

# **ANALYTICAL FINANCE II**

Floating Rate Notes, fixed coupon bonds and swaps

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## **Abstract**

This report describes Floating Rate Notes Theoretically and empirically. We will investigate the characteristics of FRN and conclude the report by describing the characteristics the risk aswell. Throughout this report we will se that FRN have zero duration and that it will change w.r.t ranking. In the end result we can even see how much the FRN will change w.r.t one basic points change in the discount margin.

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# 1 Introduction

In this paper we are going to investigate FRNs (Floating Rate Notes). We will use LIBOR spread(bp), Reset period(3/6/12 months), Issue date, Settlement date, Maturity date, Discount Margin(bp), Date count convention and Face value as parameters. The goal is to get outputs from the given parameters such as the value of FRN, the risk and the swap rate. We will also draw conclusions from the results that will be based on the given parameters aswell. (bp) is defined as basic points and FRNs have zero duration.

## 2 Problem formulation

Create a model in Excel/VBA to value Floating Rate Notes (FRN), fixed coupon bonds and swaps. The given input for such model should be:

- The Interbank Rate that the floating payments are based upon. These payments occur every three months, every six months or each a year, i.e. with reset periods of 3, 6 or 12 month.
- A given spread upon the Inter Bank Rate (LIBOR, EUROBOR, STIBOR etc) that gives the cash flow amount.
- Maturity of the FRN.
- The Discount Margin.
- Day count convention and the days of the cash flows

You need to use the forward rate for the floating cash flows. The model should, except for the price, also calculate the risk measures explained in the lecture notes. Since FRN's are traded on Discount Margin, which means that there also exist a risk in changes in the Discount Margin, called Spread Risk or Basis Risk. Also calculate this risk, i.e., the risk that the spread is changed by one basis point. You should also be able to calculate the swap rate and value swaps bought in the past.

## 3 Theory

The theoretical approach to this report is presented in order to connect the theories with the empirical work and to clearly mark the used theories in this report. There are different kinds of Floating Rate Notes and in this report we will concentrate on the Floating rate.

### 3.1 Different types of FRN

FRN or Floating Rate Notes are defined as bonds with a coupon based on some interbank rates, more specific for this case when we use the LIBOR rate. We also have a spread added to the interest rate which we assume to be constant. Usually FRN have quarterly coupons, but this can of course differ and be 6 months or 12 months coupons. Coupons are calculated by taking the fixing of the reference rate for that day and adding the spread. In Europe the main issuers of FRNs are normally banks.

We have also different types of FRNs, to start with we have the capped FRN, floored FRN and collared FRN these are all connected to maximum and minimum coupons. Perpetual FRNs or unrated FRN are connected to the akin form of capital. Synthetical FRNs can also be obtained by the combination of a fixed rate bond and an interest rate swap, which is also called Asset Swaps.

Deleveraged FRN is one bearing a coupon that is the product of the index and a leverage factor, where the leverage factor is between zero and one, it will also give the investor a decreased exposure to the underlying index. It can be replicated when buying a pure FRN and entering into a swap to pay floating and receive fixed, on a notional amount of less than the face value of the FRN. The Deleveraged FRN can also be hedged using

Deleveraged FRN = Long Pure FRN + Short (1 - Leverage factor) x Swap

Leveraged FRN gives the investor increased exposure to an underlying index, opposite to the deleveraged FRN. The leverage factor is always greater than one. Leveraged floaters also require a floor, since the coupon rate can never be negative. The leveraged FRN can be hedged using:

Leveraged FRN = Long Pure FRN + Long (Leverage factor - 1) x Swap + Long (Leverage factor) x Floor

The risk from FRNs is based on the interest rate risk, and its duration very close to zero. The correlations to the market rates are very low but negative. Thus, FRNs differ from fixed rate bonds, whose prices decline when market rates rise. FRNs are usually traded OTC instead of on a stock exchange. Since the biggest investors in Europe when it comes to FRNs are banks then they are considered to be liquid, but in USA for instance we can observe the FRNs being held until maturity so in those market the FRNs are not considered to be liquid. In the wholesale markets, FRNs are typically quoted as a spread over the reference rate.

#### 3.1.1 Discount Margin

Dealers and investors assess the investment value of the FRN by reference to its discount margin. Discount margin is defined as: The risk premium which, when added to the risk-free rate, makes the PV of the FRN equal to its market price. We can also explain discount margin in a more pragmatically way where the spread over LIBOR which should be paid on the FRN in order to make its market price equal to par. The discount margin is also called the effective LIBOR spread and can be described with the following formula:

$$PV = \frac{(L_0 + s)N}{1 + L_0 + s} + \frac{(L_1 + s)N}{(1 + L_1 + s)(1 + L_0 + s)} + \dots + \frac{(L_n + s)N + N}{(1 + L_1 + s)(1 + L_0 + s) \dots (1 + L_n + s)}$$

where

L is defined as be forward rate at the moment t with 1 year maturity.

S is defined as spread. In denominator it is called Discount Margin.

N is defined as face value.

### 3.1.2 Swaps

Swap is defined as a derivative in which counterparties exchange certain benefits of one party's financial instrument for those of the other party's financial instrument. The benefits in question depend on the type of financial instruments involved.

If we study an example and assume a swap consisting of two bonds, then the benefits can be the coupon payments associated with the bonds. More over when the two counterparties agree to exchange one stream of cash flows against another stream; this stream is denoted as legs of the swaps. The cash flows are calculated over a notional principal amount, which is usually not exchanged between counterparties. Consequently, swaps can be in cash or collateral. We can also use swaps for hedge certain risks such as interest rate risk, or to speculate on changes in the expected direction of underlying prices. In this paper we swaps in order to switch our FRN to fixed rate CashFlow. This rate is then automatically calculated.

## 3.2 Bootstrapping

Bootstrapping is defined as a modern computer-intensive and a more general approach to statistical inference, falling within a wider class of resampling methods.

Practically we use bootstrapping when estimating properties of an estimator (such as its variance) by measuring those properties when sampling from an approximating distribution. Usually when approximating distributions it is common to use the empirical distribution of the observed data.

One question that immediately took place is that why use bootstrapping, well the advantage of bootstrapping is that it is very simple and straightforward. We can also derive some estimates like of standard errors and confidence intervals for complex estimators of complex parameters of the distribution, such as percentile points, proportions, odds ratio, and correlation coefficients. In this work we made bootstrapping which is shown in the figure below.

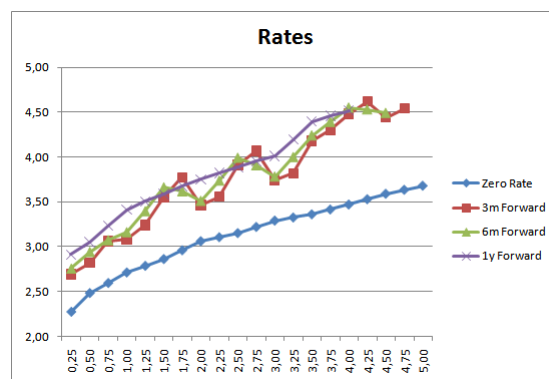


Figure 1: Bootstrapping model using different rates

Figure 1 shows Bootstrapping model using different rates. We have used LIBOR rate in order to calculate future price.

## 4 Conclusion

We created a utility to price FRNs with given parameters. Calculated the risk and calculated the swap it could be switched to. Our final conclusion from this work is that we found that FRNS are not sensitive to changes in rate. But extremely sensitive to change in credit rankings. If credit rankings are changed - then discount margin is changed. Every bp in discount margin changes the price of our given FRN by 0.08%.