



INTEREST RATES (IR): MARKET AND BASIC TOOLS

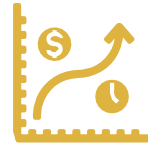
**By the end of this session you
should have a fair understanding of**

- 1 Broad concept of market interest rates and their drivers
- 2 Frequently used benchmark rates
- 3 Various yield curves and their relevance
- 4 Basics of pricing



Basic concepts

- Macroeconomic considerations
- The “benchmark” interest rates



The concept of yield curve

- Definition and main features
- How to derive a yield curve from market instruments



Pricing

- Basics of bond pricing
- The price / yield relationship



- A starting point to look at interest rate markets is through the **current level of policy rates** set by the Fed and ECB (developed countries central banks). The interest rates are currently very low (charts on next slide).
- This, in turn, has caused the entire grid of different interest rates in the market to currently trade at unprecedented low levels (we'll look at Libor in the next slides).
- Remember: maneuvering the interest rate is the basic tool a central bank can use to manage the economy.

QUESTIONS

When will a central bank hike / cut its interest rate benchmark?

What is the actual transmission mechanism?

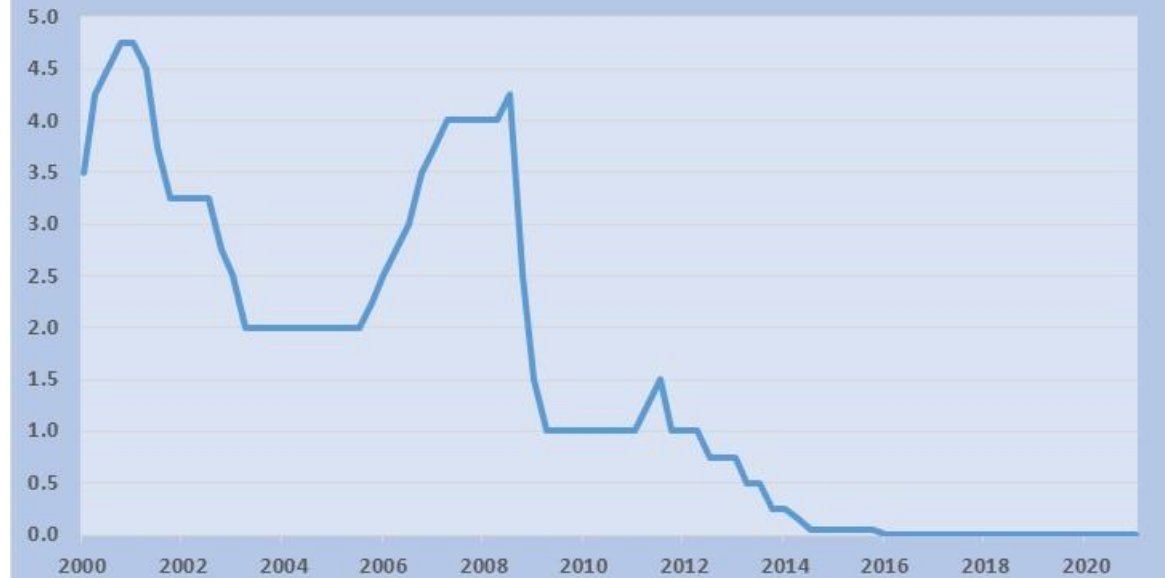
What is a Quantitative Easing (QE) program?



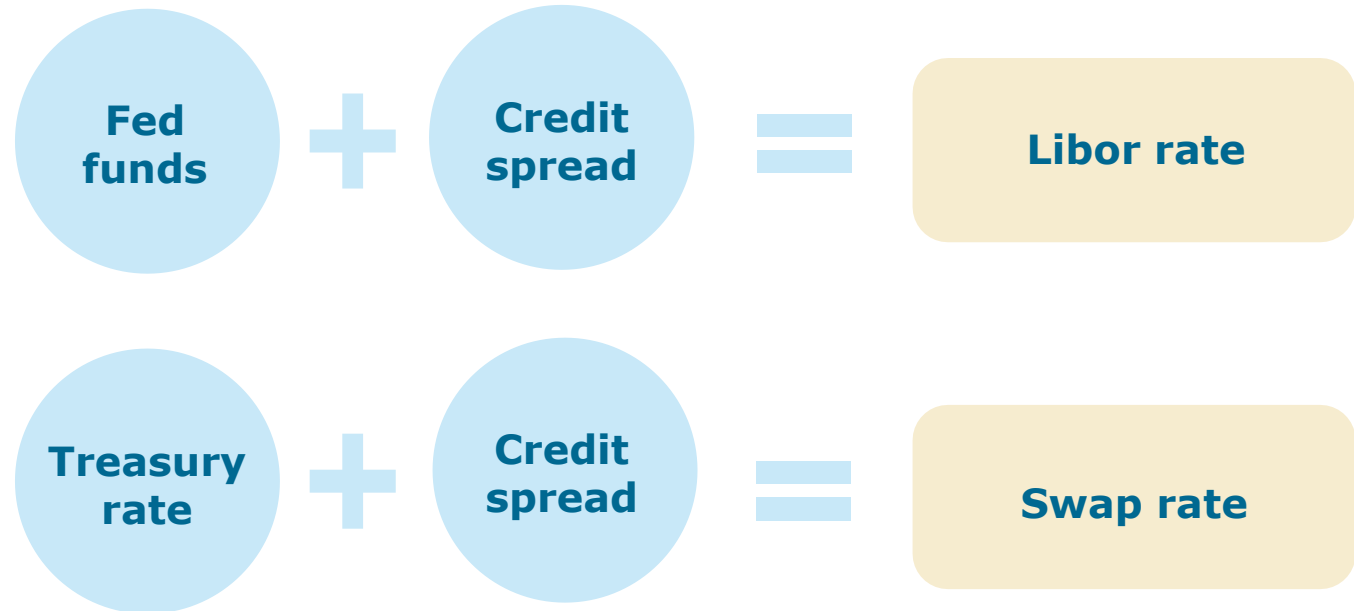
Fed Fund Upper Bound



ECB Main Refinancing Rate



- There is a huge variety of interest rates in the market, each one with its specific features in terms of reference currency (e.g. USD Libor for USD, Euribor for EUR), tenors (e.g. 6m USD Libor, 3m Euribor), market segment / issuer (e.g. 10yr US Treasury Bonds, AA-rated Commercial Paper, Mortgage Bonds, 5yr USD Swap Rate), etc.
- We need to **somehow restrict the field** and focus on the ones which are more relevant to us. Also, we want to **look at them from an alternative perspective: the credit spread.**



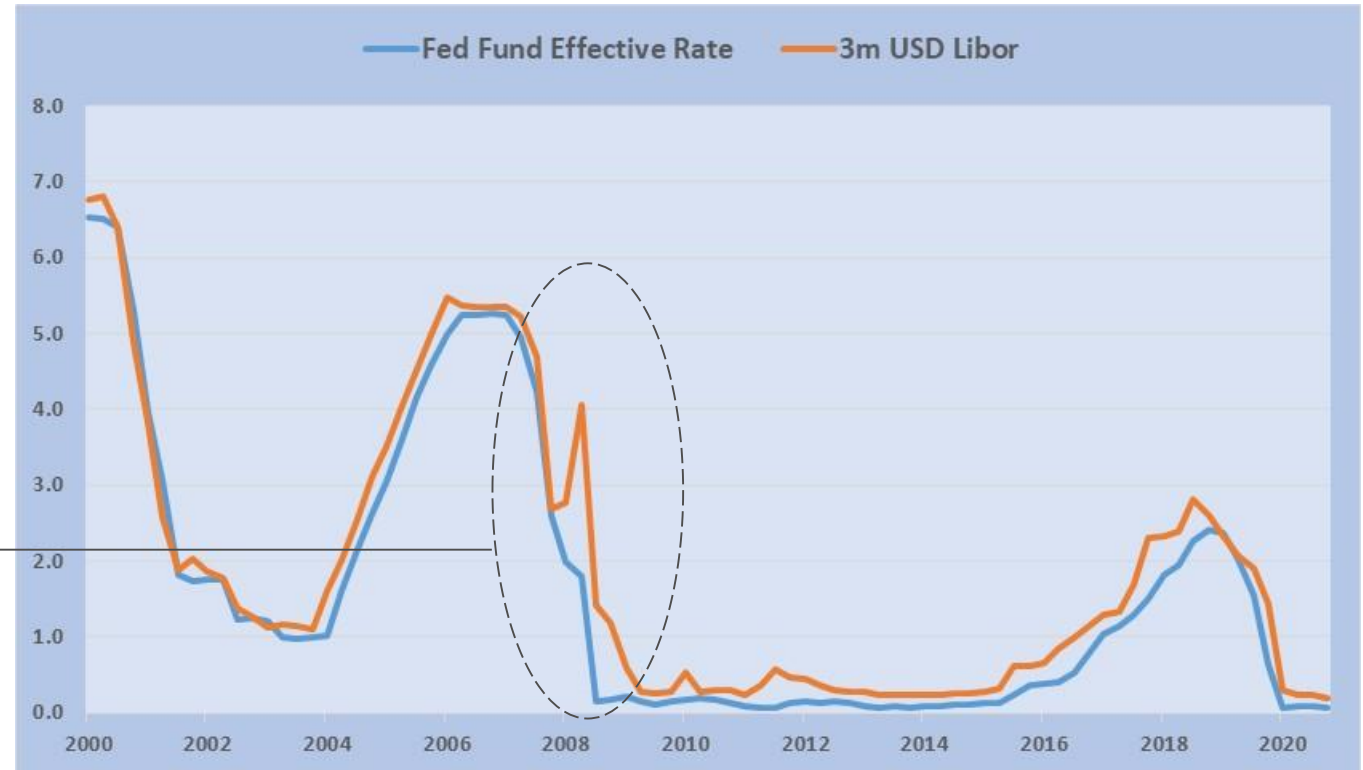
What does it mean?

- In short, the **London Inter-Bank Offer Rate** (or **LIBOR**) is the average interest rate that a leading bank in London would be charged when borrowing wholesale funds from other banks. The borrowing is intended without collateral (unsecured).
- There are several Libor rates calculated on a daily basis for 7 borrowing periods (from overnight to 12 months), spanning 5 different currencies.
- These rates are calculated based on data submitted by a panel of major banks - the number of banks on the panel varies according to the currency. Once the rates are submitted, the four highest and four lowest rates are ignored, and those left are used to calculate the rates, then published before noon UK time every weekday.

- As a broad proxy of a bank's cost of funds, Libor rates are determined by two main factors, apart from the tenor

The level of the relevant central bank's policy rate (for example, Fed funds for the USD Libor);

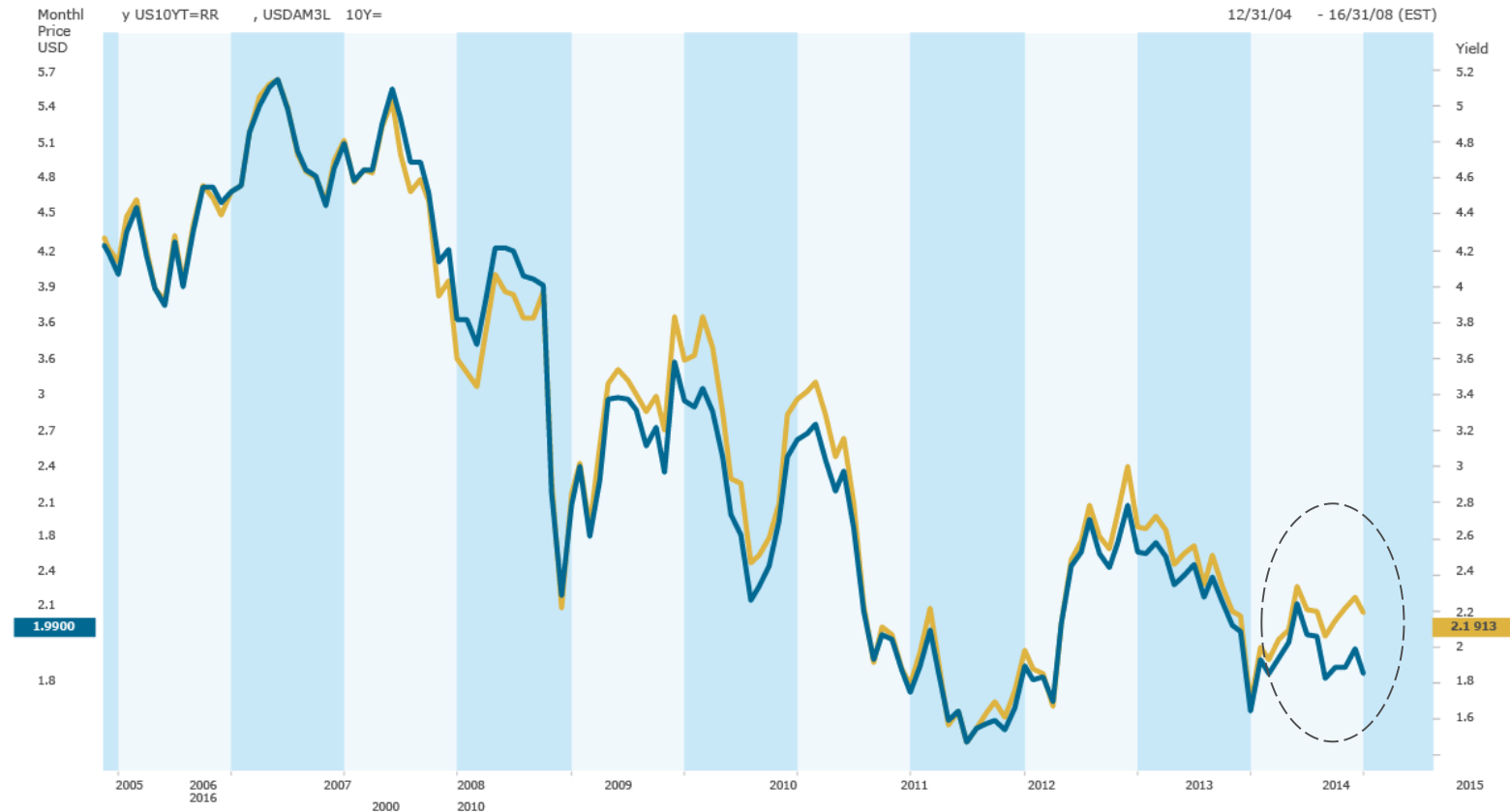
Credit risk considerations (so called TED Spread).



Fed funds rate plotted against 3m USD Libor.

Why do you think this situation is "unusual"?
Hint: this is when Lehman Bros. collapsed...

- A swap rate is, in simple terms, the **fixed rate at which one could replace a set of Libor-based payments for a future period of time** (all technical details in the next slides).
- A swap rate can also be considered as a "spread rate" made of Treasury rate plus a credit component.
- The chart on the right illustrates the dynamics of the 10yr USD Swap rate (purple line) plotted against the yield of the generic 10yr USD Treasury Bond (orange line).



Why do you think this situation is "unusual"? Think about the borrower

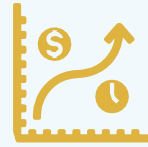


- The difference between the two rates (the "10yr Swap Spread") is a widely used indicator of the credit risk in the market for the specific tenor.
- You would expect the spread to widen during periods of increased risk perception and to tighten when the stress loosens up.
- The volatility of this spread is generally higher than the Libor spread one.



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- A **yield curve** is a graphical representation of different **yields as a function of their respective terms**.
- In order to be meaningful, the curve must show “comparable” yields, hence one has to take the same type of securities when building it from market data.
- As a consequence, there is **no single yield curve but a variety of them** based on the specific debt instruments used to derive it.



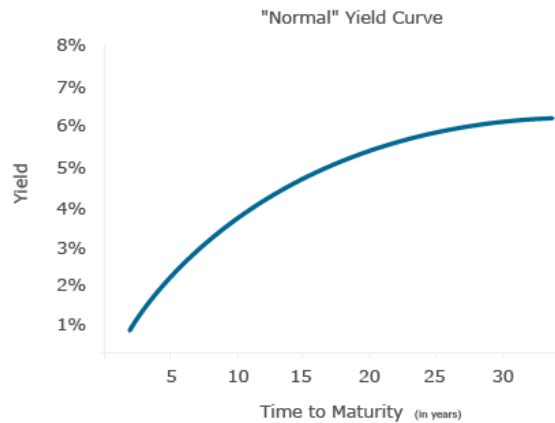
Curve	ID	3M	1Y	2Y	3Y	5Y	7Y	10Y	30Y
I25		0.0139	0.052	0.1635	0.3229	0.831	1.2852	1.6076	2.2795

The curve shown here is upward sloping (“normal” yield curve) and quite steep: what does it entails?

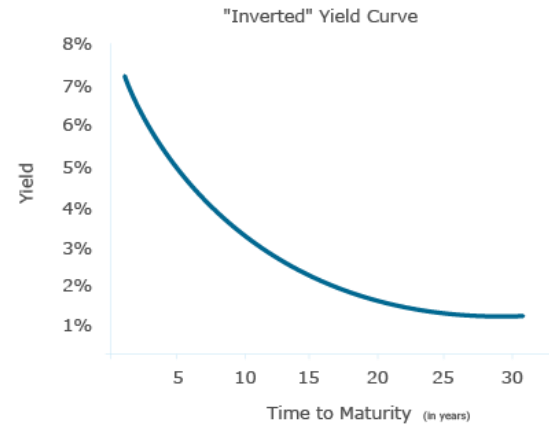
What’s the relationship between inflation and Central Bank’s policy rate?



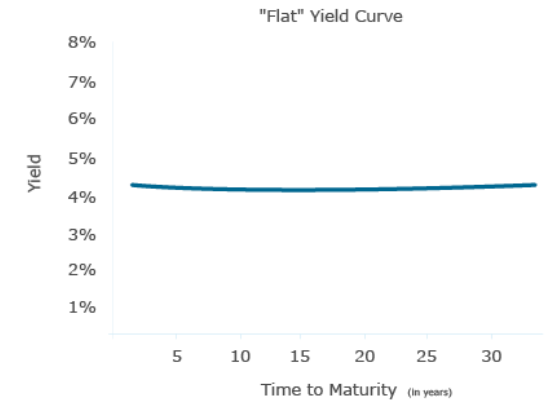
- **The features of a yield curve (like shape, steepness, order of magnitude), therefore, are determined by the specifics of the markets where the source instruments are negotiated.**
- **For example, the yield curve derived using the bonds issued by governments in their own currency are called the government bond yield curve (government or benchmark curve).**
- **Also, the more liquid the source instruments the more meaningful is the information content conveyed by the curve.**



- The shape and steepness of the yield curve carry an important information content. A positive slope ("normal" shape) reflects expectations for the economy to grow in the future and, importantly, that inflation will rise as well. It also creates a need for a risk premium associated with the uncertainty about the future rate of inflation and the risk this poses to the real value of cash flows. Investors price these risks into the yield curve by demanding higher yields for maturities further into the future.

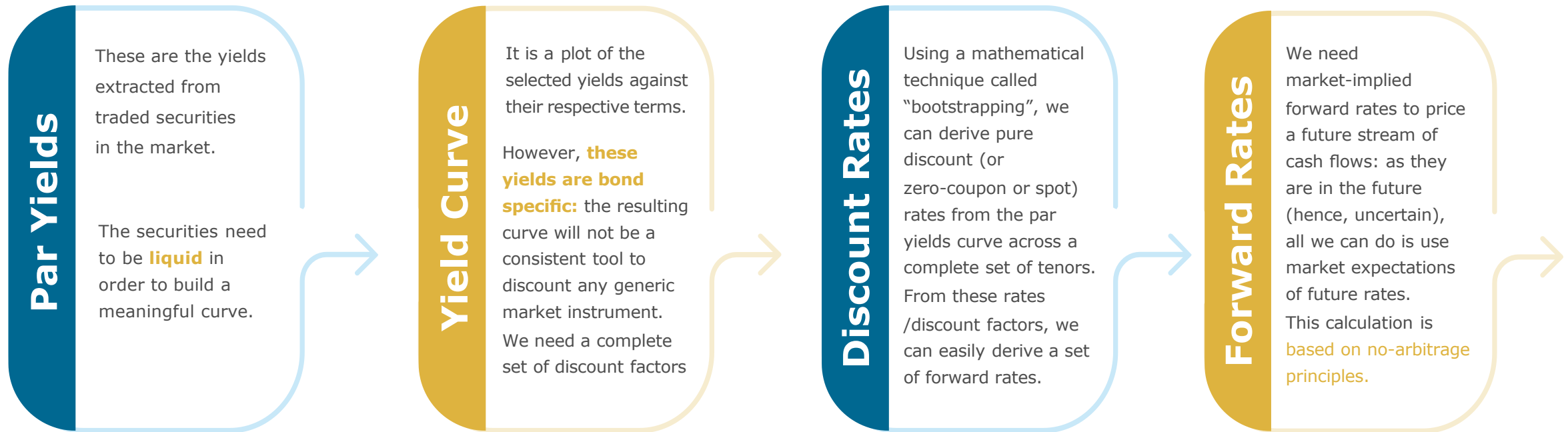


- An inverted yield curve (negative slope) is seen as a sign of a slowing economy ahead, which will lead the Central Bank to cut their policy interest rate as inflation should be mild as well. In other terms, under unusual circumstances long-term investors will settle for lower yields if they think the economy will slow or even decline in the future. In this case, inflation will not be an immediate threat to the real value of their cash flows.



- A flat yield curve is observed when all maturities have similar yields, whereas a humped curve results when short-term and long-term yields are equal and medium-term yields are higher than those of the short-term and long-term. A flat curve sends signals of uncertainty in the economy. This mixed signal can revert to a normal curve or could later result into an inverted curve.

Hold on tight, this is going to get a little rough! Let's dig deeper into the yield curve and how to derive it. Also, what are the **operational implications** of it?



By the way, do you know what a bond yield is and how to calculate it? Hint: the market price of the bond should be equal to the PV of all its future cash flows...

The chart on right shows what the different steps to calculate the zero-coupon yield curve would look like in a "normal" rate environment.

NOTE

- The zero-coupon rates (yellow line) are derived for all maturities, whereas the yields are calculated only for the available instruments in the market (blue line).
- Zero-coupon rates are generally a little lower (in number terms) than the yield for the correspondent tenor.
- The forward rates – which are zero-coupon rates themselves by calculation – are the rates that market is currently forecasting for intermediate maturities.
- For example, the 6m forward rate 6 months from now is the rate applicable between the - 6month and the 1-year maturity



For example, the 6m forward rate between 6 months and 1 year is calculated based on the following equivalence (forget the mathematics):

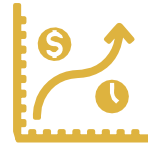
$$1\text{yr ZC Rate} = (\text{Forward Rate } 0\text{-}6 \text{ month}) \\ * (\text{Forward Rate } 6 \text{ months} - 1 \text{ year})$$

If this relation did not hold true, there would be arbitrage opportunities in the market.



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We'll keep it very simple: a vanilla bond price is calculated as the value of the future bond's cash flows, discounted at the appropriate rate (hence, the importance of the yield curve). For example, a bond of n years tenor and an annual coupon C, redeemed at par (i.e.: 100) will look like:

$$P = \frac{C_1}{1+y_1} + \frac{C_2}{(1+y_2)^2} + \frac{C_3}{(1+y_3)^3} + \dots + \frac{C + 100}{(1+y_n)^n}$$

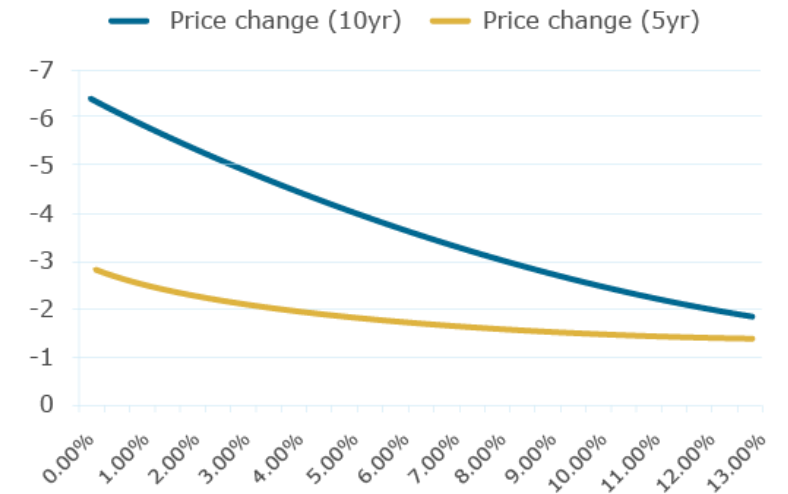
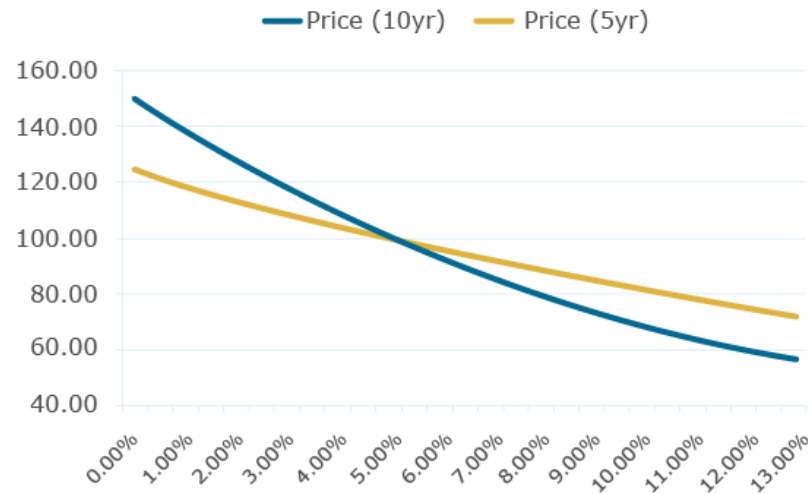
NOTE

- The set of y_i are the appropriate market discount rates (do you remember the previous slide?): hence the price will change according to changes in the shape of the yield curve (and credit spreads, but let's leave it for now);
- If you solve the equation above for the one y (same across members) that equates the price P to the stream of cash flows (coupons and redemption value) you obtain the Yield to Maturity (YTM) or Internal Rate of Return (IRR) of the bond.
- This equation is the basic form (actually, an over-simplification): technically, one must use the appropriate adjustments to take into accounts the bond's specific features (coupon frequency, day-count fraction etc.).

Can you see now why there is an inverse relationship between the bond price and its yield (or the yield curve as a whole)? What is the intuitive explanation for it (beside the mathematical one)?

What's the bond price if the calculated YTM is equal to the coupon rate? What if it's higher / lower?

Let's see if it's true and how it looks in practice: below we plot the price of two bonds with the same coupon but different maturities – a 10year and a 5year – against the market yield.



- In both cases, as the market yield goes up the bond price goes down and vice versa (left chart).

- The 10year bond price is more reactive than the 5year one: the same change in yield will move the 10year price more, both up and down (right chart).

- A basic measure of the bond price sensitivity is the duration, which basically expresses what's the bond's average "pay-back period" (from an investor's stand point).

Question: what's the duration of a 10year zero-coupon bond?

What have we achieved so far?

Our goal

Started off by looking at the current interest rate market environment

Defined the nature of some market benchmark rates (Libor, swap rates)

Defined the concept of yield curve and its building blocks

Understand swap pricing

By now, you should be able to understand the logic behind pricing an IRS and figure out how its value fluctuate as a function of market interest rates.

ANY QUESTIONS?