EUREX Architects of trusted markets

Eurex Fixed Income Futures

2024

Agenda

Product Overview

Introduction

Fixed income futures are **standardized** exchange traded futures. They are **highly liquid, low-cost** products that enable fund managers to **effectively** and **efficiently manage a fixed income investment portfolio.**

3 Key Elements of Fixed Income Futures

Deliverable Basket

Delivery is based on a **basket of bonds** which contains different contracts with a range of different coupon levels and maturity dates.

Notional Yield

Notional yield gives the deliverable bonds a **common basis for delivery** and is generally in line with the prevailing interest rate.

Conversion Factor

Conversion factor relates the coupon of each bond in the basket to the notional yield of the contract. It is the **price per unit of each deliverable bond** that generates the notional yield.

Contract Specifications

	Euro-Schatz (FGBS)	Euro-Bobl (FGBM)	Euro-Bund (FGBL)	Euro-Buxl (FGBX)	Swiss (CONF)	Euro-BONO (FBON)
Contract standard	Notional government bond issued by the FRG with 1.75-2.25 years to maturity and a (notional) 6% coupon	Notional government bond issued by the FRG with 4.5-5.5 years to maturity and a (notional) 6% coupon	Notional government bond issued by the FRG with 8.5-10.5 years to maturity and a (notional) 6% coupon	Notional government bond issued by the FRG with 24-35 years to maturity and a (notional) 4% coupon	Notional government bond issued by the Swiss Confederation with 8-13 years to maturity and a (notional) 6% coupon	Notional government bond issued by the Kingdom of Spain with 8.5-10.5 years to maturity and a (notional) 6% coupon
Delivery	Seller's obligation to deliver and the right to choose which security to deliver					
Contract Values	100,000 EUR/CHF					
Price quotation	In percent of par value with three decimal places	In percent of par value with two decimal places				
Minimum price change	0.005 percent equivalent to EUR 5	0.01 percent equivalent to EUR 10		0.02 percent equivalent to EUR 20	0.01 percent equivalent to CHF 10	0.01 percent equivalent to EUR 10
Delivery Day	Tenth calendar day of the delivery month if it is an exchange day; otherwise, the exchange day immediately succeeding that day.					
Contract months	Up to 9 months: the three nearest quarterly months of the March, June, September and December cycle.					
Last Trading Day	Two exchange trading days prior to Delivery Day. Close of trading for the maturing futures on the last trading day is at 12:30 CET.					
Trading hours	01:10 – 22:00 CET				08:30 – 17:00 CET	08:00 – 19:00 CET

Contract Specifications – contd.

	Short-term Euro-BTP (FBTS)	Mid-term Euro-BTP (FBTM)	Long-term Euro-BTP (FBTP)	Mid-term Euro-OAT (FOAM)	Long-term Euro-OAT (FOAT)
Contract standard	Notional government bond issued by the Republic of Italy with 2-3.25 years to maturity and a (notional) 6% coupon	Notional government bond issued by the Republic of Italy with 4.5-6 years to maturity and a (notional) 6% coupon	Notional government bond issued by the Republic of Italy with 8.5-11 years to maturity and a (notional) 6% coupon	Notional government bond issued by the Republic of France with 4.5-5.5 years to maturity and a (notional) 6% coupon	Notional government bond issued by the Republic of France with 8.5-10.5 years to maturity and a (notional) 6% coupon
Delivery	Seller's obligation to deliver and the right to choose which security to deliver				
Contract Values	100,000 EUR/CHF				
Price quotation	In percent of par value with two decimal places				
Minimum price change	0.01 per cent equivalent to EUR 10				
Delivery Day	Tenth calendar day of the delivery month if it is an exchange day; otherwise, the exchange day immediately succeeding that day.				
Contract months	Up to 9 months: the three nearest quarterly months of the March, June, September and December cycle.				
Last Trading Day	Two exchange trading days prior to Delivery Day. Close of trading for the maturing futures on the last trading day is at 12:30 CET.				
Trading hours	08:00 – 19:00 CET				01:10 – 22:00 CET

Yield considerations for the CTD

The amount the seller receives and the buyer pays is determined by the formula:

Invoice Amount = *Futures Settlement Price* × *Conversion Factor* + *Accrued Interest*

The conversion factor generates a price at which the bond *would* trade if its coupon were the notional coupon of the futures contract. FI futures track the price of the deliverable bond that represents a short futures position with the greatest profit/least loss at delivery. This bond is called the **"cheapest-to-deliver" (CTD) bond**. The theoretical "fair value" of a FI contract is:

Theoretical Price of Futures Contract = *Cash Price CTD* + *Financing Costs* − *Coupon Income*

General criteria for selecting the CTD

if *market yield* > *notional yield*, bond with a **long duration** (low coupon/long maturity) will be preferred

if *market yield* < *notional yield*, bond with a **short duration** (high coupon/short maturity) will be preferred

if *market yield* = *notional yield*, there will be **no obvious preference** for the CTD

! Another important determinant for the CTD is the implied repo rate. Higher the implied repo, more desirable would the bond be for CTD.

Delivery and Deliverable Basket

At Delivery

Theory

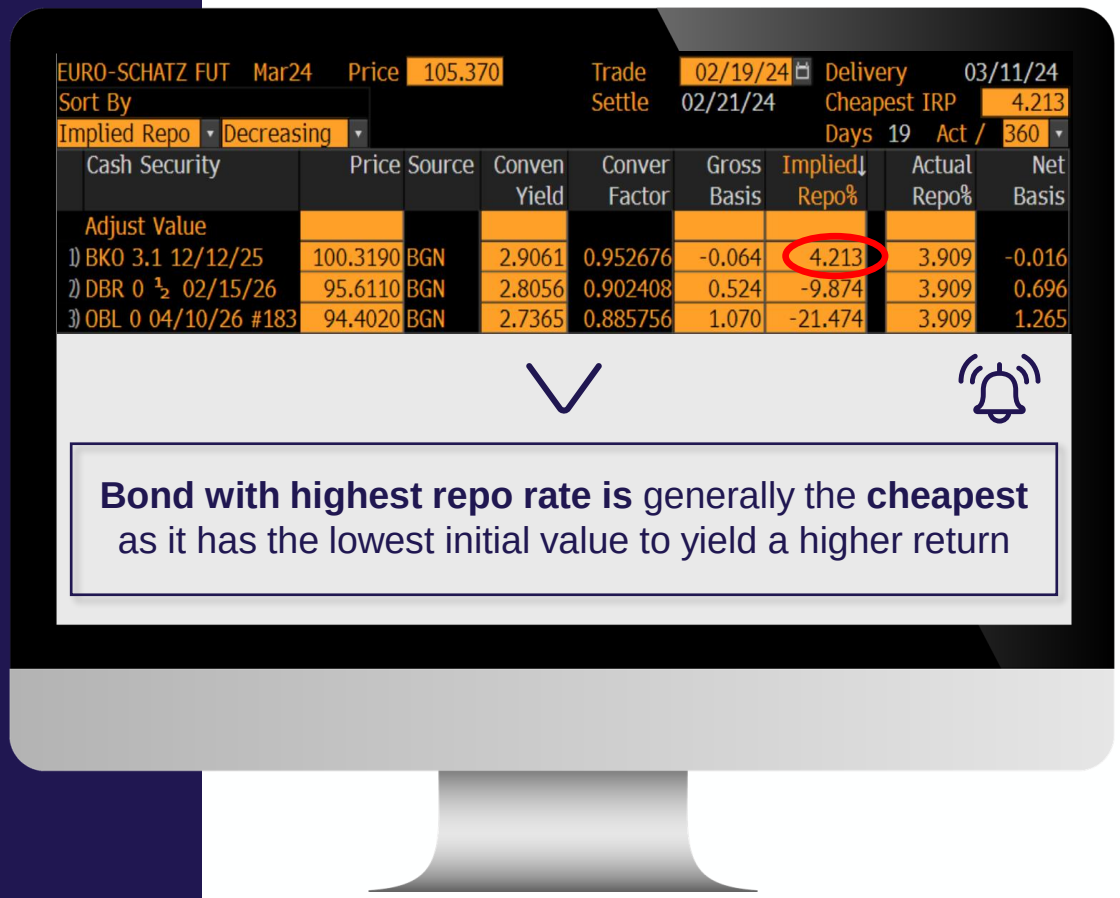
- Obligation to deliver
- Right to choose which bond

Practice

- Small proportion of bonds are delivered
- Most positions are closed or rolled

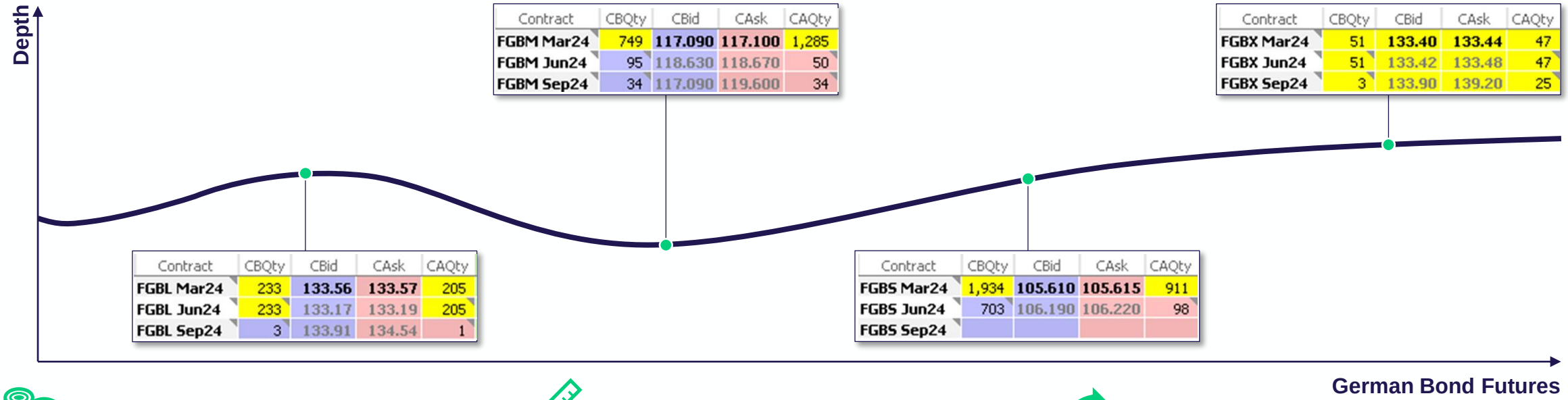
High correlation of bonds in future's delivery basket makes futures ideal tool for hedging and performance management

Example:
Which deliverable bond is cheapest and why?



II. Volume & Liquidity

Liquidity is deepest for the front month futures - Overview



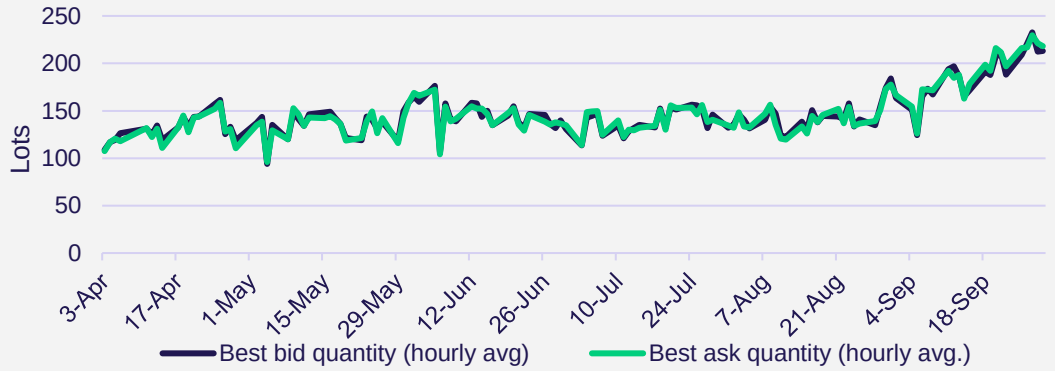
The quoted sizes vary by the duration of the futures, showing greater sizes for futures based on shorter maturities, along the lines that the shorter the maturity, the lower the inherent risk of the position

Euro-Bund and Euro-Bobl futures are quoted at a minimum tick of 0.01 points, whereas Euro-Schatz and Euro-Buxl futures trade in increments of 0.005 and 0.02 points respectively

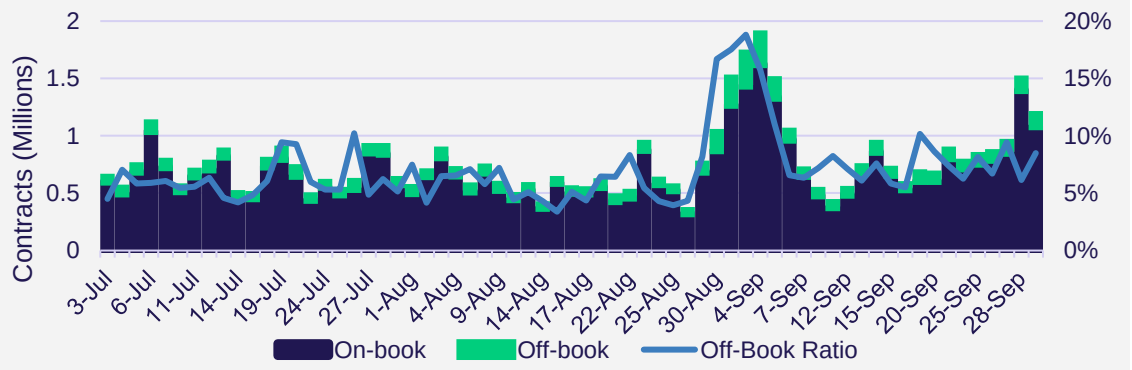
Euro Buxl futures are quoted with a bid-offer spread of 1-2 ticks and in trade sizes reflective of the market risk of a 30y government bond position

Bund futures show 100 to 250 contracts at the top of the book, exceeding average trade sizes of <10 contracts

FGBL Top of Book Liquidity



FGBL On- and Off-book Volume



Liquidity providers enable smooth on-book trading as ToB liquidity rises as yields peaked and retracted in expectation of rate cuts

2023 saw a steady increase of top of book liquidity from 100 to 150 contracts to now 200 contracts and higher

This highlights the order book's resilience, as the **volume of the resting orders exceeds the average trade size in all core products by a multiple**, allowing members to execute without impacting the market.

Off-book trading accounts for ca. 7% of trading activity. On- and off-book **ratio fluctuated around the mean peaking at 19%** at the quarterly roll as brokers supports clients in rolling futures at pre-arranged prices for trade sizes greater than 2,000 contracts.

III. Utilization of Fixed Income Futures

Added benefits of trading FI Futures

Tactical asset allocation shifts asset allocation to take advantage of market opportunities. Example: Sale of equity index futures and simultaneous purchase of bond futures to move funds from equities to bonds Usually, asset managers return to the portfolio's original strategic asset mix when desired short-term profits are achieved.	**Tactical Asset Allocation**
Re-investment of coupons and investment of new funds generated via asset sales by purchasing bond futures. Involves investing in derivatives by using available cash balances to gain exposure to bond markets. They can create well diversified, highly leveraged portfolios strapped along with added protection.	**Cash Equitisation**
Buying and selling bond futures helps investors adjust the beta or duration of portfolios. Example: When market is bullish, investors can increase beta by buying bond futures to reap greater benefits from the anticipated rally.	**Portfolio Beta / Duration Adjustment**
Fixed income futures can be used for spread trading. Example: Sale of German government bond futures to decrease the exposure to the German bond market while increasing exposure to say, the Italian bond market.	**Sector / Market Overlay**
Another use of fixed income futures is to assist in building cost efficient portfolios. Example: Sale of bond futures against purchase of cash bonds to isolate or negate market risk.	**Bond Picking**

Formulas and Hedging

Equations

The interest rate sensitivity of a fixed income future relates to the CTD bond and is expressed as ΔF.
The equation is modified as a standard measure of interest rate sensitivity and is generally expressed in **BASIS POINT VALUE** (i.e the price value of a .01% change in the yield of the fixed income future).

$$\Delta F = \frac{\Delta CTD}{CFctd}$$

$$BPV\ of\ Bond\ Future = \frac{BPV\ CTD}{CFctd}$$

where ΔF =$change\ of\ value\ in\ bond\ future$
ΔCTD=$change\ of\ value\ in\ the\ CTD\ bond$
$CFctd$=$conversion\ factor\ of\ the\ CTD\ bond$
$BPV\ CTD$=$the\ price\ value\ of$ .01%
$change\ in\ yield\ of\ the\ CTD\ bond$
$CFctd$=$conversion\ factor\ of\ the\ CTD\ bond$

This equation is at the core of **hedging, portfolio management** and **trading applications**

Hedging FI PF

Taking a short position in FI futures protects the value of a fixed income portfolio, as the fixed income futures offsets the adverse movement in the value of the bond holding. A “perfect hedge” completely offsets the decrease in the value of the bond holding with the short position in fixed income futures.

Entering a long position in fixed income futures allows the portfolio manager to manage incoming funds.

In order to hedge a bond holding with fixed income futures, the hedge ratio is $\Delta C/\Delta F$ where ΔC is the change in the value of the bond and ΔF is the change in the value of the fixed income futures. The relative movement of the fixed income futures to the cheapest-to-deliver bond (CTD) can be shown as:

Substituting ΔF gives us the Hedge Ratio as:

$$\frac{BPV\ bond\ to\ be\ hedged\ \times\ CFctd}{BPV\ CTD}$$

Hedging the Value of a Fixed Income Portfolio

Situation

A fund manager is holding EUR 100 million in GDBR 4.25% June 2018 and is worried that interest rates will rise and wants to protect the value of the bond investment by selling Euro-Bund Futures. How many futures are required to hedge the bonds?

Solution

Currently, the GDBR 3.75% June 2017 is the CTD and has a BPV of EUR 74.1 per EUR 100,000 (size of futures contract) and a conversion factor of 0.8524. The bond to be hedged i.e the GDBR 4.25% June 2018, has a BPV of EUR 82,500 per EUR 100 million.

The number of Euro-Bund Futures required to hedge a EUR 100 million holding of GDBR 4.25 % June 2018 will be:

$$\frac{BPV\ bond\ to\ be\ hedged\ \times\ CFctd}{BPV\ CTD} = \frac{EUR\ 82{,}500 \times 0.8524}{EUR\ 74.1} = 949.02\ i.e\ 949\ Euro\ Bund\ Futures$$

Caveat: In practice, hedging a bond position with fixed income futures rarely produces the “perfect hedge” as fixed income futures track the CTD bond. Hedging with fixed income futures transfers the cash market risk to “basis risk”, and that is reflected in a possible over/underperformance of a hedge.

Switching Investments between Bond markets

Situation

A European government bond portfolio manager has a EUR 50 million holding in medium term European benchmark government bonds i.e. GDBR 2.5% January 2021 (CTD of the June 2018 Euro-Bund Futures contract) and has decided to switch the investment into Italian government bonds of similar duration and maturity.

The **fund manager** has **two choices**:

Liquidate

his holding in European government bonds and buy similar duration and maturity Italian government bonds

1

2

Overlay

a short Euro-Bund Futures / long BTP Futures position to the existing portfolio

Switching Investments between Bond markets

Solution

First,
calculate the number of Euro-Bund Futures to neutralize the EUR 50 million nominal holding of GDBR 2.5% January 2021:

$$\frac{EUR\ 50\ million \times 0.770614}{EUR\ 100{,}000} = 385\ Euro\ Bund\ Futures$$

Second,
calculate the BPV ratio for Euro-Bund Futures to mid-term Italian BTP Futures i.e BPV Euro-Bund Futures / BPV mid-term BTP Futures: BPV of Euro-Bund Futures is equal to 0.1114 or 11.14 futures ticks (worth EUR 111.40) and BPV of BTP Futures is equal to 0.0615 or 6.15 futures ticks (worth EUR 61.5), we get a ratio of **1 Euro-Bund Future : 1.82 mid-term BTP Futures**.

Finally,
based on a BPV weighted Euro-Bund:mid-term BTP ratio of 1:1.82, the portfolio manager calculates how many mid-term BTP Futures to buy against a short Euro-Bund Futures position i.e. 385 x 1.82. Therefore, the fund manager ***sells 385 Euro-Bund Futures and buys 700 mid-term BTP Futures*** as a **portfolio overlay strategy** to synthetically create an asset allocation switch from European government bonds to Italian government bonds. The existing portfolio of European government bonds has been left intact.

Adjusting Portfolio Duration

Situation

Fixed income futures can be used to **enhance tactical asset allocation** by taking short to medium-term positions that may deviate from the strategic benchmark.

Trading in the cash market can be expensive and disruptive to the existing portfolio and it takes time to implement larger asset allocation shifts. Using fixed income futures can be **faster** and more **cost efficient**.

Example

A fund manager has a €50 million European government bond portfolio and has a **positive outlook** towards European bonds and wants to **increase exposure**. He decides to **increase** portfolio (Macaulay) **duration** from its current 4.3 years to 7.9 years.

The **fund manager** can **either** switch from the current bond holdings to **longer duration** bonds **OR overlay** the current **bond holding** with Euro-Bund Futures.

Adjusting Portfolio Duration

Solution

First,
calculate the BPV of the current portfolio

> Current Portfolio BPV = Portfolio modified duration × Portfolio value × 0.0001
> $= 4.3 \times EUR\ 50{,}000{,}000 \times 0.0001 =$ ***EUR 21,500***

Second,
calculate the BPV of the higher duration target portfolio

> Target Portfolio BPV = 7.9 × EUR 50,000,000 × 0.0001 = **EUR 39,500**

Finally,
calculate the number of fixed income futures contracts to reach the target portfolio duration

$$Number\ of\ FI\ Futures = \frac{Target\ Portfolio\ BPV - Current\ Portfolio\ BPV}{BPV\ Euro\ Bund\ Futures}$$

Hence, the num. of Euro-Bund Fut. required to overlay the EUR 50 million bond portfolio to increase portfolio duration from 4.3 to 7.9 years is: *Number of Euro−Bund Futures* = $\frac{EUR\ 39{,}500 - EUR\ 21{,}500}{EUR\ 111.40} = 161.58 \sim$ ***162 Euro Bund Futures***

“Fixed income and equity index futures can be used to quickly and cheaply switch portfolio asset allocation from equities to fixed income.

Switching Asset Allocation between Equity & Fixed Income

Situation

A pension fund manager decides to switch EUR 50 million of his European equity portfolio into benchmark European government bonds. The equity portfolio has a beta of 1.15 to the Eurex EURO STOXX 50® Index Futures.

The fund manager decides to sell EURO STOXX 50® Index Futures and buy Euro-Bobl Futures to adjust his asset allocation. The current cheapest-to-deliver for the Euro-Bobl Futures June 2017 contract, the GDBR 3.75% July 2018, has a duration of 4.38 years, very close to the current duration of 4.25 years for the fund managers' benchmark European government bond portfolio.

Note: *the Eurex EURO STOXX 50® Index Futures is considered at an index level of 3,123 points.*

Switching Asset Allocation between Equity & Fixed Income

Solution

First,
calculate the number of equity index futures to sell

$$Number\ of\ contracts\ to\ sell = \frac{Value\ of\ equity\ investment}{Value\ of\ equity\ index\ futures} \times Portfolio\ Beta$$

$$= \frac{EUR\ 50{,}000{,}000}{EUR\ 31{,}230} \times 1.15 = 2{,}575\ Eurex\ EURO\ STOXX\ 50®\ Futures\ contracts$$

Note: an index futures price of 3,123 points gives a contract value of €31,230 i.e. Index price x EUR 10)

Second,
calculate the number of Euro-Bobl Futures to buy

$$Number\ of\ contracts\ to\ buy = \frac{Duration\ \times\ Investment\ \times\ 0.0001}{BPV\ Euro\ Bobl\ Futures}$$

$$= \frac{4.25\ \times EUR\ 50{,}000{,}000\ \times 0.0001}{EUR\ 55.84} = 380\ Euro\ Bobl\ Futures\ contracts$$

(BPV of Euro-Bobl Future = BPV ctd / Price Factor, so with the GDBR 3.75% as CTD, this gives 0.0507/0.912138 = 0.05584 or EUR 55.84)

Hence, the fund manager sells 2,575 EURO STOXX 50® Futures contracts and buys 380 Euro-Bobl Futures to quickly and synthetically switch his equity holding to medium-term bonds.

Managing Event Risks – Yield Curve

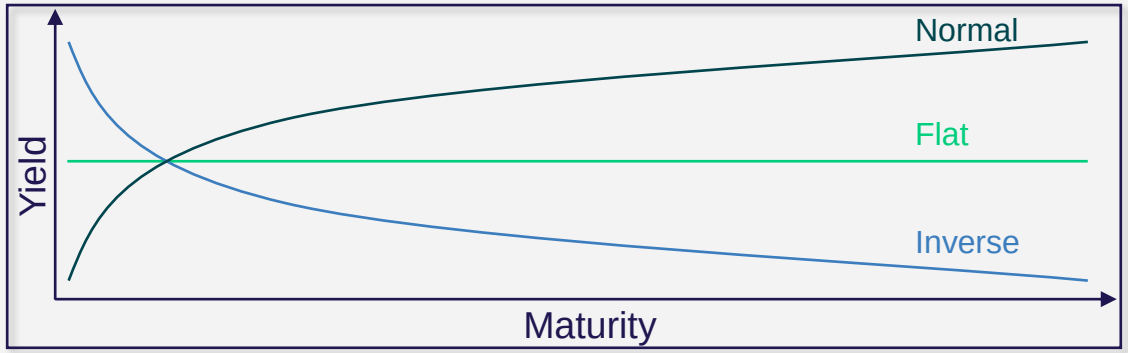
Theory

Fixed income futures can protect against certain event risks. One such example is *inflation*.

When inflation expectations rise, interest rates rise, bond yields rise and bond prices fall.

Therefore, the **price/yield** profile of bonds with different maturities are an excellent indicator of future economic activity, and the shape of the yield curve offers insights into possible interest rate changes and potential economic activity in the future. It takes on three basic shapes:

Practice



- Suggests a period of **economic expansion**
- Suggests a period of **economic transition**
- Suggests a period of **economic recession**

IV. Trading Considerations

Order types for futures trading

Limit orders

The limit price indicates the maximum price at which a buy order is allowed to match, or the minimum price at which a sell order is allowed to match.

In general, the Eurex T7 system supports prices that are positive, zero or negative. Only positive prices are allowed for most Eurex products, however, negative prices are commonly seen in calendar spreads.

Market orders

Buy or sell market orders have no limit price and are restricted to a maximum order size.

They have a higher execution priority over all other orders and are not available for spread orders.

The market order matching range protects them from execution at unreasonable trade prices.

Market data feeds does not show market orders, i.e. they are hidden orders.

Quotes

A Quote is a two-sided order entailing a bid and an ask price and is used for market-making purposes.

Eurex also supports Single-Sided Quotes, where only a buy quote or only a sell quote is entered.

A range of exchange supported safety features are available for quotes such as market maker protection and kill-switches.

Stop orders

Stop orders are initially inactive and are therefore not shown in market data.

- A buy stop order is normally placed at a stop price above the current market price
- A sell stop order is normally placed at a stop price below the current market price

A stop order is triggered when the market hits the stop level and becomes a market order. Stop orders are also constrained by a maximum order sizes.

Safeguards and error handling

Order Entry to Order Execution

Eurex has safeguards to limit the consequences of potential trading errors due to erroneously entered orders/quotes or abrupt market movements.

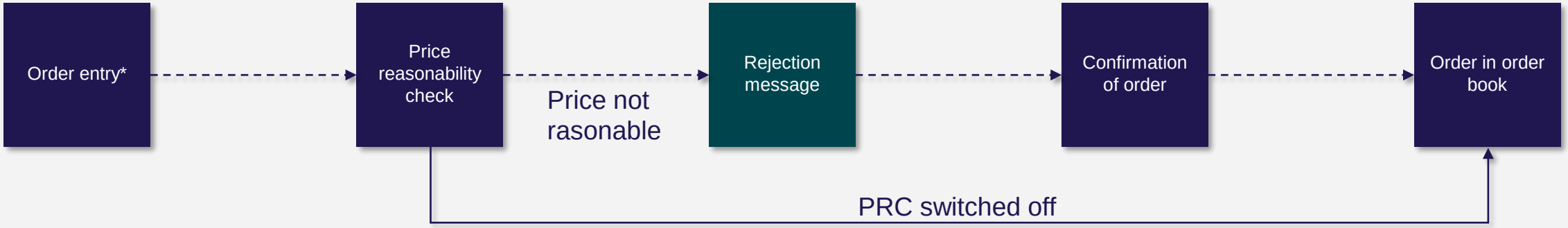
There are a number of safeguards available throughout the order execution process:

To ensure a fair and orderly market, Eurex uses Price Range Tables for various safeguards. Standard Price Range Tables are used to calculate price ranges that are detailed on the next slide:

Safeguards and error handling – contd.

Price Reasonability Check

- Ensures the reasonability of order's/quote's limit prices. If the limit price fails the check, the order/quote is rejected with message "PRICE NOT REASONABLE".
- Note that this is only an optional check and if the trader confirms the order, it goes into the system.
- The PRC can be switched on or off by the trading participant via the ETI settings.



** Simplified illustration, no distinction between mandatory and optional price reasonability check*

Order validations in practice

Balancing Market Order Matching Range and Max Quote Spread Validation

Market order matching range

Protects market orders by setting a limit to the trade price at which a market order is executable.

Matches market orders at best available bid or ask price or saves them in the book when not matchable due to the validation (partial match possible).

The market order matching range helps to prevent extreme price fluctuations and avert mistrades.

Max quote spread validation

Limits the allowed price spread between the buy side and sell side of a double-sided quote.

In addition to price reasonability checks, **extended price range tables** are maintained to validate incoming orders and quotes with a further price check.

Orders exceeding the valid limits of the **extended price range validation** are rejected and there is no way to re-confirm unless the order limit is reduced to satisfy the applicable range.

Incoming orders may also be cancelled if they are submitted in an incorrect format/incorrect time.

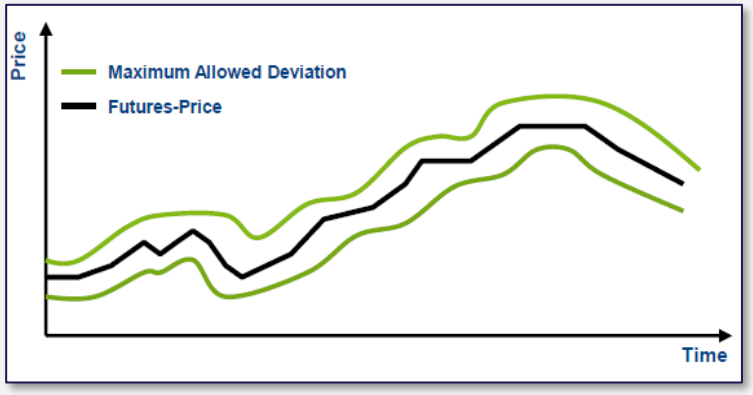
Volatility irruption

Aims at efficient price determination under highly volatile market conditions and applies to simple futures instruments.

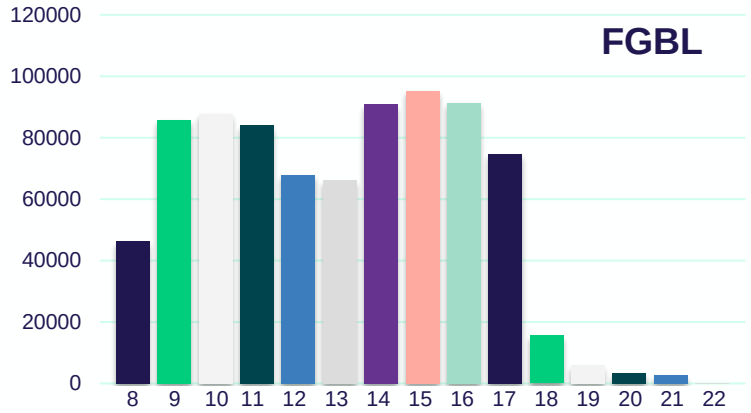
Checks the possible execution price against available execution prices and matches only up to an acceptable limit.

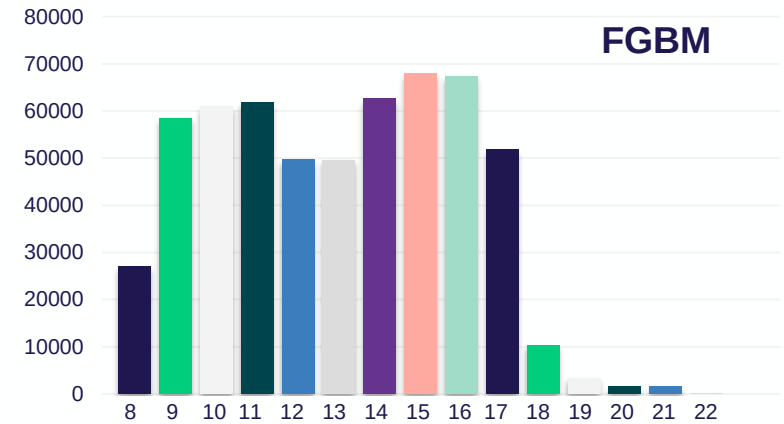
The market goes into auction when a volatility interruption occurs. This happens, if a new potential execution price differs significantly within a defined time frame.

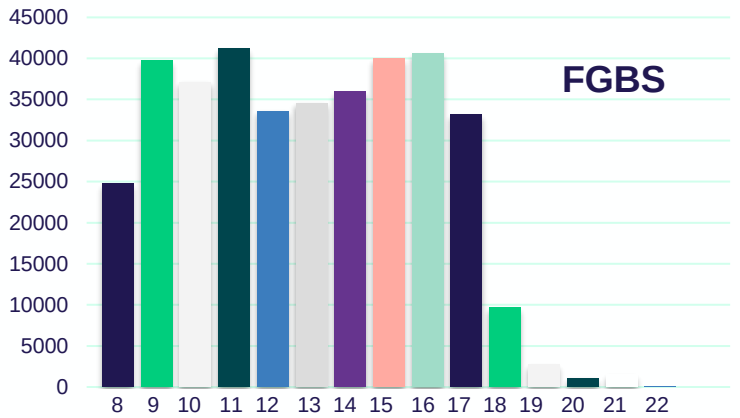
Price corridors are calculated regularly, but price corridors and time intervals are not published.

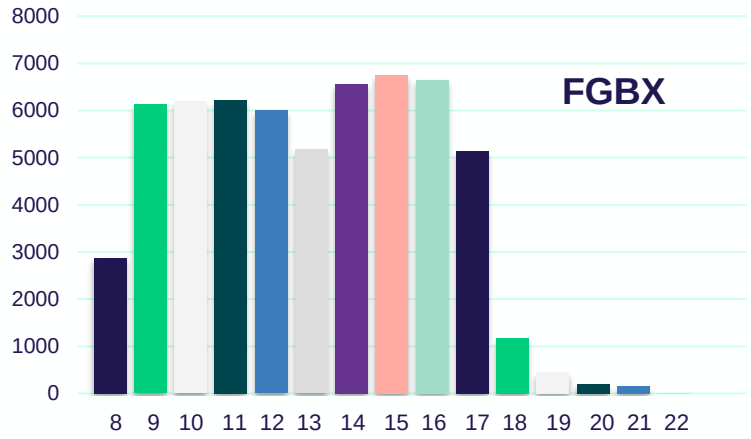


Timing of orders - market depth in trading futures









Note: all times are in 22h format

The graphs above show that market is deepest in the morning and afternoon. Timing orders between 9-11 am and 2-4 pm may help make best of use of liquidity.

Finessed order execution - trends in High Frequency Trading (HFT)

Liquidity Provision

Majority of HFT strategies are liquidity provision strategies designed to capture the spread and require **efficient response times**.

Liquidity providers need to be as fast as possible in **receiving** new information, **transforming** the new information into new prices and **updating** their bids/offers on the exchange.

The faster the liquidity provider acts, the **lower the operational risk of liquidity provision** & the **higher** the **quality of their quotes**.

Short-term Momentum Strategy

New information leads to **new price** levels.

These strategies attempt to generate profits by **reacting swiftly** to **new information**.

New information is quickly reflected in market prices.

Besides new information, market moves can generate **trading signals** (“riding the short-term trend”).

Primary source of income: short term shift in price level.

Statistical Arbitrage

Takes advantage of price differences (**or market inefficiencies**) between economically identical or correlated products.

Traders calculate fair values/spreads, and in case of deviations, they sell the more expensive product, and buy the cheaper product.

Arbitrage ensures clients **fair pricing** across all markets/products and **reduces** their **transaction costs**.

Price differences between economically related products are **eliminated**.

Liquidity Detection Strategy

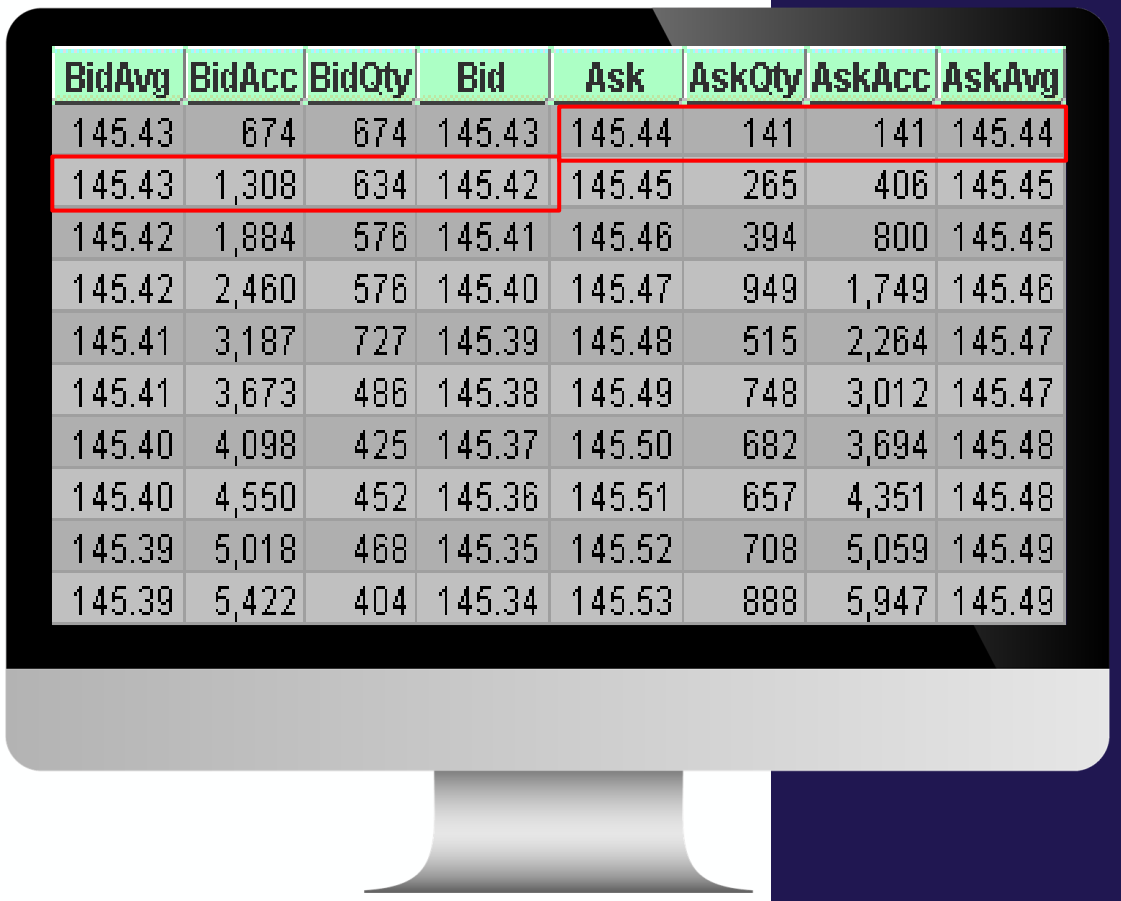
Detection of **hidden orders** or orders generated by execution **algorithms**.

The aim is to gather information about the direction of flow and thus, the market prices.

Often used by liquidity providers to **recognize** the **market direction** at an early stage.

Primary source of income: take advantage of short-term trends or avoidance of losses when providing liquidity.

Finessed order execution - Layering of quotes



BidAvg	BidAcc	BidQty	Bid	Ask	AskQty	AskAcc	AskAvg
145.43	674	674	145.43	145.44	141	141	145.44
145.43	1,308	634	145.42	145.45	265	406	145.45
145.42	1,884	576	145.41	145.46	394	800	145.45
145.42	2,460	576	145.40	145.47	949	1,749	145.46
145.41	3,187	727	145.39	145.48	515	2,264	145.47
145.41	3,673	486	145.38	145.49	748	3,012	145.47
145.40	4,098	425	145.37	145.50	682	3,694	145.48
145.40	4,550	452	145.36	145.51	657	4,351	145.48
145.39	5,018	468	145.35	145.52	708	5,059	145.49
145.39	5,422	404	145.34	145.53	888	5,947	145.49

Trading on the top-level bid-offer spread can be difficult in light of rapid price movements, and due to an order's position in the queue in price-time matched futures.

Quoting on both sides of the market (at multiple price levels) can increase chances for execution at desired price levels.

Example:

- The **buy order** needs to be at the front of the queue when **145.43** becomes best bid.
- When the **sell order** is executed at **145.44**.

Finessed order execution – TWAP and VWAP

VWAP – Volume Weighted Average Price

Works an order over time, in line with the expected market volume to meet or exceed the volume weighted average price over that time frame.

➢ Most useful for **large sizes traded** over **longer time spans**.

On a slow trading day, TWAP may be very similar to the VWAP. However, in a volatile or high-volume session, the two may differ substantially.

TWAP – Time Weighted Average Price

Executes an order in slices over a time interval to improve order execution.

➢ Especially useful for **specific time periods**.

Euro-Bund futures vs VWAP

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