Hedge Funds

Hedge Funds Overview

Gonçalo Sommer Ribeiro

- Gonçalo Sommer Ribeiro, CFA
  - Practitioner for 12y +
  - Executed most of strategies being discussed
  - Macro focus
  - Quant Strategies
  - Contact: goncalo.ribeiro@novasbe.pt
- Miguel Marecos, CFA
  - Value Investor, 10y + Experience
  - Contact: miguel.m.duarte@novasbe.pt

- Access:
  - Moodle Enrolment Key: **HFT422**
  - Teams Code: **o8dv8n5**

- Classes:
  - Tuesday 16h30 - 18h00, Room B010
  - Friday 16h30 - 18h00, Room B010

Hedge Funds
Introduction
About the Course

- Very practical, market oriented, real-life examples
- Study most common investment strategies of HFs
- What can you expect from the course? Market basics + methodology to research-> research team skills
- What do we expect from you?
  - Basic Concepts of - stocks, bonds, futures, options, portfolio theory
  - Use Excel and Market data (from Bloomberg, Reuters, Data.xls) to back-test investment strategies
- Prepare students to work in financial markets – investment bank, investment fund or Hedge-Fund

- Assignments 30%
  - Already on Moodle
- Final Project 20%
  - Groups **4** people
  - Assignments + Project - Short reports (1 page, 3-4 pages respectively)
- Exam 50%
  - Exam based on class materials (T/F + Multiple Choices + short questions)

- Textbook
  - Antti Ilmanen, 2011, *Expected Returns: An Investor's Guide to Harvesting Market Rewards*, Wiley Finance
- Research Papers
- Macroeconomic notes, news, analysis
- Lots of readings. **Need to be selective**. Read abstract and the conclusion – select what is most interesting and specialize in that area
- Videos

Hedge Funds

Introduction

What do you know about Hedge Funds?

Hedge Funds
Characteristics of Hedge Funds

- **Investment objectives**
  - Focus on capital protection (low risk)
  - Absolute return, no benchmark (low beta)
- **Flexible investment policy**
  - All asset classes, all instruments, all markets
  - Allow short-selling and leverage
- **Unregistered / unregulated**
  - Not sold to retail investors, only qualified investors
  - Target institutional investors + XL individuals → diversification = low beta | protection = low risk
  - Limitations on solicitation / advertising
- **Fees and liquidity**
  - Management fee + perform. fee (ex 1.5%, 20%) → attract talent
  - Limited liquidity (monthly / quarterly / gates / lock-ups)

Hedge Funds History
From the beginning…

- 1st Known HF
  - 1949, Alfred W. Jones, USD 100k, **Equity Long-Short**
  - Hedge market risk (Beta) by short selling stocks and…
  - …increase stock picking risk (Alpha) with the use of **leverage**

- 1st Well Known HF
  - 1970, George Soros, Quantum Fund, **Global Macro**
  - Earned 36% pa for 25 years (until fund closed to outside investors)
  - *Rec. book: "Alchemy of Finance"*

- Good performance led to strong growth and to a large number of different strategies

Hedge Funds History
To bad examples….

- Since most HFs do little or none advertising... public only knows of big problems
- Some big Failures
  - 1998, **LTCM**, lost U$ 5b in fixed income arbitrage
    - FED had to intervene due to systemic risk
    - *Rec. book: "When genius failed" (R.Merton and M.Scholes)*
  - 2000, **Tiger Funds**, lost U$ 2b shorting the dot-com bubble
  - 2006, **Amaranth**, lost U$ 6b in natural gas spreads
  - 2021, **Archego**, managed U$10b before margin call linked to Reddit stocks
- Some big Frauds
  - 2008, **Maddof** lost U$ 50b in a ponzi scheme (not a real HF)
  - Insider Trading – SAC, Galleon, Pequot *Rec. book: "Black Hedge"*

Hedge Funds History

… to great successes...

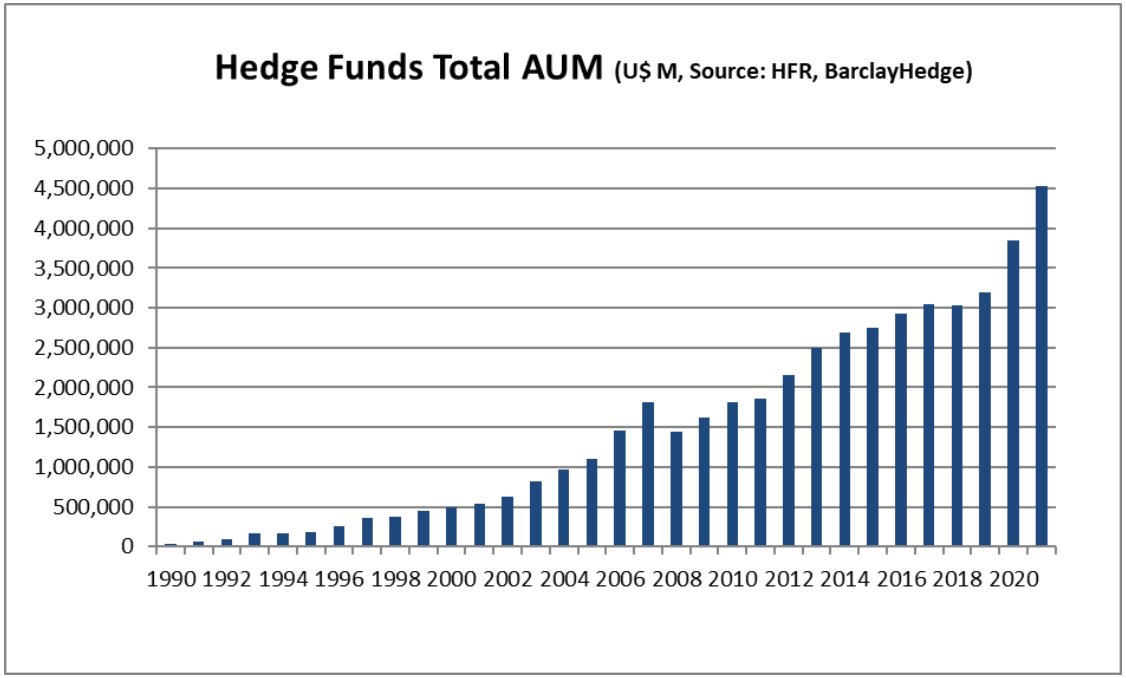
- But also some big Sucesses (not so widely advertised)
  - Bridgewater Pure Alpha and AllWeather
  - Quantum Fund
  - Baupost Group
  - Moore Capital
  - Caxton Associates
  - Farallon Capital
  - Winton Futures
  - Paulson Credit Opportunity
  - Medallion
  - BrevanHoward, Appaloosa, AQR, DEShaw, Citadel, Vega, GMO, Blue Crest, Getco, Tudor, Third Point, Greenlight Capital, TCI, Lone Pine, etc

Hedge Funds History
… and extraordinary returns

- Some Big Successes (largest HFs)
  - **Bridgewater Pure Alpha**, 18%pa over 25y+
  - **Quantum Fund**, 36%pa over 25y+
  - **Baupost Group**, 19%pa over 30y+
  - **Moore Capital**, 17%pa over 25y+
  - **Caxton Associates,** 14% over 30y+
  - **Farallon Capital**, 14% over 25y+
  - **Winton Futures**, 17% over 20y
  - **Medallion**, 40+% over 30y+ (net of 5/44)*

Good returns, even better **sharpe ratios** and % positive months
All highly unlikely under **EMH**

Hedge Funds
Strong Growth of Assets Under Management



- 17% annualized cumulative growth rate
- Still very small compared to 100T+ of total AUM globally

Hedge Funds
Types of Strategies

- Equity Long-Short
- Global Macro
- Systematic Trading
- Fixed Income Arbitrage
- Specialized Credit
- Event Driven
- Volatility Arbitrage
- Funds of Funds
- Multistrategy
- …among many others

Hedge Funds
Types of Strategies
Equity Long-Short

- **Long undervalued stocks and short overvalued stocks**
- … **or short index futures** (easier)
- Usually the hedged portfolios display a very low risk, so most managers increase it by using **leverage**
- They usually display returns uncorrelated to market performance
- Can be subdivided in
  - Long bias
  - Short bias
  - Pure market neutral

Ex. Alfred Jones, Tiger Global, JAT Capital, Coatue

Hedge Funds

Types of Strategies

Global Macro

- **Based on the manager's perception of prevailing macro-economic conditions and their impact on the financial markets…**
- **…establish directional positions (long or short) in different asset classes and in different regions of the world**
- Major focus is frequently on **interest rate positions**, as these are more directly related to economic conditions, but may take positions in all asset classes

- Macro is typically the most **discretionary** strategy and frequently one of the most **risky.** Some attempts at **systematic macro (**wp**).**

Ex. Soros Fund Management (ex-Quantum Fund), Caxton, Bridgewater

Hedge Funds

Types of Strategies

Systematic Trading

- **Investment decisions are based on some sort of system**, often automatically generated by a computer
- **Based on technical patterns, fundamental data, market anomalies, or other, and usually back-tested using historical data**
- **Diversification** of strategies is crucial to minimize the risk of model misspecification or changing market patterns

- Managers using this strategy are often mathematicians, physicians and software engineers

Ex. Medallion, AQR, Winton, OxAM

Hedge Funds

Types of Strategies

Fixed Income Arbitrage (Interest Rate risk)

- **Exploit pricing inefficiencies between related fixed income securities while hedging interest rate risk**
- Most common trades are **yield curve arbitrages (ex. 2-10, 5-30),** but may also include inter market spreads (ex. Bund vs TY), futures x bonds (CTD), bonds x swaps, caps-floors, swaptions, etc…
- May be duration neutral or have a long or short bias

Ex. Brevan Howard, Blackrock FI, LTCM

Hedge Funds

Types of Strategies

Specialized Credit (Default / Recovery risk)

- **Long credit that is perceived to be underpriced and short credit that is perceived to be overpriced**
- May arbitrage **different tiers** within the same company, different **companies**, **sectors** or even **countries**
- May trade corporate bonds, CDSs, CDOs, MBSs, ETFs, etc
- May have a market neutral view, a long bias or short bias (carry is usually important)

Ex. Paulson Credit Opp, Baupost, Fortress

Hedge Funds
Types of Strategies
Event-Driven

- **Invest in opportunities created by significant corporate events**, such as **M&A** deals, **spin-offs**, bankruptcies, **capital increases**, share buybacks, etc…
- The most common are **M&A deals** - usually the arbitrage involves buying shares of the target company and selling shares of the buyer, trying to profit with the completion of the deal
- But it can also do the opposite, betting on the breakup of the deal, or even bid up the price, betting on the appearance of a better offer
- Some attempts at **systematic event-driven (**wp**)**

Ex. Farallon, Cerberus Capital, Paulson Advantage

Hedge Funds

Types of Strategies

Volatility Arbitrage

- **Involves buying (selling) options or convertible bonds and hedging the equity risk by selling (buying) the underlying common stock (delta hedging)**
- This can be done using the appropriate delta or leaving a long or short bias
- May also arbitrage volatility between correlated assets (ex. Stock option x Index options, Variance Swaps, VIX x V2X)

Ex. Titan, AM Master, Castle Creek

Hedge Funds
Types of Strategies
Fund of Funds

- The FoF does the **due diligence** on each fund it invests in, easing life for non-specialized investors
- Main advantage – **diversification** – mitigates the risk inherent to each individual fund (important due to black box risk)
- Main disadvantage - **fees on fees** - may take away most of the alpha (positive perf pays, negative perf does not give back)
- Other advantage – specialization – every investor should focus on what is he good at

Ex. Permal, FRM, Fauchier

Hedge Funds

Types of Strategies

Multi-strategy

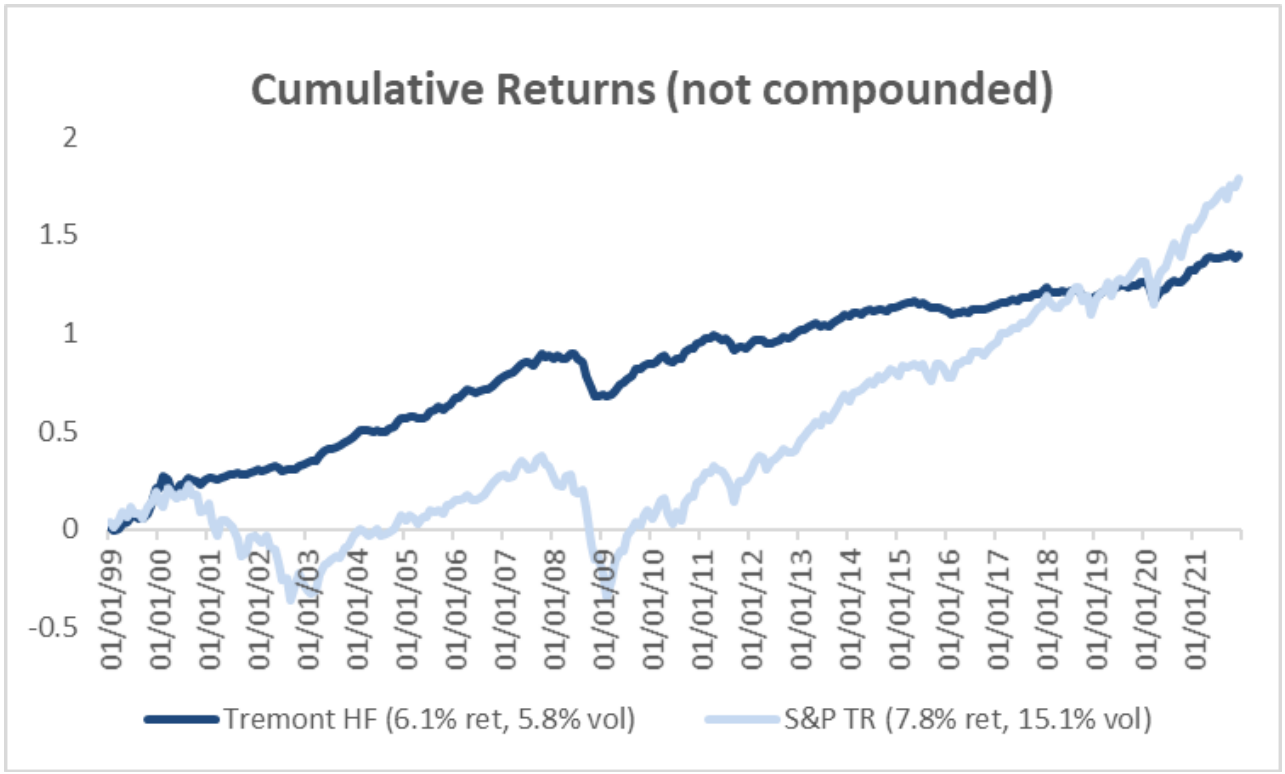
- Offer the **diversification without fees on fees**
- More flexible / faster in varying the weighting of each strategy according to opportunities and market trends
- **Less diversification / same view**
- Still some black box risk

Ex. Citadel, Stratus, DE Shaw

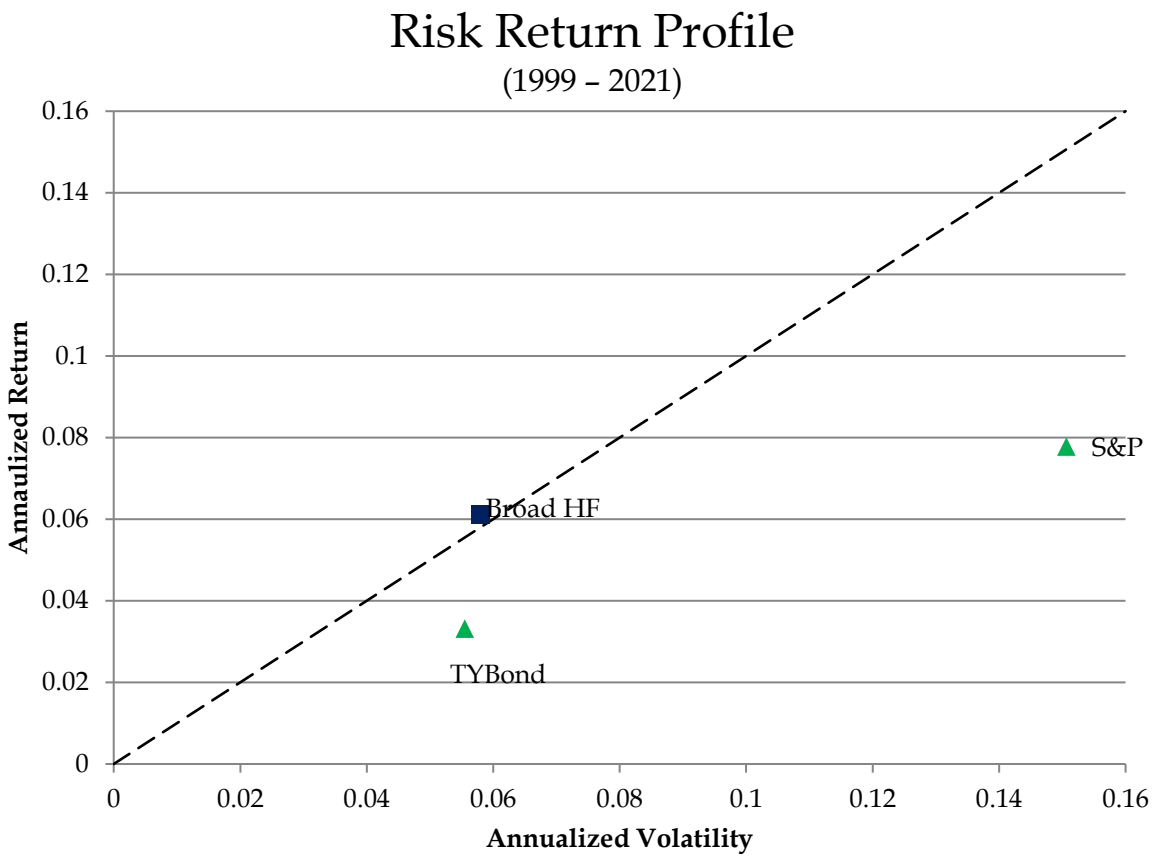
Hedge Funds

Historical Performance

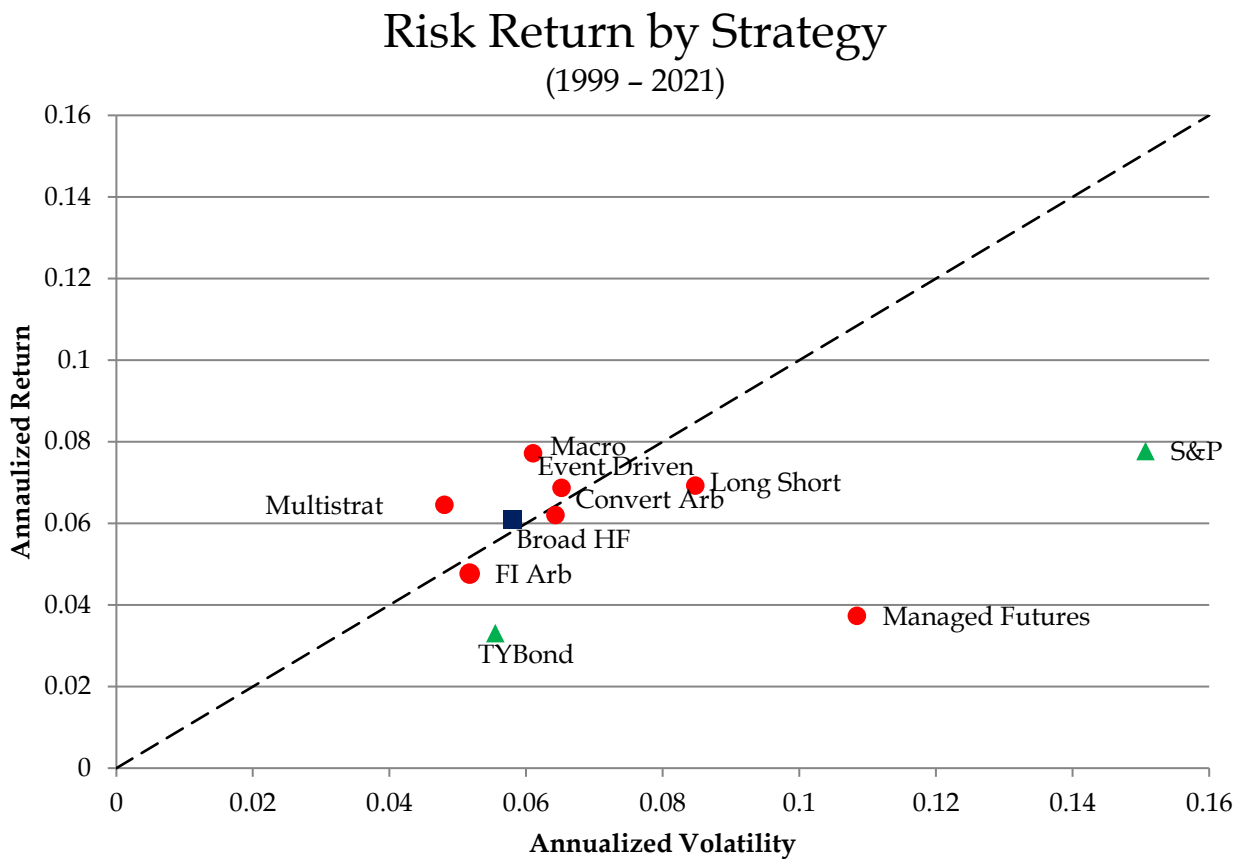
Equity-like returns with less volatility



Hedge Funds
Historical Performance
Better Info Sharpe Ratio



Hedge Funds
Historical Performance
Risk Return by Strategy

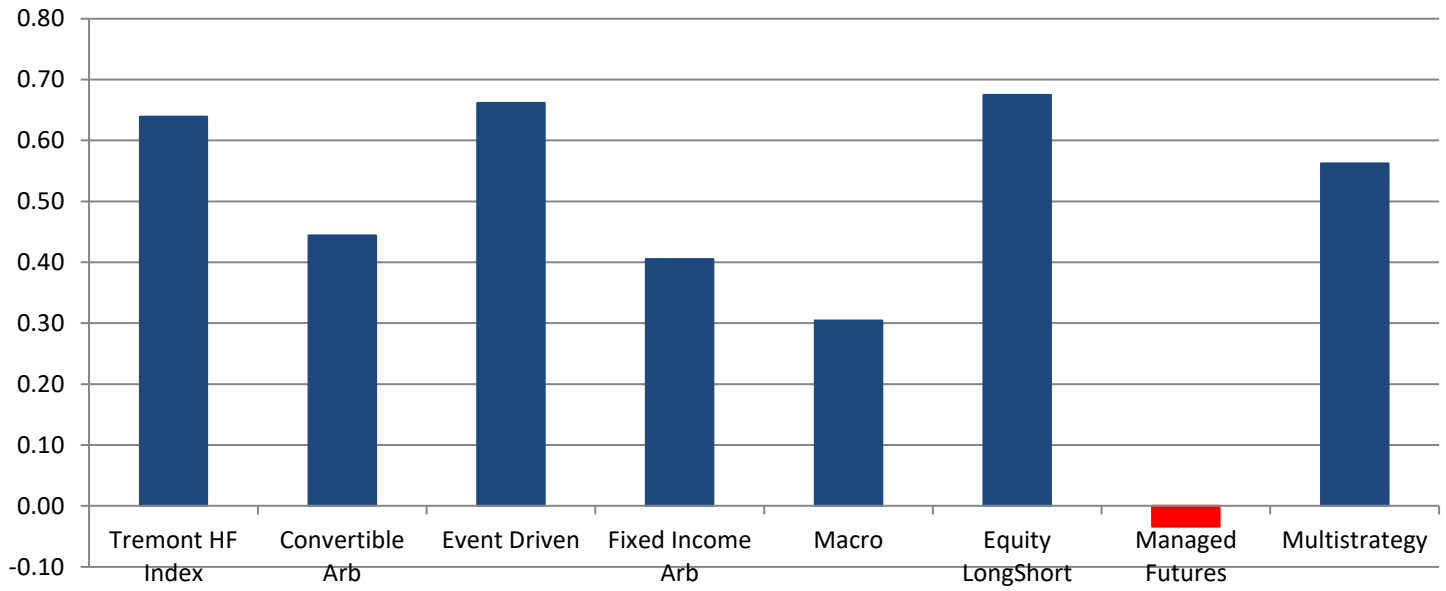


Statistical Properties of Returns (1999-2021)

	Mean	STD	Sharpe	Skew	Xss Kurt
Tremont HF Index	6.10%	5.80%	1.05	-0.61	2.46
Convertible Arb	6.20%	6.43%	0.96	-3.09	19.31
Event Driven	6.87%	6.52%	1.05	-2.37	12.21
Fixed Income Arb	4.77%	5.18%	0.92	-5.47	44.77
Macro	7.71%	6.10%	1.26	-0.36	0.64
Equity LongShort	6.93%	8.48%	0.82	0.05	0.62
Managed Futures	3.73%	10.85%	0.34	-0.03	-3.38
Multistrategy	6.46%	4.81%	1.34	-1.92	6.30
S&P Total Return	7.78%	15.07%	0.52	-0.72	-1.54
10Y Treasuries	3.31%	5.55%	0.60	0.21	-0.41

HF Tremont Indexes Correlations with S&P

(1999-2021)



Hedge Funds
Data Biases

- Hedge funds seem to have a great risk/return performance

- In fact, all funds alive and reported have had an exceptional performance in the past

- But two important biases:

1. **Back fill bias** - since most HFs are not public, indices are based on self-reported performance and usually **only successful funds report**
2. **Survivorship bias –** indexes only include the **funds that are still alive**; and there is a high degree of mortality among HFs (average life of 5y)

- According to some studies* these biases may account for up to 40% of the HF returns

* Ibbotson, Chen, Zhu (2010)

Hedge Funds

In Search for Alpha

Gonçalo Sommer Ribeiro

In Search for Alpha
How to generate Alpha?

To generate Alpha, an investor needs:

1) Active Investment Strategy
   - Go beyond Beta, go beyond Passive investment

2) Risk Control
   - Tight risk management systems and discipline

That is easier said than done! Easy to promise but hard to deliver!

EMH = all info in the prices / random walk

In Search for Alpha
Alpha generation

1) Active Investment Strategy

- Trading – based on a set of rules / system
- Macro – based on macroeconomic assessment
- Arbitrage – based on relative value

2) Risk Control

- Risk Limits / VaR / Stops
- Risk Weightings

In Search for Alpha
Backtesting

Historical data may be used to:

1) **Study the behavior of a security or asset class**
   - Go beyond Beta, go beyond Passive investment

2) Assess the performance of an **investment strategy**
   - Past performance **does not guarantee** future performance…
   - …but can help us to **evaluate a strategy** and to understand how it performed in **different periods** and **market events**

Our **level of confidence** will depend on **stability** of the backtest and on further **out-of-sample tests** (other periods, markets, etc)

In Search for Alpha
Backtesting guidelines

Example of backtest: **Long Only Strategy on the S&P500**

- Strategy – Always Long
- Dataset – SPX Index Daily Closing Prices for the last 15 years
- Compute Daily Returns – our focus is always on returns, not prices
- Compute Performance Statistics
  - Annualized Return (avg daily log return x 260)
  - Annualized Standard Deviation (stdev of daily log returns x sqrt (260))
  - Sharpe Ratio (why SR is important? why Info Sharpe?)
  - Positive Days and Positive Months
  - Daily Skew, Kurtosis and Distribution of returns
  - Autocorrelations – d, w, m, y
- Analyze the Calendar Performance of the Strategy
  - How does it perform in each and every period?
  - Is it stable across the sample? Are all statistics stable?

Long Only SPX can be used to study the behavior of an Asset Class – US Equity

In Search for Alpha

Active Strategies

Simple Active strategies

Try to **beat** the long only **strategy with active trading**

Three simple strategies: **Trend-Following, Mean-Reversion, Risk-Weighting:**

1) Go Long only if **Trend** is positive, "The trend is your friend"- may use Price Rate of Change (RoC), Slope of positive drift, Moving Averages (MA), etc…

2) Go Long / Short when the market falls / rises too fast (short-term **Mean Reversion**),"Mr Market is irrational" – use Moving Average +/- n Stdev (Bollinger Band)

3) **Risk Weighting**, maybe risk weighting, risk parity, volatility filters – use Stdev as volatility

In Search for Alpha

Active Strategies

Add Complexity to basic rules

Following the use of vanilla strategies such as Trend-Following, Mean-Reversion, Risk-Weighting, **derivations of those strategies** can be tested as well, making the trading rule more complex:

Derivations of basic strategies:

1) Try different strategy variations (ex: in 1 also go **short**)

2) Experiment with different **look-back periods**

3) Experiment with different **holding periods**

4) Mix different **asset classes, geographies, etc…**

In Search for Alpha

Active Strategies

S&P 500 Long-Only

Trend Following

Strategy – Long if medium term trend is positive

1) Use **simple moving average** (50d in ex.) as trend (could use **slope**, **rate of change**, etc)
2) Trading Rule : LONG if price above MA, OUT otherwise

In Search for Alpha

Active Strategies

S&P 500 Long-Only

Mean Reversion

Strategy – Trade S/T Mean Reversion

1) Use 5-day simple **moving average** as S/T trend and 5-day **standard deviation** to assess market exaggerations
2) Trading Rule: SHORT if price is above 5-day MA + X STD
   LONG if price is below 5-day MA – X STD

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Trading I

Gonçalo Sommer Ribeiro

Trading
Definition

Objective: try to **time the market in the short run** (yearly, monthly, weekly, daily, hourly, minute, second, nano-second…)

1) Very difficult: **EMH** = prices follow a random walk (supposedly)
2) Look for small inefficiencies and keep on doing continuous research to find new patterns: **AMH** (Adaptative Market Hypothesis) means every explorable opportunity will fade away as more agents explore it
3) More frequent in **illiquid**, **discontinuous**, **volatile**, **irrational** markets, but … **transaction costs** tend to eat up most of performance. Balancing act.

Think **different** and **simple** (avoid over-fitting)

Info Sharpe ≈ 1 is good, while > 2 is probably wrong

Trading
Trading Styles

1) Opportunistic x **Systematic**

2) Subjective x **Quantitative**

3) Technical x Fundamental x Other

Technical analysis principles are:

1) All info is in the prices
2) Prices reflect sentiment
3) Patterns repeat themselves

- **Trend Following –** Rate-of-Change (RoC), MA, slope, breakouts, etc
- **Mean Reversion –** Range Trading, Bollinger bands, MACD, Fibonacci*, RSI** (overbought / oversold), etc
- **Other Patterns –** supports x resistances, rectangles, triangles, head and shoulders, double tops / bottoms, etc

(see TECH on Bloomberg for details)

* Phi = 1.618, Golden Ratio, Fibonacci series
** Speed of movement

Fundamental analysis principles are:

1) Use more data than just prices
2) Accounting data and Macro data
3) Try to assess real value of assets

- **Value –** PE, PCF, DY, P/B, Leverage, Ev/Ebitda, ROE, Accruals, Intangibles, etc
- **Growth –** PEG, Price to Sales, PS Growth, Asset Growth, Earning Announcements, etc
  Also, qualitative changes – New Products, New Management, Disruptive Innovations, etc – usually more difficult to model
- **Macro –** CPI, GDP, Unemployment, Budget Deficit, Current Account, M3, etc – use Lag?
- **Other –** Interest Rates, Yield Curve Slope, FX Rates, Sentiment, etc

Miscellaneous types of analysis:

1) Anything that can be backtested – usually based on data/big data followed by data analysis

- **Market Anomalies** – SIM, DOM, Elections, Lunar Phases, Rainy days, Night & Day return patterns, Football Results, Daily Patterns, Holiday Periods, etc
- **Artificial Intelligence –** Neural Networks, Pattern Recognition / Optimization, Genetic Algorithms, Hidden Markov Models, Dynamic Time Warping, etc
- **Physics –** Climate models, Earthquakes, Fluid Dynamics, Fractals, etc
- **Alternative Data** – Market Data, Data Scraping, Trading pit noise, News reading, Google, Social Networks (Twitter, Facebook, etc)

Trading

Trading Styles

What Analysis works better?

- **Fundamentals** look better: most people are more comfortable with them

*"In the **short term** the market is a voting machine, in the **long term** it is a weighting machine."* Benjamin Graham

- **Technical** look a bit naive

  But they are easier to use, and helpful to measure sentiment and to access repetitive market conditions

  Sometimes they become a "self full-filing prophecy"

*"Markets can stay **irrational** longer than you can stay solvent."* John M Keynes

- **Other analysis** is more complex, less explored but if easily testable is quickly explored

Back test everything – search for good Sharpe ratio + stable profile = good trading system

Trading
Conclusions

- Beware of **over-fitting** → compare In Sample with Out of Sample

"If you torture the data long enough it will confess anything." Ronald Coase

- Pay attention to **transaction costs** (fees + bid-ask)

- **Diversify** to minimize impact of:

1) Model mis-specification
2) Market pattern changes

Ex. MODvg, Dom, Night&Day

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Trading II - Fundamentals

Gonçalo Sommer Ribeiro

Trading
Fundamental Strategies

- Factors based on **fundamental data**, not only prices
- Usually **accounting data** from companies or **macro economic data** from countries
- Frequently more difficult to work with:
  - Meaningful?
  - Reliable?
  - Comparable?
  - Timely / Available?

- Some of the most commonly used **Equity factors**:
  - **Market (Beta)** (W. Sharpe, CAPM)
  - **Value (HML)** (Fama & French)
  - **Size (SMB)** (Fama & French)
  - **Momentum** (Jegadeesh & Titman)
  - **Volatility** (Black, Haugen & Baker)
  - **Quality** (Several, Frazzini & Penderson)
  - Many others: **Liquidity, Profitability, Investment, Carry, Reversal, Sentiment, etc**
- **Methodology** to create factors: Long-Short of equities with the best /worst characteristics being evaluated (Value, Growth, Size, Momentum, Vol, Quality, etc)

Check https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html

- Most commonly used **indicators for equity** factors:
  - **Value –** PER or E/P (Earnings Yield), FCF/P, Ebitda/EV, P/BV
  - **Momentum –** 12m returns (ex-last 1m, excess returns), EPS 12m revisions
  - **Low vol –** 1m to 3y STDev
  - **Quality** – ROE, FCF/Assets, Accruals/Assets, Average Net Receivables (ANR), Market Share
  - **Size –** market cap

- Some of the most commonly used **Macroeconomic factors**:
  - **GDP**
  - **CPI**
  - **Unemployment**
  - **Current Account**
  - **Budget Deficit**
  - **Money Supply**
  - Many others: **Industrial Production, PMIs, Debt-to-GDP, etc**
- But these are frequently **lagging** / already **discounted**
- **Methodology** to use factors: changes in these variables [use lin-lin, log-log relationships, pay attention to stationarity, cointegration , absolute size of the variables]

- Some of the most commonly used **leading indicators**:
  - **GDP** – IP, PMI, Leading Index, Home Sales , Durable Goods, Productivity, Capacity Utilization, Vehicle Sales, Construction Spending, NAPM, Mortgage Applications, Capital Goods, Personal Consumption, etc
  - **CPI** – PPI, PCE Deflator, TIPs, Hourly earnings, ULC, Personal Income, etc
  - **Unemployment –** NFP, ADP, Jobless claims, Labor participation, etc
  - **Current Account** – ULC, FX Reserves, Import/ Export Px, etc
  - **Budget Deficit** – Debt O/S, Treasuries O/S, CB B/S, Monthly Budget, etc
  - **Liquidity** –TED Spread, IRS, IRS-TY, Moody's BAA, Equities/Bonds flows, etc
  - **Sentiment** – VIX, Correlation, YC Slope, Skew, Consumption/Wealth, Consumer Expectations, Bloomberg Confidence, etc

Trading
Multifactor Models
Mix factors

- Difficult to combine – **results mixed**

- How to **combine factors?**
  - Add up different baskets — Good + Cheap **is not the same as** Good & Cheap
  - Rank + rank — Good and cheap usually not good results
  - Filter + rank — ROE > 15% **afterwards** Rank P/E
  - Multiple regression — β1 x ROE + β2 x P/E

  Ex: Good & Cheap = High ROE & Low P/E

- Beware of **multi-collinearity** – use few uncorrelated factors

- Use different factors for **different Industry Groups**, e.g.:
  - Banks — Price to Book
  - Tech — Price to Sales Growth
  - Industrials — Ev-Ebitda
  - Capital Intensive — FCF, CFO
- Use **different factors to generate signals** to buy and to sell:
  - PE, PB, ROE, Volatility Smile (skew), Short Interest (SI) = sell
- Use **factor analysis / principal components** to generate your own factors
- Use **machine learning** to **select** the most explicative/relevant **factors** (steady across time)
- Use **surprise factor (**expected vs actual) - ex. Earnings beat, economic data surprises)

Trading
Trading Strategies Pitfall

Common issues to pay attention to and try to avoid:

- **Announcement dates** (forward looking bias)
- Lack of consistent **accounting standards** (US, EU, EM...20y ago)
- **Adjustments for corporate events** (dividends, splits…)
- **Periodicity** of events (ex. Q x Y earnings)
- **Window dressing** (ex. extraordinary gains, dividends)
- **Index changes** (survivorship bias)
- **Tax / Accounting changes** (dividends x buy-backs)
- **Low frequency data** – no long time series: use cross section analysis

Ex. SX5E PE, SXXE PE

Hedge Funds

Intraday Trading

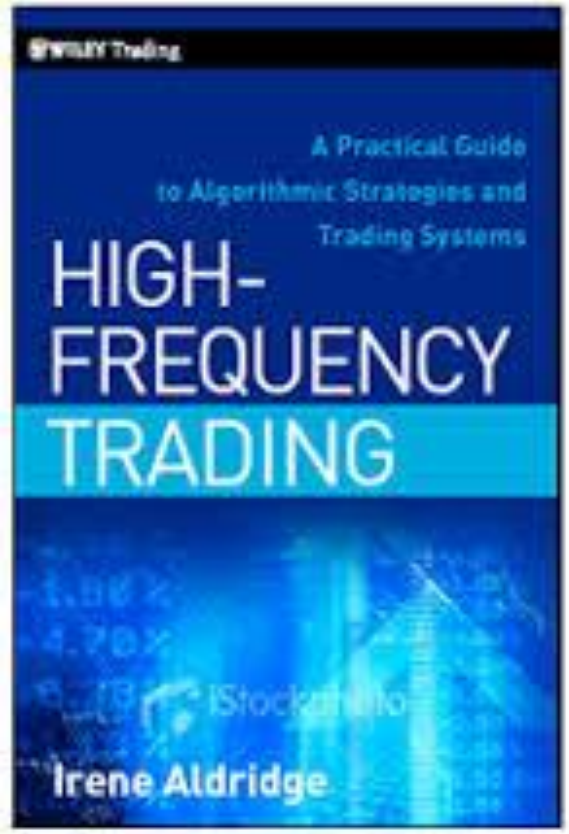
Gonçalo Sommer Ribeiro

Intraday Trading
Executive Summary

- Microstructure of Financial Markets
- Intraday Data – Strategy Development
- Intraday Data – Strategy Example
- Intraday Strategies Conclusions

Intraday Trading
Literature

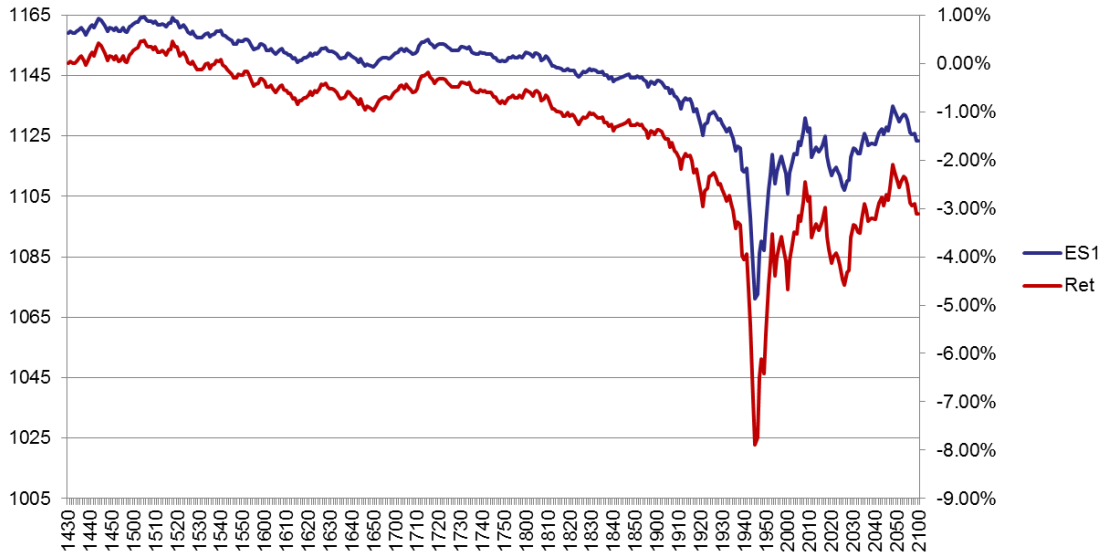
High-Frequency Trading, Irene Aldridge



Intraday Trading
Motivation

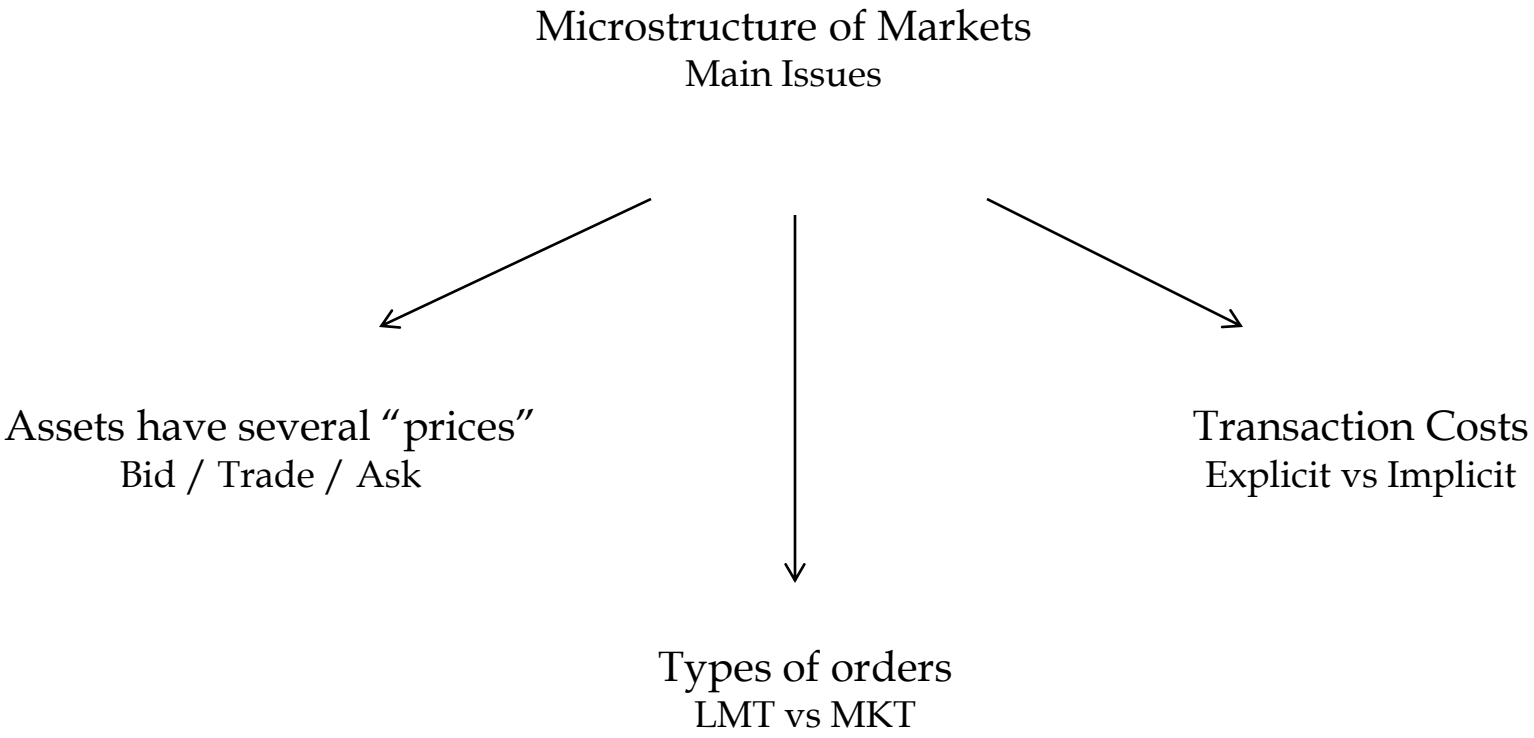
- **Intraday range** between high and low tends to be **higher** then open to close
- The objective is to **capture more volatility**
- Also the idea is to get out of a crowded place of end of day/week/month prices and capture all market movements

Intraday Trading
Motivation
Intraday Volatility
Flash Crash (6 May 2010)



S&P 500	Returns		Stdev	
Futures	Open - Close	High - Low	Daily	Annualized
5/5/2010	0.2%	1.5%	1.2%	18.6%
5/6/2010	-3.1%	8.4%	4.1%	65.0%

Intraday Trading
Microstructure of Markets



Intraday Trading

Microstructure of Markets

Assets have several "prices"

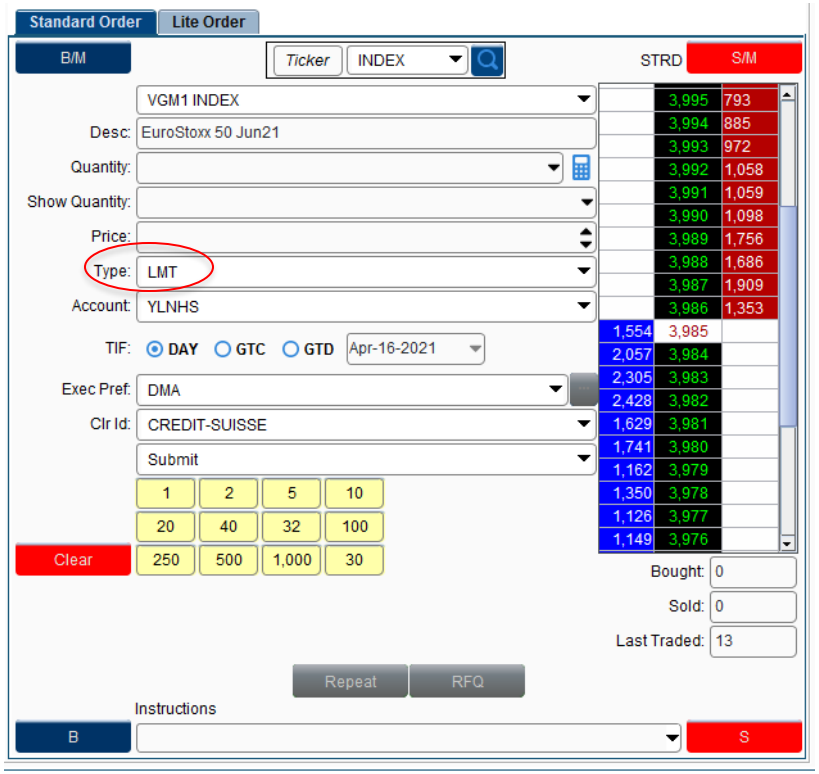
Santander Rights "Arbitrage"

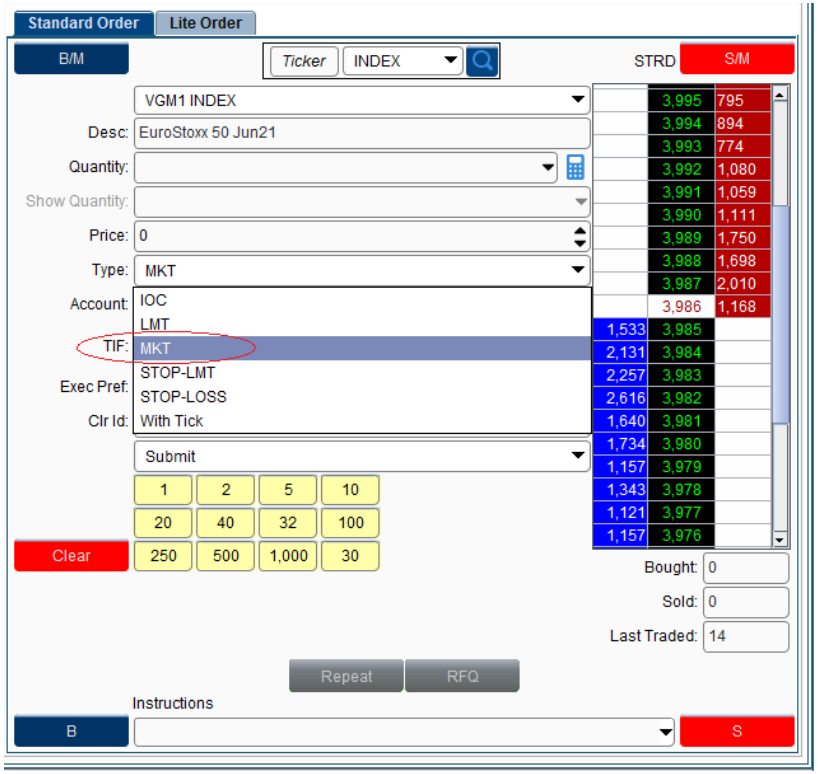
46 Rights = 1 Share

Using Trade prices	SAN/D SM Price 1 right		Price 46 rights		SAN SM Pirce 1 share		Difference		**Arbitrage Oportunity!!!! 0.08%**
	€	0.143	€	6.578	> €	6.573	= €	0.005	

		Bid	Ask			
But using Bid/Ask…	SAN/D SM	0.142 €	0.143 €	Sell 46 Rights & 1 Buy Share	-0.66%	**No Arbitrage Oportunity!!!!**
	46 SAN/D	6.532 €	6.578 €	Buy 46 Rights & 1 Sell Share	-0.08%	
	SAN SM	6.573 €	6.575 €			

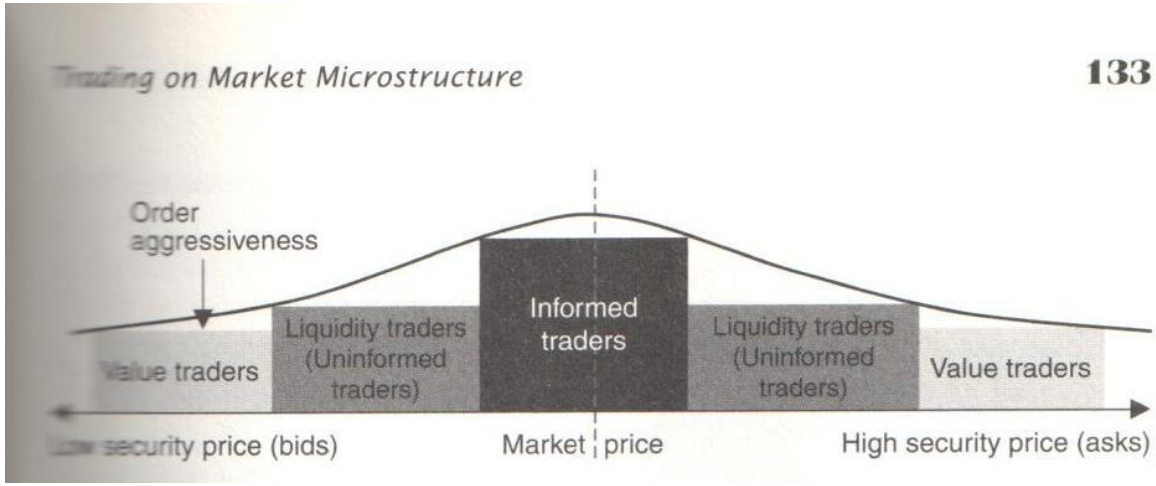
Intraday Trading
Microstructure of Markets
Type of orders





Intraday Trading
Microstructure of Markets
Type of orders
Order book

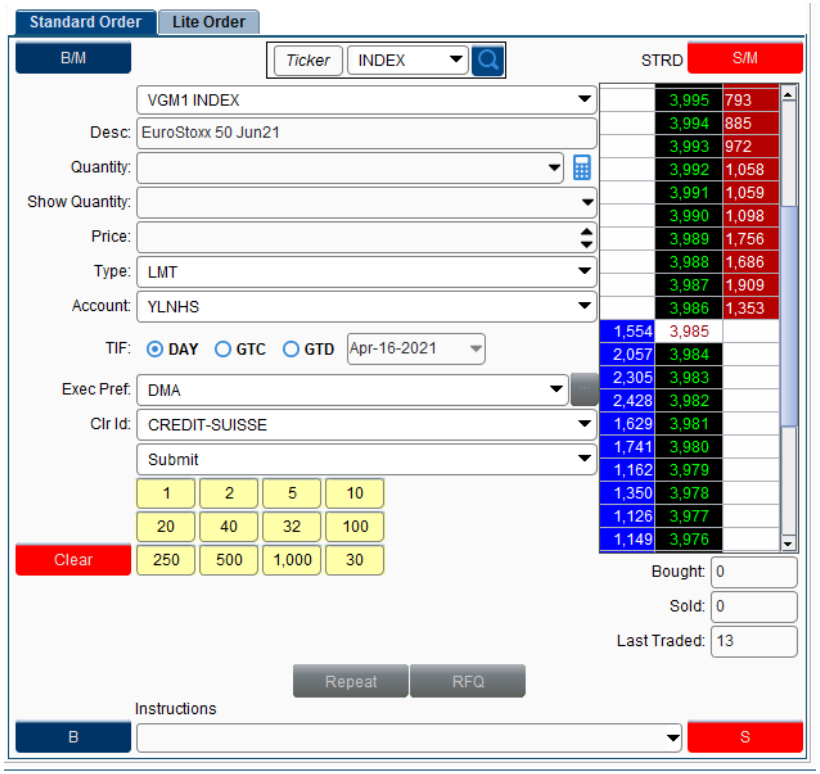
- Limit vs Market orders
  - **LMT guarantees price but not execution**
  - **MKT guarantees execution but not price**



Intraday Trading
Microstructure of Markets
Implicit Trading Costs
Bid/Ask Spread

Bid

Best price to Sell



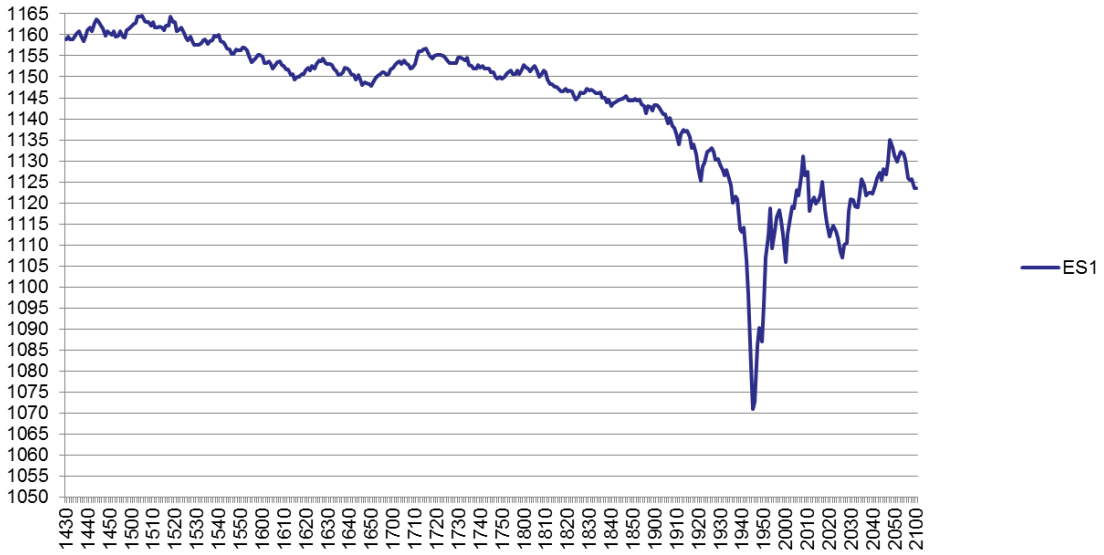
Ask / Offer

Best price to Buy

Why 2 prices instead of one? Adverse Selection

Intraday Trading
Microstructure of Markets
Implicit Trading Costs
Bid/Ask Spread (de)Formation Flash Crash

- Real life example of **distortion** of Bid-Ask Spread



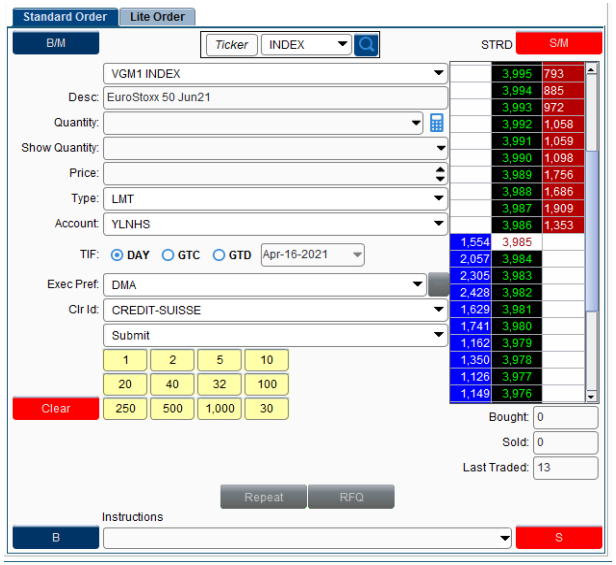
- 0:58 Stop Limit ES1: 1053
- 3:36 BidAsk spread ES1 1064.5 – 1065.75
- 3:40 Hit Limit @ 1064

Video: https://www.youtube.com/watch?v=E1xqSZy9_4I

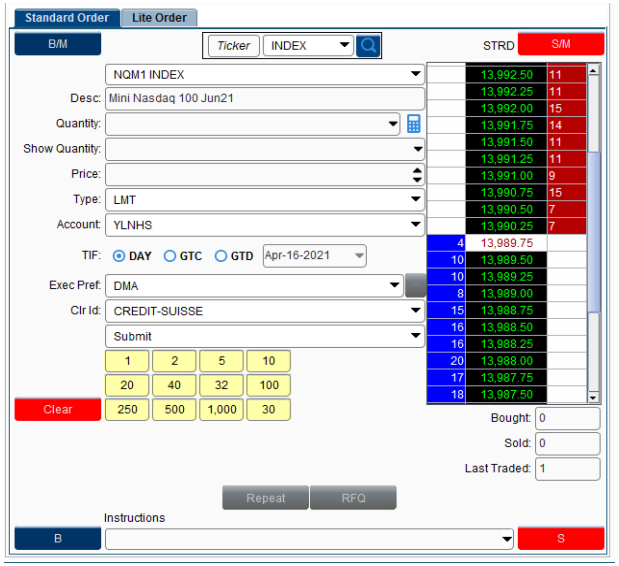
Bid/Ask Spread Factors

Factors affecting Bid/Ask Spread :

- Market liquidity (market makers)
- Market conditions (big swings in markets)
- Value of Asset and tick size (depending on exchange rules)



Eurostoxx 50 bid/ask spread is 0.025%



Nasdaq bid/ask spread is 0.002% ~ 14x lower

Intraday Trading

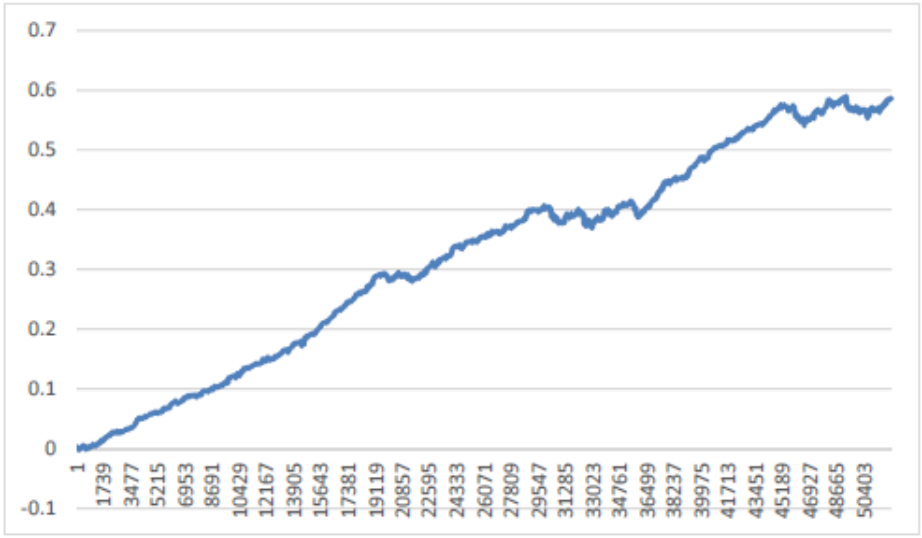
Microstructure of Markets

Illusion of Mean Reversion

Bid/Ask Bounce

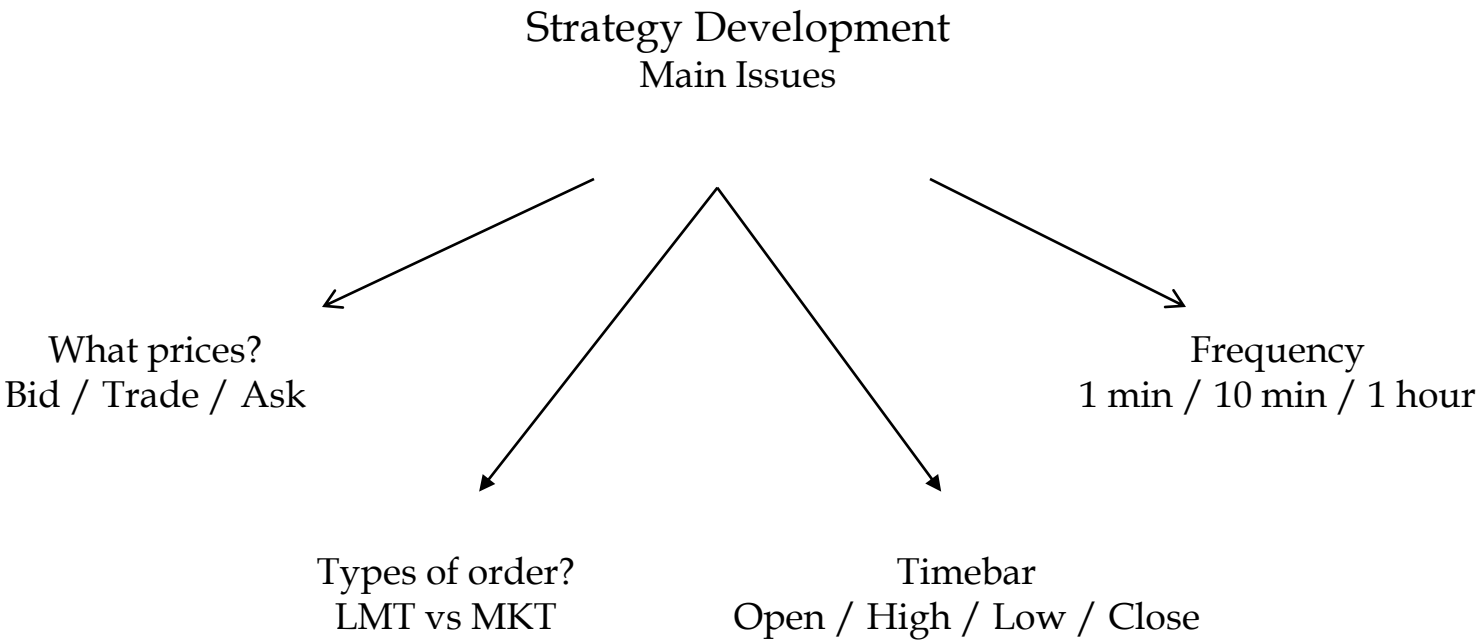
- **Bid/Ask bounce:** for the same market level, as transaction orders arrive in the market the price of the asset "bounces" from the bid (selling orders) to the ask price (buying orders) creating "fake volatility" in asset TRADING prices and the illusion of mean reversion

- Cumulative profitability of a 1 min reverse strategy in VG Futures TRADING prices (January to March 2021)



Intraday Trading
Microstructure of Markets
Illusion of Mean Reversion
Bid/Ask Bounce Video

Intraday Trading
Strategy Development

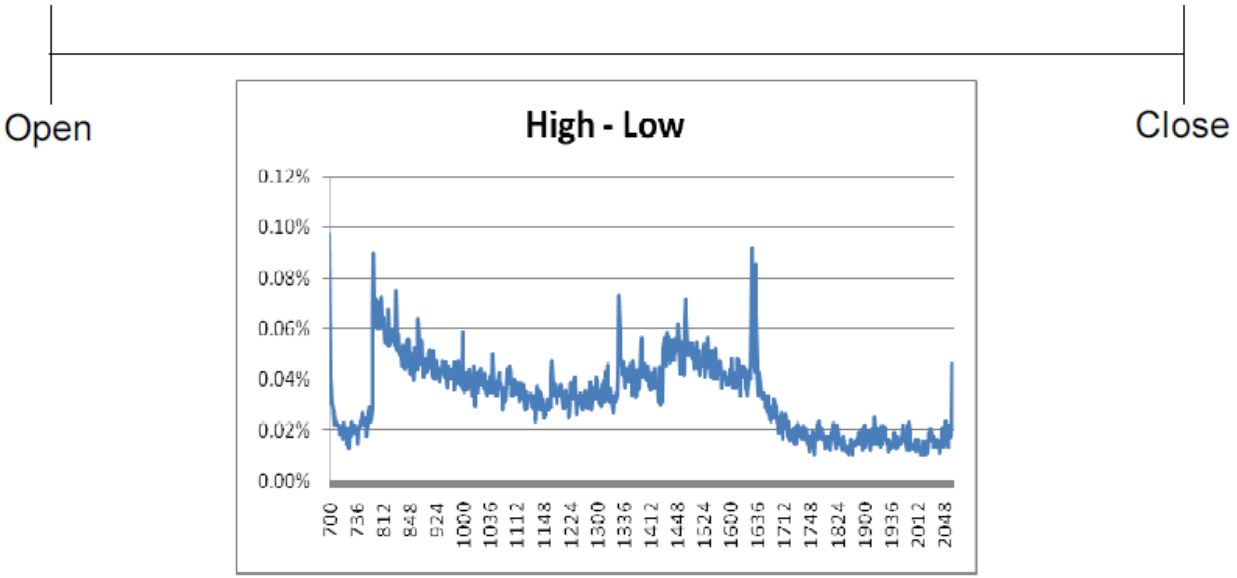


Intraday Trading

Strategy Development

Timebar

1 minute is a long time



DATE	OPEN	HIGH	LOW	CLOSE
5/6/2010 14:30	1943.25	1947	1941.75	1946.5

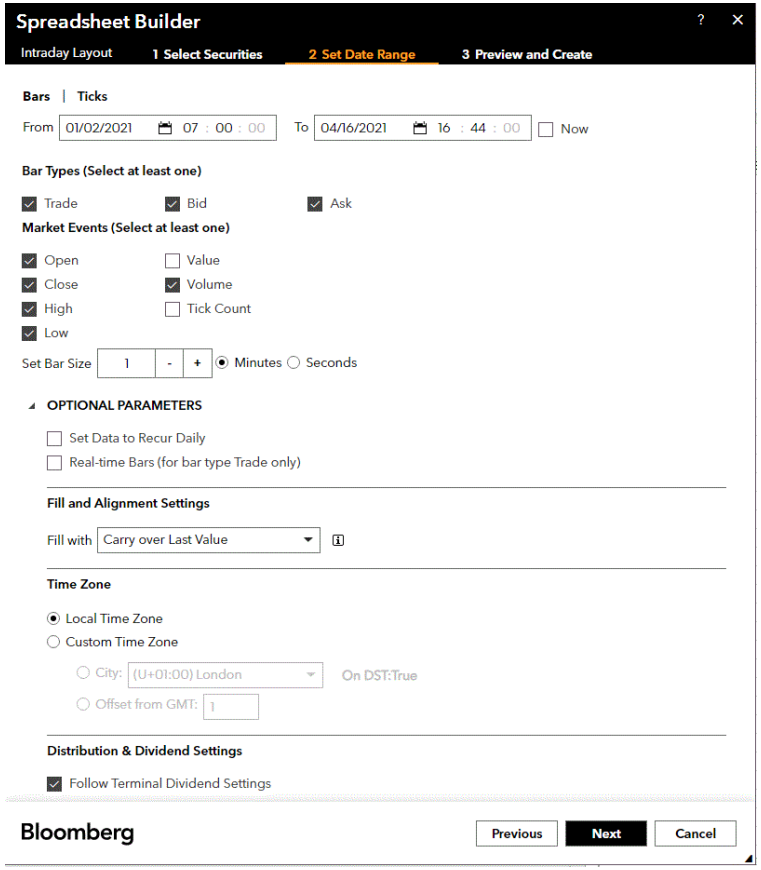
Intraday Trading
Strategy Development
Intraday Strategies

- Everything that you have discussed so far, **but intraday**
- Moving Averages **– Mean Reversion vs Trend Following**
- Explore "Seasonalities" / **Time Patterns**
- **Event Trading –** specific events (announcements, news trading, social media, etc)
- Machine/Deep Learning, Variables modeling using Physics theories The objective is to capture more volatility

Intraday Trading
Strategy Development
Signals for Intraday Strategies
Example

- Mean Reversion Strategy using minute date (negative autocorrelation?)
- Rule: Moving Average +/- Standard Deviation
- Information Lag, to avoid forward looking bias
- Which length of MA and Sigma? - Trial and error
- Using Trade prices

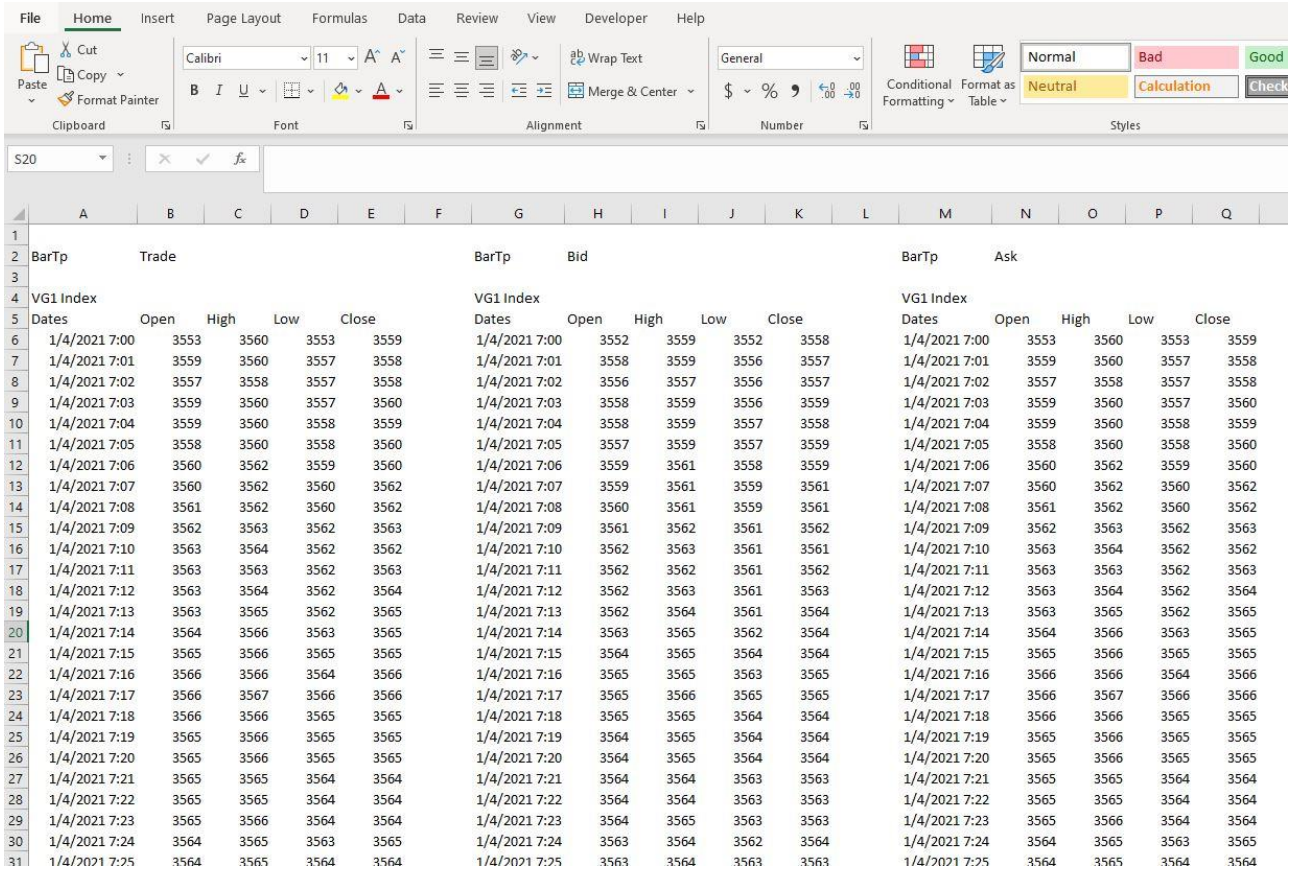
Intraday Trading
Strategy Development
Data Download



Intraday Trading

Strategy Development

Data Download Output



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1																	
2	BarTp	Trade					BarTp	Bid					BarTp	Ask			
3																	
4	VG1 Index						VG1 Index						VG1 Index				
5	Dates	Open	High	Low	Close		Dates	Open	High	Low	Close		Dates	Open	High	Low	Close
6	1/4/2021 7:00	3553	3560	3553	3559		1/4/2021 7:00	3552	3559	3552	3558		1/4/2021 7:00	3553	3560	3553	3559
7	1/4/2021 7:01	3559	3560	3557	3558		1/4/2021 7:01	3558	3559	3556	3557		1/4/2021 7:01	3559	3560	3557	3558
8	1/4/2021 7:02	3557	3558	3557	3558		1/4/2021 7:02	3556	3557	3556	3557		1/4/2021 7:02	3557	3558	3557	3558
9	1/4/2021 7:03	3559	3560	3557	3560		1/4/2021 7:03	3558	3559	3556	3559		1/4/2021 7:03	3559	3560	3557	3560
10	1/4/2021 7:04	3559	3560	3558	3559		1/4/2021 7:04	3558	3559	3557	3558		1/4/2021 7:04	3559	3560	3558	3559
11	1/4/2021 7:05	3558	3560	3558	3560		1/4/2021 7:05	3557	3559	3557	3559		1/4/2021 7:05	3558	3560	3558	3560
12	1/4/2021 7:06	3560	3562	3559	3560		1/4/2021 7:06	3559	3561	3558	3559		1/4/2021 7:06	3560	3562	3559	3560
13	1/4/2021 7:07	3560	3562	3560	3562		1/4/2021 7:07	3559	3561	3559	3561		1/4/2021 7:07	3560	3562	3560	3562
14	1/4/2021 7:08	3561	3562	3560	3562		1/4/2021 7:08	3560	3561	3559	3561		1/4/2021 7:08	3561	3562	3560	3562
15	1/4/2021 7:09	3562	3563	3562	3563		1/4/2021 7:09	3561	3562	3561	3562		1/4/2021 7:09	3562	3563	3562	3563
16	1/4/2021 7:10	3563	3564	3562	3562		1/4/2021 7:10	3562	3563	3561	3561		1/4/2021 7:10	3563	3564	3562	3562
17	1/4/2021 7:11	3563	3563	3562	3563		1/4/2021 7:11	3562	3562	3561	3562		1/4/2021 7:11	3563	3563	3562	3563
18	1/4/2021 7:12	3563	3564	3562	3564		1/4/2021 7:12	3562	3563	3561	3563		1/4/2021 7:12	3563	3564	3562	3564
19	1/4/2021 7:13	3563	3565	3562	3565		1/4/2021 7:13	3562	3564	3561	3564		1/4/2021 7:13	3563	3565	3562	3565
20	1/4/2021 7:14	3564	3566	3563	3565		1/4/2021 7:14	3563	3565	3562	3564		1/4/2021 7:14	3564	3566	3563	3565
21	1/4/2021 7:15	3565	3566	3565	3565		1/4/2021 7:15	3564	3565	3564	3564		1/4/2021 7:15	3565	3566	3565	3565
22	1/4/2021 7:16	3566	3566	3564	3566		1/4/2021 7:16	3565	3565	3563	3565		1/4/2021 7:16	3566	3566	3564	3566
23	1/4/2021 7:17	3566	3567	3566	3566		1/4/2021 7:17	3565	3566	3565	3565		1/4/2021 7:17	3566	3567	3566	3566
24	1/4/2021 7:18	3566	3566	3565	3565		1/4/2021 7:18	3565	3565	3564	3564		1/4/2021 7:18	3566	3566	3565	3565
25	1/4/2021 7:19	3565	3566	3565	3565		1/4/2021 7:19	3564	3565	3564	3564		1/4/2021 7:19	3565	3566	3565	3565
26	1/4/2021 7:20	3565	3566	3565	3565		1/4/2021 7:20	3564	3565	3564	3564		1/4/2021 7:20	3565	3566	3565	3565
27	1/4/2021 7:21	3565	3565	3564	3564		1/4/2021 7:21	3564	3564	3563	3563		1/4/2021 7:21	3565	3565	3564	3564
28	1/4/2021 7:22	3565	3565	3564	3564		1/4/2021 7:22	3564	3564	3563	3563		1/4/2021 7:22	3565	3565	3564	3564
29	1/4/2021 7:23	3565	3566	3564	3564		1/4/2021 7:23	3564	3565	3563	3563		1/4/2021 7:23	3565	3566	3564	3564
30	1/4/2021 7:24	3564	3565	3563	3565		1/4/2021 7:24	3563	3564	3562	3564		1/4/2021 7:24	3564	3565	3563	3565
31	1/4/2021 7:25	3564	3565	3564	3564		1/4/2021 7:25	3563	3564	3563	3563		1/4/2021 7:25	3564	3565	3564	3564

Example

- Simple Strategy Mean-Reversion using 20 minutes Moving Average +/- 3 Standard Deviations

Start	730
End	2030

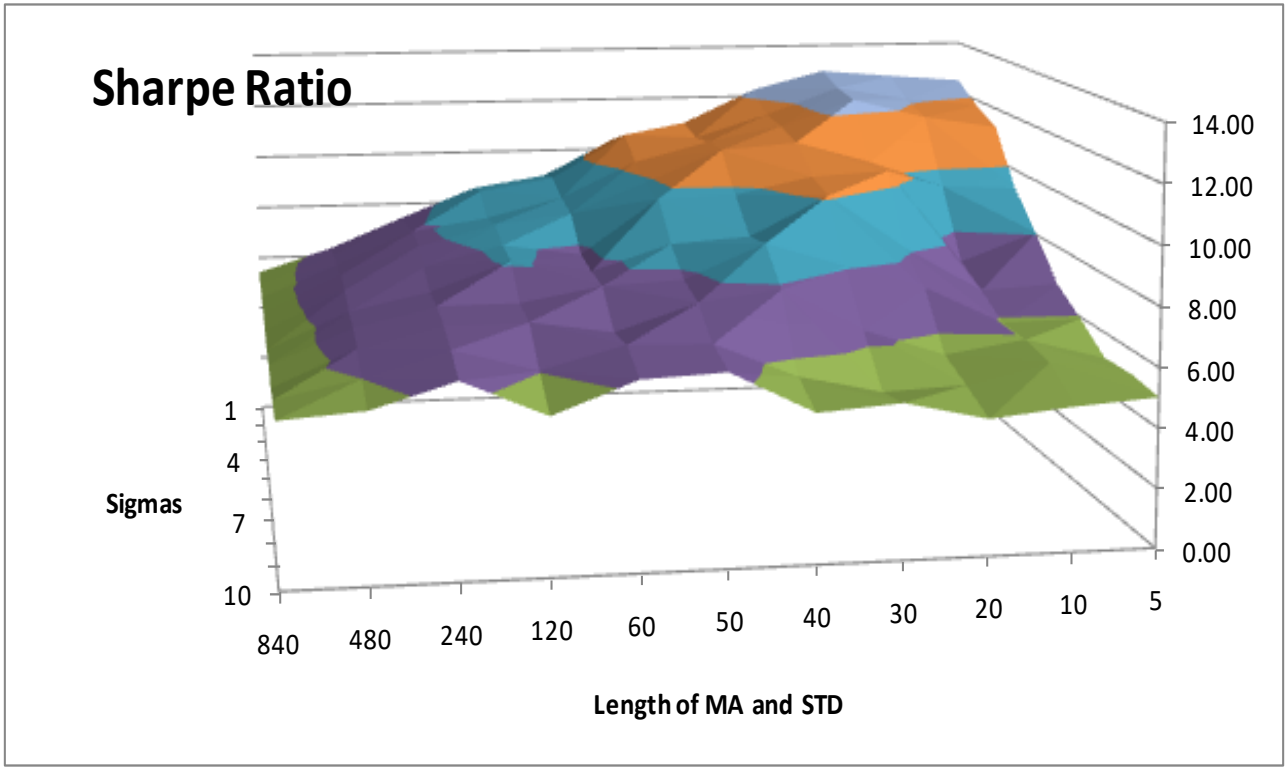
Sigma	3

avg	**32%**
std	3%
IS	**9.42**
pos d	**78%**

Assumptions:

Trade price is always executable, which is not true
Type of order being used? Assumes market, but doesnt account for bid-ask
Fill the lock, order book priority. Assumes no order book
Check stability accross the day vs time patterns
Transaction costs? Implicit and Explicit not accounted
1 minute is a lot of time!! Need to use Open High Low Close

Intraday Trading
Strategy Development
Intraday Strategies Results
Sharpe Ratio Surface

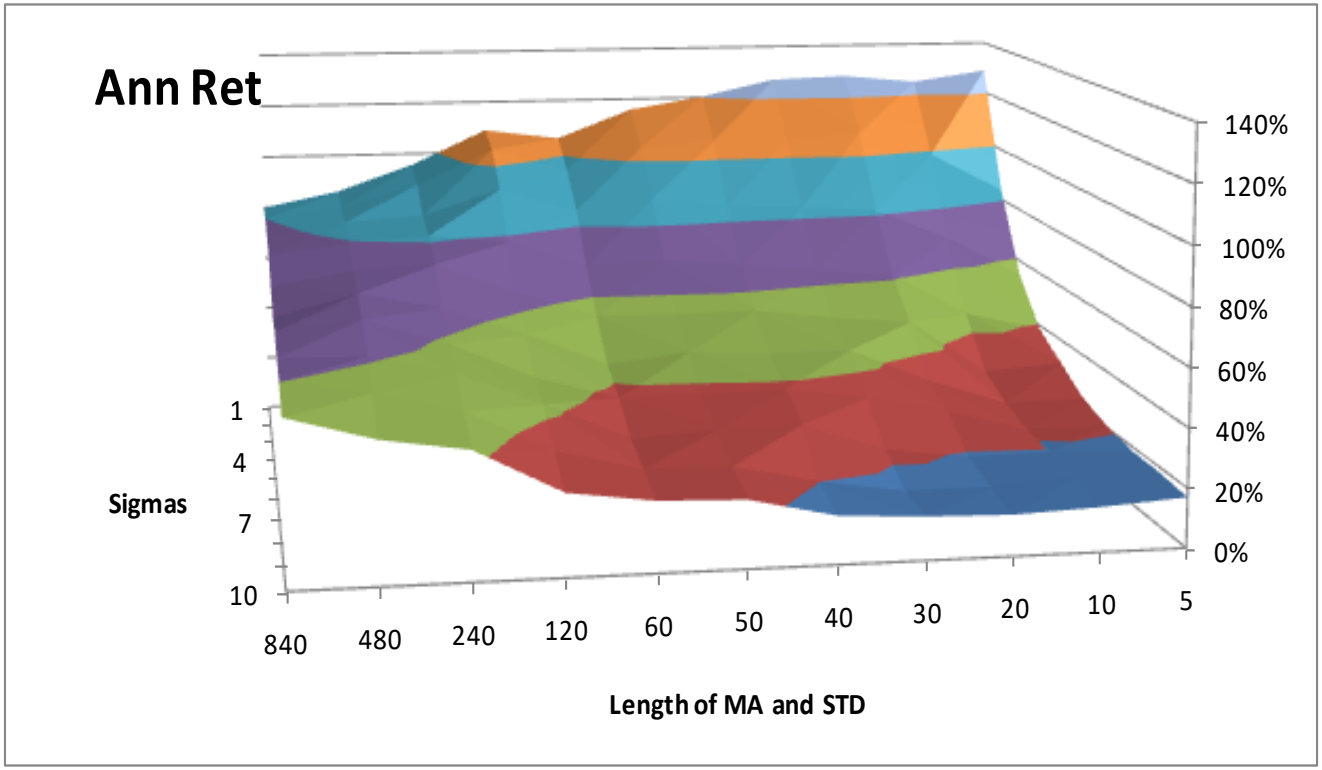


Intraday Trading

Strategy Development

Intraday Strategies Results

Sharpe Ratio Surface

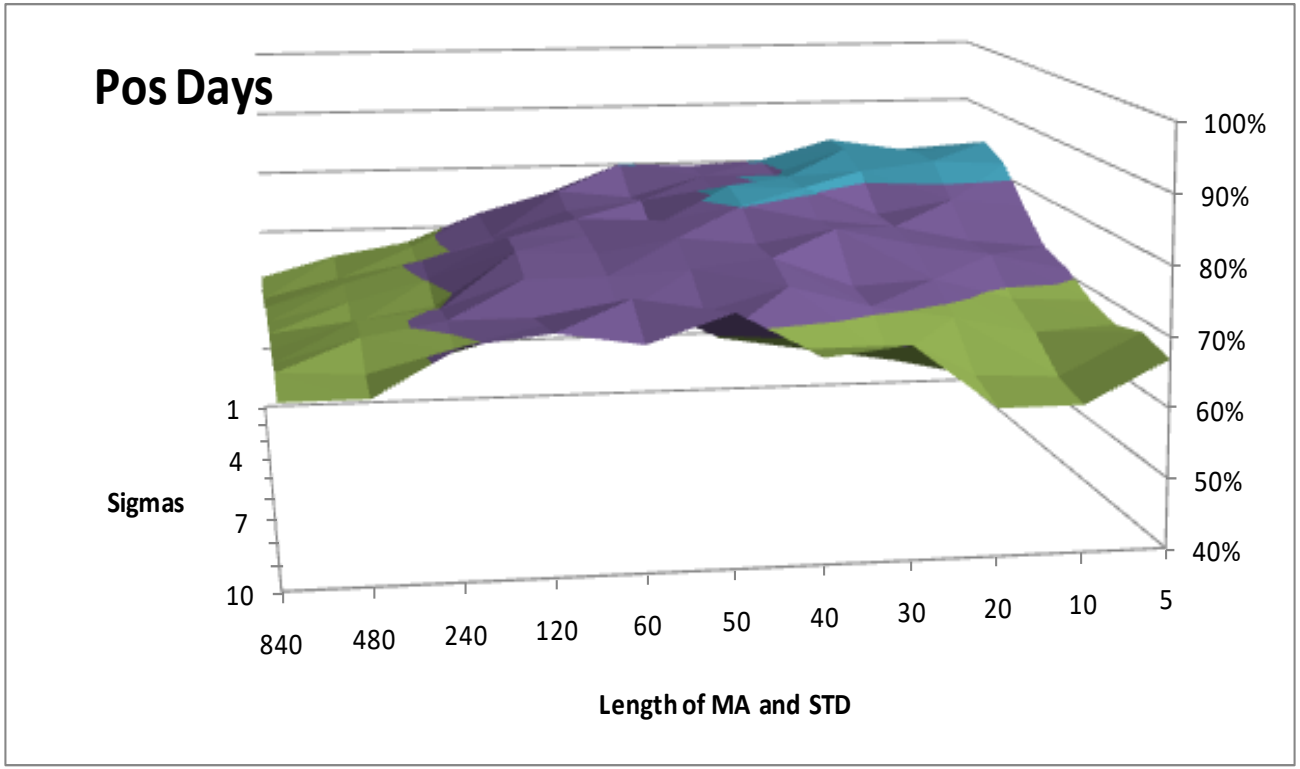


Intraday Trading

Strategy Development

Intraday Strategies Results

Positive % Surface



- Lots of trades of 1 minute – must define **entry and exit rules** accurately
- Mkt or Lmt order? – use Limit to **avoid paying the Bid/Ask spread**
- One price per minute enough? – highs and lows provide valuable info
- **In-sample bias**? – test same strategy in different data sets
- **Explicit costs** (Brokerage) and **Implicit costs** (Bid/Ask + Bounce Illusion) not being accounted for

Can we improve our backtest? Maintaining the initial criteria MA 20 minutes and 3 sigma?

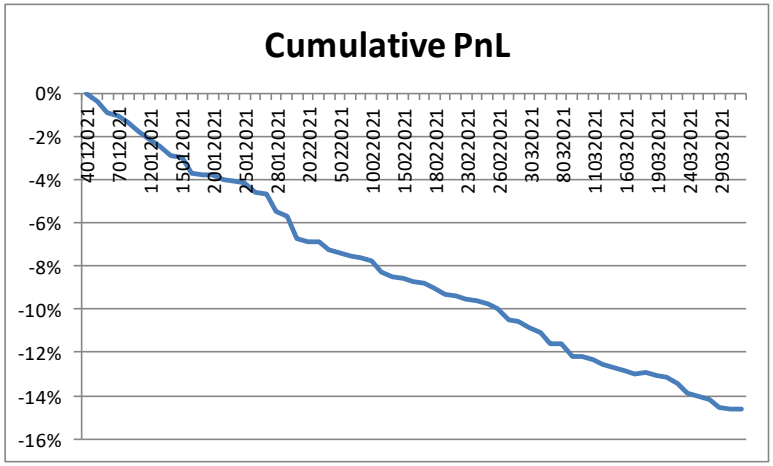
Intraday Trading
Strategy Development
Intraday Strategy accounting Implicit Costs
Bid/Ask effect

- Simple Strategy but now taking into **account the Bid/Ask** and Market orders

Start	730
End	2030

Sigma	3

avg	**-61%**
std	3%
IS	**-18.38**
pos d	**1.61%**

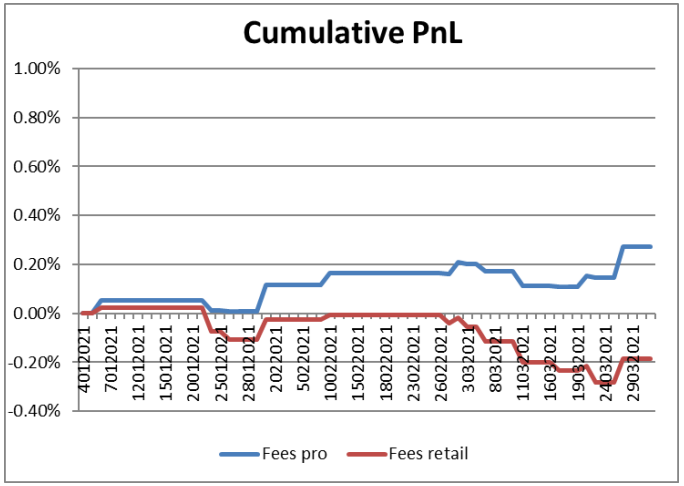


Intraday Trading
Strategy Development
Intraday Strategy accounting Explicit Costs
Brokerage Costs effect

- Simple Strategy but now taking into account **brokerage costs** (using σ = 6)

Start	730
End	2030
Sigma	6

	Explicit Costs	
	Pro	Retail
Fees	0.003%	0.017%
avg	**1.12%**	**-0.77%**
std	0.42%	0.45%
IS	**2.65**	**-1.73**
pos d	**10%**	**10%**
nº trades	32	32



Assumptions:
Even with small explicit trading costs, these are unbearable
Retail investors are unable to do High-Frequency trading

- Fees schedule for VG
  - Professional: 1€ per transaction => in/out ~ 0.003%
  - Retail: 6.25€ per transaction => in/out ~ 0.034%
- Even though the strategy makes few trades, the **explicit costs kills the strategy**

- Information lags are very important
- Lmt or Mkt orders? Can you replicate Mkt orders? Lmt guarantees price but face discontinuities
- Market has two prices, bid and offer. Don't consider trading prices – bid ask bounce
- Is one price per minute enough? Use Highs and Lows
- Lately has been as crowded as strategies using daily prices, but its a more time consuming and more difficult type of strategy to implement – works in nanoseconds space
- Usually performed by machines with more advanced algos – Machine Learning, Deep Learning, Quantum Physics

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Statistical Arbitrage

Gonçalo Sommer Ribeiro

Arbitrage Strategies
Types of Arbitrage Strategies

- **Arbitrage** → trade 2 assets (or more) one against the other(s) in the expectation that their prices will converge

- Main **types** of arbitrage:
  - Pure Arbitrage
  - Risk Arbitrage
  - Statistical Arbitrage

Arbitrage Strategies
Pure Arbitrage

- **Pure Arbitrage** → trade long/short two (or more) assets that represent the same underlying
  - Examples: Fut x Cash, ADR x Stock, Convertible x Bond+Option, Warrants, etc

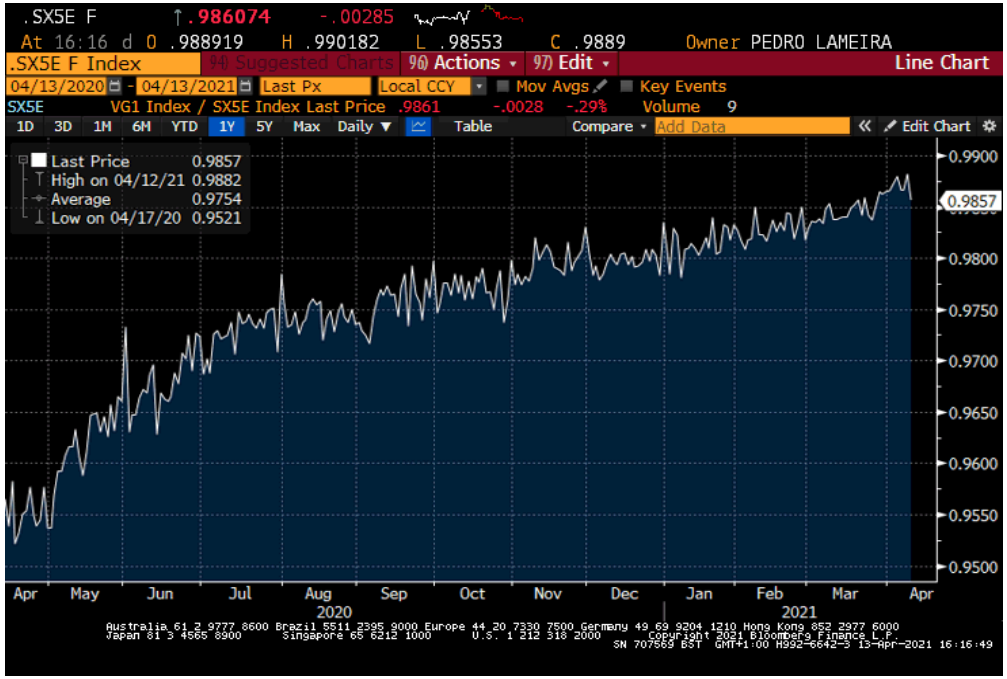
- **Best arbitrage type** but … nevertheless still dangerous – mtm risk (mark to market)
  - "Mkt can stay irrational longer than you can stay solvent", Keynes

- Opportunities are very scarce = difficult to diversify

Ex: SX5E, PSI, LQD, VW, GBTC, Parpublica

Arbitrage Strategies
Pure Arbitrage
Examples
Futures vs Cash Arbitrage

- The price of any future follows the equation => VG1 = SX5E x (1 + r)/(1+div)
  - Usually tight range < 0.5%, bellow 1 because Div > r and pull to par = carry



Arbitrage Strategies
Pure Arbitrage
Examples
Eurostoxx 50 Futures

- Occasionally some opportunities in high volatility periods

Arbitrage Strategies
Pure Arbitrage
Examples
PSI20 Futures

- In less liquid markets opportunities may be bigger

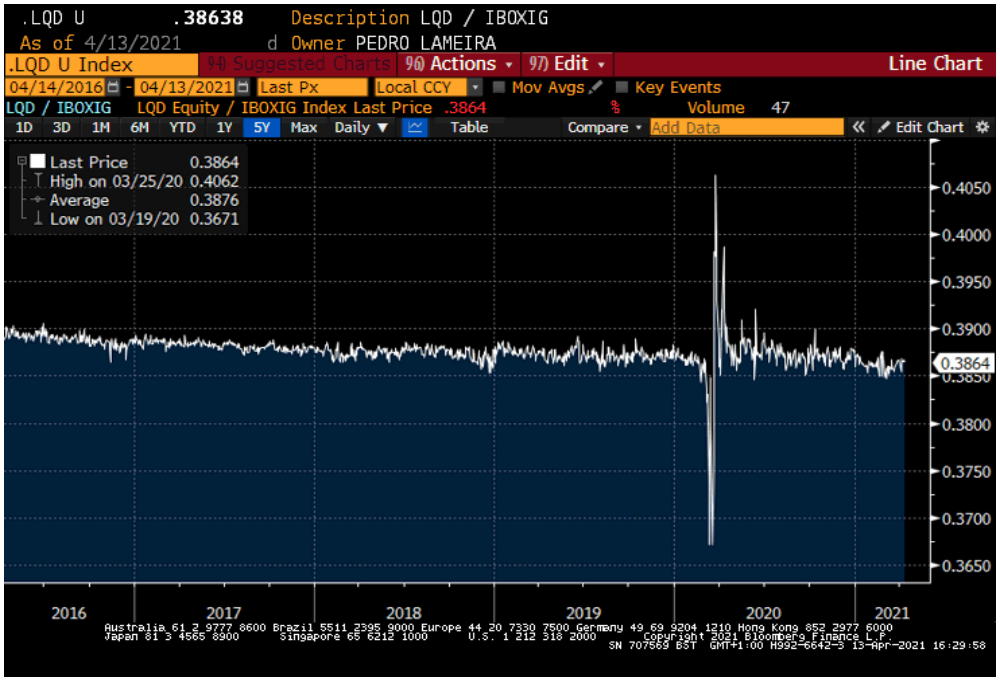
Arbitrage Strategies

Pure Arbitrage

Examples

ETF vs Underlying Arbitrage – LQD ETF vs IBOX IG

- Even in highly liquid markets, opportunities may arise due to temporary liquidity constraints



Arbitrage Strategies

Pure Arbitrage

Examples

ETF vs Underlying Arbitrage – GBTC ETF vs XBT

- Usually opportunities are more frequent in new, less arbitraged markets

Arbitrage Strategies

Pure Arbitrage

Examples

Common vs Preferred Shares – VW case

- But remember there is no such thing as risk free arbitrage

Arbitrage Strategies

Pure Arbitrage

Examples

CDS Arbitrage – EDP

- CDS on the same entity at different prices

Arbitrage Strategies

Pure Arbitrage

Examples

Convertibles Arbitrage – Parpublica vs Galp

- More comfortable to invest when we 'know' the cause of the price dislocation
- Conv Bond = PGB + Call on Galp or Galp + Call on PGB or Rainbow option

Arbitrage Strategies
Risk Arbitrage

- **Risk Arbitrage** → trade one or two companies involved in some types of special corporate events, most commonly M&A situations or bankruptcies/liquidations
- Usually **uncorrelated** with the market
- Specific risk of deal completion – legal, political, competition, shareholders, financing, etc
- Lots of deals - can diversify portfolio
- Expected return = f (premium, probability, t to completion)

Ex: ABInbev x SABMiller, Qcom x Bcom

Arbitrage Strategies

Risk Arbitrage

Examples

Merger Arbitrage – Ab InBev vs SABMiller

- Anheuser-Busch InBev offered £38 per SABMiller share; but deal was rejected
- Then ABInbev increased the offer price to £44 and deal was completed

Arbitrage Strategies

Risk Arbitrage

Examples

Merger Arbitrag – Broadcom x Qualcomm

- Broadcom offered $70 per Qualcomm share but deal was blocked by US authorities
- 5% upside versus 20% downside

Arbitrage Strategies
Statistical Arbitrage

- **Statistical Arbitrage** → trade two assets (or more) that have been correlated in the past in the expectation that their prices will continue to mean revert/converge
- 5 main types of strategies (so far):
  - Pair Trading – equity spreads tend to revert to a mean [Look for: high correlation (Pearson), high rank correlation (Spearman), co-integration, fundamental links]
  - Baskets - multiple pairs (see "What happened to the quants?")
  - Baskets with forced diversification (Ind.Groups)
  - Factor Analysis to identify groups
  - Residuals from Multiple Regressions (see "Extract Alpha")

Ex: Pair Trading, SXXE All, SXXE IG, Index rvrs

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Macro

Gonçalo Sommer Ribeiro

Macro Strategy
Macro Environment

- Monitor the global economy and try to **identify imbalances** based on your assessment of:
  - Macroeconomic conditions *vs* monetary policy and fiscal policy

- Perform the same **analysis for each economic block**

- Interconnect different regions to get the broad picture and assess what are the expected returns for each asset class (in light of their **correlations and relationships**)

Macro Strategy
Objective

- Try to **anticipate close future events** and **take positions accordingly**

- Steps:
  1. Assess Macro Environment *vs* Macro Economic Policies
  2. Choose those events that
     i. Seem **more predictable** (trends, self fulfilling prophecies) and/or
     ii. Seem to have **biased outcomes** (not properly discounted)
  3. Select efficient instruments to implement trades (**skewed**)

Macro Strategy
Reflexivity Theory
George Soros

One simple model to help you "tell the story", i.e. to identify imbalances and on-going trends

- **Equilibrium x Conundrum** (feedback loops pull mkts away from equilibrium)
- **Reality → Perception → Reaction → (new) Reality**

Observer's actions may affect the reality [approach from sociology] Ex: credit

1) Identify trends = f (**dominant themes**, major concerns, fashions)
2) Trend = **deviation from equilibrium** / economic logic
3) Identifying imbalances **does not mean** betting on a correction
4) Understand them (are there any **feedback loops** in place?) and
5) Try to identify possible **triggers for reversal**

"Don't fight the trend. Markets are reflexive. Positive feedback. That is why we need a supranational altruistic authority to stabilize things.", *George Soros*

- S/T rates - *Taylor* Rule
  - **Target S/T rates** = (Inf + Target real rate) + 0.5 x (Inf – Target Inf) + 0.5 x (GDP - GDP potential)
- L/T rates = f (expectations, Supply/Demand imbalances)
  - Expectations - expected inflation + expected growth + perceived risks
  - D x S Imbalances – QE, regulations, aging population, international reserves, investment Fashions
  - L/T r = 0.5 x S/T r + 0.5 x L/T GDP Nominal (*Maurice Allais*)
- Shape of the Yield Curve
  - Normal YC – positive slope
  - Too steep Yield Curve – inflation / strong growth expectations
  - Flat / inverted YC – deflation / recession expectations

Macro Strategy
Skewed Trades

- Compare **your expectations** with **market expectations**
- Look for trades with the **most skewed possible outcome**
- I.e. trades that probably will
  - Win big, if you are right
  - Loose small, if you are wrong
- This is the most important part of a successful macro strategy (you will not be right most of the time! Accuracy ratios of 60% are already a good record, so the best way is to cut the left tail, diminishing extreme negative returns and/or to increase the right tail with large positive returns)

E.g. Brexit - volatility

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Investment Strategy – Fixed Income I

Gonçalo Sommer Ribeiro

Fixed Income
Basic Concepts

- Bond
- Duration
- BPVs (Basis Point Value)
- Convexity
- Carry
- Roll Down

Fixed Income
Basic Concepts
Calculations

- Bond — i) String of fixed cash-flows
  ii) Price = PV of CFs @ market rates => P is inversely related to rates
- Duration — Weighted avg life before repayment / or rate reset
  MDuration = **price sensitivity to rate changes**
  MDuration = - dP / dY x 1 / P
- BPVs — MDuration x Price /100 x 0.01%
- Convexity — **MDuration sensitivity to rate changes**
  Conv = d2P / dY2 x 1 / P
- Carry — Return due to passage of time if Y unchanged
  Yield - r (Coupon + P pull to par - r)
- Roll Down — Return due to passage of time if YC unchanged
  Change in Yield x MDuration

Fixed Income
Fixed Income Arbitrage

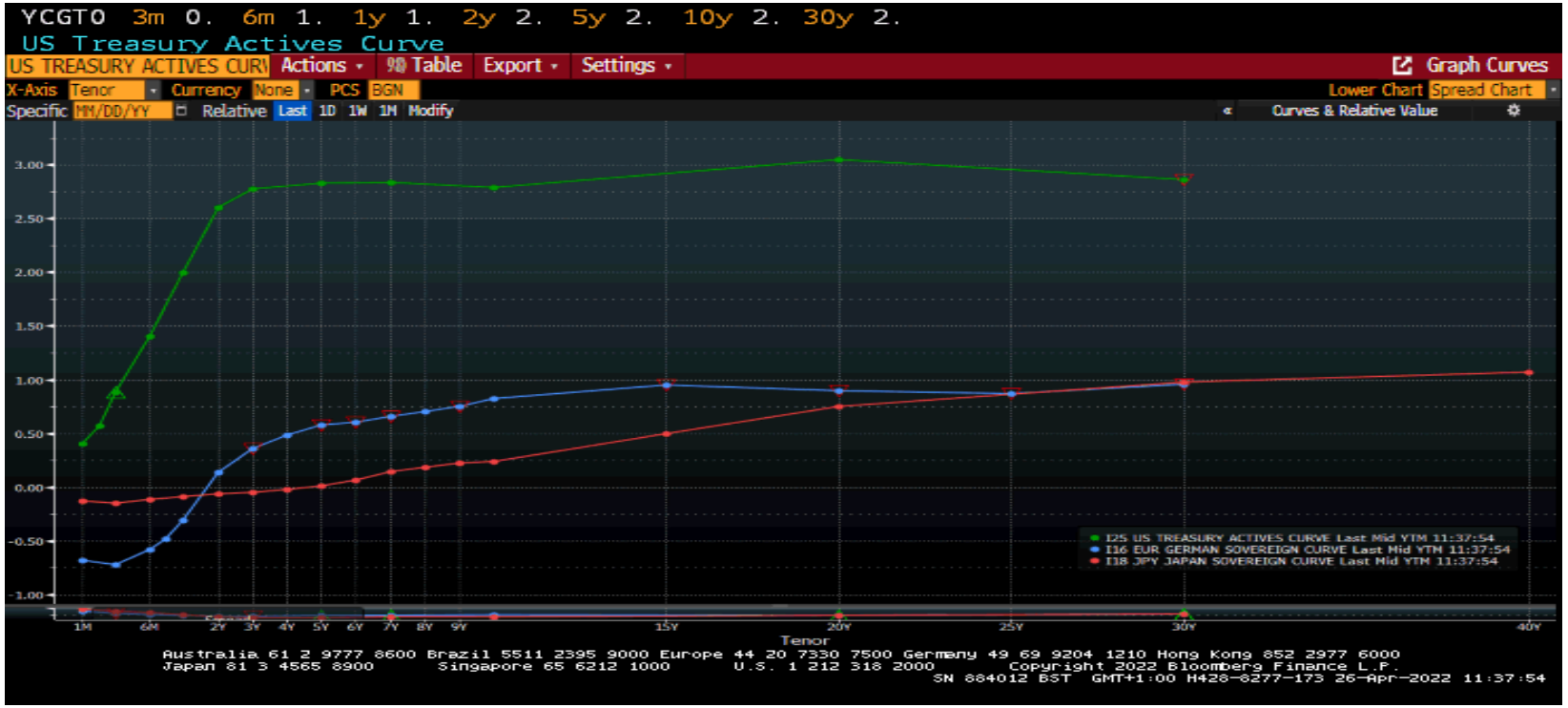
- **Fixed Income includes several types of instruments** such as Bonds (treasuries), IRS, FRAs, Futures, Swaptions, Caps & Floors, etc
- **May involve directional positions** to express a Macro / Interest Rate view, but
- **Most frequently involves trading 2 or more points of the Yield Curve**, as a safer / more efficient way to express such view
- **Positions are usually calibrated by Duration / BPVs**

Fixed Income

Rates Curves

Main Sovereign Yield Curves

- Bonds with maturity less then 1 year are T-Bills, thereafter are considered Treasury Bonds
- Underlying Risk is issuing Government

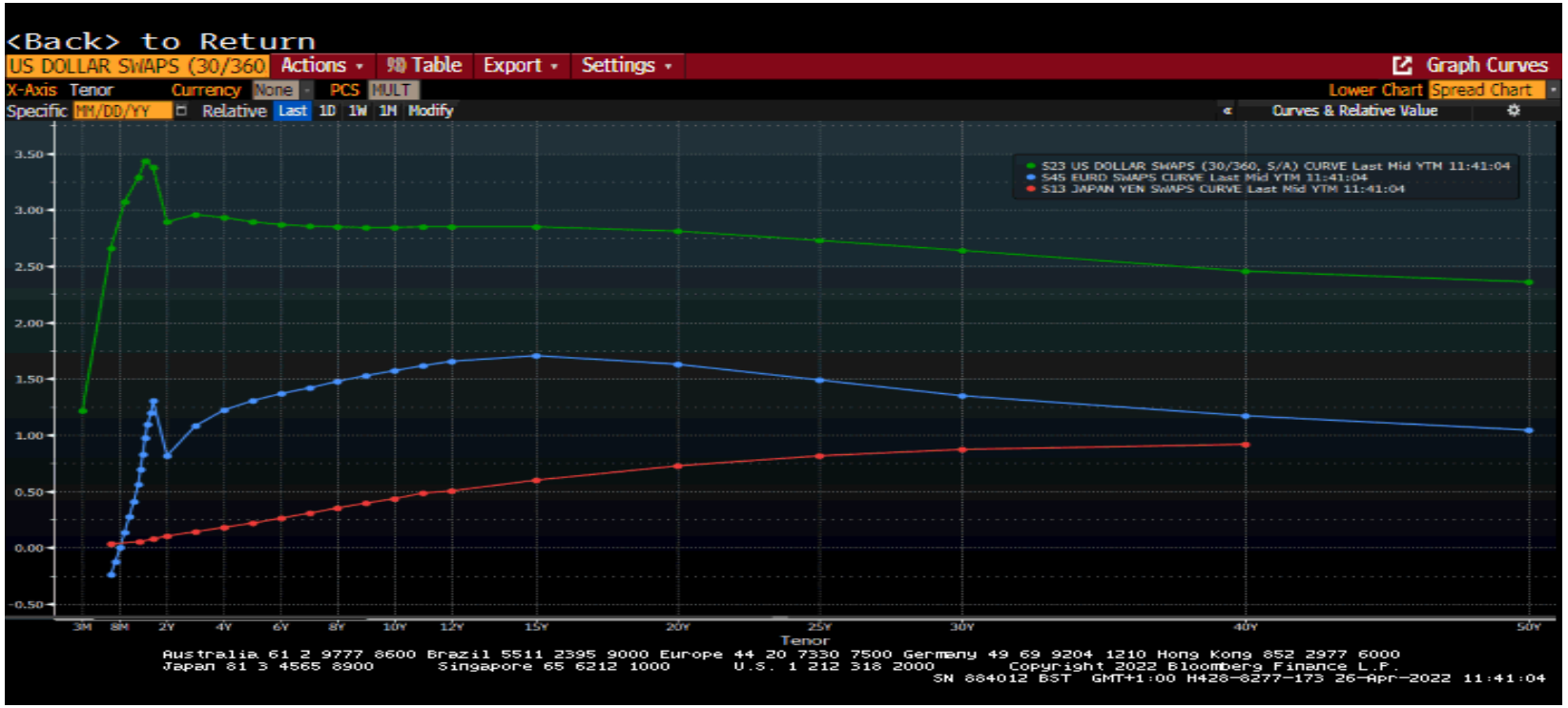


Fixed Income

Rates Curves

Main Swap Yield Curves

- Rates up to 1 year maturity are Libor, thereafter are considered for Interest Rate Swaps
- Underlying Risk is Banks

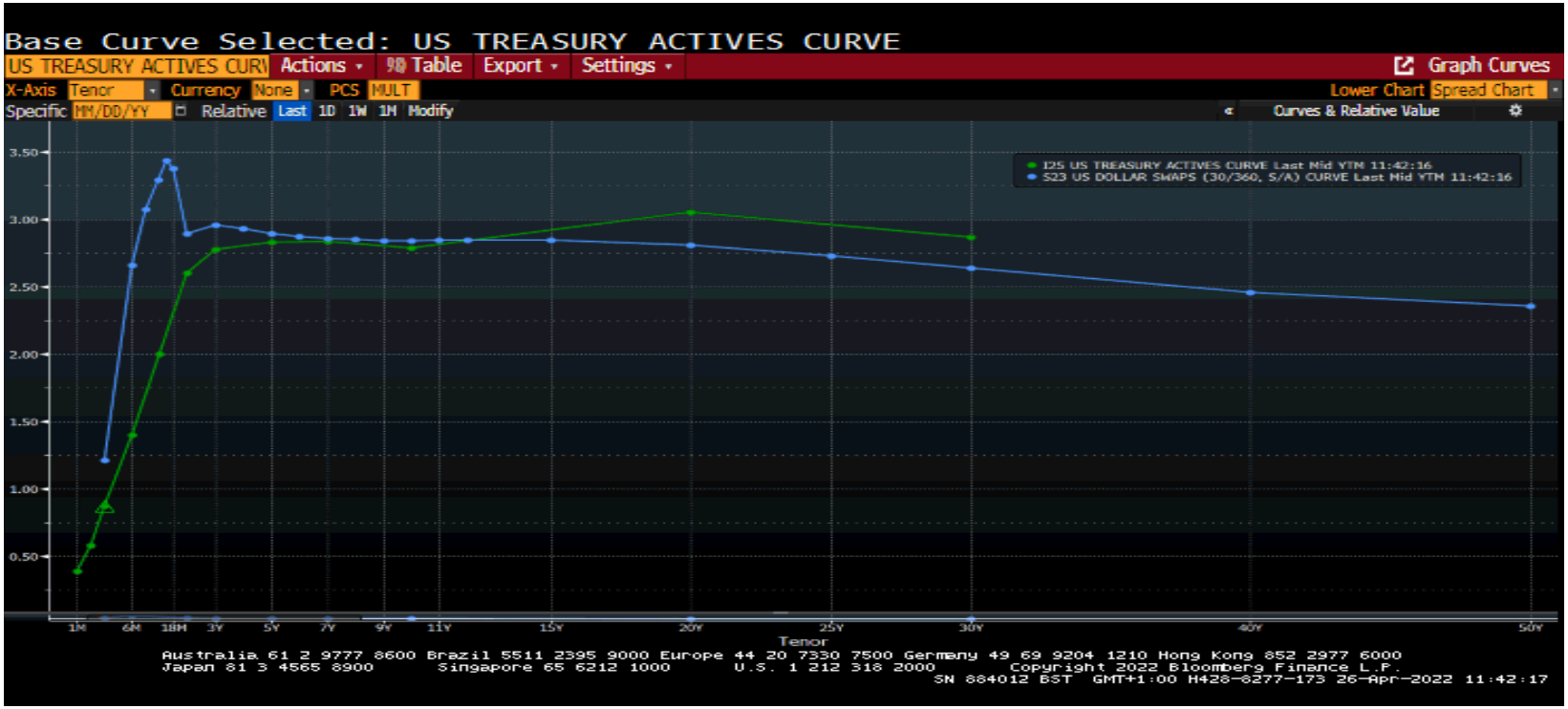


Fixed Income

Rates Curves

US Treasuries vs Swaps

- IRS Curve should always be > Treasury Curve
- Inversion in LT = Anomaly (> 10y market not very liquid, top rated players, etc)



Yield Curve Shape	Possible Explanation / Theory
Mildly Positive Slope	Liquidity Preferences
Too Steep / Flat / Inverted	Inflation / Growth expectations
Bumps / anomalies	Market Segmentation
Zero / negative rates	Demand-Supply imbalances (CBs, regulation, aging pop, intl reserves, fashion inv.,…)

Fixed Income
Rates Curves
Yield Curve Shape

- **Flattening / Steepening – ex. 2-10 Duration Weighted**

	ST rates lead	LT rates lead
YC Flattens	**Bear Flattening** ST rates up – ex: rate inc Cash	**Bull Flattening** LT rates down – ex: QE Bonds
YC Steepens	**Bull Steepening** ST rates down – ex: rate cut Gold	**Bear Steepening** LT rates up – ex: inflation Equities

Fixed Income
Yield Curves
Common Trades

- **InterMarket spreads –** Ex. EUUS 22, 55, 1010, 3030, **BOX**
- YC to concave / convex – **Barbell** ex. 2510, 21030, 51030
- **Treasury Bond x IRS** (Asset swap, Basis)
- **Credit curve –** normal shape = positive slope
  flat / inverted = default (recovery value)

Fixed Income

Yield Curves

Common Trades

210US

- US YC has been flattening quite significantly, close to no YC spread
- Discounting aggressive monetary policy tightening and growth deceleration

Fixed Income

Yield Curves

Common Trades

210EU

- EU YC has been steeping somewhat, breaking the previous tight range
- The 10y rate (Bunds) are coming out of negative territory while s-t rates are still anchored

Fixed Income

Yield Curves

Common Trades

Box USEU 210

- BOX 210 = (US10Yr - US2Yr) - (EU10Yr - EU2Yr)
- Byproduct of last two graphs, US flattening and EU steepening

Fixed Income

Yield Curves

Common Trades

USEU 1010

- US10Yr – EU10Yr
- US monetary policy normalization starting ahead of EU's, pushing l-t rates higher

Fixed Income

Yield Curves

Common Trades

21030US

- US Barbell 21030 = 2Yr + 30Yr – 2 x 10Yr
- Usually negative → YC is slightly concave

Fixed Income

Yield Curves

Common Trades

US10Yr Swap Spread

Bank risk premia	Russian Crisis	Subprime Crisis	Why negative ???
over treasuries	TY = Safe Heaven	Bank nationalizations	Regulation - less B/S, repos ?
LT Mean = 35/40 bps	LTCM crisis	Bank risk = Sovereign risk	Corp Issuance + Swap ?

Fixed Income

Yield Curve Anomalies

Inverted Sovereign YC

Greek YC

- Greek YC pre-Restructuring - completely inverted – Why?
- Recovery value = in all tenors => bonds start trade in price logic instead of yield

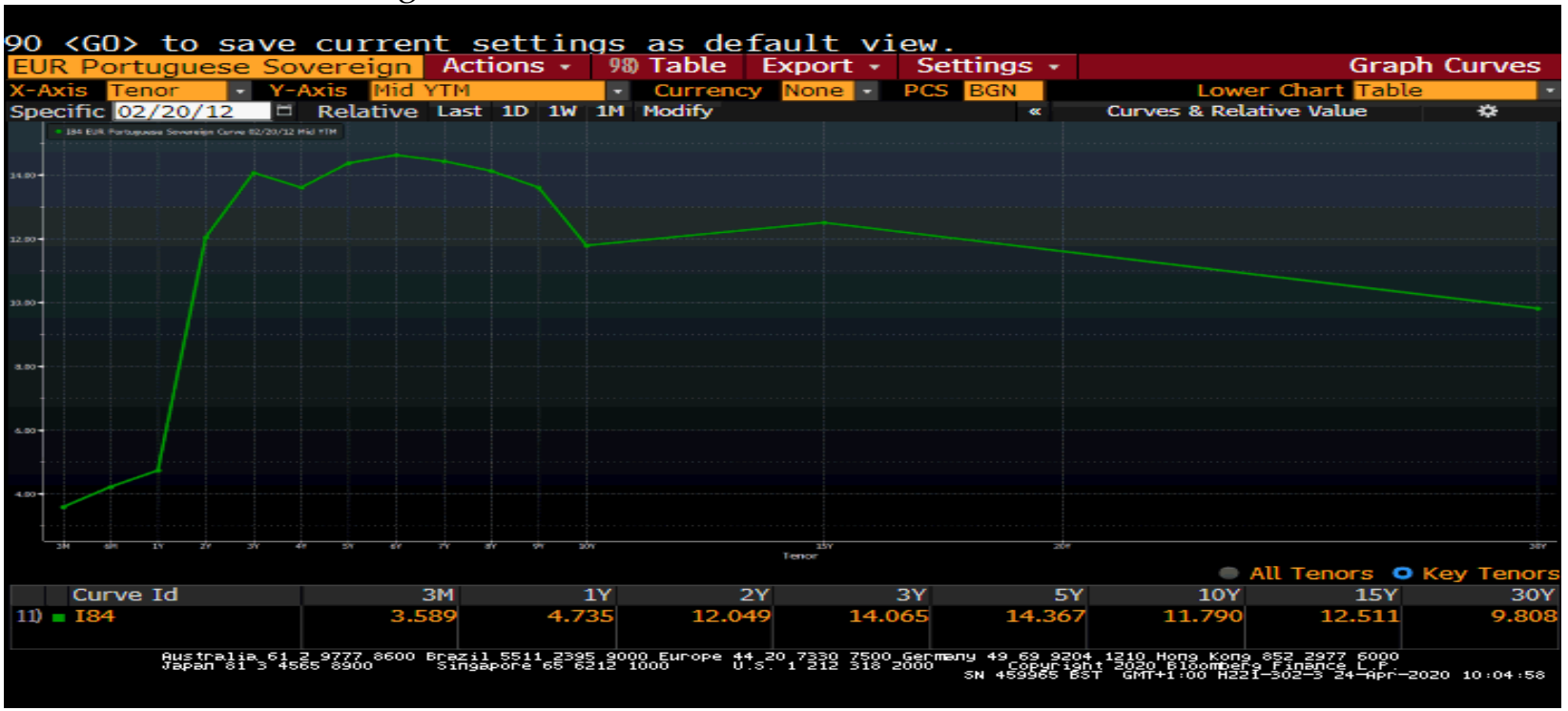
Fixed Income

Yield Curve Anomalies

Inverted Sovereign YC

Portuguese YC

- Portuguese YC pre-PSI – also starting to invert
- Fear of restructuring



Fixed Income
Trading Example
Steepening
Example

- Place a **Steepening** trade in US bonds (2x10) ... ... with Usd **10,000$ BPVs** from **31 Dec 2021 to 1 March 22**

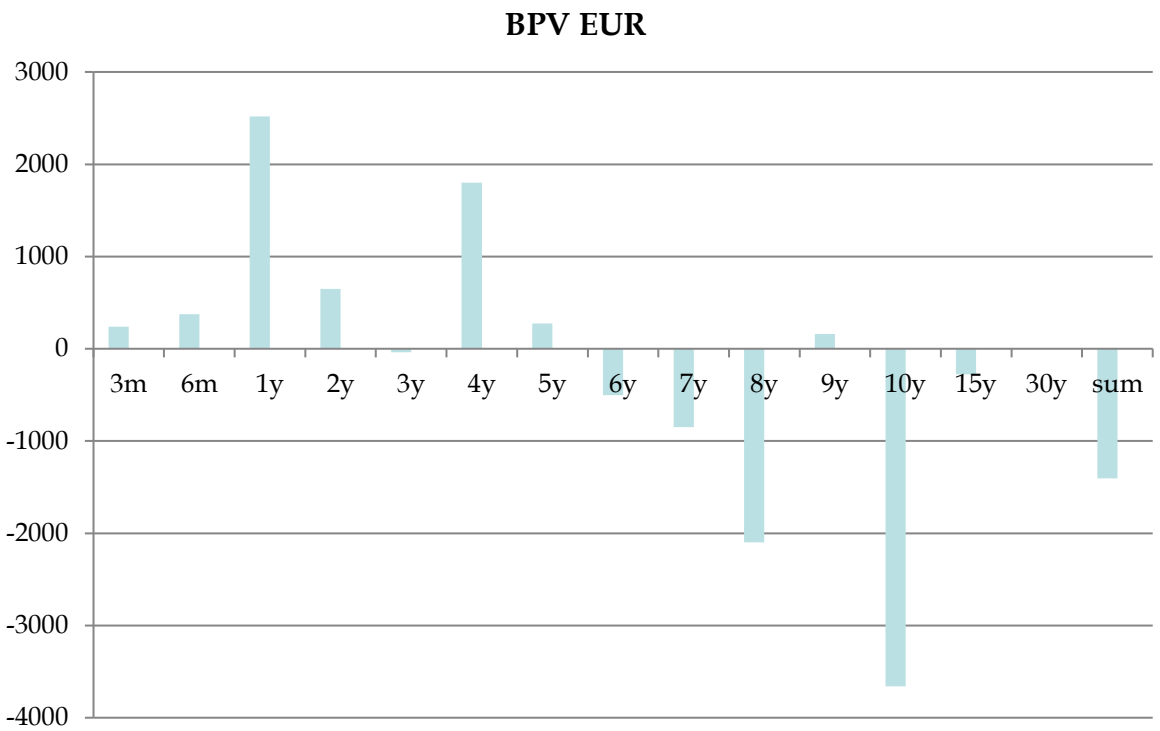
- 1) **Why** would one investor want to do this trade?

- 2) **Which bond** does he have **to buy** and **which bond** does he have **to sell**?

- 3) How much does he have to invest in each bond to be **duration neutral**?

Fixed Income
BPV Map

- Ex. of portfolio positioned for **YC Flatening**



Hedge Funds

Investment Strategy – Fixed Income II

Gonçalo Sommer Ribeiro

Fixed Income
Models

- **MOD FI** - bonds = f (TF, r, CPI, GDP, Slope, Equity, VIX, DOM, CESI)

  - r / CPI / GDP lagging - **leading** indicators better
- **Carry** - one by one ok but low Sharpe; world mix works well
- **Global rvrs mix**
- **Slope trends**
- **TY fair value**

Final Project
Ideas Discussion

- **Ideas / Rationale**
- **Technical questions**
- **Overfitting**

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Investment Strategy – Volatility

Gonçalo Sommer Ribeiro

Volatility Arbitrage
Options

- **What is an option?**

  Right, but not the obligation, to buy (Call) or to sell (Put) a certain asset at a pre-established price (Strike Price) at (or until) a certain future date (Maturity)

- **Which factors impact option value?**

  Spot (s), strike (x), time to maturity (t), int. rate (r), div (d), vol (σ)

- **Which factor is the most important?**

Volatility Arbitrage
Options
Volatility

- **Why volatility is key?**

  Option is a derivative

  No Arbitrage Rule

  All models based on payout replication via delta hedging

- **Why not price / expectations?**

  Market efficient

  Expectations already reflected in spot price

- **Need to estimate Volatility**

- **Volatility estimation**

  Vol easier to estimate than Price

  Vol is Auto regressive

  ARCH, GARCH, EGARCH, EWMA - all based on recent vol + L/T mean

- **Which factors can explain Vol?**

  Vol = f (past vol, lt mean, events, liquidity, …)

- **How good is your model?**

  Ex. t for kurtosis, hypergeometric for events

It's a pros market - who is being arbitraged?

Volatility Arbitrage
Types of Arbitrage

- **Option x Option** (ex. Put-Call parity) not very common

  Market makers careful = bid/ask, smile, etc

- **Listed products**

  easier to find mispricing's – warrants, rights, convertible bonds, structured products, etc

- **Futures on volatility**

  sell vol (vix), intermarket spreads (ex vix-v2x)

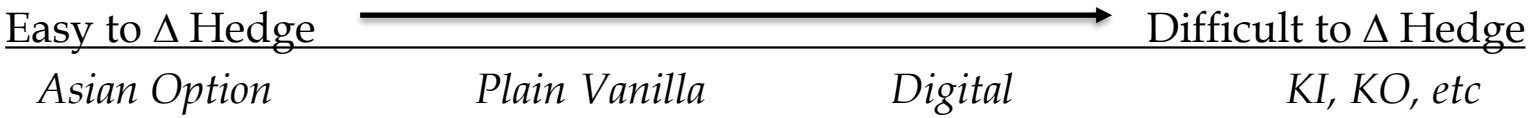
Volatility Arbitrage
Investment Strategies

- **How to extract value from an embedded option?**

Convertible bond = Bond + Call Option on Stock
Structured Product = Bond + Call Option on Market Index

May buy package and hedge bond + **delta hedge** option separately

But careful with **exotic options** → Sometimes **delta hedge no good**



NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Investment Strategy – FX

Gonçalo Sommer Ribeiro

FX Arbitrage
FX Market

- **FX is probably the largest, most efficient asset class**
  - Biggest traded volume
  - Almost 24/7, very liquid (major crosses)
  - Several instruments - Spot, Forward, Futures, Options
  - Mostly OTC (Over The Counter)
    - very large operators / market makers
    - no brokerage fees, just bid-ask ex: 1.0951-52
- Quote = always pair of currencies
  - ex. EURUSD = 1.0951 = Usd per 1 Eur
  - Volatility smile but no skew – Why?

FX Arbitrage
FX Fundamental Value

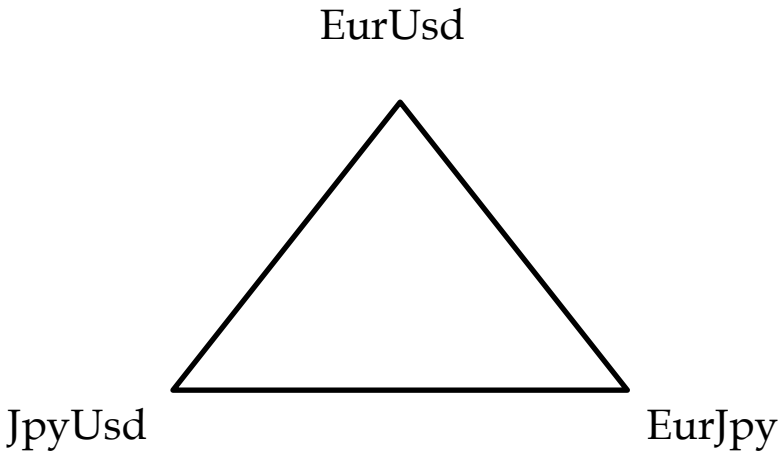
- **Very difficult to access fundamental value of currency**
  - Some variables that provide insight: Gold/fx reserves, GDP, interest rates (real and nominal), CPI, deficit, current account, liquidity, demand for countries assets (fiscal policy, trade, etc)
  - Benchmark to some historic "fair" value

- Some **market inefficiencies** - occasional ex: triangle arb
  - conjunctural ex: forward prices during crisis
  - structural ex: carry, BH

FX Arbitrage

Non-Arbitrage Relationship

Triangle Arbitrage



- Theses arbitrage opportunities exist but are quite rare (**need auto-monitor**), very fast (**need auto-trader**) and very difficult to implement in OTC market (**need justification**)

FX Arbitrage

Non-Arbitrage Relationship

Forward Arbitrage

EURUSD spot vs 1M Forward

Subprime Crisis | EU Sov Crisis | Trump Election | FED Hikes | Covid

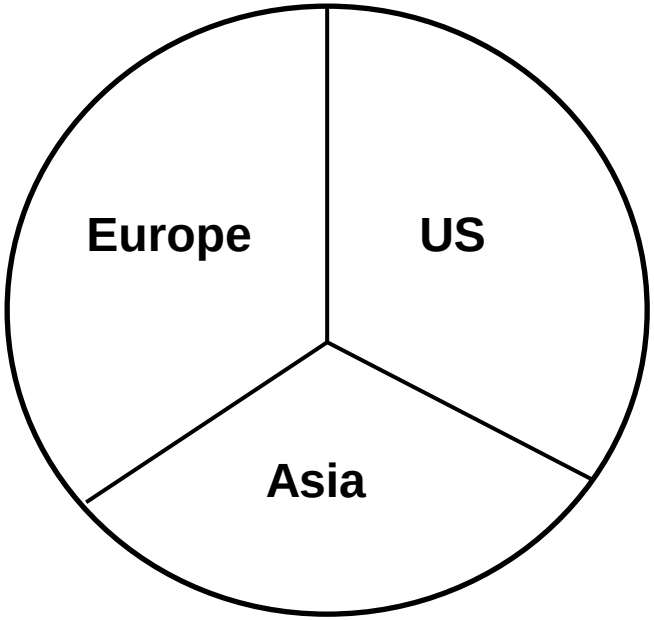
FX Arbitrage
FX Carry

- **Carry is the most exploited arb opportunity in FX**
  - **No Arb Rule**
    - Fwd = spot + dif rates

    ex: BrlUsd → Fwd 1y = 0.176819 = 0.1972 x (1.0159 / 1.133) ^ 1
    Borrow Usd @ 1,59%, buy BrlUsd @ 0.1972, depo Brl @ 13.3%
    Then sell Fwd BrlUsd @ 0.176819
- Forwards **has nothing to do with expectations** (only through spot)
- And FWD is **not a good estimator of future spot rate**
  - Usually high (low) yield currencies do not devalue (appreciate) as much as implied in interest rate differentials
- So FX Carry persists. But trade too crowded => very volatile

FX Arbitrage
FX BH

- Currencies tend to devalue during their home market opening hours



Ranaldo (2007,2011)

- Might be due to **hedgers immunizing** FX risk of recently bought positions

FX Arbitrage
FX Hedging

- **How to hedge FX risk?**
  - How can EU investor buy US stock without USD risk?
  - May use **forward, future, options**
  - But **natural hedge** is easier – ex. borrow in USD
    - Asset in foreign currency
    - Funded with loan in that same currency
      - Naturally hedges the FX risk and partially the interest rate risk

Ex: Carry, FX BH, Mod FX

NOVA SCHOOL OF BUSINESS & ECONOMICS

Hedge Funds

Investment Strategy – Commodities

Gonçalo Sommer Ribeiro

Commodities Arbitrage

Commodities Market

Reuters (Refinitiv) Commodity Index

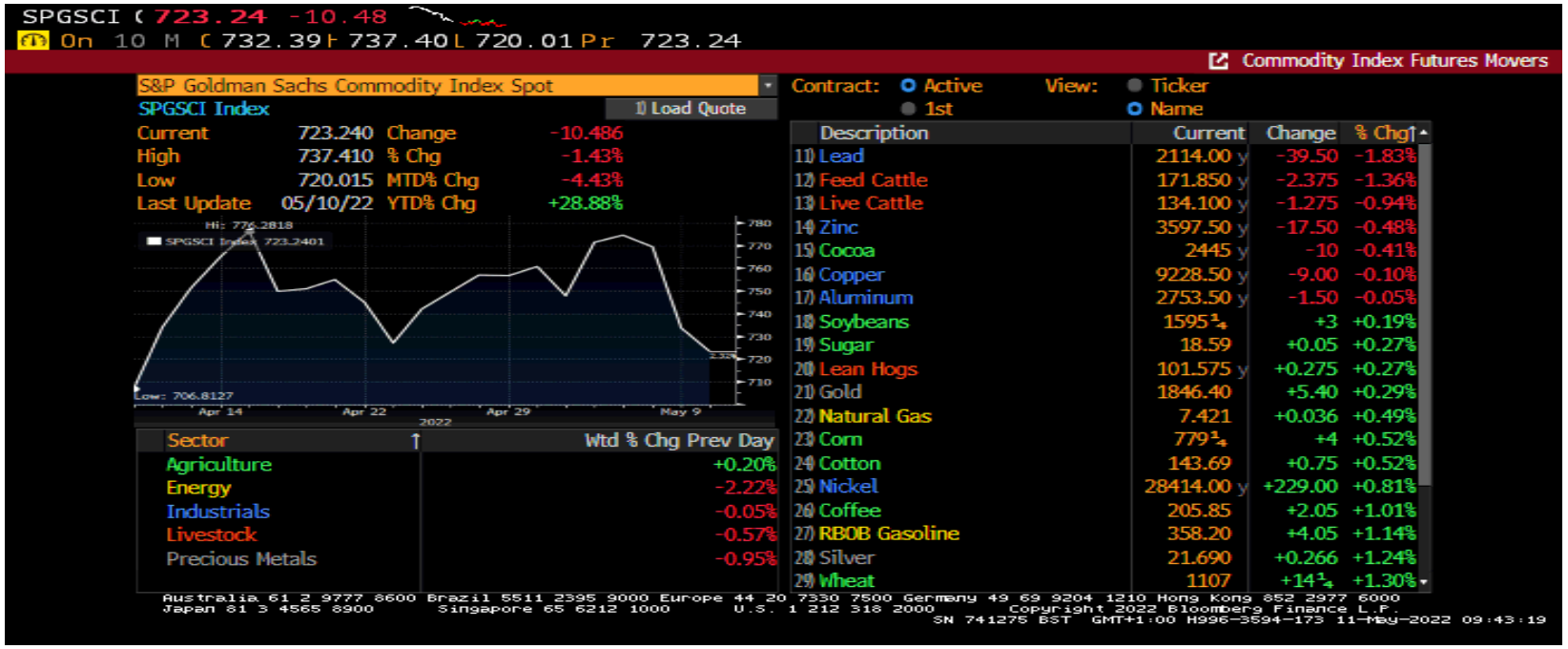
- **Commodities are part of a large universe with lots of specificities within each sub-class**
- CRY has 6 sub-groups: Energy, Grains, Industrials, Livestock, Precious Metals, Soft

Commodities Arbitrage

Commodities Market

Goldman Sachs Commodity Index

- **Even the indexes are different and show different performance metrics**
- GSCI has 5 sub-groups: Agriculture, Energy, Industrials, Livestock, Precious Metals



Commodities Arbitrage
Fundamentals

- **Fundamentals very specific to each commodity and sometimes quite complex**
  - production costs (ex. Oil - how much? cheapest x marginal producer?)
  - warehousing costs (how much? where? tanks x tankers)
  - transportation costs (may use as factor ex. FFA1 Midland-WTI = Crude - Shale)
  - stock levels (location, similarities / dif. grades)
  - new technologies / new infrastructures
  - weather (expected / seasonality x unexpected)
  - demand / consumption trends
  - world growth (demand, exporters x importers)
  - legal restrictions / government agencies, etc..
  - Benchmark to some historic "fair" value
- There are specialists in each commodity (which we are not!!) and some very sophisticated systems (ex. satellite images, sensors, etc)

Commodities Arbitrage
Common Factors

- **But still some common factors that we may use to built trading models:**
  - quoted in USD (inverse correlation with USD)
  - seasonality (weather, production, consumption)
  - trends (economy, fashions, lag time to adjust production)
  - volatility (squeezes - weather)
  - curve slope (contango x backwardation)
  - market segmentation (investors x producers)

Commodities Arbitrage
Futures Curve Slope
Contango vs Backwardation

- **Price Curve Slope: Contango x Backwardation**
  - **Contango = normal upward slope**
    - Explained by warehousing costs, funding, insurance, depreciation, etc
  - **Backwardation = inverted / downward slope**
    - Explained by short term shortage and/or expected future surplus
  - Steep contango may be arbitraged (with limits…), backwardation may not

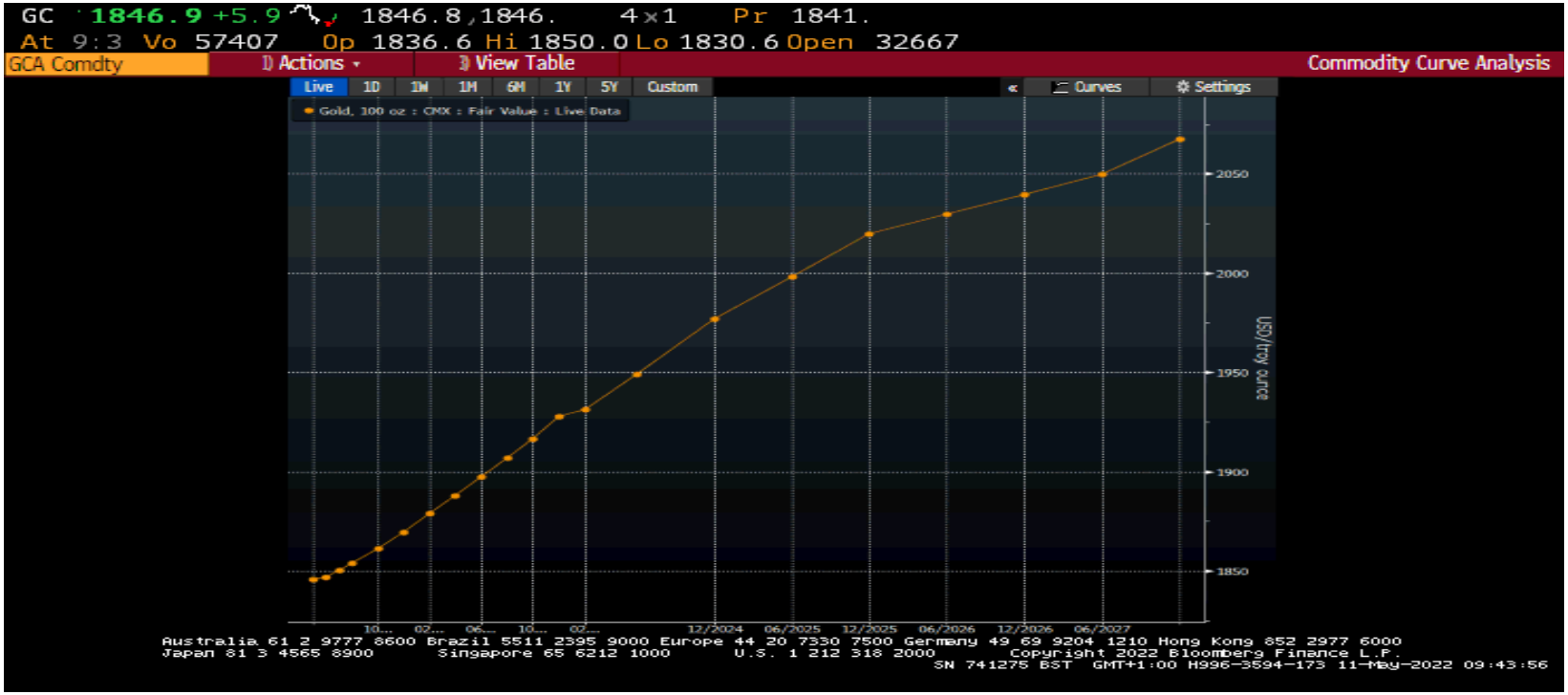
Commodities Arbitrage

Curve Slope

Examples

Gold Curve

- Price Curve in **Contango** – if curve too steep it is possible to arbitrage (buy and store)



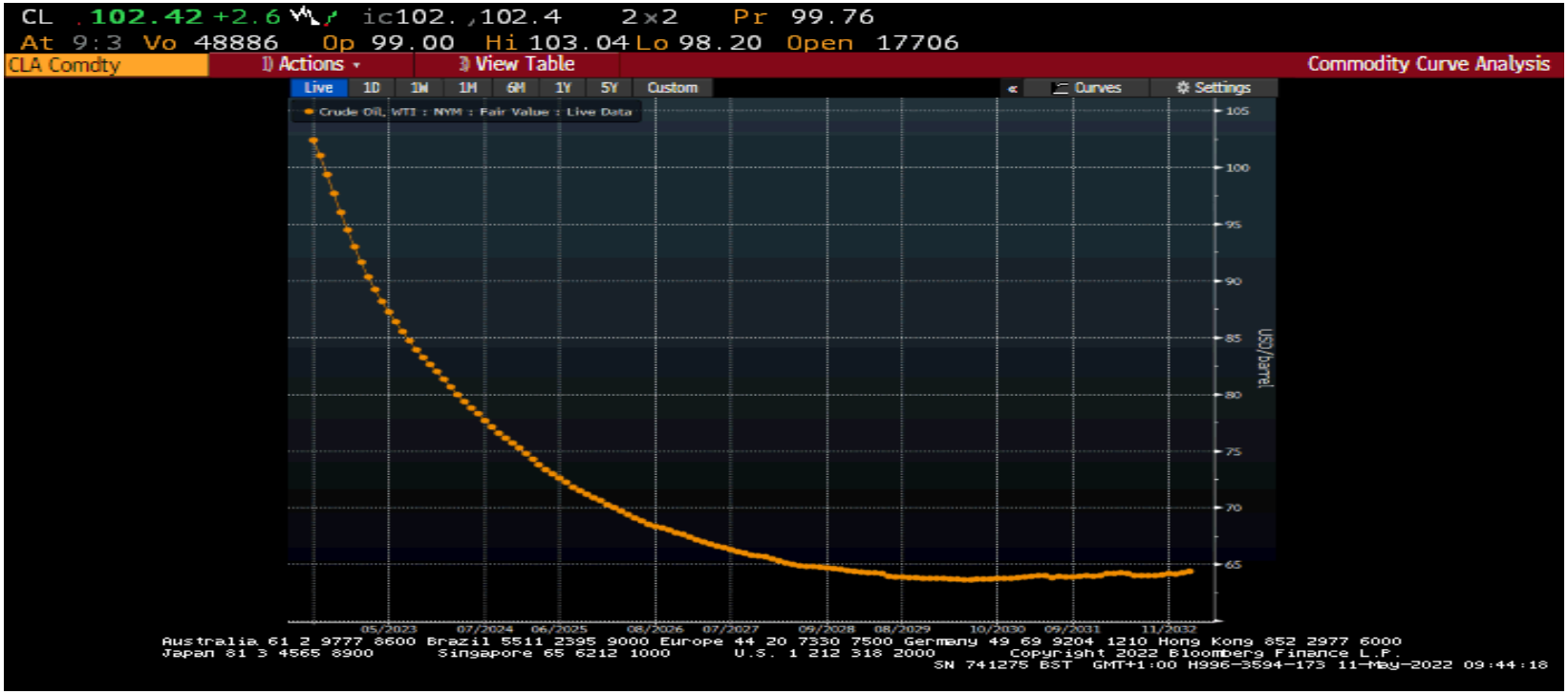
Commodities Arbitrage

Curve Slope

Examples

Crude Oil (WTI) Curve

- Price Curve in **Backwardation** – not easy to arbitrage (cannot short physical commodity)



Commodities Arbitrage
Investment Strategies

- **Some usual strategies** with commodities:
  - Statistical Arbitrage – correlated commodities or stocks (see ex.)
  - Momentum strategies – see UBS Comm-pass
  - Seasonality – see GS Alpha
  - Curve slope Arb – see CYD Research
    - **CYD TR (Total Return)**
      - **sell 1st month** as it decays faster towards delivery
      - **buy 2nd month** as a hedge
    - **CYD LS (Long-Short)**
      - **buy Backwardation (1y/1m < 1)**, positive roll / carry gain
      - **sell Contango (1y/1m > 1),** negative roll / carry loss

Ex: CYD TR (front month roll), CYD LS (carry), comm TFMRSEASON

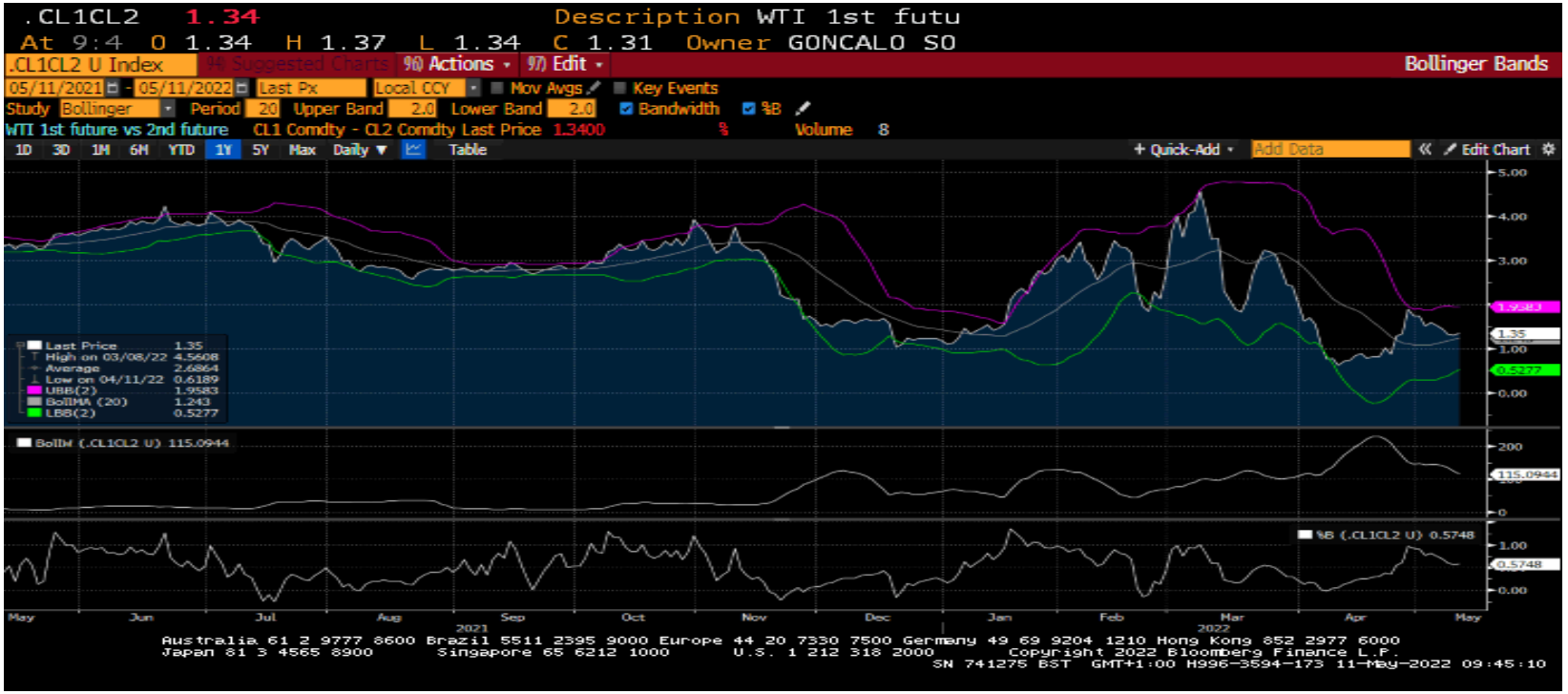
Commodities Arbitrage

Statistical Arbitrage

Example 1

Crude Oil (WTI) Curve

- **Strategy: trade same commodity along the curve**. Spread between 1st future and 2nd future price in WTI using Bollinger Bands to generate signals



Commodities Arbitrage

Statistical Arbitrage

Example 2

Soybean vs Soybean Meal Spread

- **Strategy: trade related commodities (CL+CO, C+W, SM+S)**. Spread between related commodity prices to generate signals

Commodities Arbitrage
Statistical Arbitrage
Example 3
Gold vs Gold Producers

- **Strategy:** trade commodities *vs* related stocks, such as producers (CL+Xom, GC+Barrick). Spread between related commodity prices and their producers