

Financial Institutions and Markets
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Lecture – 06
Systematic Risks in Financial System

So, after discussing about the basic role of financial system and how it is related to the economy growth; we can start the discussion on certain concepts, which are linked to this particular financial system. And this particular concepts will be used across the different type of Financial Institutions and Market what we are going to discuss in the coming sessions.

So, as you know that the most important thing in the financial system is the management of the risk. Because every participants come to the market knowing that they are going to exports certain amount of risk, and accordingly they want to maximize the return in such a way that whatever risk, they will face, the risk can be adjusted and as well as they can get certain return for their benefits and as well as the maximization of the wealth.

So, keeping those things in the mind, we can start some discussion related to different type of risk what always we observe in the financial system as a whole. Then those type of risk will be discussed more elaborately, whenever we go and discover whenever we are going to discuss these particular market and institution specifically in the following sessions.

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What is Risk?

- Risk is a situation wherein objective probability distribution of the values a variable is known, even though the exact values it would take are not known.
- The objective probability is one which is supported by rigorous theory, past experience, and the laws of chance.
- the risk can be defined as the chance that the expected or prospective advantage, gain, profit or return may not materialise; that the actual outcome of investment may be less than the expected outcome.
- The greater the variability or dispersion in the possible outcomes, or the broader the range of possible outcomes, the greater the risk.

Handwritten notes:
b. norm $\rightarrow 40\% \rightarrow 10\%$
Normal $\rightarrow 30\% \rightarrow 8\%$
decumum $\rightarrow 30\% \rightarrow 5\%$
12%
8%
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The slide features a video inset of a man in a white shirt speaking. The bottom of the slide has a blue banner with the 'swayam' logo and the text 'FREE ONLINE EDUCATION'.

So, let us first see that what do you mean by the risk, how the risk is defined. So, you might have known that the risk and uncertainty, these are the two words, which are popularly used in the financial literature. And there are some kinds of theoretical differences between them. So, I will give you these basic differences between them little bit later.

But, let us first analyze or try to understand, what exactly the risk is. The risk is basically a situation, where the objective probability distribution of the values a variable is known, even though the exact value it would take are not known. What exactly it means? It means that whenever we are going to predict something in the market or we are going to say that, how this particular stock or particular bond is going to perform, and what is the probability that we are going to 5 percent, 10 percent, 15 percent return, we can have different scenarios.

For example, you say that let the particular market has three scenarios. One is a normal condition, there is a normal condition, there is a recession, and there is boom, the market is growing up. So, in these two condition, let we can assign different probability. There is a probability that if there is a 40 percent chance that there will be a boom. So, if there is a boom, the return will be let 10 percent.

And there is a 30 percent chance maybe the market will be in the normal condition, the return will be 80 percent. And if there is a recession, and a 30 percent probability that is recession, and you can get let 5 percent return. So, here what you are trying to say that whenever we are talking about the return what you are going to observe from the market, we are defining a certain probability distribution.

And we are assigning that if something is going to happen, then what is the probability that we are going to get this amount of return? But exactly we do not know, whether really this returns can be realized or not, but still we are thinking there is a probability that this kind of return can be achieved from the market. So that is why, we are saying that the exact values basically is not known here. But, we can go for a probability distribution of that particular variable, which is our outcome variable or the focused variable.

And how the probability distribution is made? The probability distribution is made on the basis of the theory, and the past experience, and as well as the laws of chance. What basically this, we have the data about that particular variable, which is available for may be last 10 years or 15 years. And we have observed that how this data behaved in the last periods. And accordingly, we can decide that if the data is behaving in this way historically, then how this

particular data is going to behave in the future also. So, the probability distribution can be derived from the past observations, whatever we have. And accordingly, we can assign certain probability with respect to this. And finally, this expected return, what we are going to get from this that can be calculated.

So, therefore here what we say, what is the risk here? The risk here is for example, you are expecting if there is a boom, you are going to get 10 percent return, but it is not necessary that you are going to get this 10 percent return. The reason is maybe you may get 12 percent or you may get also 8 percent. So, what is trying to say? If there is a deviation, if there is a deviation from the actual expectations whatever you have, it is not actual, basically you are expecting something.

So, if you are expecting something, but you are getting something that means, there is a probability that whatever thing you are expecting that may not be realized. So, if it is not going to be realized or it is not going to be materialized, then we are facing certain amount of risk in the market that means, we are saying that investment or positioning in the market is risky, because whatever way we are expecting that particular thing may not be received by us.

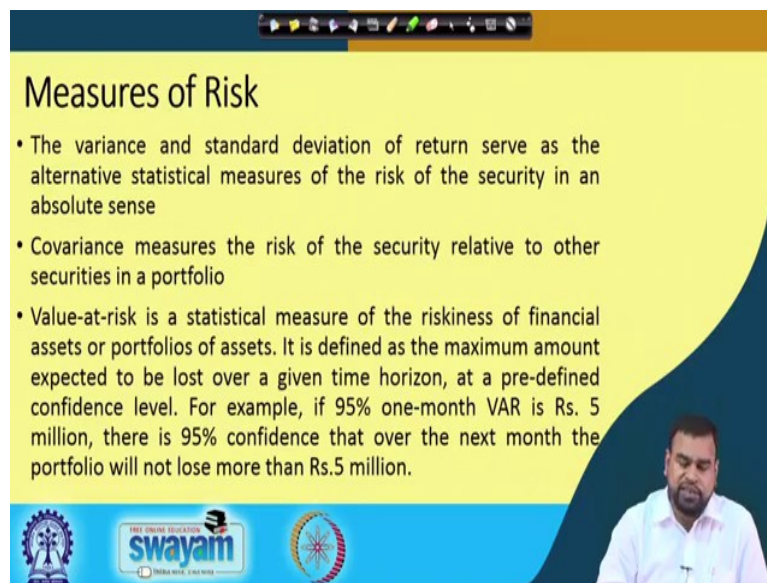
So, then what basically, we are trying to say? If the variation is more, then the risk will be more. You are expecting 10 percent, you are getting 1 percent, somebody else is expecting it possible 10 percent, getting 8 percent. So, there is a differences. If somebody is getting 2 percent or 3 percent, we are expecting 10 percent and somebody is getting 8 percent, but he was expecting 10 percent. So, there is a deviation. The deviation there is a variation in the deviations, so that variation or the variability basically measures the risk. How the actual value is deviated from the expected value?

So, in the statistical sense, the expected value is nothing but the mean value of that particular series that is what in the simplistic way we can say. Although there are different ways the expectations of that particular distribution can be calculated. But, in general, we can say that the mean value of that particular series can be used as the expectations or expected value of that particular data, so that is why more the variation, the risk will be more.

And obviously, if the broader the range of the possible outcomes, the greater is the risk. So, more the variation more is the risk that is what basically, what we can conclude. So, the risk what we are going to face that is not basically related to the actual return, what you are

getting that is related to the we always calculate the risk with respect to the variation of the return of that particular data with respect to the expected return, what we are expecting or we are calculating before, so that is why the variability or the dispersion in the possible outcomes, basically measures the risk of that particular series or risk of that particular distribution. So, this is the basic concept of the risk, what always we observe in the market or we always use it in our analysis.

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Measures of Risk

- The variance and standard deviation of return serve as the alternative statistical measures of the risk of the security in an absolute sense
- Covariance measures the risk of the security relative to other securities in a portfolio
- Value-at-risk is a statistical measure of the riskiness of financial assets or portfolios of assets. It is defined as the maximum amount expected to be lost over a given time horizon, at a pre-defined confidence level. For example, if 95% one-month VAR is Rs. 5 million, there is 95% confidence that over the next month the portfolio will not lose more than Rs.5 million.

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Then let us see that how this what are the popular measures of risk, how the risk is basically measured? Whenever we measure the risk all of you might have known, that the basic way of measuring the risk is the variance, the basic way of the measuring the risk is basically what, we can say that is the standard deviation.

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Measures of Risk

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$Cov(x, y) \rightarrow \text{Risk}$

A $\rightarrow 10\% - 8\%$
B $\rightarrow 12\% - 9\%$

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So, variance or standard deviation, these are the basic measures of the risk. All of you know that how the variance can be calculated that it is the deviation from the mean of that actual series. If you take those square of that divided by the degrees of freedom that is n minus 2, so that basically measures the standard deviation of that variance of that series and if you take the square root of the variance, then we can measure the standard deviation. So, this variance and standard deviation, these are the two things basically what we always use for measuring the risk in the market.

So, then another thing is basically you see, you can also use the co-variance. The co-variance basically measures the risk of the security, they related to the other security in the portfolio. And whenever we are comparing the different type of alternatives whatever we have, if you are comparing the alternatives of the choosing the assets in the market, then what basically we are trying to do? We are using the concept of the covariance between x and y and that covariance between x and y is basically measures the risk factor of that particular variable or how that particular variable is risky, and whether this particular variable or particular alternative can be taken for investment or not.

And another thing also we have that is called the coefficient of variation. The coefficient of variation, we use it basically whenever we are comparing the two alternatives. For example, in one alternative you have A, in another alternative you have the B. If A is giving 10

percent return and giving a risk of 8 percent and B is giving a return of 12 percent, and you are facing a risk of 9 percent.

Then here if there is a dilemma that which alternative should be chosen, so in that particular point of time, basically we use the coefficient of variation. And the coefficient of variance is nothing but that for one unit of the risk, how much extra return you are getting? It is basically the ratio between the mean return what you are getting, and the standard deviation, so that particular measure is used whenever we have the different alternatives. And we are going to use that alternatives in the market for the investment or choosing the investment from the varieties of alternatives, which are available.

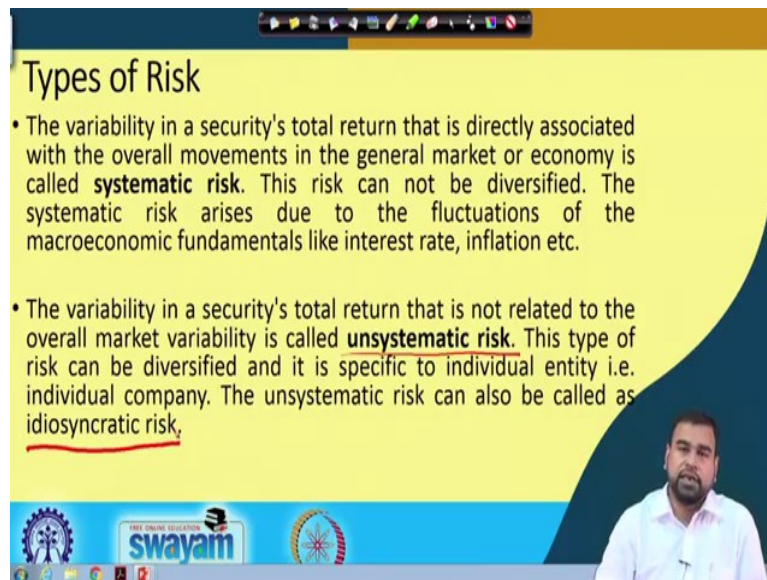
Then another type of measure, we have popularly used that is called the value-at-risk. So, what this value-at-risk means? The value at risk is basically a statistical measure. The value-at-risk is statistical measure of the riskiness of the financial asset; it is a statistical measure of the riskiness of the financial asset or portfolio of the assets. What it defines? How we can define this value-at-risk?

The value-at-risk is nothing but the maximum amount expected to be lost over a given time horizon, at a pre-defined confidence level. In the statistics, you might have known about the confidence level and the significance level. And whenever we measure the value-at-risk, we basically consider at what significance level or at what confidence level, we are basically measuring this value-at-risk.

So, if you have the 95 percent confidence level, then that means significance level is 100 percent minus 95 percent that is 5 percent. If it is a 90 percent confidence level, then the significance level is 10 percent like that. So, here what we are trying to say? If you see this example, if 95 percent one-month VAR is rupees 5 million that means, if you want to interpret it what basically the interpretation is the interpretation is that is 95 confidence that over the next month the portfolio will not last more than 5 million.

What basically it means, it means that what is the maximum loss or the worst loss somebody can make in a particular time period at a particular confidence level that is basically defined as the value-at-risk. The value-at-risk is basically a measure, which tried to tell you that, what is the maximum loss this particular investor or particular company is going to make if he or she wants to invest in the market, that is basically the measure of the value-at-risk; or this is the way the value-at-risk can be defined.

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Types of Risk

- The variability in a security's total return that is directly associated with the overall movements in the general market or economy is called **systematic risk**. This risk can not be diversified. The systematic risk arises due to the fluctuations of the macroeconomic fundamentals like interest rate, inflation etc.
- The variability in a security's total return that is not related to the overall market variability is called **unsystematic risk**. This type of risk can be diversified and it is specific to individual entity i.e. individual company. The unsystematic risk can also be called as idiosyncratic risk.

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Then if you see that there are different types of risk, broadly the risk can be defined in two ways. One is your systematic risk, and another one is the unsystematic risk. What do you mean by the systematic risk? The systematic risk is a risk, which is basically everybody is basically suffering from that. All the entities are exposed to the systematic risk, because that is basically related to the macroeconomic fundamentals.

And if the general market or macroeconomic fundamentals like interest rate, inflation all these things became volatile, so in that sense we can say that we are exposed to the systematic risk of particular market that means, whether any company operates or any individual operates in the market. So, if there is a change in the inflation, there is a change in the interest rate everything, so then what will happen that everybody will be going to face that particular risk in the system. So, therefore it is called systematic.

So, any kind of investment strategy if you want to make so that particular risk cannot be diversified. So, this systematic risk cannot be diversified that is why, the other name of the systematic risk is also on diversifiable risk. This particular risk cannot be diversified in the system. So, whatever way you want to make your portfolio strategy or investment strategy that is not going to help the participants to the investor to reduce or to diversify that risk in the market.

Then another type of risk is the unsystematic risk. So, this unsystematic risk is basically nothing but this risk is specific to the particular entity, either it is maybe with respect to

individual or with respect to a company. So, any fluctuations within the company like if the sales is fluctuating or if there is some kind of uneven situations, which have occurred in the company, but that is not applicable to another company.

So, those kind of events, those kind of incidents can also create certain kind of risk for the particular investment alternatives or for that particular entity. So, those risk can be diversified, but in the sense what we are trying to say? If any kind of investor wants to invest in the stock market, if they are holding 50 stocks, 20 stocks or 30 stocks, so in that context what happens that if all those 30 stocks if you are chosen, and if one stock is do not doing well, another stock can do well. At one sector particularly may not perform well, but another sector may perform well.

So, in that context what they trying to do, they are trying to minimize the risk, so that is why, what we can say? The unsystematic risk is also known as it is called the idiosyncratic risk. The idiosyncratic risk is nothing but it is specific to the individuals. And those kind of risk can be diversified, if you are holding more number of assets or more number of investment alternatives in the system or your investment portfolio that is why, we can say that this is a diversifiable risk. So, if you are holding more assets in your portfolio, then this particular risk can be diversified. So, this is basically another thing, what we can say.

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Types of Systematic Risk

- Market Risk (Beta)
- Interest Rate Risk
- Inflation Risk
- Exchange Rate or Currency Risk

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Now, let us discuss that, what are those different types of systematic risk, major type of systematic risk, what we face in the market. So, the 1st one is the beta. The market risk,

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Market Risk (Beta)

- Beta** indicates the extent to which the risk of a given asset is non-diversifiable; it is a coefficient measuring a security's relative volatility. Statistically, beta is the covariance of a security's return with that of the market for a security class.
- It is the slope of the regression line relating a security return with the market return. The security with a higher (than 1) beta is more volatile than the market, and the asset with a lower (than 1) beta would rise or fall more slowly than the market.

$$\beta = \frac{\text{Cov}(i, m)}{\sigma_m^2}$$

Handwritten notes on the slide:

- $\beta = \frac{\sigma_i \cdot \rho_{i,m}}{\sigma_m}$
- $\text{Cov}(i, m) = \frac{\sigma_i \cdot \sigma_m \cdot \rho_{i,m}}{\sigma_m} = \sigma_i \cdot \rho_{i,m}$
- $\beta = \frac{\sigma_i \cdot \rho_{i,m}}{\sigma_m}$
- $\beta = \frac{\text{Cov}(i, m)}{\sigma_m^2}$
- BSE Sensex
- Market Portfolio
- A → (i)

So, for example, if you take the stock market, in the stock market the m is basically what. Let you can take the proxy BSE Sensex, this is an index. And people consider this as a market portfolio. So, the return from the BSE can be consider as the market return. Let you are using a stock A, the stock A is returned is basically represented as i . So, we are talking about the

covariance between the return of the individual asset or the individual stock, and the return from the market divided by the variance of the market that will give you the value of the beta.

$$\beta = \frac{Cov_{i,m}}{\sigma_m^2}$$

So, here what we are telling that if you little bit expand it,

$$Cov_{i,m} = \frac{\sigma_i \sigma_m \rho_{i,m}}{\sigma_m^2} = \frac{\sigma_i \rho_{i,m}}{\sigma_m}$$

then your covariance i and m is nothing but the standard deviation of i into the standard deviation of m into the correlation between i and m divided by the variance of m. So, one standard deviation and one standard deviation can be cancelled out. So, you will end up with the standard deviation of the i multiplied by the correlation between i return of the individual security in the market divided by the standard deviation of the market.

So, in general we can represent it that your covariance i, m is equal to or the beta is equal to basically this one. Then beta is equal to covariance is equal to this, standard deviation of i and the standard deviation m into the correlation between i and m divided by the variance of m. So, then what has happened. Finally, one standard deviation of m can be cancelled out, because the standard deviation variance of m is nothing but standard deviation of m into standard deviation of m.

Then finally, we have your final

$$\beta = \frac{\sigma_i}{\sigma_m} \rho_{i,m}$$

This i represents already I told you, this is the return from the individual stock or individual security, and this is the return from the market, and this is the standard deviation of the market, and this is the standard deviation of the return of the particular security, so that is why, this is basically what, this is basically the calculation of the beta. So, this is the actual calculation of the beta, but the beta also can be calculated in other way.

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Market Risk (Beta)

- **Beta** indicates the extent to which the risk of a given asset is non-diversifiable; it is a coefficient measuring a security's relative volatility. Statistically, beta is the covariance of a security's return with that of the market for a security class.
- It is the slope of the regression line relating a security return with the market return. The security with a higher (than 1) beta is more volatile than the market, and the asset with a lower (than 1) beta would rise or fall more slowly than the market.

Handwritten notes:
 $R_i \propto Z_m$ (with three vertical lines)
 $R_i = \beta(R_m)$ (with an arrow pointing to 'Market risk')

If you regress if you can run the regression line, let $R_i = \beta(R_m)$, this is the simplistic way of calculation. The beta is the coefficient, R_m is the market return, then what you can do, you can take two columns. One column you can take the return from this individual asset, and another column you can take the return from the market run the regression, where R_i is the dependent variable R_m is the independent variable.

And whatever coefficient, you will find that coefficient also this beta, this is basically the also the market risk, this is the way also the market risk can be calculated. So, therefore the security the this is a slope, and the security with the higher beta is more volatile than the market, and the asset with a lower beta would rise or fall more slowly than the how the market is volatile that is the way the beta can be defined.

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Interest Rate Risk

- Interest rate risk is the variability in return on security due to changes in the level of market interest rates
- Interest rate risk has two parts. First, the price risk resulting from the inverse relationship between the security price and interest rates.
- Second, the reinvestment risk resulting from the uncertainty about the interest rate at which the future coupon income or principal can be reinvested.
- These two parts of interest rate risk move in opposite directions.

$V_0 = \frac{CF_t}{(1+r)^t}$ in m.c.

Then we can come to the other type of risk that is basically you have interest rate risk. So, what this interest rate risk is basically talk about the interest rate risk is basically nothing but the variability of the return on security due to changes in the level of market interest rate. If you go back generally if there is a change in the interest rate, then the value of this particular asset gets changed. However it basically happens?

For example, if you talk about the bond the price of the bond is what, if you write this price of the bond, the price of the bond works in this way write

$$V_0 = \frac{CF_i}{(1+r)^t}$$

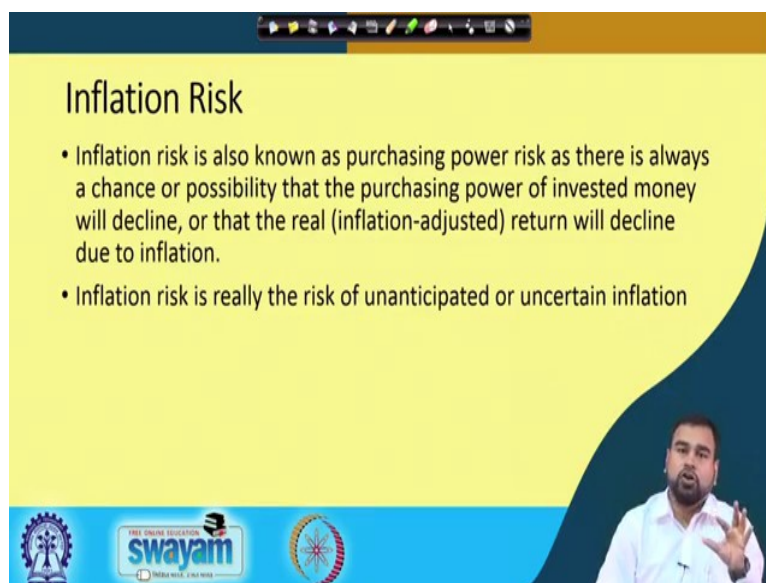
V_0 = Price of the bond, CF_i = cash flow and this r is nothing but the interest rate or the discount rate. So, here if you see, if your r changes, then V_0 changes if r increases, the value of the bond goes down. If r declines, then value of the bond goes up, because it is a discount factor, which is taken in the denominator.

And here the price is increasing, for example somebody has invested in the bond. And in the bond if they get the coupon, so the coupon is nothing but the regular cash flow right and as well as in the principal amount, whenever in the end we get it. So, in that context what we say, if the interest rate increases the value of the bond goes down, but whatever coupon they get, if the coupon amount can be reinvested in the market, they get more return that is why,

whenever the value of the bond goes down, we say that increase the interest rates declines the value of the bond that is why the price risk increases, which is called the price risk.

And whatever money we get it from the coupon, like if we have bond value of the par value of the bond is 1000 rupees, your coupon is 10 percent, then every year you will be getting 100 rupees. If that 100 rupees again you are reinvesting in the market, then if your interest rate goes up, maybe you can get some more return. So, therefore the price risk and reinvestment risk work in the opposite direction.

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Inflation Risk

- Inflation risk is also known as purchasing power risk as there is always a chance or possibility that the purchasing power of invested money will decline, or that the real (inflation-adjusted) return will decline due to inflation.
- Inflation risk is really the risk of unanticipated or uncertain inflation

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Then we can come to the other type of risk like inflation that everybody knows. Inflation is basically nothing but the purchasing power. If the inflation goes up, the purchasing power of the consumer goes down. And that is always if the inflation increases, the real value of that particular asset goes down, because it affects or it negatively affects the purchasing power.

So, therefore always we should expect that inflation should be low, because the real addition or the real return from that particular asset can be increasing. Always you remember whenever we compare or we try to analyze the inflation risk, we are not talking about the actual inflation, which is happening now, we also consider the uncertain inflation or the expected inflation. The expected inflation is very much so important, whenever we talk about the inflation risk in the market, so that is basically we have to keep in the mind.

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Exchange Rate or Currency Risk

- Exchange rate risk refers to cash-flow variability experienced by economic units engaged in international transactions or international exchange, on account of uncertain or unexpected changes in exchange rates.
- There is no exchange rate risk under the fixed exchange rate system, while it is the highest under the freely floating exchange rate system.

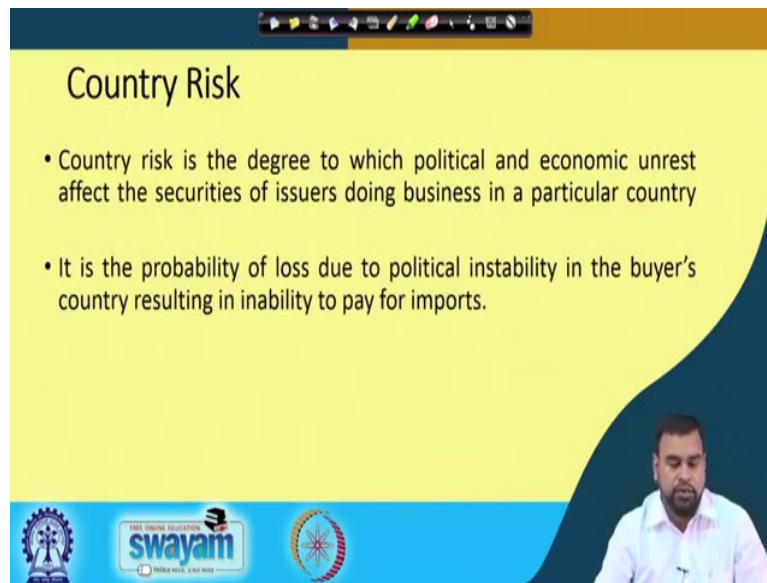
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Then we have another one that is called the exchange rate or the currency risk. So, the currency risk all of you much very much aware about if there is a change in the exchange rate, then the value of that particular currency changes. And that affects every type of international transactions or anybody who are doing this international business across this basically, it effects mostly the multinational companies and who are doing the foreign exchange business.

So, therefore the exchange rate risk is defined as the cash-flow variability experienced by the economic units engaged in the international business or international exchange. And there is no exchange rate if you see that we have different type of exchange rate system like India adopt a managed exchange rate system, China adopts a fixed exchange rate system, because the government decide what should be the exchange rate of that particular currency with respect to another currency.

So, if that is the fixed exchange rate system, we are not exposed to exchange rate risk. If there is a floating exchange rate system, market determines how much should be the exchange rate of that particular currency with respect to another currency, then what will happen that we are much more exposed to the exchange rate risk and accordingly the value of the set can go down. So, therefore these are the different one of the major risk, which is affecting the value.

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Country Risk

- Country risk is the degree to which political and economic unrest affect the securities of issuers doing business in a particular country
- It is the probability of loss due to political instability in the buyer's country resulting in inability to pay for imports.

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Then finally, the country risk. The country risk is basically what, the particular risk which to which the political and the economic unrest affect value of the securities. If there is the probability that there is an unstable instability in the political scenario or there is no political instability exist in the system. Then what will happen that basically affects the balance of payment.

Mostly it affects the buyer's country, who are basically doing this foreign exchange business or any kind of business, whatever anybody any company is doing or any individual is doing. And that is why it is the probability of loss due to political instability in the buyer's country resulting in inability to pay for imports, because there is a political instability.

That sometimes affects the whole economic system and generally if it is adversely affecting the balance of payment, and finally the value of the total assets can be affected, so that is the way the currents the country risk can be defined. So, these are the major type of systematic risk. And we will be discussing the unsystematic risk in the next session.

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Please go through these particular references for this particular session.

Thank you.