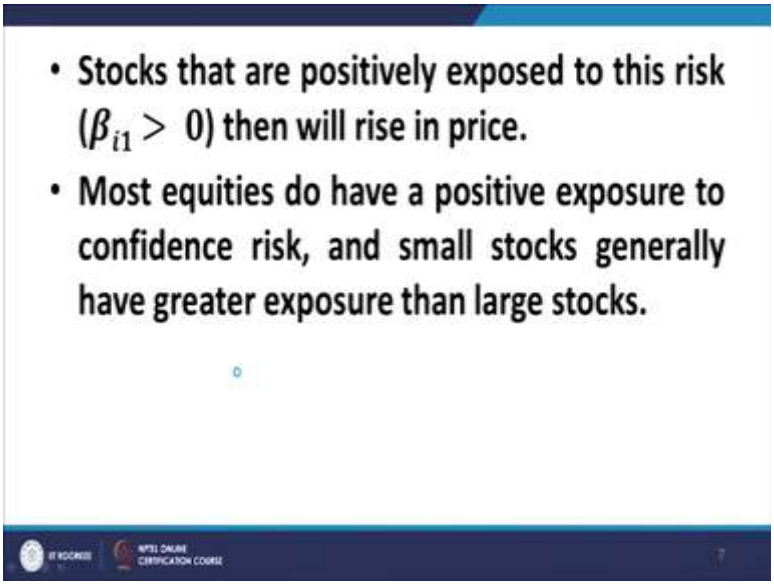

Stocks that are positively exposed to this risk, then will rise in price. Most equities do have a positive exposure to confidence risk can small stocks generally have greater exposure, then large stocks.

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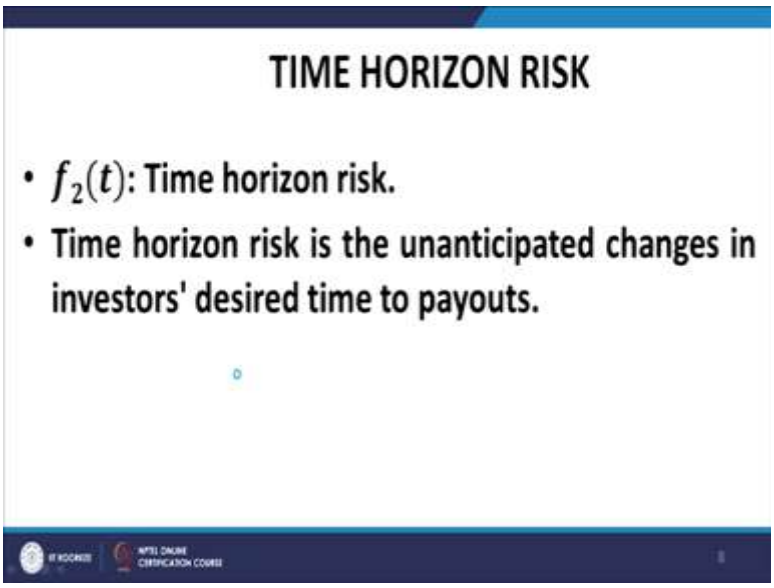

Now we talk about time horizon risk. The time horizon risk that is f2 t is the unanticipated changes in investor's desired time to payouts. Let me repeat, the time horizon risk is the unanticipated changes in investor's desired time to payouts. And how do we measure time horizon risk? Let us see.

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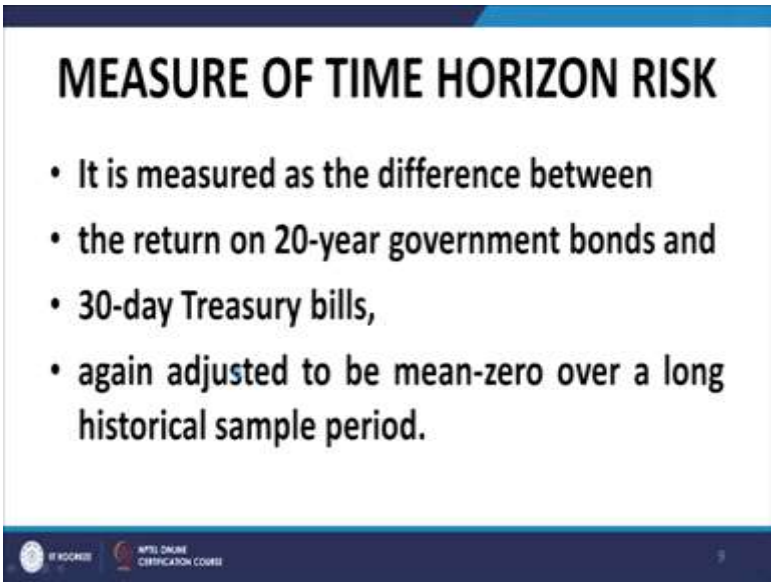

It is measured by the difference between the return on 20 year government bonds and 30 day treasury bills. Please note treasury bills are also common securities. So, the return on 20 year government bonds and 30 day treasury bills. The risk of default obviously is eliminated in the

consideration of this. It is only the propensity of the of the investor to hold on to the securities for a longer period of time, which has been measured by the time horizon just.

So, we measure it by the return on 20 year government bonds and 30 year treasury bills, the difference between the returns and of course, the difference is so adjusted to mean 0 over a long historical sample period.

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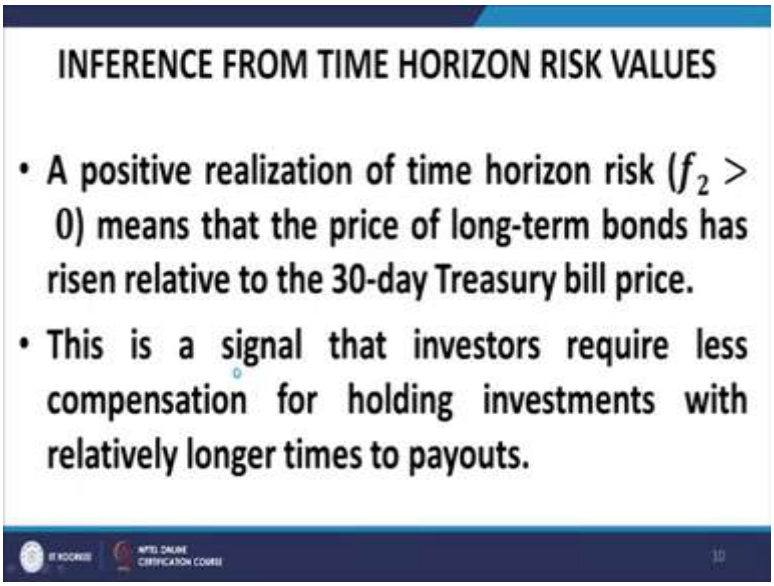

What is the inference from time horizon risk values? A positive realization of time horizon risk have to greater than 0 that means, the returns on the long term treasury bills, treasury bonds rather is greater than the return on the treasury bills, short term treasury bills. Means that the price of long term bonds has risen. As I mentioned, the return and the yield are inversely related. And so, the price of long term bonds has risen relative to 30 day Treasury bill price.

And this is a signal that investors require less compensation for holding investments with relatively longer times to payouts. So, this is the inference of the time horizon risk values. If the prices have increased, the return increases and the prices will increase only when the yields have decreased. In other words, the required return or the required yield by the investors has decreased or the people are more willing to invest in long term securities.

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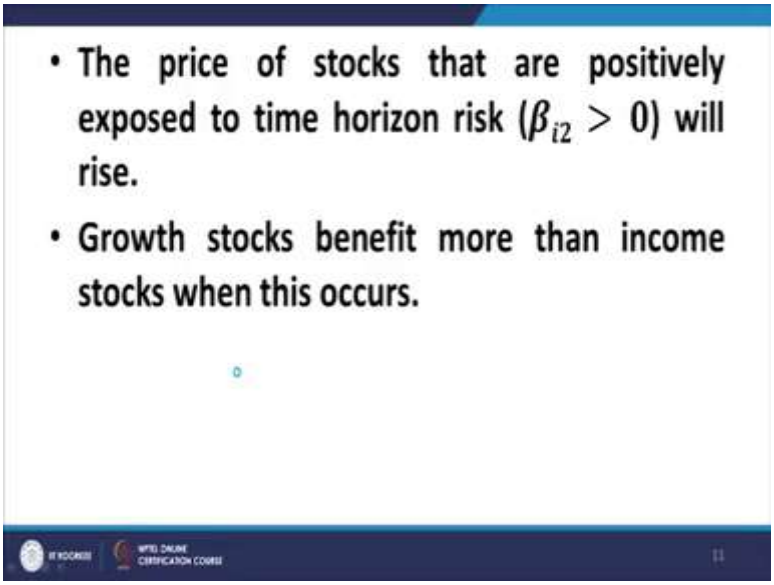

The price of stocks that are positively exposed to time horizon risk will rise growth stocks which are usually held by the investor for a long period of time will benefit more than income stocks, which are usually held for regular income purposes. And therefore, growth stocks will benefit more than income stocks when the time arises and risk or the time horizon risk returns a positive number.

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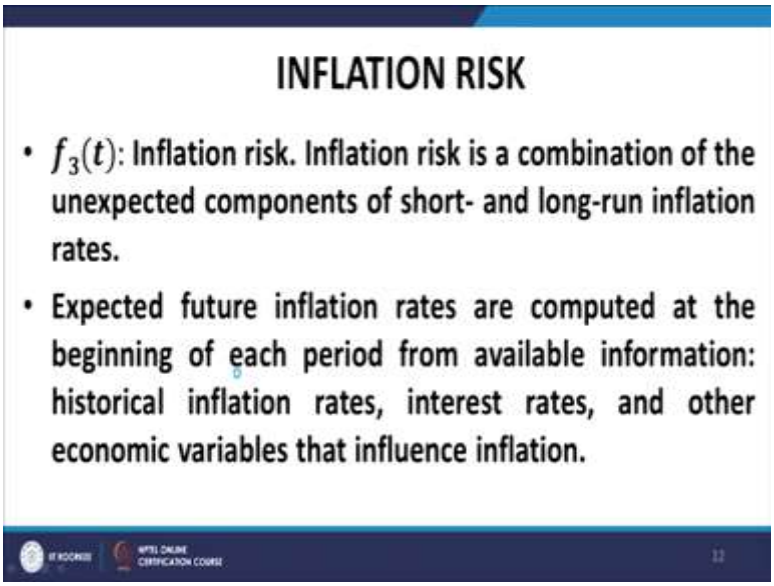

Now we come to inflation risk, f3 t. Inflation risk is a combination of the unexpected components of short and long term inflation rates. So, expected future inflation rates are

computed at the beginning of each period underlined, beginning of each period from available information, historical inflation rates, interest rates and other economic variables that influence inflation.

So, we work out number 1, we work out the expected future inflation rates at the beginning of the relevant period from various sources or from various databases, which provide information on the economic variables that influence the inflation.

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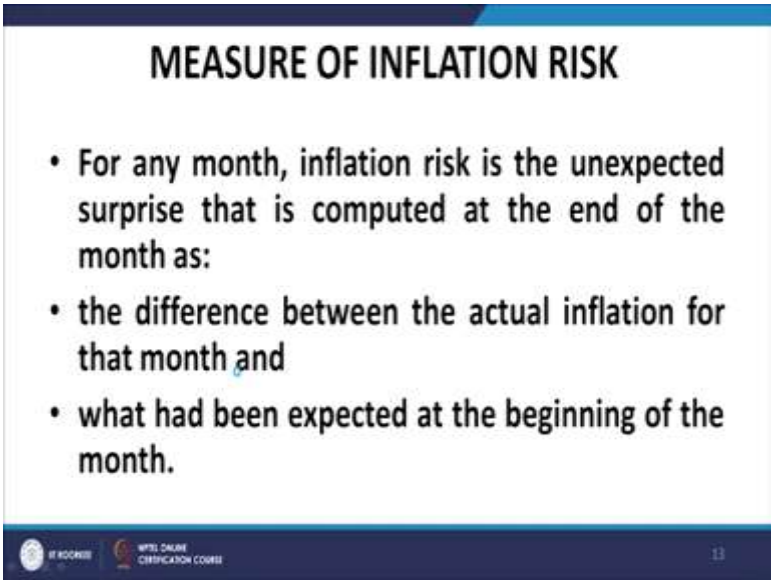

Then for any month, the inflation risk is measured, it is the unexpected surprise, it is measured by the unexpected surprise that is computed at the end of the month as the difference between the actual inflation for that period and what had been expected at the beginning of the period. So for any month, the inflation risk is the is measured by the unexpected surprise and how that is measured and how that is computed.

It is computed at the end of the month as the difference between the actual inflation that has been realized over that period, vis a vis the expected inflation, which was worked out at the beginning of the period.

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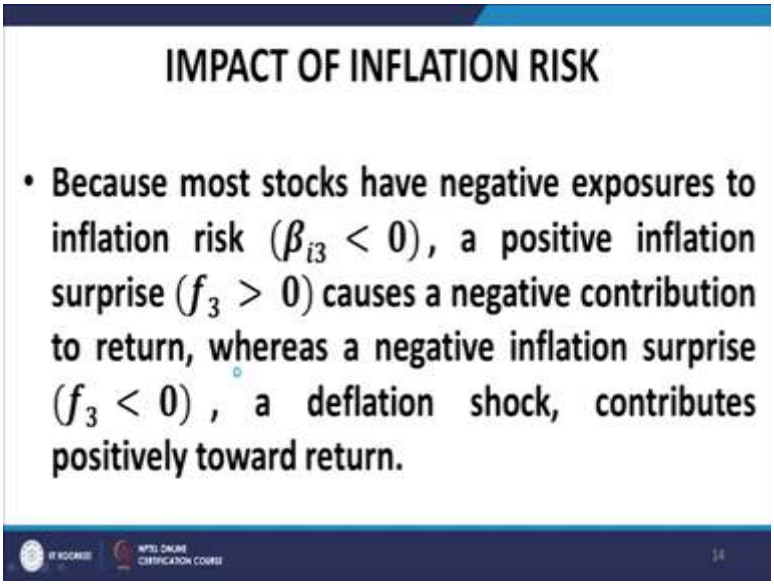

Impact of inflation risk. Because most stocks have negative exposures to inflation risk, beta i3 is less than 0, a positive inflation surprise, that is f3 greater than 0 causes a negative contribution to return. Whereas a negative inflation surprise f3 less than 0, that is a depression shock contributes positively towards returns.

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Now we talk about business cycle risk. Business cycle risk represents the unanticipated changes in the level of real business activity that is adjusted for inflation.

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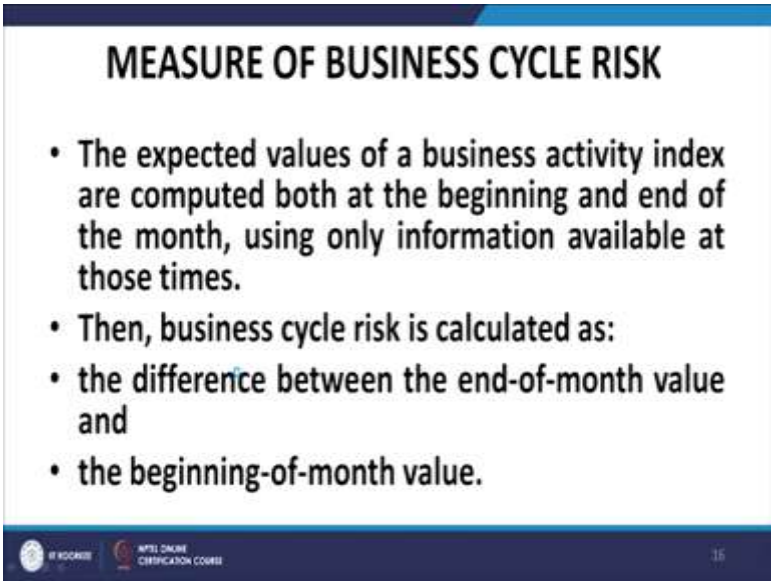

The expected value of a business activity how do we measure business cycle risk? The expected values of a business activity index are computed both at the beginning and end of the period using all the information available at those times. Then the business cycle risk is calculated by the difference between the end of the month value and the beginning of the month value.

Let me repeat, we work out the expected values of a business activity index, both at the beginning and the end of the relevant period using only information that is available at those times. Then the business cycle risk is the difference between the end of the month value and the beginning of the month value.

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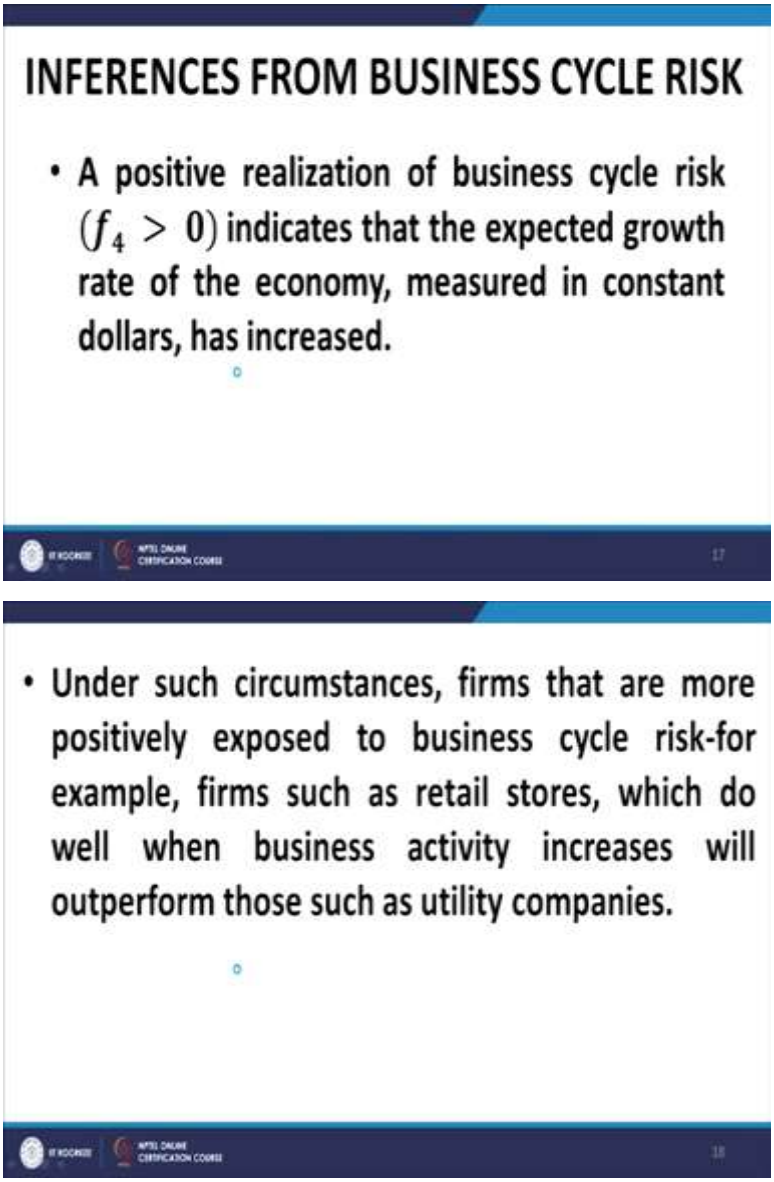

A positive realization of business cycle risk indicates that the expected growth rate in the economy measured in constant dollars has increased. And what would it affect in terms of the stock markets, when the business cycle or the in the measure of business cycle risk has returned a positive number, it shows that the expected growth rate of the economy measured in constant dollars has increased and as a result of it, those stocks which are positively exposed to business cycle risk.

For example, retail firms will do better and such stocks which relate to entities which are not so directly associated or influenced by businesses cycle changes, such as utility companies would not grow to that extent.

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Market timing risk, the last of the risk factors in the five factor model. Market me risk is computed at that part of the market indexes total return that is not explained by the first four macroeconomic risk factors and the interceptor. So, in some sense it is the residual risk factor please note it is different from the idea syncretic term it is not the same as the idea syncretic term which is the unsystematic risk, it is it captures the residual systematic risk.

Let me repeat it captures it the residual systematic risk. Let me read it out again market timing risk is computed as that part of the market indexes total return that that is not explained by the first four macroeconomic risks and the intercept term.

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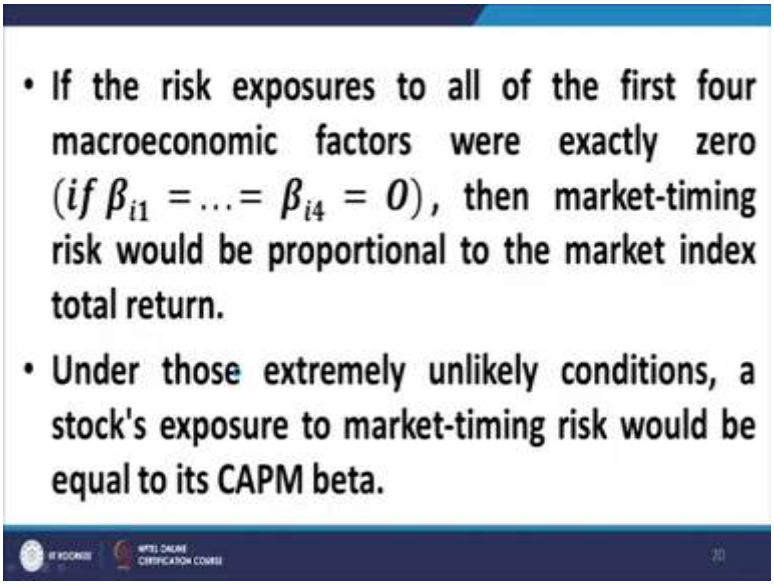

So, if the risk exposure to all the first four macroeconomic factors f1, f2, f3, f4, were exactly 0. That is beta i1 beta i2 is equal to beta i3 is equal to beta i4 is equal to 0. Then the market timing risk would be proportional to the market indexes total return. Under those extremely unlikely conditions, stock's exposure to market timing risk would be equal to its CAPM beta.

So, if all the, if all the other betas are 0, then the solitary beta which captures or which retains or which is relevant to the market timing risk would be the CAPM beta and the model would coincide with the CAPM.

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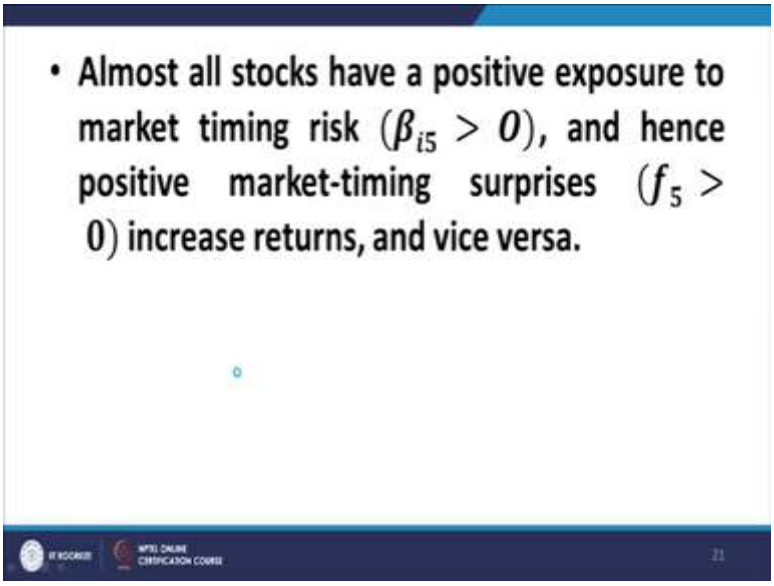

Almost all stocks have a positive exposure to market timing risk and hence positive market timing surprises increase returns and vice versa.

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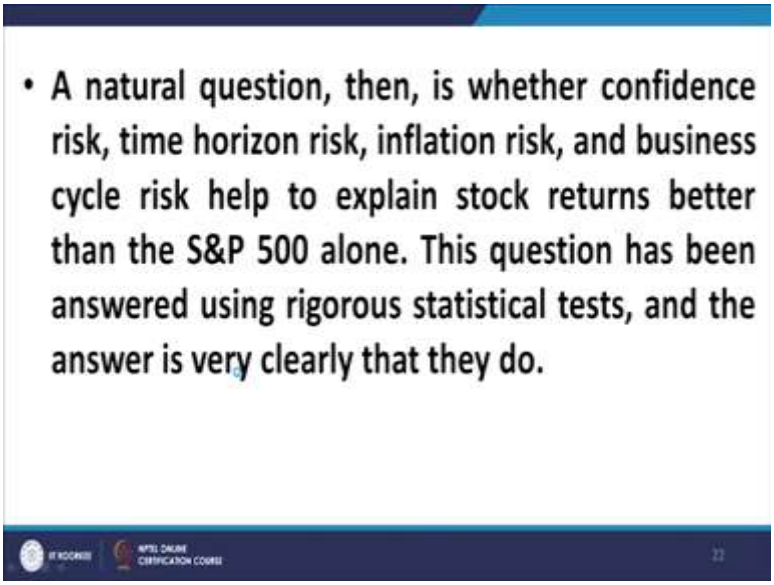

Now, at no obvious question, which I answered in fact, in the beginning of the exposition on this particular topic, that whether these risks, the five risks that we have talked about to explain the stock returns do better than the use of the index for the market index alone. In other words, whether the segregation of this systematic risk into the confidence risk, time horizon risk, inflation risk, business cycle risk and the residual market timing risk does a better job at explaining the stock returns compared to the purely these CAPM risk or the market timing risk.

If the market timing this was the only or the single risk factor as in the CAPM model, the this question of course, warrants or deserves empirical investigation, which has duly been done in many cases, in many reviews, many empirical studies and the outcome is that it does improve the risk return representation of contemporary markets.

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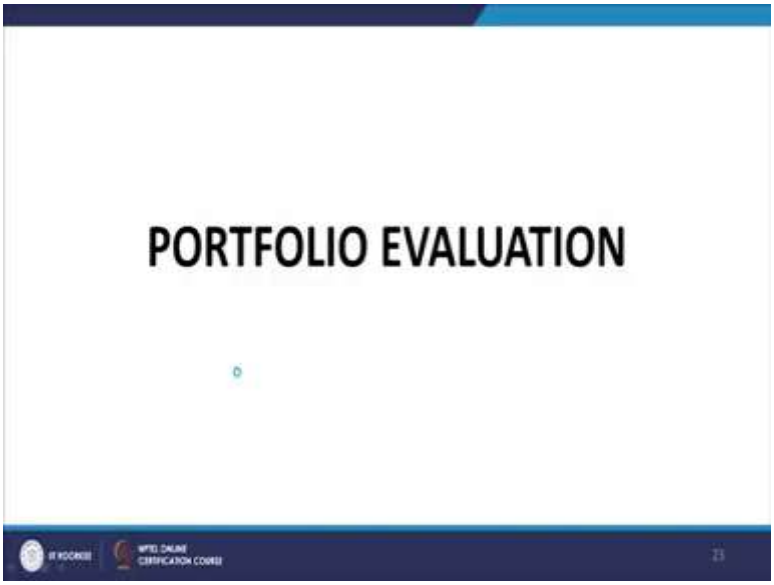

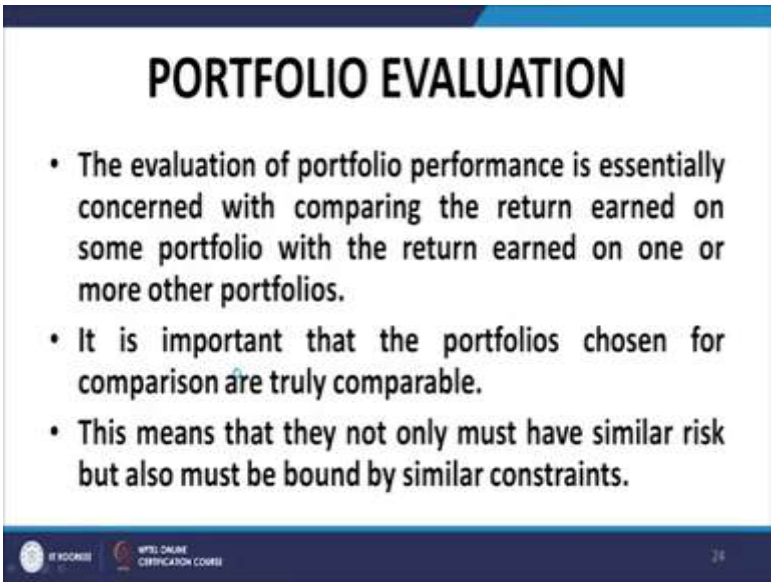

So, now, we come to the next topic, which is portfolio evaluation. Now, the evaluation of portfolio performance is essentially concerned with comparing the return on obtained on some portfolio with a return on one or more other portfolios. It is important that the portfolio's chosen for comparison are truly comparable, this is fundamental. This means that they not only must have similar risk, but also be bound by similar constraints.

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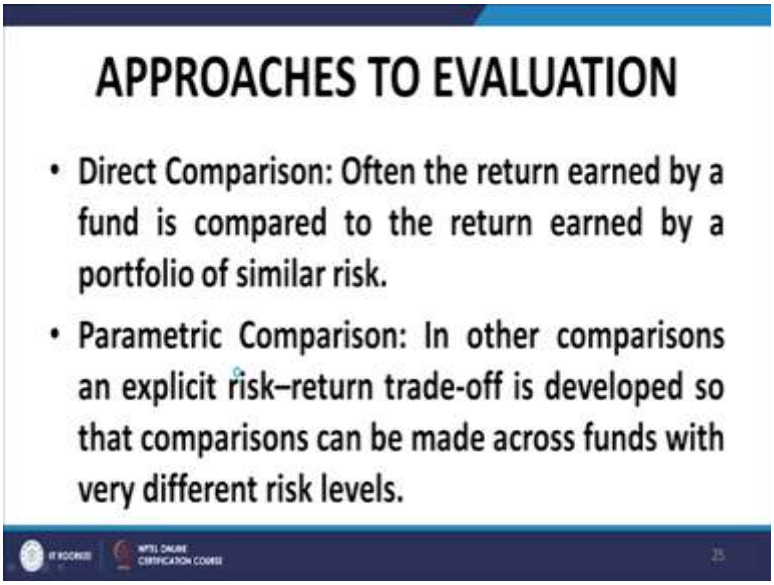

So, what are the various approaches to evaluation? Portfolio evaluation you have, you can have direct evaluation or you can have parametric evaluation. In the direct evaluation what we do is the return and by a fund is compared by the returned by a portfolio of similar risk. So, straightaway you have two portfolios of similar risk levels in terms of the risk measures that you deem appropriate and then you compare the relative returns and arrive at which of the two portfolios has performed in a superior manner.

In parametric comparison, we have not, we use an explicit risk return trade off and we use that explicit return trade off parameter in order to arrive at the relative performance or compare the relative performance of two different portfolios in a situation. This is of course relevant when we have two portfolios with different risk levels, where direct evaluation would obviously be redundant.

So, measures of return on portfolios with intermittent cash flows. Now, usually, when we have a portfolio of securities we either use these logarithmic return or the arithmetic return as a measure of return. This is the standard practice. But there is this problem when we talk about the measures of return in the context of active portfolios of securities.

In other words, in the context of portfolios of securities, where there is a frequent inflow and outflow cash flows or there is a inflow or outflow cash flows on a regular basis, then it becomes difficult to select an appropriate approach to the measurement of return over a given period of

time. There are three fundamental approaches. One is the money weighted rate of return, the other is the time weighted rate of return. And the third is the link rate of return, we shall talk about each of them.

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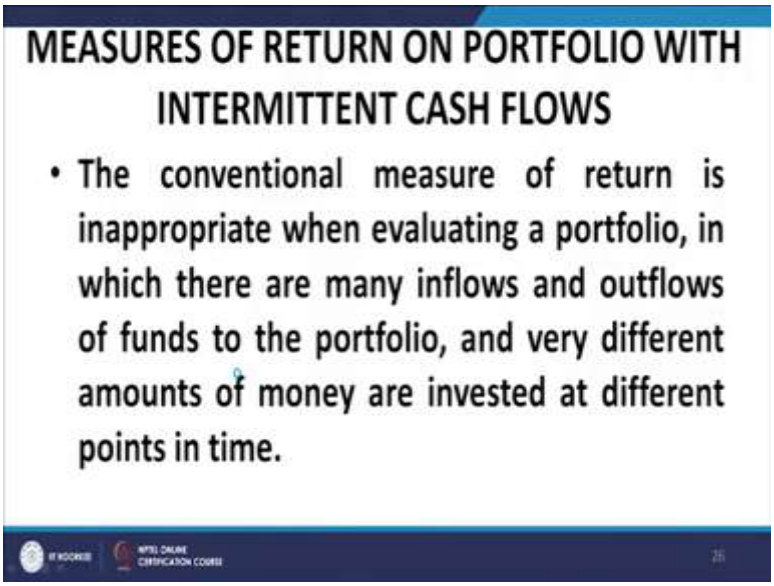

The conventional measure of return is in appropriate when evaluating a portfolio in which there are many inflows and outflows of funds to the portfolio and very different amounts of money are invested at different points in time. As I mentioned, we have a lot of difficulty in applying the standard rules approaches or to measurement of returns in this context, when the intermittent flows of money are frequent.

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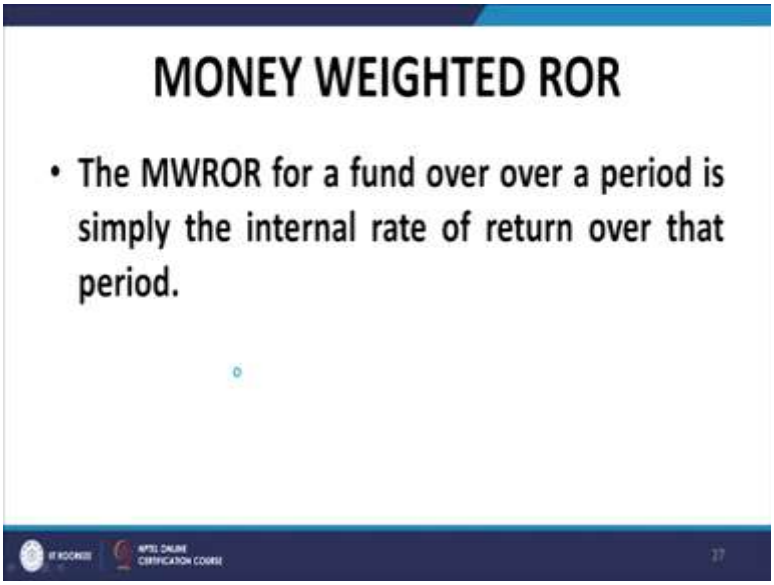

The first one is the money weighted rate of return which I mentioned, the money weighted rate of return for a fund over a period of time is simply the internal rate of return over that period. Let me repeat, the money weighted rate of return for a fund over a period is simply the internal rate of return over the period.

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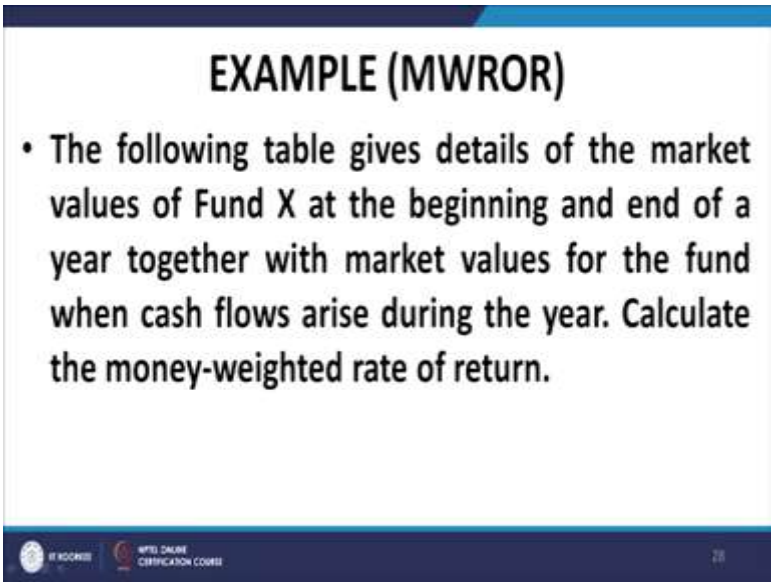

Let us do an example. The following table gives details of the market values of fund X at the beginning and end of a year, together with the market values for the fund when cash flows arise during the year. Calculate the money weighted rate of return.

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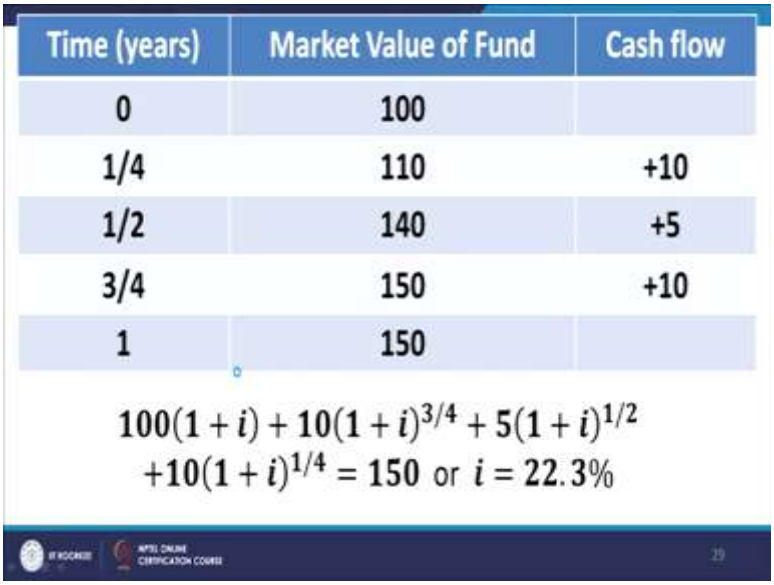

This is the data that is given to you. In t equal to 0, you start with a market value of 100. At t equal to 3 months, that is 1 by 4 of an year, the market value of the fund becomes 110. And there is an inflow of 10 units. And the market value at the half year mark is 140. There is an inflow of 5 units and so on.

So, we simply work out the internal rate of return that constitutes the money weighted rate of return, the computation is given in the bottom panel of the slide, you can see it is straightforward. The first you start with 100 you compound it over 1 year and the next inflow is 10 and that is at t equal to 0.25. So, you compound it over 0.75 of an year.

The third influence 5, you compounded for half year. The fourth inflows 10. Of course, if these were negative, you would use the negative sign here, it has to be algebraic that is important. Please note that point, it is not the absolute value, it is the algebraic value. In fact, it was instead of plus 10, it was minus 10, then it would be minus 10 here and so on.

So, if it was minus 5, it would be minus 5 here. So, the last in flow is 10 and it is at t equal to 0.75. So it would be compounded for 0.25 of an year and the total compounding is equal to the market value of the fund at the end of 1 year which is 150. We solve this equation you find that the internal rate of return is 22.3 percent, which is the money weighted rate of return.

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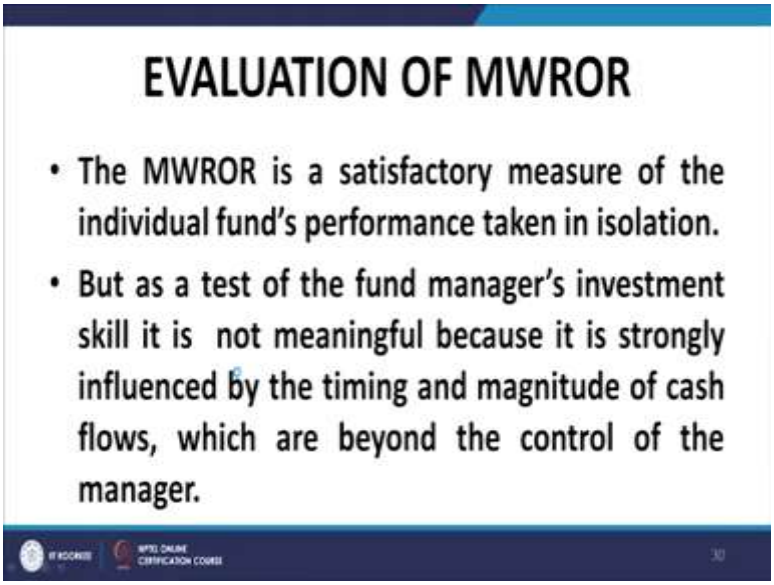

Evaluation of the money weighted rate of return. The money weighted rate of return is a satisfactory measure for the individual fund's performance taken in isolation. But as a test of the fund manager's investment skill, it is not meaningful. This is important I will illustrate it with an example also.

But as a test of the fund manager's investment skill, it is not meaningful because it is strongly influenced by the timing and magnitude of cash flows which are beyond the control of the manager. The cash inflows that took place in the previous example could well be outside the control of the manager and should, therefore should not impact the assessment or the evaluation of the portfolio manager.

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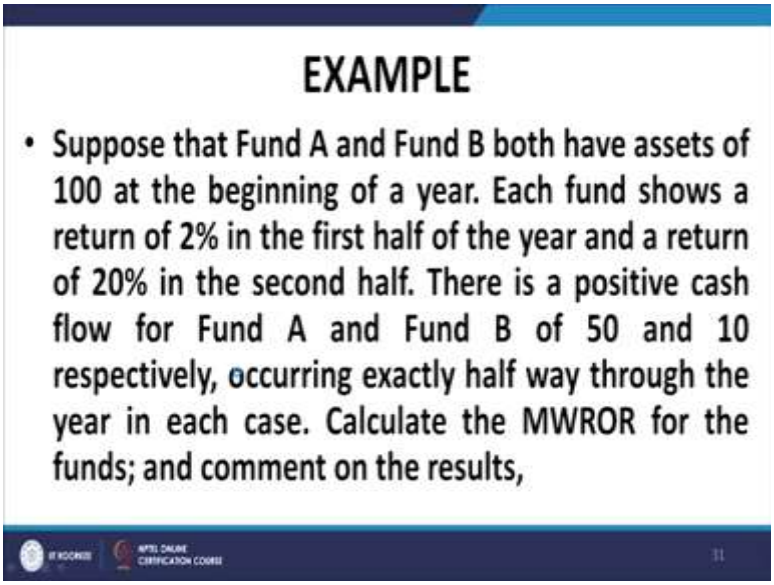

This is explicitly illustrated in this example. Suppose that we have a fund A and a fund B both with assets of 100 at the beginning of a year, each fund shows a return of 2 percent in the first half of the year and a return of 20 percent in the second half of the year. There is a positive cash flow for fund A and fund B of 50 and 10 units respectively, occurring exactly halfway through the year in each case. Calculate the money weighted rate of return for the funds and comment on the results. So, let us see.

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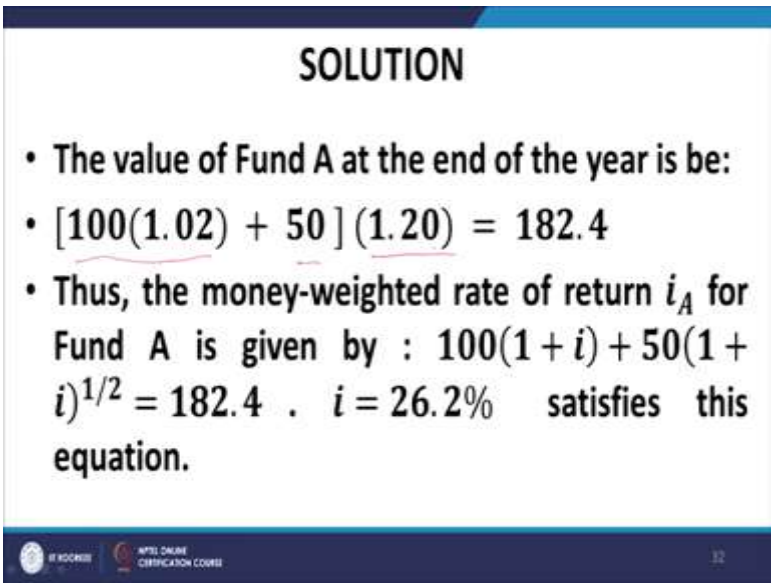

The value of fund A at the end of the year is 100 into 1.02. That is the growth or the return for the first 6 months plus 50 into plus 50 that is the inflow at t equal to 6 months. And this total growth for the second, second half of the year at the rate of 20 percent. So, the investment let us understand this equation, the investment of 100 that was made at t equal to 0 grew up at the rate of 2 percent over the first 6 months to give you the first term, this term.

And then you added 50 there was an inflow of 50 which is the second term and then this entire amount grew over the remaining 6 months or the next 6 months are t equal to 6 months to t equal to 12 months or 1 year is at the rate of 20 percent that is that growth is represented by the post factor.

So, the total value of the fund at the end of the year at the end of the year that is at t equal to 1 year is equal to 182.4. And when we work out the money weighted rate of return and that is obtained as 100 into 1 plus i that is the 100 is invested for 1 year, the 50 is invested for the half year and that is equal to the value of the fund at the end of the year, we solve this equation, we find that i is equal to 26.2 percent.

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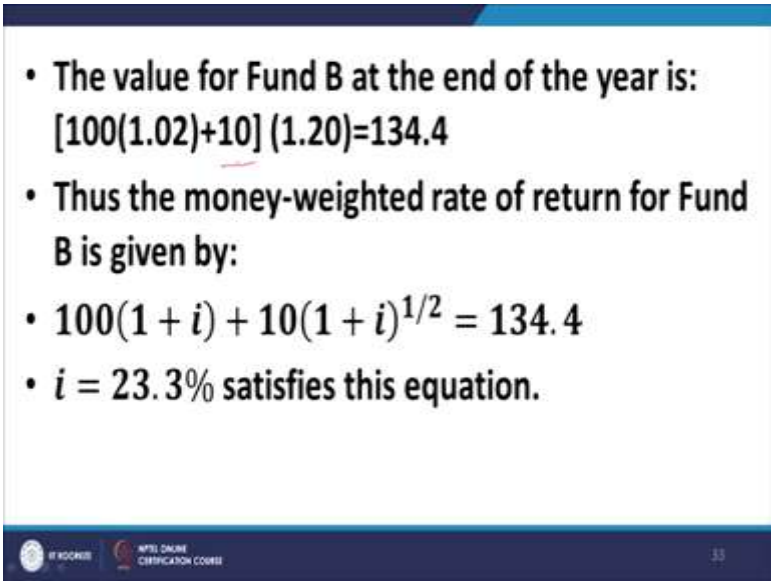

Now, let us see the same working in the context of fund B. In the context of fund B the only difference is that the cash inflow that occurs at t equal to 6 months is equal to 10 instead of 50 is equal to this 10 instead of 50. And therefore, the ending value or the terminal value of the fund at

the end of the year is equal to 134.4. We again solve the IRR equation and we find that i is equal to 23.3 percent.

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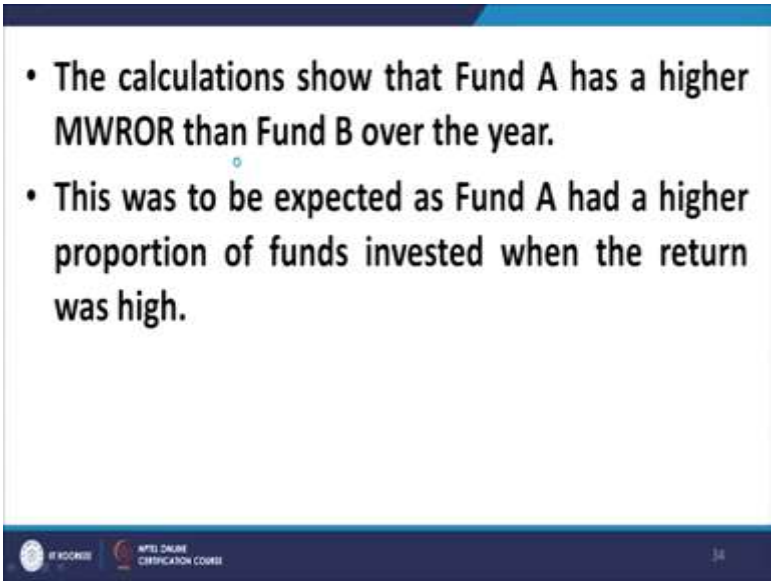

So, fund A has a higher money weighted rate of return then fund B over the year. Although, it is explicitly given that their performance over the past 6 months in both cases is at the rate of 2 percent and over the next 6 months in both cases, it is the growth is at the rate of 10 percent, sorry 20 percent.

So, why has this happened? This has clearly happened because in the second period when the growth rate was higher, the investment in fund A was more there was a cash inflow at the beginning of the second period of 6 months of 50 in contrast to a cash inflow of only 10 in the case of fund B. Therefore, as far as fund A was concerned, an amount of 150 was invested from t equal to 6 months to t equal to 12 months at the rate of 20 percent, whereas in the case of fund B it was only 110.

So, this contributed to the higher return on portfolio A compared to portfolio B. So, but it would be wrong to say that portfolio A had been better managed than portfolio B because their cash inflow of 50 or 10 as the case may be was not within the control of the portfolio manager. So, to remedy this, what the alternative that is being propounded in the literature is the time weighted rate of return. Time weighted rate of return seeks to eliminate the distorting effects of cash flows so that more valid comparisons of fund manager's investment skills can be made.

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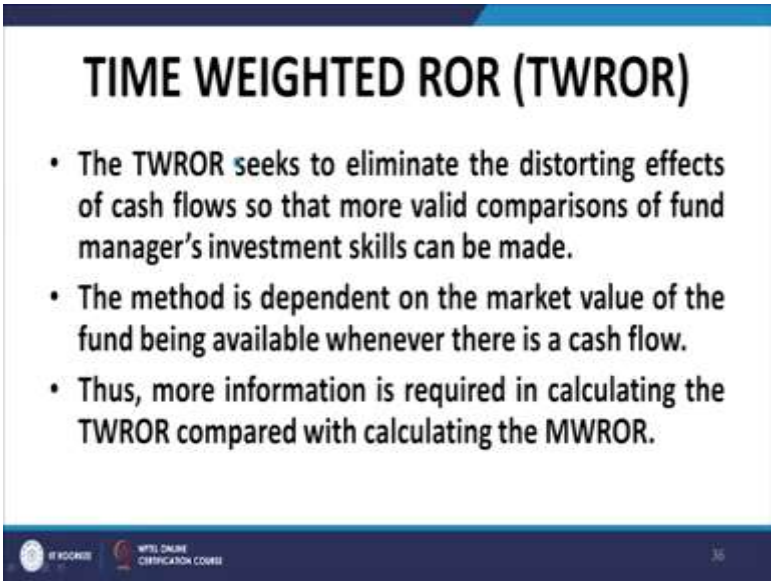

The method is dependent on the market value of the fund being available whenever there is a cash flows. And this is the major constraint of this particular method. I repeat, the method is dependent on the market value of the fund being available whenever there is a cash flow. As more information is required in calculating the time weighted rate of return, then is required for calculating the money weighted rate of return.

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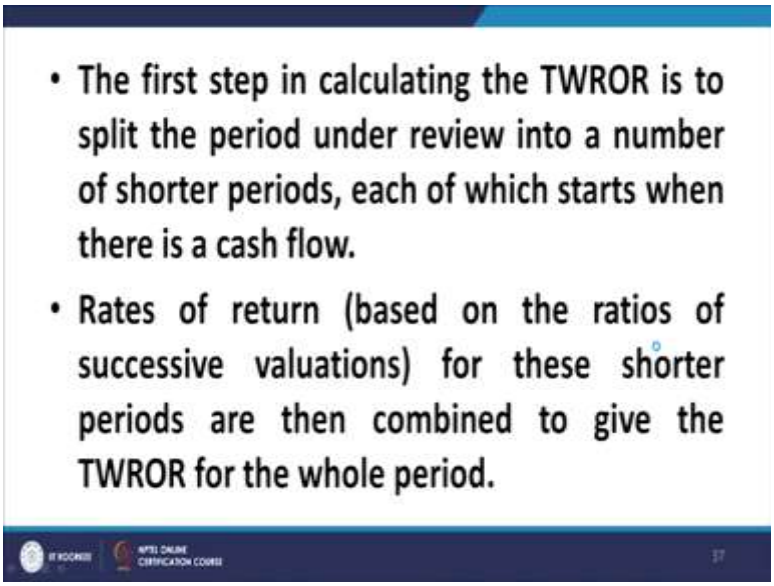

The first step to calculating the time weighted rate of return is to split the period under review into a number of shorter periods, each of which starts when there is a cash flow. I repeat, the first

step in calculating the time weighted rate of return is to split the period under review into a number of shorter periods, each of which starts with, starts when there is a cash flow. Rates of return based on the ratios of success evaluations for the shorter periods can then be combined to give the time weighted rate of return for the whole period.

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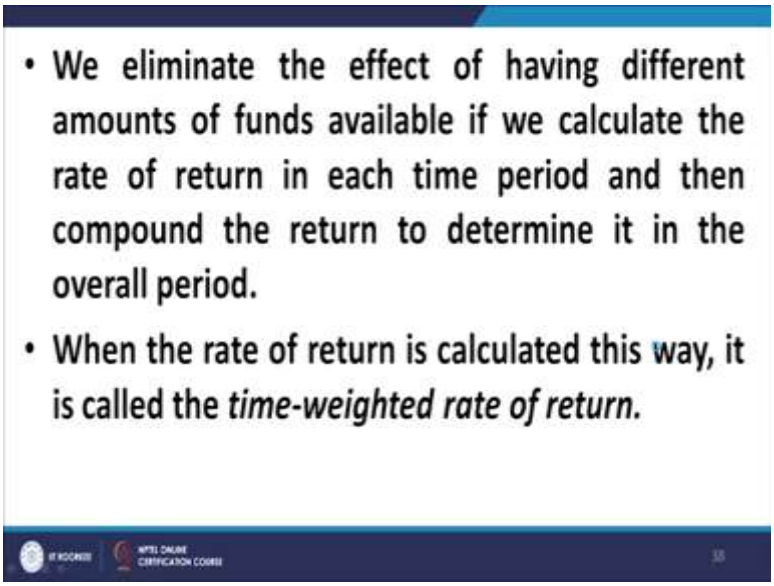

We eliminate the effect of having different amounts of funds available, if we calculate the rate of return in each time period, and then compound the return to determine it in the overall period, and the rate of return is calculated in this way, it is called the time weighted rate of return.

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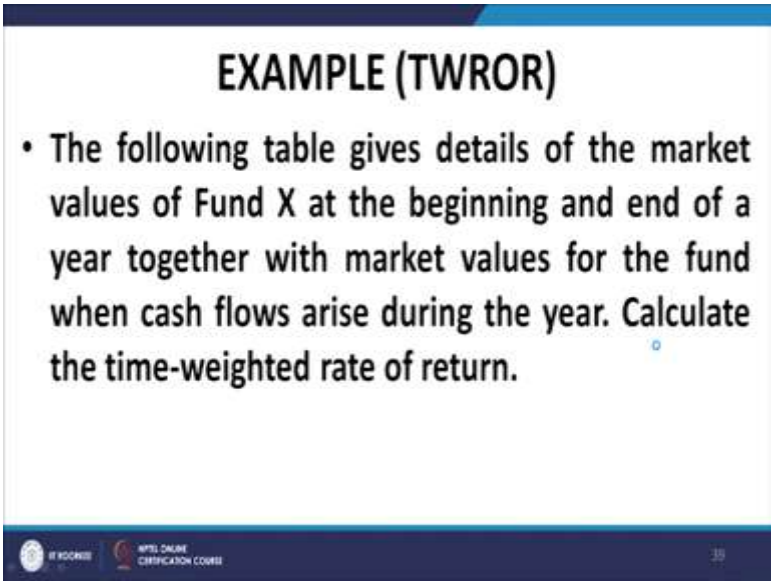

Let us do an example. The following table that is the previous table that we had for the first example, the following table gives details of the market values of X at the beginning and end of a year together with market values for the fund when cash flows arise during the year, we calculate the time weighted rate of return.

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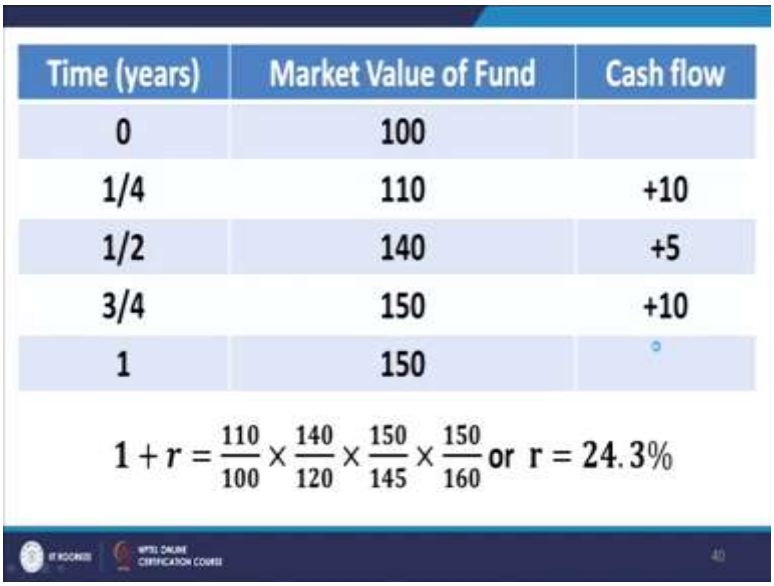

The working is quite simple, we simply work out the rates of return between the periods at which there are cash flows. So, for the first quarter that is t equal to 0 to t equal to 0.25 of the year the accretion in value of the fund has been from 100 to 110. Therefore, the return is obtained as 110 upon 100.

Now, we move to the second period, in the second period, the initial investment has gone from 100 to 120. Please note this point, started with 100, it moved over to 110 due to growth at the end of the 3 month mark, but there was an additional inflow of 10 at the end of the 3 month mark. So, the value of the fund at t equal to 0.25 and for the next relevant for the next 3 months there is not 110 it is 120 because there has been an inflow of 10 units at t equal to 3 month mark.

So, the investment has grown from 120 to 140 between t equal to 3 months and t equal to 6 months corresponding to a growth rate given by the second term. Similarly, for the third term, what has happened, has been an additional inflow of 5 units weighted t equal to 140. So the investment that is available for the next 3 months that is t equal to 0.5 months to t equal to 0.7

months is 145 and it has grown up to 150 at the end of t equal to 0.75. So, the growth rate for the next 3 months is captured by 150 divided by 145.

And finally, for the fourth quarter what happened? The funds available for investment 160, 150 which comprises of the amount brought forward plus an additional cash inflow of 10 at t equal to 0.75 of the year. And the ending values 150. So there has been a decline in value during this last quarter. And that is captured by the last term 150 divided by 160, 160 is the amount that was invested at t equal to 0.75 months and this has resulted in a valuation of the fund at 150 at the end of 1 year.

So, the growth or the decline rather over the last 3 months is captured by the last term in this expression. And when you solve this expression, what we end up is r equal to 24.3 percent.

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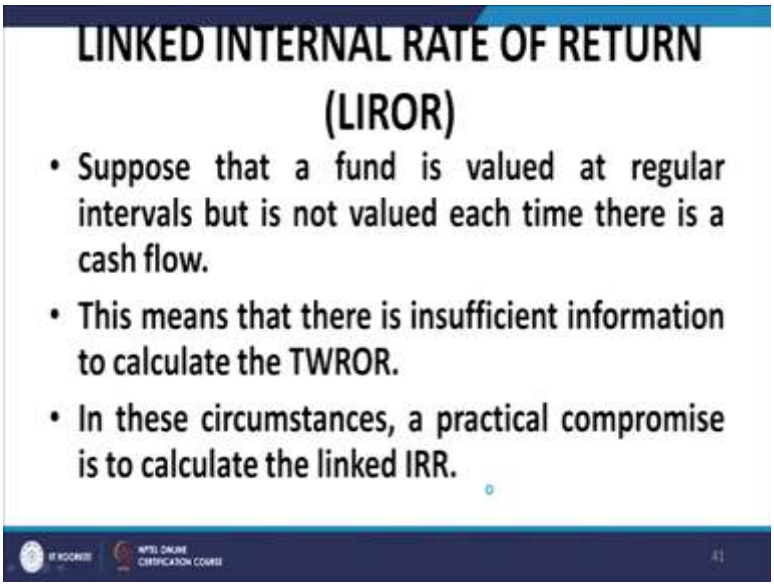

And we come to the linked internal rate of return. Suppose that a fund is valued at regular intervals, but is not valued each time there is a cash flow. This is the problem with a time weighted rate of return is that you need the market value of the fund at each point in time at which there is a cash flow, only then the time weighted rate of return can be accurately worked out.

So, this linked internal rate of return is a compromise between the two extremes of the money weighted rate of return and the time weighted rate of return. We assume that a fund is valued at regular intervals, but is not valued each time there is a cash flow. This means that there is

insufficient information to calculate the time weighted rate of return. In these circumstances, a practical compromise is to calculate the linked rate of return.

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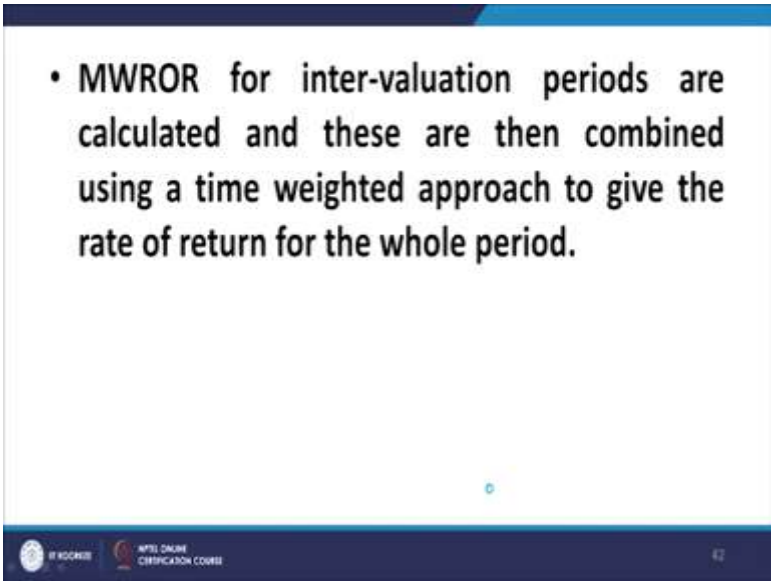

Now, the money weighted rate of return for inter valuation periods are calculated and these are then combined using a time weighted approach to give the rate of return for the whole period. In other words, with respect to the points in time at which cash flows occur, but for which market value is not available, we use money weighted rate of return and then as we have the market value, we take recourse to the time weighted rate of return.

So, this approach is a combination of the money weighted rate of return when information is not adequately available, when market value of the fund is not available, and the time weighted rate of return for the periods for which the market value is available. Now, we talk about the measures of risk, we talked about the measures of return, let us talk about the measures of risk. In fact, we have dealt this in a lot of detail over the last set of lectures or last about 10 lectures.

There are two fundamental measures of risk, number one, that is the total risk that is captured by variance or the standard deviation. And number two, is the systematic risk that is under this CAPM model captured by the in the beta of the security or the regression coefficient or in the APT model it is captured by a sequence of returns or a set of betas.

So, these are the, but for the purposes of portfolio performance evaluation, the measures of risk are usually confined to the use of standard deviation or the use of beta that is the systematic risk.

Let me also emphasize that there are several other measures of risk in particular value at risk is being extensively used nowadays for in the stock markets.

In fact, it is being used for the calculating of margins in relation to derivative products and also in relation to stock positions in respect of the investments in the stock market. It is gradually with the availability of extensive computing power, it is gradually finding its way into the rule books of various stock exchanges.

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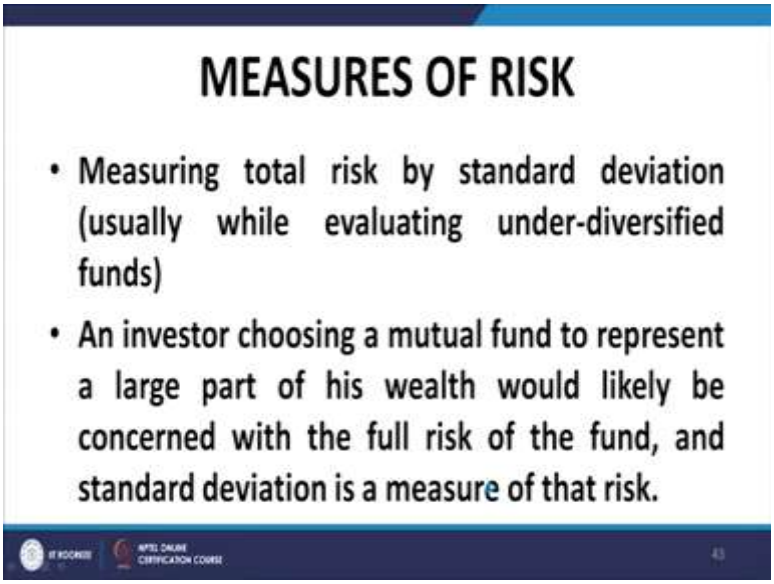

So, measuring total risk by the standard deviation is done while evaluating under diversified funds, because of diversification, there would be a significant component of unsystematic risk and therefore, it is the total risk that becomes relevant. An investor choosing a mutual fund to represent a large part of his wealth would likely be concerned with the full risk of the fund and standard deviation is a measure of that risk.

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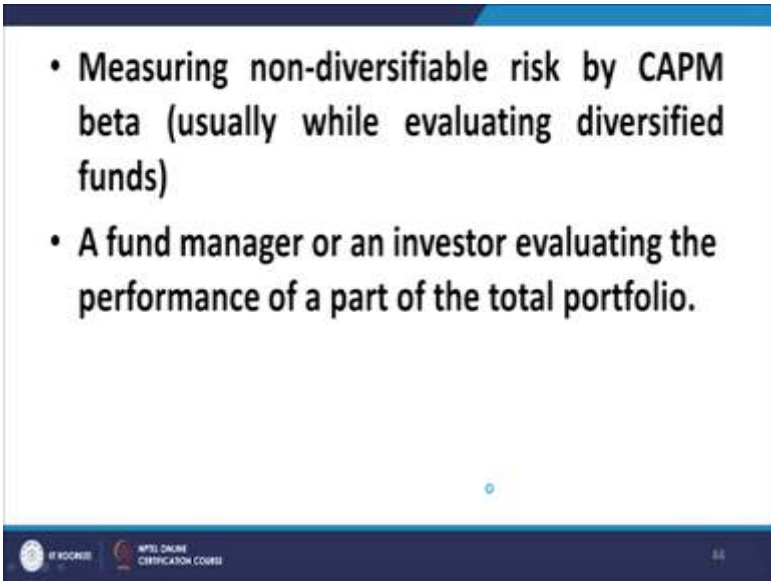

Measuring non diversifiable risk by the CAPM beta usually while evaluating diversified is the practice. A fund manager or an investor evaluating the performance of a part of the total portfolio can take the course to the use of beta for the measuring or for the evaluation or the risk or the performance of his portfolio.

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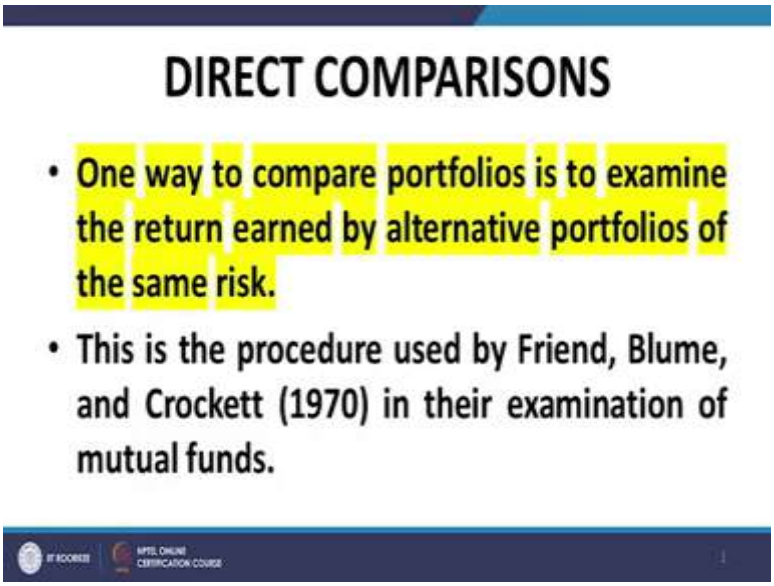

Now approaches to portfolio performance appraisal. As I mentioned, the first or the simplest approach is the direct approach, where we simply compare portfolios by examining the return of

with respect to alternative portfolios of the same risk. This is a procedure that was used by Friend, Blume and Crockett in 1970 in their examination of mutual funds.

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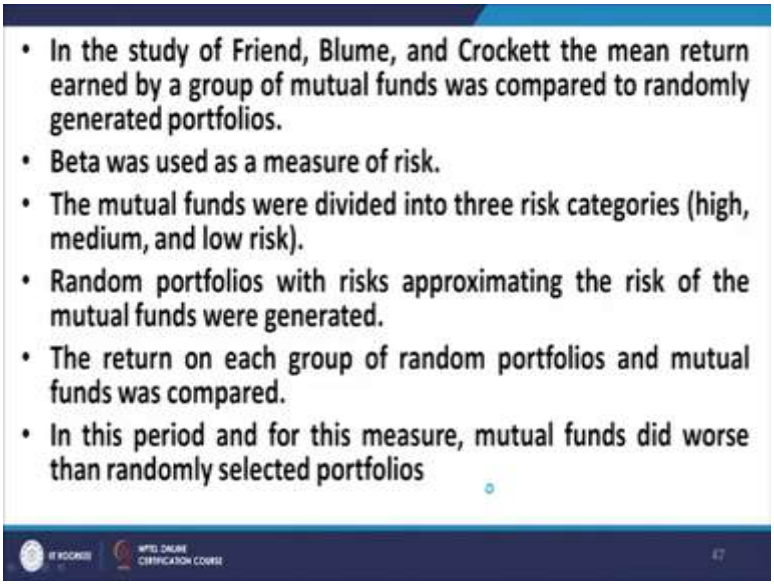

In the study of Friend, Blume and Crockett, the mean return earned by a group of mutual funds was compared with randomly generated portfolios and beta was used as a measure of risk. The mutual funds were divided into three risk categories, high, medium and low risk. Random portfolio with risks approximating the risk of mutual funds are generated, the return on each group of random portfolios and mutual funds are compared in this period. And for this measure, mutual funds did worse than randomly generated portfolios.

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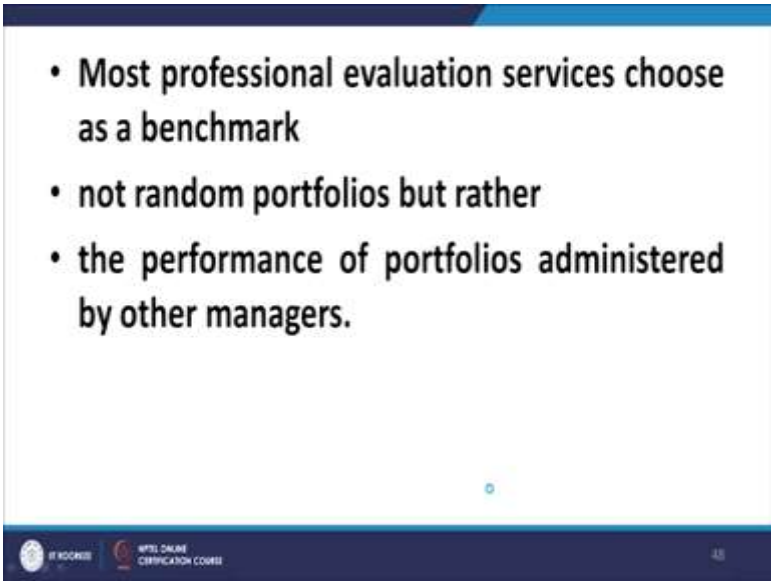

However, it is the practice in most cases, not to use randomly generated portfolios, but to select a benchmark instead of randomly generated portfolios, like a portfolio that is administered by other managers. So this is the direct method. It has very little to recommend itself, but it is often practiced in real life.

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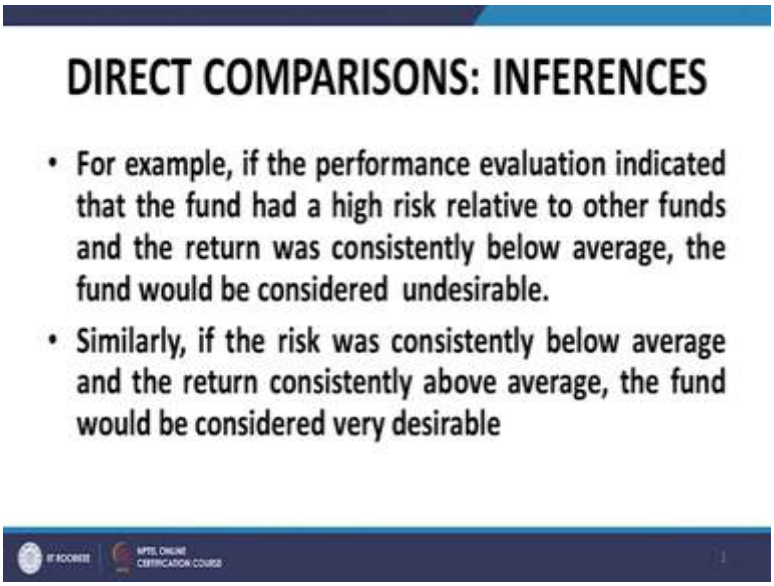

As far as the inferences from direct portfolios are concerned, they are pretty straightforward. They are pretty obvious. If the performance evaluation indicates that the fund has a high risk relative to other funds and the return is consistently below average, the fund would be considered

undesirable and if the risk was consistently below average, and the return consistently above average, the fund would be considered as highly desirable. Now we talk about parametric performance measures that I will talk about in the next lecture. Thank you.