Interest Rates and Derivatives

Sandra Kudlacek, 2008-10-02

Interest Rates and Bonds

Introduction to Interest Rates

Interest is a “fee” that a borrower pays to the lender as a compensation for foregoing investments that could have been done otherwise – the *opportunity cost*. In other words, it is the price of credit. The “fee” expressed as a percentage of the borrowed capital is called the *interest rate*.

Short term interest rates have a maturity of up to one year and *long term* interest rates have a maturity of more than one year.

The *nominal* interest rate is the interest before adjustment for inflation. The *real* interest rate on the other hand is adjusted for inflation and thus includes compensation for the lender's lost value due to inflation. The real “fee” that the lender receives from the borrower is the real interest rate.

The relationship between real and nominal interest rates can be expressed with the following equation[1]:

$R = (1+r)*(1+i)-1$

where R is the nominal interest rate, r is the real interest rate and i is the inflation rate.

Usually this equation is approximated as:

$R = r + i$

Future inflation is uncertain and can only be estimated. Therefore the expected real interest rate might differ from the actual real interest rate.

Since inflation is unknown, an investor will demand an inflation premium, especially for longer maturities. There is also a liquidity risk, which signifies the risk that a security cannot be traded quickly enough on the market to prevent a loss or to be

[1] Principles of Corporate Finance, Brealy, Myers, Allen, p. 76

transformed into liquid assets. The credit risk is the risk of the interest rate payments of a loan not being made or a loan not being repaid at the end of its maturity. These two latter risks imply that institutions or companies with lower credit rating will have to pay a higher risk premium than those with high credit rating. Bonds and bills issued by the government don't have a premium for this, since the liquidity risk is assumed to be nonexistent.

The risk free interest rate is a concept in theory, but does not really exist in reality.

The Yield Curve

The *yield curve* of interest rates is an important concept to understand when talking about interest rates with different maturities. This curve describes the relationship between interest levels and their maturity. Curves can be constructed for each type of different debt instruments. Since there are only a limited number of maturities for a certain set of debt instruments, not every single possible maturity is known. These points on the curve have to be estimated. Because of this estimation, the curve has an even shape. There are several techniques for constructing a yield curve, but the description of these techniques are beyond the scope of this report. The important thing for now is to understand the implication of yield curves.

The curvature is "normal" when interest rates increase with maturity. Since the uncertainty grows with longer maturities, the risk premiums are higher the longer the maturity. When the curve is inverted, i.e. interest rates with shorter maturities are higher than those with longer maturities, the short term interest will ultimately decrease. This can be explained by the expectations of future interest rates that are implied in the long term interest rates. In times when long term interest rates go down and tend to be lower than short term rates, it shows that the expectation is that interest rates will go down. Eventually the yield curve will be tending upward with increasing maturity.

Today (i.e. September 18th, 2008) the yield curve in Swedish kronor (SEK) is inverted as shown in the chart in figure 1. Looking back one year, one can see that the yield curve had a more "normal" type of curvature – as shown in the figure 2 chart.

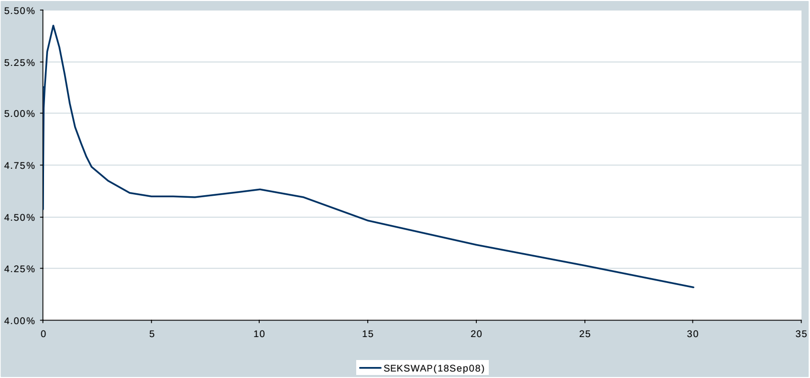

Figure 1: SEK-swap yield curve September 18th, 2008

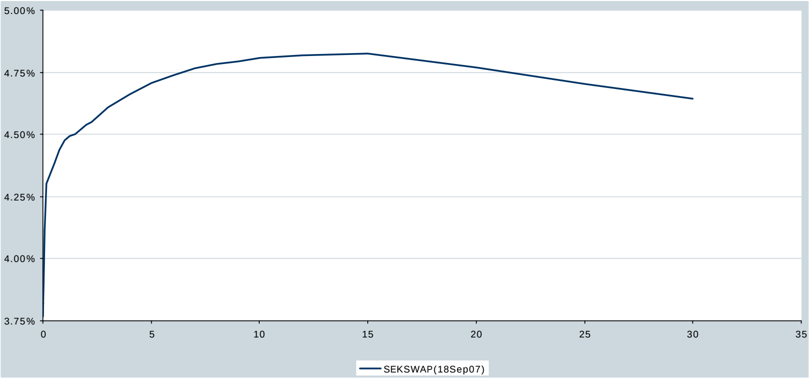

Figure 2: SEK-swap yield curve September 18th, 2007

The Swedish Repo Rate and the Role of Key Interest Rates of other Central Banks

The most important key interest rate of the Swedish Riksbank (Sweden's central bank) is the *repo rate*. It is used for monetary policies. The term *monetary policy* refers to the actions undertaken by a central bank, such as the Swedish Riksbank, to influence the availability and cost of money and credit to help promote national economic goals. The main goal of the Riksbank is keeping the inflation between 2-4 percent. From 1985 to 1994, the margin rate was the key rate and was substituted by the repo rate, the deposit rate and the lending rate.[2]

The word repo rate is derived from ”repa” which is Swedish slang for ”repurchasing agreement”. Banks can borrow or deposit funds at the Riksbank at this rate for seven days. When banks deposit funds overnight, they can do it at a rate that is 75 basis points (1 BPS = one hundredth of one percent) lower than the repo rate. This is the *deposit rate*. Accordingly, banks can borrow funds overnight at a rate that is 75 BPS higher than the repo rate, i.e. to the *lending rate*. The repo rate since 1994 is shown in figure 3.

[2] www.riksbank.se, 2008-09-18

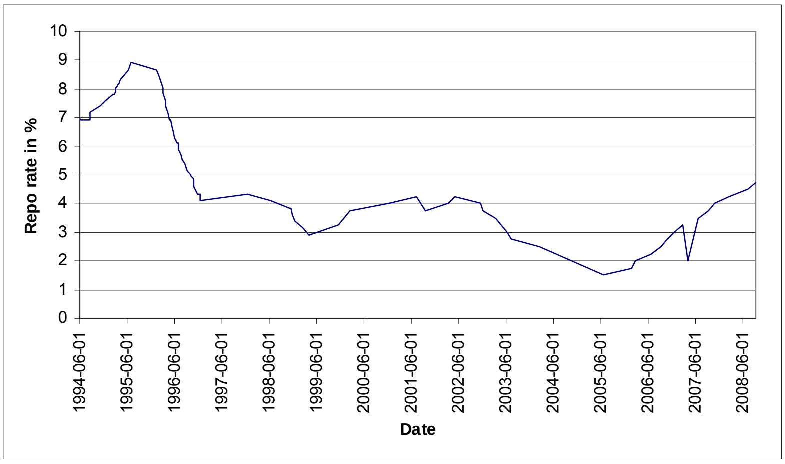

Figure 3: The Swedish repo rate from June, 1994 to September, 2008

All the central banks have their own key interest rates. For example, the ECB uses the refinance (refi) rate[3] and the American Fed uses the discount rate[4] as one of the tools for monetary policy. Using only one key interest rate for signalling the intentions of the central bank is preferred, since it is easier for the market to interpret the intentions with only one figure to look at. Multiple key interest rates increase the flexibility of the central bank. At the same time, this might confuse the market and lead to incorrect interpretations of the central bank's intentions.

The possibility for central banks to govern the interest rate of the economy depends on their position to issue money. Simply put, this means that when there is a demand for bank notes and coins, the central bank can supply the banks with this in exchange for claims against the banks. If the central bank has a monopoly on issuing money, it is able to decide on the interest rate on these claims. The central banks also determine the conditions for lending, which is usually an overnight rate, i.e. the interest rate from one day to the next.[5] By changing the conditions under which the central bank is willing to enter into transactions with banks, the central banks signal its monetary policy to the market.[6]

To sum up, the central banks have two different means to the interest rates: either by managing liquidity or by signalling its monetary policy to the market.

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[3] www.ecb.int, 2008-09-18
[4] www.federalreserve.gov, 2008-09-18
[5] De finansiella marknaderna i ett internationellt perspektiv, Hässel, Norman, Andersson, p. 61-64
[6] www.ecb.int, 2008-09-18

Reference Rates

A *reference rate* is a rate that two or more parties involved in a transaction have no influence over. It is, however, an independent rate that cannot be manipulated by either of the parties. The most common reference rates are the inter-bank rates, i.e. the interest rate charged on short term loans between banks. Banks borrow funds from each other (when they have a shortage of money) and deposit funds to each other (when they have an oversupply), thus managing their liquidity. The level of the inter-bank rate depends on the availability of funds on the market, other prevailing interest rates, such as the key interest rates of the central banks, and on the maturity.

All larger financial markets have an inter-bank rate. In Sweden this rate is called STIBOR, which is short for Stockholm Interbank Offered Rate. There are various maturities: such as one day, one week, one month, three months, etc. up to one year. Three month STIBOR, for example, is an average of all the interest rates that banks offer to each other for borrowing in SEK with a maturity of three months. The fixing of the rate is the average, excluding the highest and the lowest quote, and is published every business day at 11 a.m.

Examples of other inter-bank reference rates:

- EURIBOR - Euro Interbank Offered Rate
- LIBOR - London Interbank Offered Rate
- SIBOR - Singapore Interbank Offered Rate
- TIBOR - Tokyo Interbank Offered Rate

As described earlier in this report, banks can borrow money from the Riksbank, paying 75 BPS over the repo rate, or deposit money, receiving the repo rate less 75 BPS. Since the spread is quite high, banks prefer to do these placements with each other. The interest paid or received is the over-night (O/N) interest rate. There is no fixing for STIBOR O/N. For EURIBOR and USD LIBOR on the other hand, there are fixings for the O/N rates. The shortest STIBOR is the STIBOR T/N, where T/N stands for tomorrow/next: i.e. starting from tomorrow to the day after.

Treasury Bills, Government Bonds and other Bonds

The government issues short term debt instruments (with maturities of up to one year) called *treasury bills* or government bills to finance its short term borrowing needs. The instruments are denominated in the country’s own currency. Bonds issued by the government in a foreign currency are called sovereign bonds. Treasury bills are zero coupon bonds, which are bonds with no coupon payments. The interest of a zero coupon bond is capitalized throughout the maturity of the bond. A zero coupon bond is issued at a price lower than its face value and redeems at its face value at the end of maturity[7].

Government bonds correspond to the medium to long term borrowing needs of the government. In Sweden, these bonds are issued by the Swedish National Debt Office (Riksgäldskontoret). The bonds are coupon bonds, where a coupon interest rate is paid every year until maturity. There are also *inflation-linked* government bonds, which are adjusted for inflation. They have a fixed real interest rate plus a compensation for the actual inflation. This implies that any inflation cannot lessen the value of the investment.

Government bonds and treasury bills are usually referred to as risk-free bonds, because the government can raise taxes or issue more banknotes and coins to redeem the bond at maturity. Therefore the interest rate on these instruments can be seen as almost risk-free. An investor investing in, e.g., shares will therefore demand a risk premium for taking a risk by investing in a company rather than in the government.

In Sweden, it is the Swedish National Debt Office that issues treasury bills and government bonds. The fixing rates for the instruments are quoted daily at 11 a.m.

Among public promissory notes we find *mortgage bonds* that are issued by mortgage institutions to finance their long term mortgage lending. Swedish mortgage institutions include SEB Bolån, Spintab, Stadshypotek and SBAB. The definition of a promissory note is, simply put, a promise of the borrower to repay the loan under certain agreed-upon terms. Mortgage bonds are usually structured as coupon bonds.

Companies that need short term money can issue *corporate certificates* on the money market. For medium to long term funding, companies can issue *corporate bonds*. The collateral for these instruments is usually the payment ability of the company, which is expressed through the rating of the company. Also the physical assets of the company can be used for this purpose. Since these instruments are more risky to invest in than treasury bills and government bonds, investors will demand a risk premium, which results in higher interest rates.

[7] For calculations of the price and face value of bonds, please see “How to Calculate the Price of a Bond”, p. 8

Simple, Effective and Nominal Interest Rates

To better understand the difference between simple, effective and nominal interest rates, let's start looking at zero coupon bonds and coupon bonds.

The rate of return on an investment in a zero coupon bond is as follows[8]:

$$R = (P_b - P_s)/P_b$$

where R is the rate of return or the *nominal interest rate* on the zero coupon bond, P_b is the purchase price and P_s the selling price. If the zero coupon bond is held until maturity, the selling price will be the same as the face value. This calculation implies that there must be an infinite number of rates of returns, i.e. one for each maturity (one day, two months, two and a half months, one year, etc.). To make the rates for different maturities comparable, the rates of return are given as annual rates of return. In Sweden, all zero coupon bonds are published at *simple interest rate*, which is a rate of interest for a given period, calculated as a straight rate, in contrast to compound interest. It is calculated as follows[9]:

$$r_s = R*360/d$$

where r_s is the simple interest rate, R the nominal rate of return and d the number of days that the bond is kept.

One could also calculate the interest rate as an *effective interest rate* where the return is calculated as compound interest.

The effective interest rate is the rate that is the result of the annually compounding nominal interest rate. It is useful when comparing e.g. loans with different compounding (daily, weekly, monthly, quarterly etc.).

The effective rate is calculated as follows[10]:

$$r_e = (1+R)^{d/360}-1$$

where r_e is the effective interest rate, R the nominal interest rate and d the number of days (e.g. 90 days/360 days = quarter of a year = 0.25 years, which means 4 compounding periods in a year).

[8] Penningmarknaden, Nyberg, Viotti, Wissén, p. 16
[9] Penningmarknaden, Nyberg, Viotti, Wissén, p. 18
[10] Penningmarknaden, Nyberg, Viotti, Wissén, p. 19

When compounding reaches infinity (when a loan is compounded continuously) the formula is[11]:

$r = e^R-1$

where e is approximately 2.718, which is the base for the natural logarithm. This formula is only of interest in a theoretical perspective, when deriving different formulas, e.g. Black & Scholes option formula[12].

In Sweden, coupon bonds are quoted as effective interest rates.

As we can see from our calculations, nominal interest rates are only comparable when the compounding period is the same. Otherwise the interest rate must be converted into simple or effective interest rates.

It is also possible to convert simple interest rates to effective interest rates or vice versa by using the following formula:

$r_e = (1+r_s*d/360)^{360/d}-1$

simply by replacing R in the formula for effective interest rates with $r_s*d/360$ derived from the formula used for simple interest rate calculations.

To sum it up, the nominal interest rate is the interest rate for each period times the number of periods per year. For example, if the annual nominal interest rate is 6 percent, then, monthly compounded, the interest rate per month is 0.5 percent. To calculate the effective interest rate, one has to know the frequency of compounding, i.e. the number of periods. As opposed to nominal interest rates, effective interest rates are comparable regardless of compounding periods. The effective interest rate is the nominal interest rate converted into annual compound interest. Simple interest is interest that is not compounded. It is always based on the original principal, not calculated on earned interest.

How to Calculate the Price of a Bond[13]

We now know how to calculate the return of a bond. But how are prices of bonds calculated? The price of a bond consists of discounted future cash flows.

For a coupon bond the equation is therefore:

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[11] Penningmarknaden, Nyberg, Viotti, Wissén, p. 48
[12] Will not be discussed in this report. For more reading on this topic, see Options, Futures and other Derivatives, Hull, Chapter 11, p. 237-272
[13] Principles of Corporate Finance, Brealy, Myers, Allen, Chapter 4, p. 59-84

$P = \sum C_t/(1+y)^t$

This formula is also known as the discounted cash flow (DCF) formula, where P is the price of the bond (or the present value of all cash flows), C_t the cash flow at time t and y is the yield to maturity (or the interest rate on the coupon bond, nominated as an effective interest rate). For a coupon bond, the cash flows for the different periods are the same with the exception for the last period which consists of the coupon plus the face value. An example of cash-flows of a coupon bond is shown in figure 2.

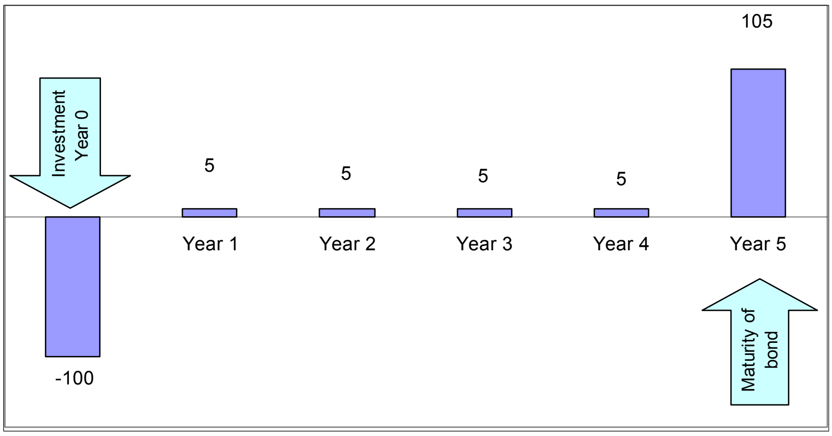

Figure 4: Example of cash-flows of a coupon bond

For a zero coupon bond, only the face value is discounted to its present value, since there are no coupon payments. The only payment is at the end of the maturity. Thus, the equation is:

$P = C_t/(1+y)^t$

where C_t is the cash flow at time t, i.e. the face value at maturity. The cash-flows of a sample bond are shown in figure 5.

Figure 5: Example of cash-flows of a zero coupon bond

Example 1: Let's assume that the issuer of the bond wants a loan amounting to 100 million (m) SEK for five years. The issuer is willing to pay 5 percent interest for this. The face value that has to be repaid after five years is thus 100m SEK*$(1+5\%)^5$=128m SEK (see figure 5). In this case, the company issues a zero coupon bond. Since interest is capitalized, interest is paid on interest. The alternative is to issue a bond with a yearly coupon and thus pay 100m SEK*8%=5m SEK annually for five years (see figure 4). When discounting the coupons, this should result in the same face value.

Day Count Conventions

The day count convention system is used to determine the number of days between two interest rate payments. In other words, it specifies how to count the number of days between two dates and how to calculate the size of an interest period. The conventions have different assumptions on the number of days in a period and the number of days in a year.

The four most common day count conventions are the following:

- 30/360: Assumes that there are 30 days in a month and 360 days in a year.
- Act/Act: Uses the actual number of days in the period and the actual number of days of a year.
- Act/360 and Act/365: Is the actual number of days in the period divided by either 360 or 365, assuming that a year has either 360 or 365 days.

It is important to know which of the day count conventions that is used when comparing different bonds. A bond with interest rate payments based on 30/360 and another based on Act/360 does not result in the same effective interest rate, even though they have the same nominal rate.

Interest Hedge and Derivatives

Interest Hedge Strategy

The dilemma in making *interest hedge decisions* is the different angles of interest risk. It is defined as the risk that changing interest rates causes a negative effect on the result or on the net interest cost of the company. From this definition one could make the false conclusion that simply having fixed interest rates would solve the problem. But what if a company locks in interest rates for long periods and the market interest rate suddenly drops? Having to deal with high levels of interest rates compared to the market could be as troublesome as the opposite situation.

Over the years, the average of floating interest rates has been lower than fixed rates as shown in the chart in figure 6, where 3 month STIBOR is compared to 5 year SEK Swaps, both expressed as annual rates.

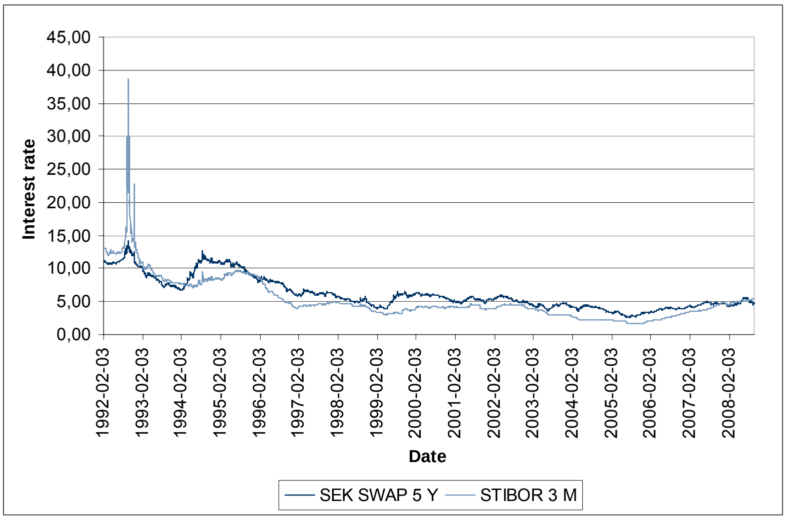

Figure 6: 3 month STIBOR and 5 year SEK Swaps expressed in annual rates, February 1992-September 2008

With this in mind, it is very tempting to stick to floating rates only on all your loans. But can the company manage the "highs"? As shown in chart 4, the floating rate was significantly higher than the fixed rate at the beginning of 1992. In 2008 we can see the same tendency, but not at the same extent (not yet at least). The strategy that you have to decide on has to keep interest costs and risk within desired levels, so that a company can survive even if the market booms. This sounds fairly straightforward, but is a much harder exercise than it would seem at first glimpse.

How do firms chose their strategy then? You have to consider the following:

- Match the interest bearing assets to the debts in the balance sheet in order to reduce interest risk.
- Create different interest rate scenarios, i.e. quantify the interest risk. Link the effects of the different scenarios to financial key figures and see how they change.
- Benchmark your company to other companies in the same branch. What is their strategy? Are they doing well? If your strategy differs from others, do you have a good and rational reason for that?

We do also have to remember the risk profile of the owners and investors. The result of higher interest hedge is less fluctuation in equity. Even if interest hedging costs, banks and financial institutions will require smaller margins for their lending if the company is stable, which reduces the cost of funding. Less fluctuation also means that the owners will receive stable dividend payments over time.

After having made the analysis of the risk profile, you have to define your goals:

- *Duration/average interest hedge*. This is a good goal when matching the maturity of the assets. It is easy to use, but might be a little too simplistic, because it does not show how the interest cost changes over time. An average duration of, e.g., five years could be the result of many different interest hedge structures. For example, a large share of floating rate and a small part of longer maturity could produce a duration of five years, as could a portfolio with smaller part of floating and a large part of medium term maturities.
- *Limitation of the share of floating interest rate*. This goal attempts to minimize effects of changing market interest rates, in assuming that a smaller share of floating rate is less sensitive to changes and thus more constant over time. But in and of itself, this is not a good goal either.
- *A combination of the two goals*. This would be the preferred goal, since when the duration goal is insufficient, the goal of limited floating interest rates can step in and vice versa.

When discussing interest rate risk, it is important to distinguish between credit risk and market risk. *Credit risk* stems from the possibility of default of the counterparty in a derivative or loan transaction whenever the value of the contract is positive. *Market risk* on the other hand, is the risk that arises from the possibility that interest rates and other market variables will shift, so that the contract will have a negative value. The good news is that market risk can be hedged through the use of derivatives. The bad news is that credit risk is less easy to hedge.

Why Use Derivatives?

The advantage of derivatives is that you can change the interest hedge without changing the credit structure, i.e. the maturity of the loans. The most common approach for companies is to have long credit agreements with a floating rate combined with derivatives to regulate the maturity of the debt portfolio. Not only is this approach flexible, but the use of derivatives also gives you effective pricing, because of the many parties involved in the pricing of the instruments.

Furthermore, if there is a financial crisis, banks often have liquidity problems. This implies that banks are not willing to lend long term funds, or only willing to do so at very high prices because of the liquidity premium, since they might need the money themselves. Therefore there might not be an alternative to loans with a floating rate. Companies then have to use derivatives to change the interest hedge.

Interest Rate Swaps - IRS

The most common *interest rate swap,* or IRS, is the *plain vanilla* interest swap. Without paying the underlying nominal amount, exchanges of cash flows are made between two parties. In the case of an IRS, the parties exchange interest rate payments. One party pays fixed interest rate and receives a floating interest rate and the other party pays a floating interest rate and receives a fixed interest rate. The cash flows are shown below in figure 7.

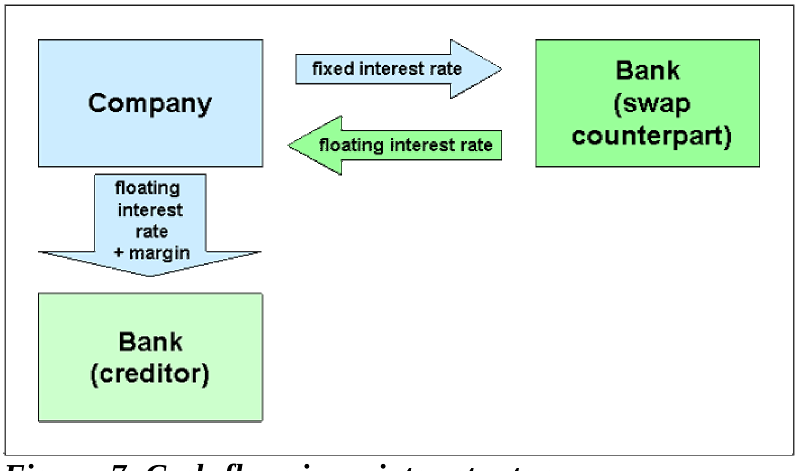

Figure 7: Cash-flows in an interest rate swap

> *Example 2:* Let's say that a company has a loan of 100m SEK with a floating interest rate of 3 M STIBOR plus a margin of 60 BPS, but wishes to increase the interest rate maturity of the loan to 10 years. Party A can then enter a 10-year IRS with the bank. The company pays, e.g. a 5 percent fixed interest rate on 100m SEK quarterly for 10 years to the bank, while it receives 3 M STIBOR. Note that the 100m SEK nominal amount is not traded between the parties. The floating interest is therefore netted and all the company pays is 5.6 percent (the fixed rate plus 60 BPS margin).
>
> *Example 3:* Let's change the example somewhat. If the company pays the quarterly base interest rate of the bank instead of STIBOR on the loan, even greater savings can be made. The base rate of the bank is usually lower than STIBOR. In our example, the base rate is 20 BPS lower than STIBOR on average. This means that the company only pays 5.4 percent (the fixed rate plus 60 BPS margin minus 20 BPS for paying the base rate but receiving STIBOR).

The advantage of using interest rate swaps instead of fixed loans with longer maturities is that the IRS is more flexible. The interest hedge structure can be changed whenever needed. Also the number of loans can be reduced, since one bigger loan with a floating rate can be hedged through a number of IRS with different maturities. Another advantage is that positive market values of the swaps can be made use of. This would be possible with fixed loans too, but more costly to realize. Last but not least, using different types of derivatives (described in the paragraphs below), can reduce the interest rate costs.

Caps and Floors

A cap and a floor can both be seen as interest rate insurance. To hedge your loan portfolio against rising interest rates, you can buy a *cap*. It can be described as a "roof", i.e. should interest rates go up, you only pay up to a certain level. If the strike level is set to 5 percent, the highest level that has to be paid is 5 percent, disregarding whether the interest rates rise to 6 percent or 12 percent. Below the strike level, the interest rate to be paid is the market rate. With a *floor*, the strike level represents the lowest level of interest rate to be paid. If the market rate drops below the strike level, you still have to pay the strike interest rate. For doing this, i.e. for giving up potential "gains" when market rates drop, you receive a premium from the bank. In other words, the bank gets an insurance against falling interest levels. For a cap on the other hand, you have to pay a premium.

When combining a cap and a floor, the result is a *collar*. This way you can lower the premium for the cap by receiving a premium for the floor. There will be a maximum level and at the same time a lowest level for your interest rate.

In figure 8, the concept of caps, floors and collars is shown.

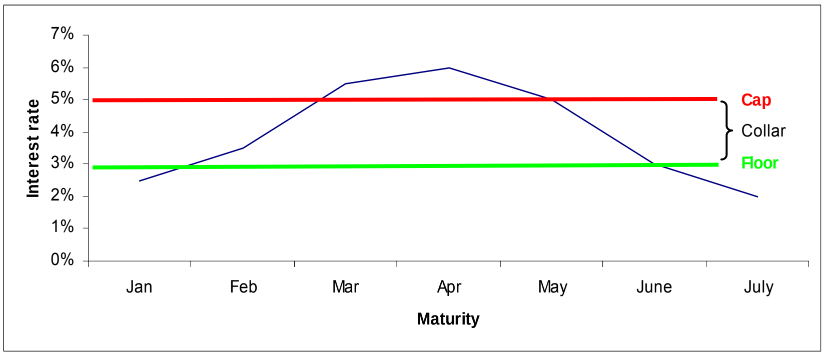

Figure 8: Example of a cap, floor and collar

Options

An *option* is a contract that gives the owner the right, but not the obligation, to buy or sell a given financial instrument or currency at a predetermined price, the strike price, on a predetermined future date, the maturity date. The option to buy is known as a *call option* (figure 9 shows an example) and the option to sell is a *put option* (figure shows an example).

There are two different types of options, American options and European options. The American options can be exercised at any date until the maturity date, while the European option can only be exercised on the maturity date.

An option has to be bought or sold, i.e. it has a price. Remember that entering a swap agreement does not cost anything. On the other hand, when buying an option, the biggest loss is the cost of the option, whereas the gain is unlimited.

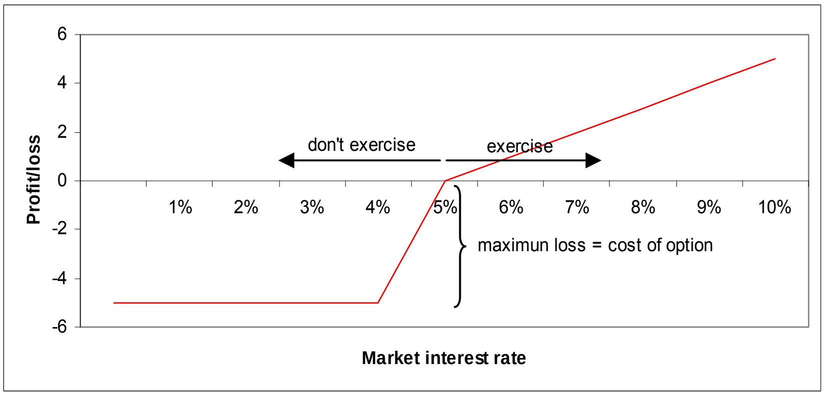

Figure 9: Profit from buying a call option, option price = 5 and strike interest rate = 5%

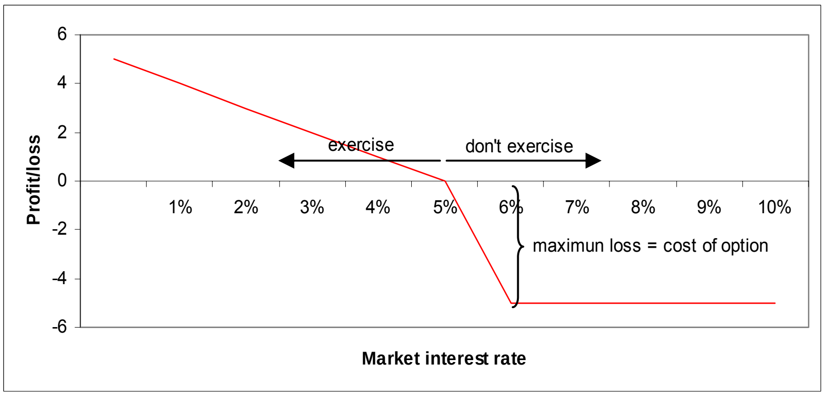

Figure 10: Profit from buying a put option, option price = 5 and strike interest rate = 5%

Forward Swaps, Forward Rate Agreements (FRA) and Futures

A *forward swap* does not differ that much from a normal IRS. The only difference is that a forward swap starts in the future. It is thus an agreement to exchange interest rate payments for a given period starting at a certain date in the future. The purpose with a forward swap is to hedge against higher interest rates on future borrowings and long term loans. This also means that the fluctuations in net liquidity will be offset.

> *Example 4:* When a company issues bonds, e.g. through a securitisation such as the Akero bond that Akelius issued in 2004, it can use a forward swap. At the time of issue, the company does not know how high the interest rate level will be in when the bonds mature after a certain number of years (2010 for the Akero bonds). To hedge against rising interest rates, the company can enter into a forward swap. In our example with the Akero bonds, the swaps start in 2010 and have different maturities.

A *forward rate agreement*, or FRA, is also an agreement to lock in the interest rate for a given future period. The difference between a forward swap and a FRA is the maturity. FRAs usually don't have expiration dates that exceed three years. The contract base is normally three or six months. A FRA constitutes a valuable tool in management of short-term interest rate risk. If a company has a floating rate loan and expects that interest rates will rise until the next fixing and then decline again, which often is the case around the turn of the year, then the company can enter a FRA.

> *Example 5:* Let's assume that a company pays three month STIBOR on its loan and the fixing for the coming period is 5 percent. If the company expects the interest rate to rise to 5.5 percent at the next fixing and then decline a couple of days later to 4.9 percent, the company can chose to buy a 3-6 FRA (starting in three months with a maturity of three months) with an agreed rate of 5 percent. If the interest rate really rises to 5.5 percent, the company receives 0.5 percent of the principal amount. On the other hand, if the expectation of the company is wrong and the interest rate declines to 4.5 percent at the next fixing, the company has to pay 0.5 percent of the principal amount to the bank.

As opposed to forward swaps, FRAs can be *standardised* and traded on the exchange, which means that liquidity is good. The contract has standardized expiration days, i.e. IMM days. In Sweden the IMM days are every third Monday in March, June, September and December. This means that liquidity is concentrated to a limited number of contracts, which benefits trading. But FRAs can also be agreed upon between two parties, and thus traded *over the counter* (OTC). The liquidity for OTC-traded FRAs is not as good. For example, if you wanted to close the OTC-traded FRA, it might be hard to do so.

A *future* is a standardised forward contract and is always traded on the exchange. For example, the contract size and expiration date are standardised. A standardised FRA is a future. Futures are not only traded on short term interest rates, as is the case for FRA, but also on government bonds, mortgage bonds, currencies and other assets.

Structured Derivative Instruments

There are a wide range of combinations of derivative instruments, called *structured derivatives*. By combining derivatives, the company can either get a more flexible product or lower the interest rate or cost. However one must be aware of the implications of these products, since they might not be useful as interest hedge instruments. Some of them can, for example, be used for market interest rate speculation.

In this report, only three common structured derivatives will be described.

A *performance swap* is an interest rate swap with a reduction on the fixed interest rate. As long as the floating rate, e.g. 3 month STIBOR, is lower than an agreed upon level, the fixed rate payer pays a discounted fixed rate. As soon as the floating rate rises above the given level, the fixed rate payer pays a floating interest rate. The floating rate payer thus gives the fixed rate payer a discount in exchange for a protection against rising interest rates.

A performance swap can be seen as a combination of an IRS and a sold cap. The premium on the fixed interest rate is generated from the sold cap.

The interest hedge is only as long as the market believes that the floating rate will perform beneath the agreed upon performance level. If the yield curve is very flat, i.e. the market does not expect the future interest rates to rise, the interest hedge has the same length as the maturity of the performance swap, thus performing almost like a plain vanilla interest rate swap.

In an *extendable swap* the fixed rate payer receives a discount. In exchange, the bank has the right to extend the swap with a certain amount of years at the same level. Should the market interest rate go down, the bank prolongs the maturity and thus receives a higher fixed interest rate than it would have received if it had not had the possibility to extend the swap and had instead, entered into a new swap transaction. If market rates rise, the bank does not extend the swap. In this case, it does not make sense to use the option to prolong, because entering a new swap transaction would be more profitable.

An extendable swap can be seen as a combination of an IRS and a sold or a bought option on a forward swap. The premium that the fixed rate payer receives when giving the bank the right to extend the maturity stems from a sold option. A bought option gives the fixed rate payer the right to extend the maturity. For this, a premium has to be paid.

A *callable swap* is a swap that allows one of the parties to close the swap before it reaches the date of maturity. If the bank is given the right, an option, to close the swap in advance, the company receives a premium in the form of a discounted fixed interest rate.

The extendable swap is a better instrument for interest hedge, since there is a known maturity with a possibility of that maturity to be extended. The minimum length of the interest hedge is thus known. A callable swap can be determined whenever the market value of the swap is positive. If interest rates are not expected to rise, then a callable swap equals a plain vanilla swap. The greater the chance that interest rates will rise, the greater the likelihood that the option to close the swap is exercised. The closer in time this scenario is, the closer the interest maturity approaches zero. Thus, to determine the length of the interest hedge, an estimation has do be done based on the expectations of the market regarding interest rate levels.

Currency Risk

Currency risk can occur when there is a time period between a transaction in a foreign currency and the payment thereof. It can be related to sales of goods or to a debt denominated in a foreign currency where amortisations and interest rate payments are to be made. These types of risks are called *transaction risk*. Another type of currency risk is *translation risk*, arising from consolidation of foreign subsidiaries. It is one of the most challenging tasks in group accounting. *Economic risk* is the third type. It stems from mismatches in cash inflows and outflows compared to competitors. If a company has all its costs in SEK, but is competing for customers with other companies in the US, this company may have a disadvantage or advantage depending on the foreign exchange rate.

To match cash outflows to cash inflows, a company in the example above, can enter a currency swap.

A *currency swap* or an *FX swap* involves exchanging the principal amount and interest payments in one currency for the equivalent cash flows in another currency. Thus, it is not different maturities of interest rates, as the case is with an IRS, that is exchanged, but currencies. The FX swap can be used to transform borrowings in one currency to borrowings in another currency. It can also be used to transform an investment in one currency to an investment in another currency.

One can also use a FX swap if there is an oversupply in one currency and a shortage in another. Let's illustrate this with an example.

> *Example 6:* Assume that a Swedish company is going to pay for an investment of 10m euros in Germany. The company does not have any euros available, but has 100m SEK on its account. In 10 days the company will receive 10m euros as a loan from a bank and it does not need the 100m SEK in the coming weeks. By entering an FX swap, the company can buy euros today and sell it back 10 days later. At the time of our example, 1 euro costs 9.45 SEK. Buying 10m euros would thus cost 94.5m SEK. When selling (or paying) back the euros 10 days later, the company does this at the forward exchange rate of shall we say 9.40 euros/SEK, thus receiving 94m SEK.

To better understand what currency swaps consist of, let's look at the valuation of currency swaps. A swap can be seen as a decomposition of two bonds, one that is sold and one that is bought. Valuing a swap in a currency A, where currency A is received and currency B is paid, we can use the following equation[14]:

$V_A = B_A - S^*B_B$

where V_A is the value of the swap in currency A, B_A is the value of the bond denominated in currency A, S is the current spot exchange rate expressed as currency A/currency B and B_B is the value of the bond denominated in currency B. From this, we see that the value of the swap can be determined from the interest rate in the two currencies and the spot exchange rate. Simplified, the value of a currency swap is the difference between the two currencies, expressed in one of the currencies.

There are a wide range of other currency derivatives; options, forwards, futures, etc. to hedge currency risk. A company that intends to buy an asset in a foreign currency in three months can, for example, buy a call option on that currency. Should the exchange rate increase, the company can make use of the option.

[14] Options, Futures and other Derivatives, Hull, p. 139

References

Books

Options, Futures and other Derivatives, John C. Hull, 4th edition, Prentice-Hall International, Inc., 2000

Penningmarknaden, Lars Nyberg, Staffan Viotti, Pehr Wissén, 4th edition, SNS Förlag, 2006

De finansiella marknaderna i ett internationellt perspektiv, Leif Hässel, Marie Norman, Christian Andersson, 3rd edition, SNS Förlag, 2001

Financial Instruments, Nordea Bank, 1st edition, 2004

Web-pages

www.wikipedia.com, September 2008

www.riksbank.se, September 2008

www.investorwords.com, September 2008

www.investopedia.com, September 2008

www.federalreserve.gov, September 2008

www.ecb.int, September 2008

www.omxnordicexchange.com, September 2008

Information systems

e-markets, Nordea Bank, 2008