# Interest Rate Risk Management

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## Introduction

Interest rates fluctuate continuously. The ideal of analysts is to find a model that explains and hopefully forecasts the variations of the interest rate. However, no such system exists.

The implication is that corporations with debt have a certain amount of uncertainty in relation to their financial net. Investors with financial assets have an interest risk in relation to their possession.

Anyone that is opposed to interest rate risk should try to calculate how severe the risk is on key factors such as net financial items and the market value of debt and assets.

Gap-analysis is used to measure the risk to the financial net and duration analysis is a technique employed for understanding the sensitivity in market values. Stress tests and simulations are used to see how major interest rate changes affect the key factors. Value-at-risk is used to calculate the probability of a negative interest rate change.

Knowing the risk, the next step is to adopt a strategy concerning how to deal with it. The four main strategies are: avoiding, accepting, hedging, and diversifying the interest rate risk.

The answer as to which strategy to use depends on the company's desired risk level and its ability to manage negative events. Nevertheless, a mix of strategies might be a good solution. Non-financial companies should try to avoid risk as the first option. Secondly, a mix of hedging and accepting risks would depend on the characteristics of the company and the risks involved.

The ideal situation is that the board creates a financial policy which describes the interest rate risk strategy for the company. This policy should be communicated to the owners, the management and to the market.

It is vital to implement a system for internal control. Constant monitoring and reporting concerning the development of interest rate risk will provide the management with the opportunity to change policies in good time when needed.

# Risks of interest bearing assets

When managing an interest-bearing portfolio, several risk factors must be taken into consideration:

- Interest rate risk
- Currency risk
- Credit risk
- Liquidity risk
- Operational risk

*Interest rate risk* can be defined as the sensitivity in the key figures due to changes in the interest level.[1] The important key figures are the net financial items and the market value of the debt and assets.

Interest fluctuations affect companies both directly and indirectly. In this text we will only describe the direct influence that interest volatility has on the company's result or balance. An indirect effect is for example when a company's customers reduce their purchases due to their higher financial costs.

*Currency risks* occur when you invest in assets in a foreign currency. The return on the investment will be different if the foreign exchange rate does not follow the anticipated path.

If an investor buys a risk free asset, such as government bonds, there is no credit risk. When buying other bonds there is a chance that the return will be less than expected. This risk is called *credit risk*. Investors demand a higher price before accepting credit risk.

*Liquidity risk* occurs when an investor is not able to sell an asset, or face an unfavourable market price due to limited liquidity. Sometimes bonds are bought that have a longer maturity than the investor's investment horizon. The investor assumes that the asset can be sold when needed. However, the market may not always be liquid. Historically, events such as war or financial crisis have decreased the liquidity dramatically.

Now and then people make mistakes, or for other reasons act outside the policies set up by the company. When these things occur and when huge amounts are at stake, the loss can be severe. The risk of these kinds of events is called *operational risk*.

In this text we will focus on interest rate risk. The other risks that exist when managing interest-bearing assets will not be described further.

[1] Söderlind, 1996, p. 12

# Creating a risk strategy

The first step when managing interest rate risk is to identify which risks your company is exposed to. Step 2 is trying to measure the risk. Step 3 is to analyse the impact the risk might have on the company. The fourth step is to choose a strategy for dealing with the risk.


***Picture 1: The process of choosing strategy***

Normally, a company chooses a strategy which is consistent with the wanted risk level and the ability of absorbing negative changes in the interest level.

The ideal situation is that the strategy regarding how to deal with interest rate risk is formalised in a financial policy, which is approved by the board. This policy should be communicated throughout the company and to the market.

After choosing how the interest rate risks should be addressed, the management must investigate if the company has the current skills to implement the strategies. It is crucial that the employees have the correct education, enough time, information, and systems to manage the risk. This is to ensure that the decision making process is good.

The company should, within a specific period or after a major event, discuss the current strategy and if needed propose changes. A major event could for example be a large increase in debt due to an acquisition. Due to the increased leverage, the company may feel the need to reduce the interest rate risk by increasing the amount hedged.


***Picture 2: The process of changing strategy***

The interest risk should be monitored and reported to the management on regular basis. The company should also build up a system of internal control, so that poor management, mistakes, or unauthorized transactions can be minimized.

The board has a duty to create the system of internal control. The management has the task to implement it, and all employees should have the responsibility to act in accordance with the policies and guidelines.[2]

# Measuring interest rate risks

There are several ways of measuring the interest rate risk, and all methods have their advantages and limitations. The decision about which method or methods to use depends on the activities within the company. For example, a bank that borrows and lends money to small clients prefers to look at the sensitivity of the net interest income. Investment banks trading in the capital market might, on the other hand, focus on methods that measure the effect the interest rate variation has on the market value of assets and debts.[3]

## Analysing the net interest income

The most common way of analysing the interest rate risk sensitivity in the net interest income is the *gap analysis*. The gap is the net difference between interest bearing assets and debts within a certain maturity period. The interest risk exposure is a function of the amount of the net position, the time frame of the unbalance, and the level of interest change.

It is important that both on-balance and off-balance products are included in the study and that a company performs a breakdown of each currency it is exposed to.

The advantage of the gap analysis is the simplicity; it is easy to understand and easy to monitor. For non-sophisticated companies the method provides a good overview of the interest rate risks. For example, a manager in a small firm can easily calculate the miss-matches and describe the net-position to the owner. Neither the manager nor the owner will have problems in understanding the risks and the impact it might have on the company's result.

The disadvantage is that the technique cannot completely measure all the risks that a company might be exposed to. Derivatives such as interest rate caps are troublesome to include in the calculations.

[2] Stephens, 2002, p. 30
[3] Söderlind, 1996, p. 21

Example 1: Gap analysis
A savings bank receives deposits from its clients who mostly pay floating interest. The bank lends the money to small clients against floating and fixed interest. The interest maturities for the banks debts and assets are shown in picture 3.

Interest maturities — Amounts in Billion Euro

| Months | 0-1 | 1-12 | 12-24 | 24-48 | 48< |
|---|---|---|---|---|---|
| Assets | 40 | 30 | 20 | 20 | 30 |
| Debts | 100 | 20 | 10 | 5 | 5 |
| Period gap | 60 | -10 | -10 | -15 | -25 |
| Culmulative gap | 60 | 50 | 40 | 25 | 0 |

***Picture 3: Example of gap analysis***

If the floating interest rate changes two percent, then the bank`s net financial income will change two percent multiplied by the net position multiplied by the duration the position will persist. For the first month the net position is 60 billion EUR and the effect on the net financial income will be 100 million EUR (2%*60 billion EUR *1/12). The effect will persist until the gap or the interest change is eliminated.

**Simulation of the financial net**
A simulation of the financial net is the natural extension of the gap analysis. Simulation models start with the current exposure and analyse the changes in relation to different scenarios[4]. The changes could be in the interest hedge strategy or in the yield curve.

Example 2 – Simulation of interest costs
A real estate company estimates that its income before financial items will be 100 for the next year. The company has 1250 in loans against floating interest. The expected interest for next year is 6 percent, which bring about financial costs of 75 and a result of 25. Now it simulates what the result would be given a possible increase in the interest. As picture 4 shows, the company will start to show losses if the interest increases more than two percentage points.

Since the company does not like the possibility of showing losses, it simulates a possible change in the interest hedge strategy in order to minimize the possibility of losing money. It simulates an interest hike of 4 percentage points which is the worst-case scenario for the company.

[4] Söderlind, 1996, p. 42

| Interest increase | Interest level | Debt | Financial costs | Result |
|---|---|---|---|---|
| 0% | 6% | 1250 | 75 | 25 |
| 1% | 7% | 1250 | 87.5 | 12.5 |
| 2% | 8% | 1250 | 100 | 0 |
| 3% | 9% | 1250 | 112.5 | -12.5 |
| 4% | 10% | 1250 | 125 | -25 |

***Picture 4: Simulation of increase in interest rate***

| Share fixed interest | Fixed interest | Floating interest | Average interest | Result |
|---|---|---|---|---|
| 20% | 6% | 10% | 9,2% | -15 |
| 50% | 6% | 10% | 8,0% | 0 |
| 70% | 6% | 10% | 7,2% | 10 |

***Picture 5: Simulation share fixed interest***

After the simulation, the company decides to hedge 50 percent of the interest so that the result will not be negative as the result of a sudden interest rate increase of 4 percentage points.

To be absolutely sure of not showing a negative result, the company buys interest rate caps at the level of 10 percent against the loans that are still against floating interest. Since such a large interest hike is unlikely, the cost for the hedge is very small.

By doing this, the company has eliminated the risk that the result will be negative due to an increase in the interest rate level.

## Interest rate risk on capital

The market value of an interest-bearing asset is the present value of all cash flows. When the interest level changes, the present value of the cash flows also changes. Bearing this in mind, we understand the importance of analysing how much different assets change in value as a result of the interest level.

A technique that measures the market value sensitivity to changes in the interest is described as duration analysis. *Duration* is a term that was introduced by Fredrick Macaulay and is therefore often described as *Macaulay´s duration*. It measures the present value weighted average maturity of interest bearing assets.[5]

[5] Söderlind, p. 1996, p 50-52

Duration= $1/P(1*C_1/(1+y)^1+2*C/(1+y)^2+...T(C_T+N)/1+y)^T)$

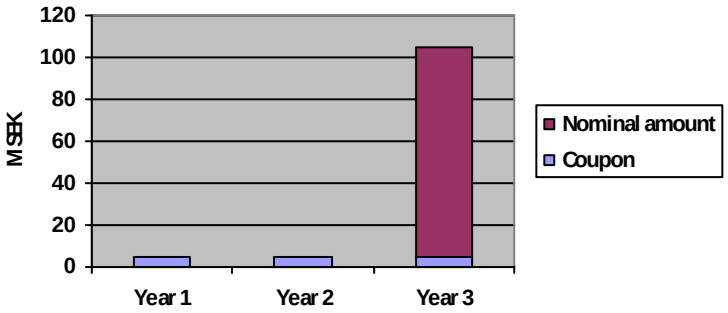
Where N is the nominal amount of the asset, P is the price as a percentage of the nominal amount, C is the coupon and y is the market yield to maturity.

Calculating the duration for a zero coupon bond is straightforward, since there is only one cash flow.

> Example 4 – Calculation of duration
> If we have a five year zero coupon bond that is priced to 70 percent of the nominal amount the yield to maturity is 7.39 percent and the duration is:
>
> Duration = $1/70*(5*100)/(1+0.0739)^{\wedge 5}=5.00$
>
> As we can see from this example the duration for a zero coupon is always equal to the time to maturity.

The duration for coupon bonds is always shorter than the time to maturity since a coupon bond has several cash flows that mature before the final maturity.

> Example 5 – Duration of a coupon bond
> Suppose that an investor holds 100 MSEK of a three-year bond with an annual coupon of 5 percent and that the bond is traded at pari. The cash flows of the bond are shown in picture 6.




***Picture 6: Cash flow from a coupon bond***

> The coupon bond can also be described as three zero coupon bonds that mature with 5 MSEK year one, 5 MSEK year two and 105 MSEK after three years.
>
> Using the above formula, the duration is:
>
> $1/100(1*5/(1+0.05)^1+2*5/(1+0.05)^2+3*(5+100)/1+0.05)^3)$ = 2.86 years

The larger the coupon is on a bond, the more cash flows from the bond are generated before the maturity, and the shorter is the duration. The higher the market interest rate is the shorter the duration is on coupon bonds. This is the case because the present value of remote cash flows will be smaller than cash flows in the near future when interest increases.

One assumption behind duration is that the yield curve is flat and that changes in interest provide a parallel shift in the yield curve. If all cash flows in a portfolio are discounted with the same interest, then the duration is additive, which can be useful when trying to eliminate interest risk.

Suppose that you manage a debt portfolio. If you calculate the duration of all debts then you could also calculate the average duration for the portfolio. If for example you know that the portfolio has a duration of four year then you could easily cover you position by a single transaction. The action when equalizing the duration of assets and liabilities is called *immunization*, since the risk is neutralized[6].

> Example 6 – Immunization of the duration
> An investor holds an equal amount in three bonds with different maturities. The first step is to calculate the duration for each of the positions. Suppose that the different durations are two, four, and nine years. The next step is to calculate the duration for the total portfolio, which in this case is 5 years ((2+4+9)/3). In order to immunize the portfolio the investor can choose to pay fixed interest in an interest rate swap with duration of five years.

It is possible to calculate the duration in the equity through the formula;

$D_A$*Assets = $D_E$*Equity+$D_D$*Debt

Were $D_A$ is the duration for assets, $D_E$ is the duration for equity and $D_D$ is the duration for debt[7].

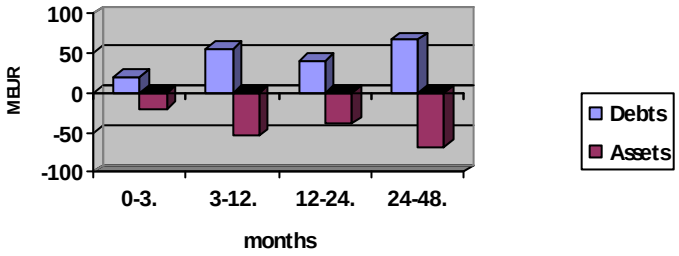
> Example 7 – Duration in equity
> A real estate company has properties which are valued with a discount rate of 8 percent. The duration of the assets is therefore 12.5 years (1/0.08). The properties are financed with 50 percent equity and 50 percent debt. The duration of the debt is 10 years. Using the equation of

[6] Brealey et al, 2008, p. 743
[7] Hägg, 2000, p. 12

above, we calculate the duration in the equity to 15 years ((12.5-0.5*10)/0.5).

Duration calculations assume parallel changes in the yield curve. But, changes in the yield curve`s steepness and its convexity will also create value changes in interest bearing assets. For example, an unexpected interest hike by the central bank will instantly increase the short interest level. The long interest rates will not automatically increase, since the hike might reduce the future inflation expectations.

One way to go around the problem is to use a *duration gap analysis*. Picture 7 describes a bank that has divided the assets into different maturities and then immunized each position. So now the bank is protected also against shifts in the yield curve.




***Picture 7: Duration gap analysis***

If the price formula for bonds is derived in respect of the interest then it is possible to show that duration relates changes in interest to a percentage change in the market value according to the relation:

Percentage change in market value = duration/(1+y)*Δy.

Where y is yield to maturity and Δy is change in yield to maturity.

This change expressed in percent is called *modified duration*.[8] It is useful to know the modified duration of a bond or a portfolio of bonds. If you get the information of an interest rate change then you could approximately calculate how it affects the value of you positions.

Example 8 – Modified duration
If we apply the formula of modified duration on the earlier example of the three-year bond, we could calculate how much the value of the bond changes in value as a result of a one-percentage increase in the interest level

[8] Söderlind, 1996, p. 5

Duration/(1+y) * interest change = 2.86/(1+0.05) *0.01=2.72 %

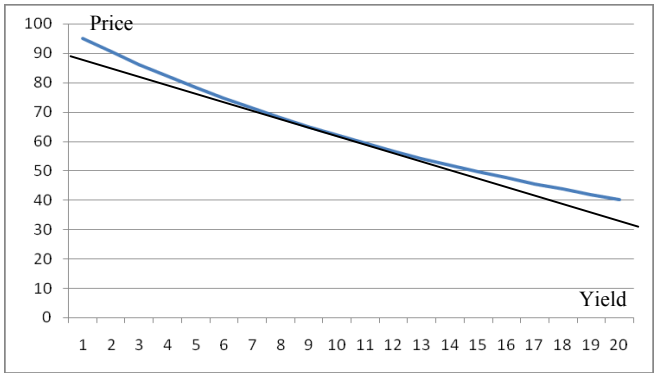
A well-used term to describe how much a basis point (BP) change in the yield will affect the price of a bond is *price value per basis point* (PVBP).

PVBP = modified duration * 0.01 % * P

Where P is the price of a bond.

If you own SEK 100 million of a bond with a modified duration of 2.72 percent, then the PVBP is SEK 27 200.

It is worth mentioning that duration, modified duration and PVBP only give a good approximation for interest changes up to 0.40 percent[9]. This is because the bond price is a non- linear function of the interest, and a linear approximation will be worse the greater the interest change is[10]. In picture 8 the blue line represents the price for a five year zero coupon bond.




***Picture 8 – Price of a bond for different yields***

Interest rate risk is often described as the standard deviation of the interest rate level. As short term interest rates are more volatile than long interest rates one could come to the conclusion that buying long bonds is less risky than buying short bonds. However, that is not the case. The value of long bonds is much more sensitive to changes in the interest rate than short interest bonds. The reason is that the present value of distant cash flow is much more dependent on the discount rate.

Example 9 – Interest sensitivity and duration
Let us see how the values of bonds change with the interest. Assume that we have zero coupon bonds that mature in one, five and ten years and that they are yielding

[9] Hässel et al, 2001, p. 390
[10] Nyberg et al, 2006, p. 208

five percent, which is equal to the current market yield. If a sudden increase in rate of 0.3 percent occurs, the value of the bonds will change in accordance with picture 9. As we can see, longer bonds are more sensitive to changes in the interest rates.

| Maturity (years) | Current yield | Current price | New yield | New price | Price change |
|---|---|---|---|---|---|
| 1 | 5.0% | 95.2% | 5.3% | 95.0% | -0.3% |
| 5 | 5.0% | 78.4% | 5.3% | 77.2% | -1.4% |
| 10 | 5.0% | 61.4% | 5.3% | 59.7% | -2.8% |

***Picture 9 – Interest sensitivity for different durations***

This shows that it is better to describe interest risk as the standard deviation on the price of bonds. Studies have shown that the interest risk on long bonds is higher than the interest risk of short bonds[11]. This also explains why the yield curve on average should have a positive slope. If the interest risk increases with time, then the investors will demand a risk premium that will increase with the investment period.

In addition, the interest level influences the interest rate risk. In picture 10 the yield increases with one percentage point and we can see what the value change is for the bonds that initially had two, four, and six percent interest. We see that the sensitivity to an interest increase is higher for bonds with low interest. However, the risk is usually partially offset by the lower variation of interest rates on low yield bonds.

| Maturity (years) | Current yield | Interest increase | New yield | Price change |
|---|---|---|---|---|
| 10 | 2% | 1% | 3% | -8% |
| 10 | 4% | 1% | 5% | -6% |
| 10 | 6% | 1% | 7% | -5% |

***Picture 10 – Interest sensitivity and interest level***

Analysing the duration is very useful for understanding how your equity is affected by parallel shifts in the interest rates. The main disadvantages when using duration as a risk measurement is that it is only valid for small interest changes and that it is hard to include products such as interest rate options in the analysis.[12]

[11] Hässel et al, 2001, p. 390
[12] Söderlind, 1996, p. 67

**Discovering the probability of interest changes**
So far we have calculated how much an interest rate change affects the value of a portfolio. To get the total picture of the risks in a portfolio we must try to calculate the probability of an interest change[13].

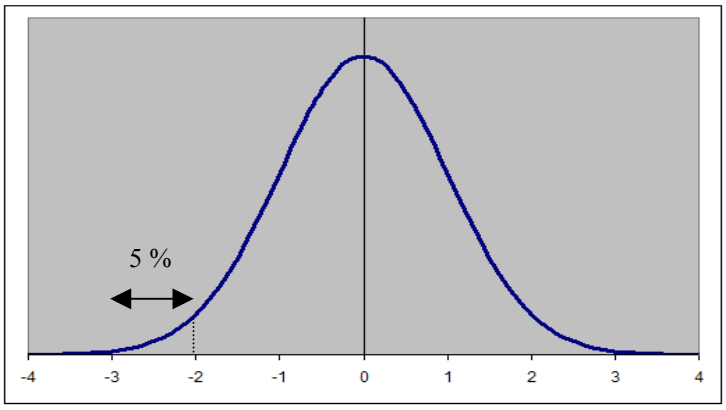
*Value-at-Risk* (VAR) is a risk measure that covers both the sensitivity of the market value and the probability of interest rate changes. VAR is usually described as the possible loss (gain) in a position given a certain probability and during a certain period of time. [14]

> Example 10 – Value-at-risk
> An investor holds a portfolio of long bonds. The value is 200 MEUR and the value will change with 0.2 MEUR if the interest changes 1 BP. If the most likely interest rate change during a day is 5 BP, then the VAR for this period would be 1 MEUR.

The first step when calculating VAR is to find the volatility of the risk factor, which in this case is the interest rate level. Historic data or simulations are usually studied and used to calculate the volatility. The larger the movements a certain factor has, the higher the volatility. If we use the modified duration for an asset we can transform the volatility of the risk factor to the volatility in the price of the asset.[15]

The next step is to choose a confidence interval for the risk factor, which in the standardized normal distribution has a certain number of standard deviations. For every confidence interval there is a value, a confidence level, for example 95 percent. A confidence level of 95 percent states that the probability is 95 percent that the true value for the risk factor is within the confidence interval. Picture 11 shows a normal distribution. The five percent of the most unlikely negative outcomes are shown in the picture.

[13] Nyberg et al, 2006, p. 205
[14] Söderlind, 1996, p. 68
[15] Söderlind, 1996, p. 74




***Picture 11: Example of a normal distribution***

VAR for a specific period can be calculated through the formula:

VAR = C * V * MV

Where C is the number of standard deviations for a confidence interval, V is the price volatility and MV is the market value of the assets.

The period for which VAR is calculated could be one day or longer. A short period is useful for investors with huge trading portfolios, while a longer period is used when analyzing the risk in strategic positions.

**Simulation of market value**
So far we have calculated the interest risk on the value by using duration calculation and by trying to find out the probability of a value change by using VAR-analysis. The next step is to simulate the value of assets in different scenarios.

The four most commonly used techniques in simulating the market value are[16]:

- Stress tests
- Historic simulation
- Monte Carlo simulation
- Binary search tree

When doing *stress tests* the current positions in the market are stressed by simulating large changes in the interest rate. We could for example try to find out what happens with the market values if the short-term interests increase by five

[16] Söderlind, 1996, p. 92

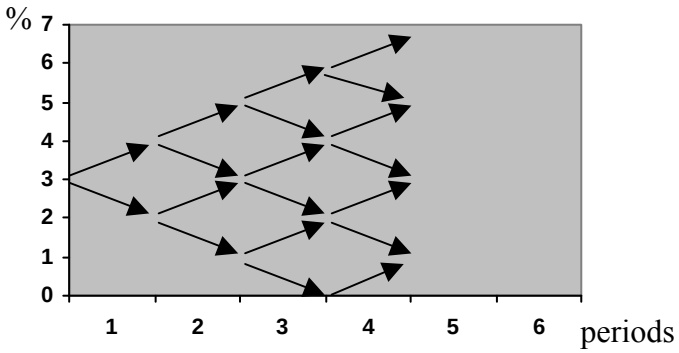
percentage points, or what occurs if the long term interests rates decrease by three percentage points.

A problem with stress tests is choosing the major market changes that the company should be able to cope with. One risk is that the company's risk policy is set in order to cover very remote risks, and by doing that the company may act too conservatively.[17]

In *historic simulation* we use the historic data of the interest development and run it on the current portfolio. It is important to choose a series of interest observations that are representative of the current situation.[18] The historic observations are used to create a normal distribution, which in turn is used to calculate VAR.

Instead of using historic data to create a normal distribution we could create a model of the interest rate changes and run the model trough a computer in order to get many random observations. This method is called *Monte Carlo simulations*.

Another way to simulate the interest movements is to use a *binary search tree*. The start is the current interest level and for each following period the interest could go up or down. How large the movements are for each period depends on the assumed variance. The different possible paths of the interest rate create a tree. If many periods are calculated the possible outcomes create a normal distribution.[19]




***Picture 12 - Example of a binary search tree***

Each of the techniques for simulating interest rate risk on assets has its advantages. A good idea is to combine the different methods. For example, VAR based on Monte Carlo simulations could be the main tool for calculating the most probable value change in a portfolio. To see how the values change as a result of large market movements, a stress test

[17] Söderlind, 1996, p. 92-93
[18] Nyberg et al, 2006 p. 232-233
[19] Wikipedia, 2008

could be a useful. Dramatic events from history could be used in the stress test.

# Interest rate risk strategies

After the company has measured the interest rate risk in the result and on the balance sheet it must decide how to act. There are four ways to address the interest rate risk:

- avoiding
- accepting
- hedging
- diversify

## Avoiding interest rate risk

Avoiding the interest rate risk is always the first option in any business situation, unless the core business of the company is to make profits on interest rate risk. For companies the interest rate risk is usually incidental to the ordinary business. [20]

Even though risk avoidance is the company's preferred strategy it may not be wise to follow it too rigidly. There might be situations where it is advisable to employ other strategies.

> Example 11 - Avoiding interest rate risk
> Before Bank A lends out money to real estate companies it demands that its clients must hedge the interest. With this rule the bank avoids the risk that customers are not able honour the loan agreement due to a large interest increase. If the interest rate increases, it is likely that property values decrease, which may cause the bank a possible loss if it has to take over the security.
>
> By using this interest hedge rule in all cases the bank may lose some customers who, for some reason, do not want to hedge the interest rate risk. Therefore, by avoiding risk the bank may also exclude some possible customers, which will reduce revenues.

## Accepting interest rate risk

The general rule is that interest rate risk should only be accepted if the risk is not cost effective to manage or run for the sake of profit. It is worth mentioning that non-financial companies should not try to make profit out of interest rate risk in the ordinary business.

The daily business in a company creates many small or medium sized risks. Hedging, avoiding or diversify them is almost

[20] Stephens, 2002, p. 15-16

impossible. There are also external and internal costs that must be considered when trying to cover interest risk. The benefit of the measure might be smaller than the cost of achieving it. Therefore, the company should accept that it is impossible or not cost efficient to cover all small or medium sized risks that are created.

The company should instead make efforts to investigate what the major risks are and decide on how to deal with them. It goes without saying that risks that are a threat to the company must be covered.[21]

The personnel in the company must be able to take correct decisions when risks should be avoided, accepted, or hedged. The staff must also know about the essence of timing and have knowledge about what kind of hedging instrument that is favourable during the current market conditions.

There are however theories that companies should accept interest risk and that increasing or decreasing risk creates no value to the company. In 1958 Miller and Modigliani published a paper which started the debate. They argued that the value of a company is only determined by its operations and real investment decisions. The value is independent by the capital structure, how the company finances the investments and also if the company hedges its risks or not. [22]

The idea is that investors can conduct appropriate actions themselves and that they will not pay a premium for a company when they can create the value by making own adjustments.

It may be so that large and active investors are much better suited than the company to take correct actions. The investors could have the possibility to follow and analyse the markets in a better way and could have a team of highly skilled personnel, which on average make better decisions than the company. The opposite could be said in regards to small and/or passive investors. They might not have the ability, knowledge, or desire to hedge interest risk.

In order for investors to make correct decisions the company must provide correct and immediate information to the market in regards to its positions. In most cases the managers within a company have much more information than a person outside the company.

[21] Stephens, 2002, p. 16-17
[22] Stephens, 2002, p. 24

## Hedging the interest rate risk

Avoiding a risk and hedging a risk is not the same thing. When you hedge you take on an additional risk that is negatively correlated with the initial risk, so that your net position is risk-free.[23]

The arguments for hedging are obvious. Most companies have a core business in which they have certain knowledge. At the same time the companies may lack expertise in predicting variables such as the interest rate level. It makes sense for them to focus on the things were they have an edge.

Hedging may not be appropriate if the norm in a certain industry is to be unhedged. Then the competitors will be hit by the same price changes and they will all increase their prices in order to keep the current profitability. If a company acts opposite to the norm it will be able to increase the profitability when the interest rates go up and will face low profitability when interest rates go down. Therefore, in this case the company's result will be more volatile when trying to hedge.[24]

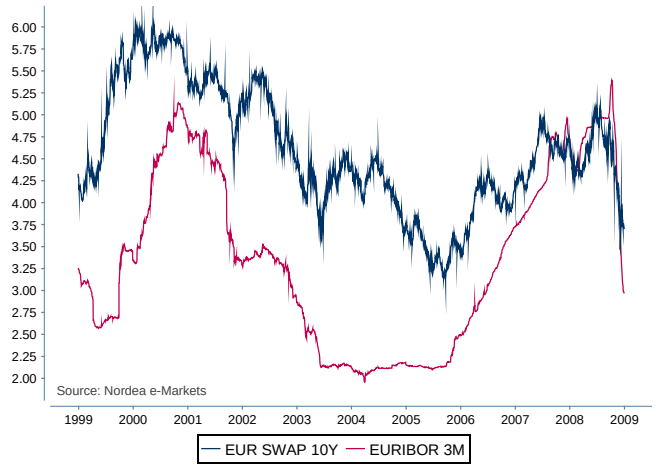
Fixed interest rates are well liked by conservative managers since it makes it easier to calculate the future interest cost and to achieve the forecasted results. Limiting the interest rate risk will also reduce the risk for financial distress. These costs are usually much higher than the benefit for the company when interest moves in a favourable way.

Another argument for hedging is that a company may be forced to hedge when it is unfavourable to do so. Then it may be better to hedge when the pricing is good. Assume that a real estate company only uses loans with floating interest and has negotiated long term funding with a bank on very good terms. Then the interest suddenly increases sharply and the company violate the interest rate cover agreement in the loan documentation. The company may be forced to accept higher margins due to the increased financial risk and the bank may demand that the interest rates must be hedged. Because of this sudden peak in interest, the company is forced to lock in high financial costs for many years.

Picture 13 shows the interest rates for 3 months Euribor and 10 year EUR swap rate during the last ten years. Empirical studies also show that, over time, long interest rates are more expensive than short interest rates.[25] This implies that companies which use fixed interest rates will on average pay higher interest. This

[23] Stephens, 2002, p. 18
[24] Hull, 2002, p. 50
[25] Nyberg et al, 2006, p. 154

effect is to some extent offset by the lower prices conservative companies get from business partners, such as banks. When the risk is lower the bank offers better prices. Furthermore, attractive companies may have the possibility to choose between more banks and as a result be able to negotiate better terms.




***Picture 13 – Short (Euribor 3M) and long (EUR Swap 10y) interests rates during the last ten years***

A company's main objective is to earn as much money as possible given a certain risk-profile. In a company there is usually a trade-off between risks. By using fixed interest a company may be able to use a higher leverage without taking too much risk. The extra cost for fixed interest rate may be small in comparison to the benefit that comes with high leverage.

The market value of a company is the net present value of all expected cash flows. When risk in the company is lowered through risk management, the investors should request a lower risk premium. Using a lower interest rate when discounting future revenues will increase the value of the company.[26]

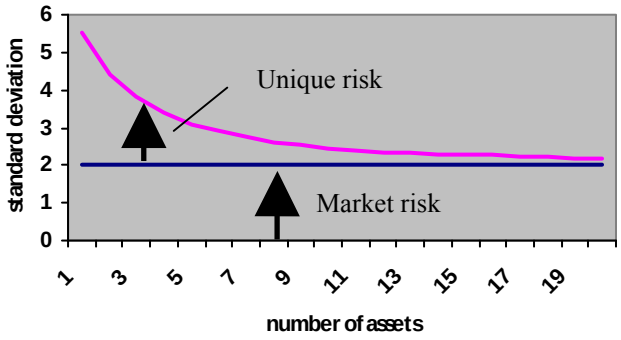
Finally, it is important to point out that before a hedging program is launched by a company, there must be adequate knowledge within the company to manage it. The ideal situation is that the board set up a financial policy which describes the risk that should be hedged. This policy should be communicated to the owners, the management and to the market.

## Diversify the interest rate risk

Diversification of investments gives a portfolio less variability, since the individual assets in a portfolio do not move in the same direction. The risk that can be eliminated through diversification is called *unique risk*. In picture 14 we can see how the risk

[26] Stephens, 2002, p. 25-26

decreases with the number of assets in a portfolio. Risk that cannot be reduced is called *market risk*.[27]




***Picture 14 – Risks given different number of assets***

Historically there have been many mistakes as regards to diversification of interest rate risk. There has been an over optimistic view on the effect of diversification. Interest rate risks are mainly market risks, and can therefore only to some extent be eliminated by diversification.

> Example 12 – Systematic risks
> A mortgage bank lends money to real estate companies with a loan to value of 90 percent. Instead of demanding that the customers fix the interest, it tries instead to lend out a small amount to many clients. The idea is that diversification will almost eliminate the interest rate risk. However, all companies with unhedged interest rate risks will be hit at the same time if the interest rate suddenly increases dramatically. Many small losses will accumulate to a major loss for the bank. Not understanding which risks that are systematic may therefore result in a really serious problem.

Usually is it easier for an investor to achieve lower risk through diversification, this is because they can buy a small amount of bonds in many companies. A borrower, for example a large real estate company, only has limited possibilities of reducing the risk through diversification. Borrowers can to some extent diversify the risk, by issuing debt to different markets.

[27] Brealey et al, 2008, p. 186-189

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