Morgan Stanley

Teach-in:
Interest Rate Swaps and Options

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Agenda

- **Interest Rate Swap Review**
- **Trading Strategies**
- **Roll and Carry Considerations**
- **Interest Rate Options: Swaptions**
- **Drivers of Volatility**

By the end of this class you will be able to:

- **Use swap duration and convexity to measure your risk and determine your exposure**
- **Explain the uses of Interest Rate Options, who uses them and why**
- **Converse with your clients about various trading strategies they can execute using Interest Rate Derivatives, including duration, curve, swap spread, forward, and butterfly strategies**

Swaps Review

Review: What is a *Swap*?

Let's not forget what we discussed in our first swap presentation

- **In the most basic sense, a swap is a par bond financed in Libor:**
  - A long position in a swap is equivalent to a levered long position in a cash bond
- **Throughout this presentation there are a couple of things to keep straight in your mind:**
  - **Positioning is relative to what one is doing on the *fixed* leg**
  - **LONG THE MARKET = RECEIVING FIXED ON A SWAP**
  - **SHORT THE MARKET = PAYING FIXED ON A SWAP**

Parties of the Interest Rate Swap

Party A: Fixed Rate Payer

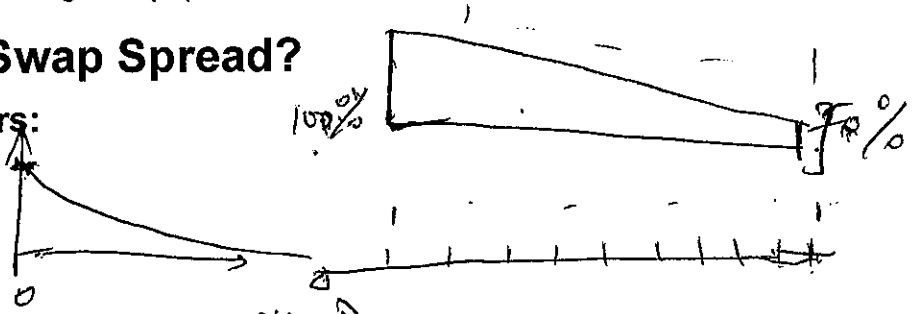
- Pays Fixed
- Receives Floating
- **Like *selling* the bond market**
  - Loses if rates fall
  - Wins if rates rise
- Has established the price sensitivities of a longer term liability and a floating rate asset

Party B: Fixed Rate Receiver

- Receives Fixed
- Pays Floating
- **Like *buying* the bond market**
  - Wins if rates fall
  - Loses if rates rise
- Has established the price sensitivities of a longer term asset and a floating rate liability

Swap Quoted as Swap Spread

- **Swap Spread is the difference between:**
  - The yield on a government security (such as a US Treasury)
  - The fixed rate of a floating swap (with the same maturity as the Treasury)
- **What drives the Swap Spread?**
  - **Fundamental Factors:**
    - Carry & Funding
    - Systematic risk
  - **Technical factors**
    - Treasury-specific factors
    - Supply/demand effect



Duration and Convexity of a Swap

- **DV01 (for a bond)**
  - The change in the price of the bond for a 1bp change in yield
  - To calculate shift the bond yield by 1 bp and compute the price change
- **DV01 (for a swap)**
  - The change in PV (present value) of the swap for a 1 bp parallel shift in the swap curve
- **PV01**
  - The present value of a 1bp annuity with a maturity equal to the swap maturity
  - **Note that for a par swap, DV01 ≈ PV01**, For a swap that is not at par DV01 must be used
- **Quoting Duration**
  - The market convention is typically to only quote the duration of the fixed leg of the swap
- **Stub Risk**
  - The duration of the floating leg of the swap, arises because once LIBOR is set it becomes a 3M fixed rate
  - Typically managed separately, but can be meaningful when LIBOR is volatile
- **Convexity**
  - Change in DV01 of a swap for a 1 bp parallel shift in the swap curve

Duration Example

- **2y Swap, with $100mm Notional**
  - DV01 = 1.9
  - DV01 = $100mm * 1.9 /10,000
  - DV01 = $19,000 per bp
- **10y Swap, with $100mm Notional**
  - DV01 = 8.1
  - DV01 = $100mm * 8.1 /10,000
  - DV01 = $81,000 per bp
- **Duration Neutral Curve Trade**
  - 2y DV01 = $426mm * 1.9 / 10000 = $81,000 per bp
  - 10y DV01 = $100mm * 8.1 / 10000 = $81,000 per bp

Convexity Example

- **Consider a duration neutral 10s/30s flattener 10 years forward**
- **Differences in convexity mean that as the market moves, re-hedging is required to remain duration neutral**

		Rate (%)	PV01	Notional (mm)	Risk
Pay	10y10y	5.75	4.85	190.91	9.26
Receive	10y30y	5.60	9.26	100	9.26

Market rallies - yield curve falls 100 bp in parallel

		Rate (%)	PV01	Notional (mm)	Risk
Pay	10y10y	4.75	5.64	190.91	10.77
Receive	10y30y	4.60	11.57	100	11.57

Market sells-off - yield curve rises 200 bp in parallel

		Rate (%)	PV01	Notional (mm)	Risk
Pay	10y10y	6.75	4.18	190.91	7.98
Receive	10y30y	6.60	7.47	93.06	6.95

Market rallies back to original level of yields

		Rate (%)	PV01	Notional (mm)	Risk
Pay	10y10y	5.75	4.85	190.91	9.26
Receive	10y30y	5.60	9.26	106.8	9.89

- Initially, the trade is set up to be duration neutral
- As market rallies, higher convexity means the duration on the 10y30y rate increases, leaving the trade to be re-hedged to make it market directional again
- The investor therefore has to pay on around $ 7 mm 10y30y at 4.60%
- Similarly, when the market sells off, the duration of the 10y30y falls faster, and now the investor needs to receive on around $14 mm 10y30 at 6.60% to re-hedge
- As the market rallies back to the original level, a final hedge of paying around $7 mm of 10y30y at 5.60% is required

Convexity Example

- **So what has happened?**
  - The market has returned to the original levels, suggesting the flattener has had zero P&L
  - However, during the hedging, the investor has paid at 4.60% and received at 6.60% and 5.60% resulting in profit
  - This is due to being long convexity, and so the forward curve demands a premium for this privilege
  - Hence, the 10y30y rate is lower and the forward curve is inverted

Trade Strategies:

Outright Swap
Curve Trade
Curve Cap
Butterfly
Fwd Starting
Yield/Yield Asset Swap

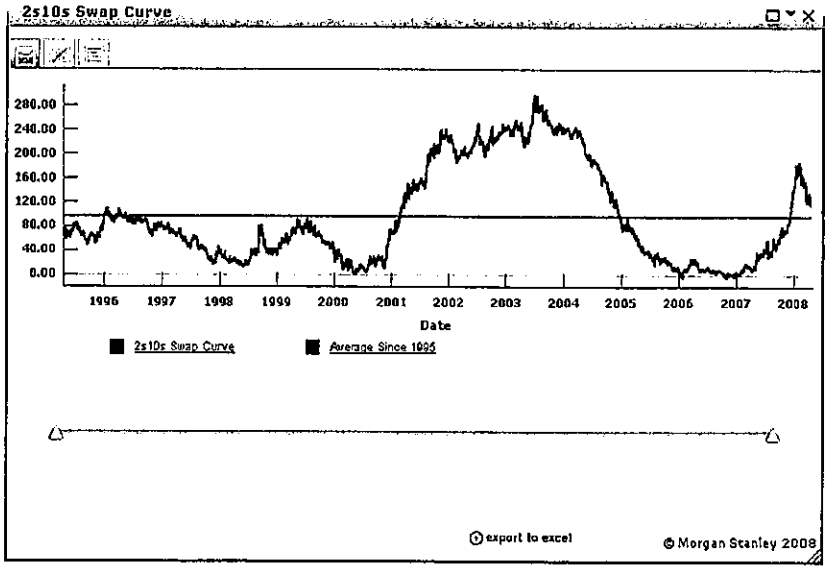
Outright Trade - Execution Example

- **A typical IRS inquiry would sound like this:**

Account A:	*Thanks again for sending that chart over. I agree yields are going higher, let's **short** the market here.*
MS Salesperson:	No problem. Let me get a level. (calls Mike Barletta, Mike Jesionowski or Tanuj Kana on the trading desk)..."Tanuj, where can Account A, **pay** on 100mm 10yrs outright?"
Tanuj:	Mid right now is 4.615%, you client can **pay** 4.62% on 100mm outright
MS Salesperson:	(*to Account A*) You can **pay** 4.62%
Account A:	*That's done. I **pay** 100mm 10yr rates at 4.62%. What's my dv01?*
MS Salesperson:	(to Tanuj) Tanuj you're done. Account A **pays**, you **receive** on 100m @ 4.62%. (*to Account A*) I see your **short** approximately $80,800/bp of 10yrs. Thanks for the trade.

Curve Trade - Overview

- Many of Morgan Stanley's clients use Interest Rate Swaps to ***hedge*** positions and to ***speculate*** in the rates market
- Use ***msq*** *to* see that yield movement
- Accounts looking to ***speculate*** in the market may bet on long end yields going higher relative to front end yields



Curve Trade - Details

- **Steepener**
  - Receive on short maturity swap, pay on long maturity swap
  - Duration neutral
- **Flattener**
  - Pay on short maturity swap, receive on long maturity swap
  - Duration neutral
- **Example**
  - Receive on $426mm 2y swap @ 3.33%
  - Pay on $100mm 10y swaps @ 4.56%

2y DV01 = $426mm * 1.9 / 10000 = $81,000 per bp (long)

10y DV01 = $100mm * 8.1 / 10000 = $81,000 per bp (short)

  - If 2y rates rally 20 bp and 10y rates rally 10 bp, gain on the trade will be:

$81,000 / bp * 20 – $81,000 / bp * 10 = $810,000

Curve Trade - Execution Example

- **A typical IRS inquiry would sound like this:**

Account A:	*Thanks again for sending that chart over. I agree with your argument that the curve should re-steepen from current levels. Where can I put on 25k/01 of 2s10s curve. I pay on the curve.*
MS Salesperson:	No problem. Let me get a level. (calls Mike Barletta, Mike Jesionowski or Tanuj Kana on the trading desk)…"Tanuj, where can Account A, **pay** on 25k/01 of the 2s10s curve. Account **pays** 10s and **receives** 2s.?"
Tanuj:	Mid right now is 123bps, your client can enter the steepener at 123.5bps
MS Salesperson:	(*to Account A*) You can **pay** 123.5bps
Account A:	*That's done. I **pay** on 25k/01 of the 2s10s curve at 123.5*
MS Salesperson:	(to Tanuj) Tanuj you're done. Account A **pays**, you **receive** on 25k/01 @ 123.5bps.

CMS Forwards & Options

- **CMS (constant maturity swap) forwards and options provide a payout based on swap rates**
- **Allow investors to express rate & curve views without worrying about managing DV01 & convexity exposure of underlying swaps**
- **Convexity Adjustment**
  - Difference between CMS forward rate and traditional forward swap rate
  - Accounts for value of convexity difference between a CMS forward and forward swap

Example: 1y 2s10s Curve Cap

INDICATIVE TRADE TERMS:

Notional Amount:	**USD 1,000,000,000**
Option Buyer:	**Client**
Expiration Date:	**May 30, 2009 (1 year)**
Strike:	**0.85% (85bp)**
Reference Index:	**10-year swap rate minus 2-year swap rate**
Premium:	**30 bps ($3,000,000)**

- **The breakeven on the trade is 115bps**
- **Spot curve is 123bps**
- **The client's maximum loss on the trade is limited to the option premium of 30bps**

Butterfly Trades:
Risk Weighting Methodologies

Trading one curve against another
Risk weightings can be developed in several ways:

Simple Butterfly (50/50 Risk Weighted)
- Butterfly Level quoted as 1 x 5y rate – 0.5 x 2y rate – 0.5 x 10y rate
- Risk distributed equally on each wing.

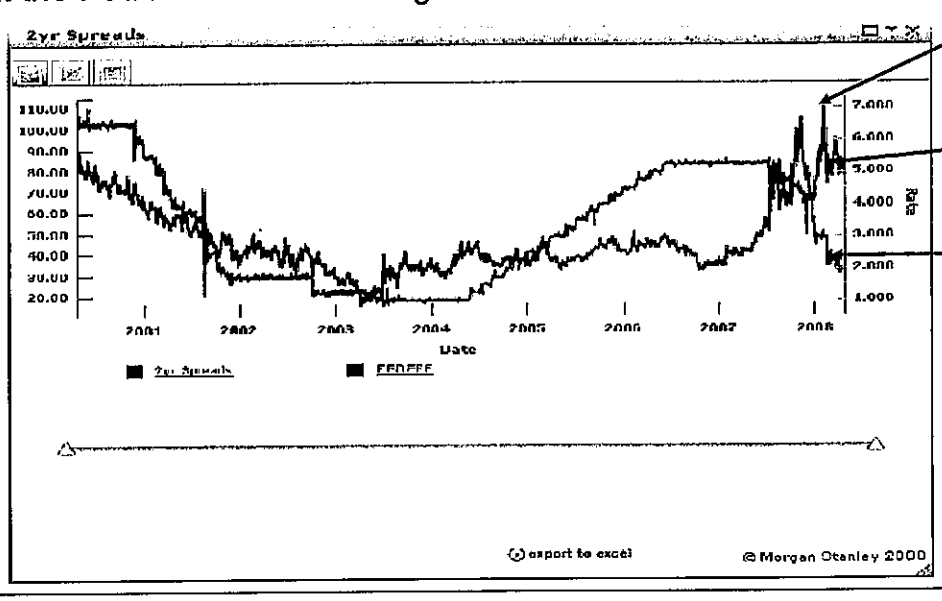
Volatility-adjusted Butterfly
- Risk assigned according to volatility of the curves involved in the butterfly.
- Accounts for relative volatilities but not correlations.

Regression Weighted Butterfly
- Regress one curve in the butterfly against the other and determine the hedge ratio based on the beta of the regression.
- Regressions are not symmetrical. The hedge ratio is dependent on which curve is chosen as the independent variable.

PCA Weighted Butterfly
- Principal component analysis – Decomposes the covariance matrix between points on the yield curve into orthogonal eigenvectors
- Weight trades to minimize exposure to the 2 eigenvectors that explain 99% of curve movements.
- Accounts for correlations and relative volatilities, and results are symmetrical.

2 Year Spread Trade - Overview

- 2yr spreads between Treasury and Fed Funds have come in from wide levels seen in January, but are ***still at historic wides***, especially given what the Fed has done lowering rates over the last 2 months



2 Year Spread Trade - Details

- **Spread widener (long spreads) –**
  - **Buy on-the-run Treasury / Pay Fixed on benchmark Swap**
- **Spread tightener (short spreads) –**
  - **Short on-the-run Treasury / Receive Fixed on Swaps**

- **Example:**
  2y Spread Tightener @ 80.5 bp
  - **Receive $1.0B on 2y swap**
    - Effective: 5/30/2008
    - Maturity: 5/30/2010
    - Rate 3.23%
    - DV01: $1.0B * 1.92/10,000 = **$192,000**
  - **Short $1.032Bm 2y USTs**
    - Settle: 5/30/2008
    - Maturity: 4/30/2010
    - Yield: 2.425%
    - DV01: $1.032B * 1.86/10,000 = **$192,000**

2y Swap Spread Trade – Execution Example

- A typical inquiry would sound like this:

Account A: *I really think all of the recent actions by the Fed is going to have an impact on the credit crisis. I think Libor should start to come in as banks start lending to one another. Where can I **sell** some 2yr spreads – $192k/bp.*

MS Salesperson: Got it. Let me get a level from Tanuj. (to Tanuj) "Where can account A **receive** on $1bln 2yr spreads – he **sells** 2yr spreads?"

Tanuj: Bid side on 2yr spreads is 80.5 right now.

MS Salesperson: (*to Account A*) You can **sell** $1bln which is $192k/bp at 80.5. You **receive** 2yr swaps vs **selling** 2yr treasuries at a spread of 80.5bps.

Account A: *That is done. Thank you.*

MS Salesperson: (to Tanuj) Done.

(*to Account A*) Done. Thanks for the trade.

Yield/Yield Asset Swap

The focus on simplicity

- **On a long swap spread position, the investor simply purchases a bond and pays fixed on a swap to the maturity of the bond, duration weighted**
- **The Yield/Yield Asset Swap spread is simply:**
  - The difference between the yield-to-maturity of the bond and the par swap rate to the maturity of the bond
- **Yield/Yield Spreads are typically used to hedge or take RV trades among specific bonds**

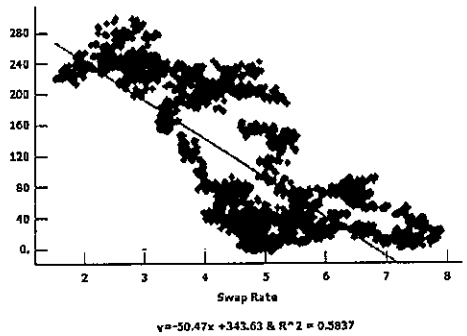
Yield/Yield Asset Swap Example

- **05/28/2008 Trade Date**
  - Investor buys $100mm UST 4.75 8/17 at a yield of 3.830%
  - Investor enters into a Swap where they pay 4.392% (swap rate) on a $102.5mm from 5/30/2008 to 8/15/17
- **Yield/yield swap spread equals:**
  - 4.392% - 3.830% = **56.9 bp**
- **Hedge ratio equals:**
  - DV01 of the bond: 7.77
  - DV01 of the fixed leg of the swap: 7.577
  - 7.77 divided by 7.577 = **1.025**

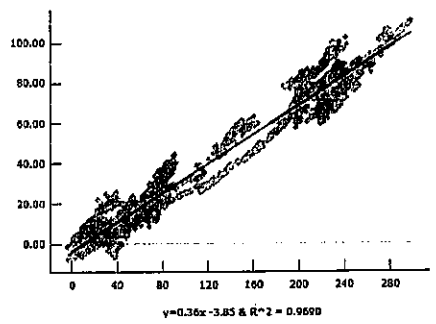
Swap Market Correlations to Be Aware of...

- **Most swap curve trades and many butterfly trades have a high degree of market directionality which should always be kept in mind when considering such trades**
- **The correlations are useful guides in relative value analysis - it should always be remembered, however, that they can break down and reasons for such breakdowns are usually of interest**

USD 2s10s vs 1y1y Rate



USD 50/50 2s10s30 Fly vs 2s10s Curve



In general:

- The yield curve steepens in rallies and flattens in sell-offs as central bank movement leads the way
- 2s10s curve is more volatile than the 10s30s curve, so the belly of the 2s10s30s fly tends to cheapen when the 2s10s curve steepens

Roll and Carry Considerations

Roll-Down & Carry – Definitions and Concepts

- **Roll-Down & Carry comprise the entire PnL in an unchanged market**
- **Especially important in an environment of low volatility or low conviction**
- **Profit/Loss = Capital Gains + Interest Income**

  = Δ(Price) from Market Volatility + Roll-Down + *Pull-to-Par* + *Coupon* - *Funding*

  ≈ Δ(Price) from Market Volatility + Roll-Down + *Yield* - *Funding*

  ≈ **Δ(Price) from Market Volatility + Roll-Down + *Carry***

Roll-Down & Carry – Calculations

- **Roll-Down**
  - Fully realized in a stable yield curve environment
  - Example: 6M roll-down on a 10Y swap:

    Leveraged Perspective = 10Y Rate – 9.5Y Rate

    Total Return ≈ (10Y Rate – 9.5Y Rate) * (PV01 of a 9.5Y Swap)

- **Carry**
  - Can be locked in on trade date
  - Example: 6M carry on a 10Y swap:

    Leveraged Perspective ≈ $\frac{\text{(10Y Rate)*(180/360) - (6M LIBOR)*(Act/360)}}{\text{(PV01 of a 9.5y Swap)}}$

    Total Return = (10Y Rate)*(180/360) - (6M LIBOR)*(Act/360)
  - Forward rates are determined by carry.
  - Difference between 10y and 6m9.5y forward rate is equal to the carry

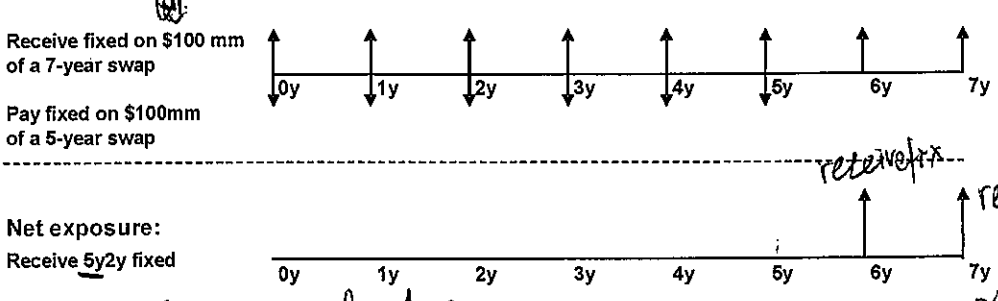
Note: In a forward-starting swap, there is no carry, only roll-down

Trading Forward-Starting Swaps

- **A forward-starting swap = Combination of two spot-starting swaps**
- **Allows investor to lock in carry to a specific date**

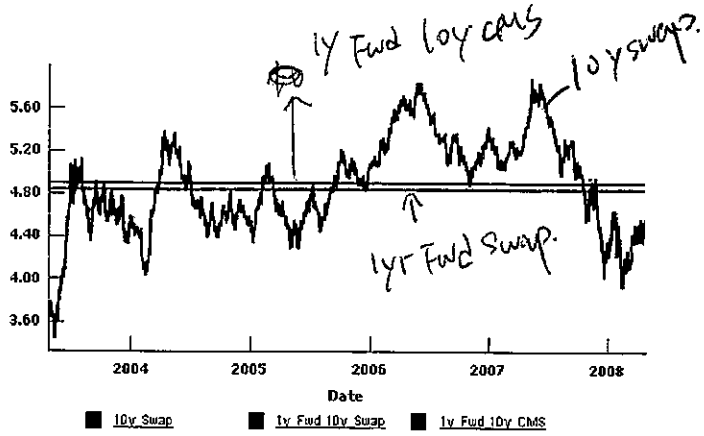
Example: A 5-year swap 2-years forward is a combination of:

- Receiving on a 7-year swap
- Paying on a 5-year swap with equal notional amount



Floating rate components cancel each other out for the first five years, leaving you with the 2yr swap 5yrs forward

Forward Swap Example



Potential Mean Reversion Trade:

- 10y Swaps are low historically (4.56%)
- Can I bet on reversion to 4.88% 5y average?
- Ability to make money on this view depends on rolldown & carry to horizon
- 1y fwd 10y rate is 4.84%, CMS is 4.90%.
- Market priced for mean reversion in 1y
- 10y swap rate needs be above forwards to profit on this view

If your Horizon > 1d you are trading forward rates

Swaptions

The Volatility Products

- **Exchange Traded Options**
  - Chicago Board of Trade (CBOT)
  - Chicago Mercantile Exchange (CME)
  - Options on Treasury futures and Eurodollar futures
  - Defined option types and expiries
    - Most are American
    - Most options expire in 1 to 1.5 years or less
- **Over-The-Counter (OTC) Options**
  - Options on Treasuries
  - Options on bullet agencies
  - Options on swap rates
  - Wide variety of option types. Ability to customize the option to fit the investor's particular trading or hedging needs

Exchange Traded Options

- **CBOT (Chicago Board of Trade)**
  - Short dated options on bond futures
  - Expiries out to 6 months on 2-year, 5-year, 10-year, and 30-year futures
  - Actively traded by speculators and hedgers
- **CME (Chicago Mercantile Exchange)**
  - Short dated options on Eurodollar futures
  - Expiries out to 2-years on Eurodollar futures (Futures out to 10-years)
- **Exchanges:**
  - Provide good indications of option levels (Bloomberg)
  - Reasonable liquidity
  - Excellent credit
  - Underlying bond futures have convexity due to delivery options

OTC Options

The key feature of the OTC market is the ability to obtain a two-way market in virtually any interest-rate swap or option product

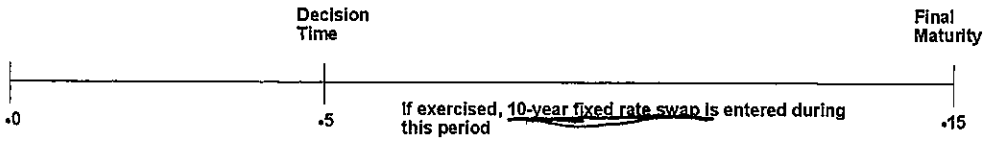
- **Unlike Exchange Traded, an investor can specify:**
  - Underlying
  - Maturity
  - Expiry and expiry type
  - Payoff
  - Size
- **Most liquid market:**
  - European options on bullet swap rates (European swaptions)

OTC Options: Swaptions

- **Option to enter into an interest rate swap**
- **Most liquid and actively traded OTC options**
- **Wide range of option expiries: 1 month to 20 years**
- **Wide range of underlying swap maturities: (1 year to 30 years)**

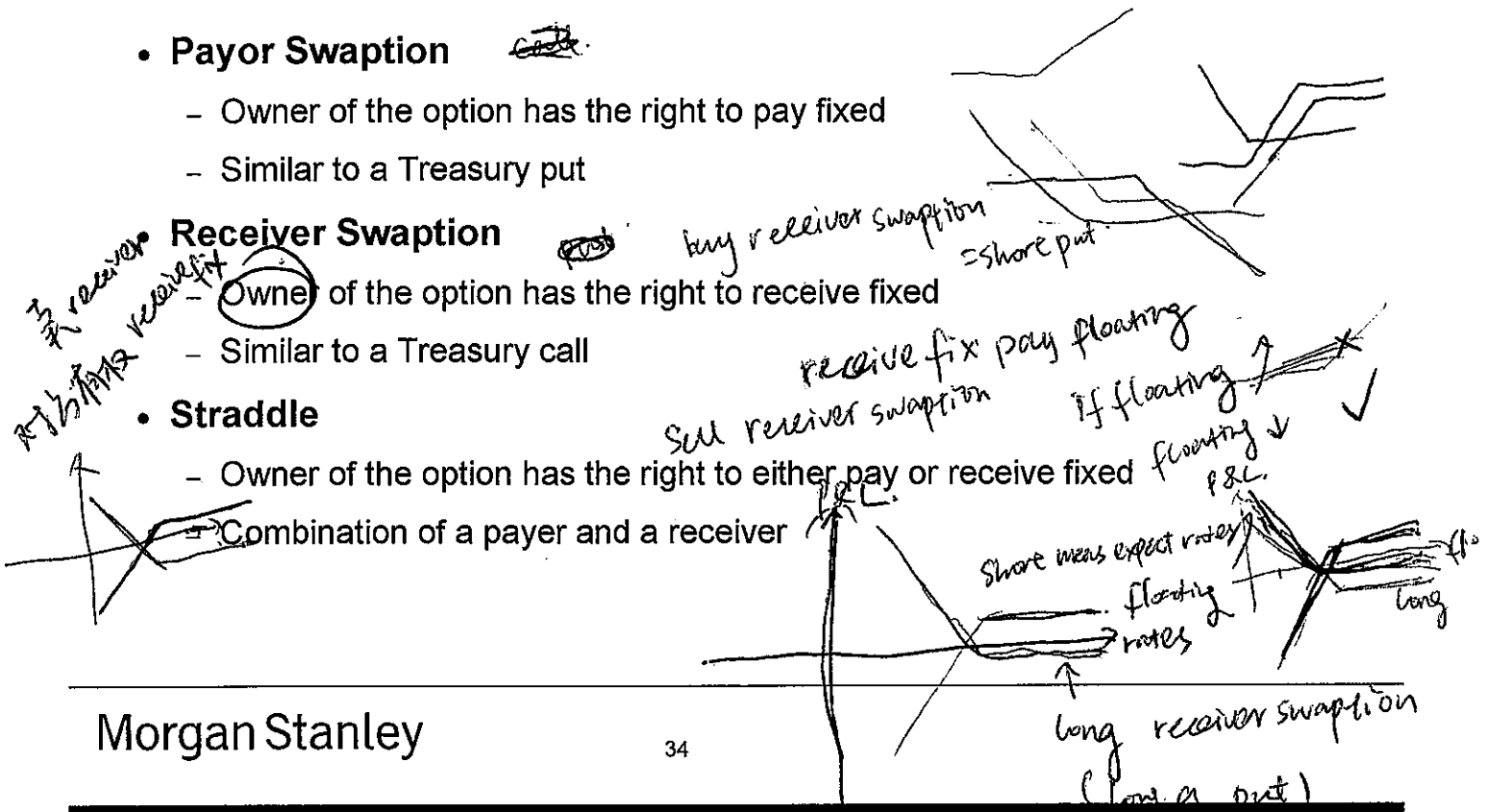
Example:

A 5-year expiry option, European style, with the right to pay 5% fixed S/A 30/360 vs. 3-month LIBOR for 10 Years ("A 5-into-10 5% Payor")



OTC Options: Swaptions

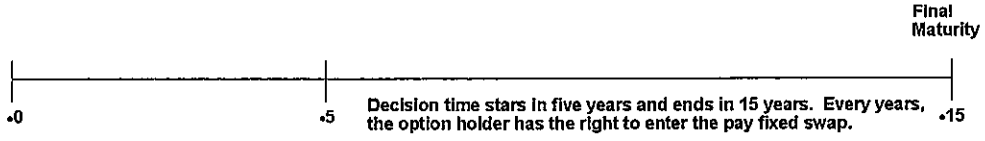
- **Payor Swaption**
  - Owner of the option has the right to pay fixed
  - Similar to a Treasury put
- **Receiver Swaption**
  - Owner of the option has the right to receive fixed
  - Similar to a Treasury call
- **Straddle**
  - Owner of the option has the right to either pay or receive fixed
  - Combination of a payer and a receiver



OTC Options: Swaptions

- **Bermudan Swaption: Right to exercise the option periodically**

Example: A 15nc5 payer swaption, 6% strike, annual right to pay



  - Bermudan options trade often, though vega and gamma risk is complex to model
  - Bermudan options better replicate the prepayment option in a mortgage than European options
- **American Swaption: Right to exercise the option over the exercise period on any day**
  - American options are least frequently traded

OTC Options: Caps and Floors

- **Options on 3-Month LIBOR**
- **Option resets monthly, quarterly, or semiannually**
- **Maturities typically range from 6 months to 20 years**
- **Good liquidity**
- **Represent a "string of options". A European swaption, in contrast, is only one option**

Example:

- A 10-year expiry cap on 3M LIBOR struck at 6% (Quarterly, Act/360). Cap resets quarterly.
- The option is composed of 40 individual "caplets" or options on 3M LIBOR.
- If one caplet is in the money, the option holder receives a payout over that period.

OTC Options: CMS Options and Exotics

- **Constant-Maturity-Swap Options**
  - Caps or floors on 2, 5, 10, 30 year CMS
  - The payoff structure is the same as for LIBOR caps/floors; however, the underlying index is CMS
  - Similar to a "string" of European swaptions
  - CMS set according to ISDAFIX
- **Structured (Exotic) Products**
  - Typically understood to encompass all products not previously mentioned
  - Options on a wide variety of underlying variables
  - **Example:**
    - One year call option on the yield curve spread between 10-year CMT and 2-year CMT struck at zero basis points
    - In one year, observe the spread between the 10-year CMT and the 2-year CMT; if the spread is positive, the customer receives that amount
    - This allows the customer to put on steepener view with limited (premium) downside

Market Participants

- **Dealers**
  - 5-10 large market makers
  - 20-25 smaller dealers
- **End users**
  - Government agencies (FNMA, FHLMC, FHLB)
  - Mortgage servicers
  - Asset managers / Central banks
  - Banks
  - Corporates
  - Insurance Companies
  - Supranationals
  - Hedge Funds
- **Mortgage Hedging**
  - Due to the size and scope of the US mortgage market and the negative convexity of US mortgages, the options market is needed and very actively traded as a hedging and trading vehicle

P-measure

$dS_t = R_{grow} S_t dt + \sigma S_t dW_t$

let $X = \log S$

$dX_t = \nu\, dt + \sigma dW_t$

$\nu = R_{grow} - \sigma^2/2$

$Var[X_t] = \sigma^2 t$

$SD[X_t] = \sigma\sqrt{t}$

Lognormal Volatility

- **Implied Lognormal Volatility ("Black-Scholes Volatility")**
  - Defined such that σ*(Sqrt(T)) is the standard deviation of the terminal distribution of the *log of the rate* at time T
  - The most popular measure of implied and actual interest rate volatility
  - Because a lognormal model assumes that the standard deviation of the log rate is constant, the standard deviation of the rate is a function of the level of interest rates
- **Example:**
  - Constant lognormal volatility means that as rates go from 6% to 4%, the implied basis point volatility would decrease by one-third
    - 6% x 20% = 120 bp
    - 4% x 20% = 80 bp

risk-neutral.

$\sigma\sqrt{T} = \log r$

$Var(\Delta X) = \sigma^2 T$

The market prices options using a risk-neutral distribution of log-returns with fatter tails than normal.

Normalized Volatility

- **Normalized Volatility ("Rate Adjusted Volatility")**
  - Normalized vol (τ) is defined such that $\tau^*(\text{Sqrt}(T))$ is the standard deviation of the terminal distribution of the *rate* at time T
  - Approximately equal to Black-Scholes vol multiplied by the forward rate
  - Used to compare the uncertainty of rates regardless of the level of rates
  - Important to use when comparing volatility levels across different rate environments
- **Implied basis point volatility remains constant through all interest rate levels**
  - For example, if the implied normalized volatility of a particular rate is 100 bp, a sell-off from 4% to 5% must be met by a proportionate decrease in implied lognormal volatility from 25% to 20%
    - 4% x 25% = 100 bp = 5% x 20%
  - The relationship of lognormal volatility between the two rate environments under a normalized model can be defined as the inverse of the two rates

Drivers of Volatility

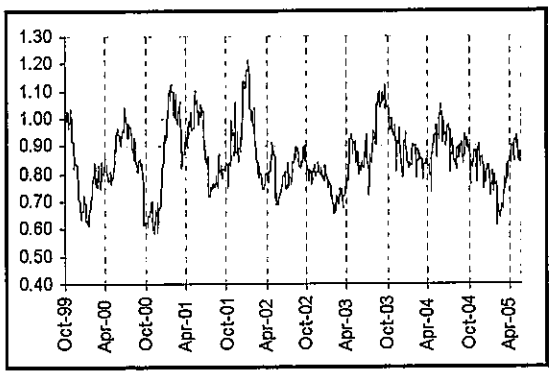
Short Expiry Volatility

- **Dealers delta hedge their option exposures**
- **Profit from long option position depends on realized volatility**
- **Implied vol = market's best estimate of realized volatility during the life of the option**
  - If implied volatility is equal to actual volatility, hedging profit equals premium
- **Historical realized volatility is one of the most important inputs to the market's estimate**
- **Implied volatility in the US tends to trade higher than actual volatility**

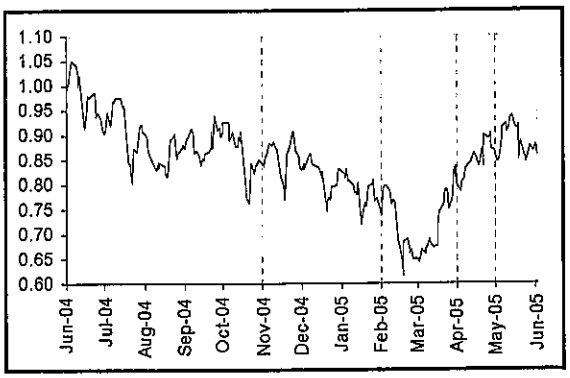
Actual vs. Implied Normalized Volatility

For options with expiries of 6m and less, one of the biggest drivers of implied volatility is *recent actual volatility*

3m5y Actual / Implied (Last 5 years)



3m5y Actual / Implied (Last Year)



Currently, 3-month rolling actual normalized volatility has richened relative to the level of 3m5y implied volatility

Source: Morgan Stanley

Long Expiry Volatility

- **For Options of 1-year expiry and greater:**
  - Supply and demand is much more important than realized volatility
- **High vega risk, low gamma risk**
  - Vega: Risk to movements in implied volatility
  - Gamma: Risk to movements in actual market volatility
- **Dealer risk limits are important factors**

Supply and Demand: Long Expiry Options

Supply

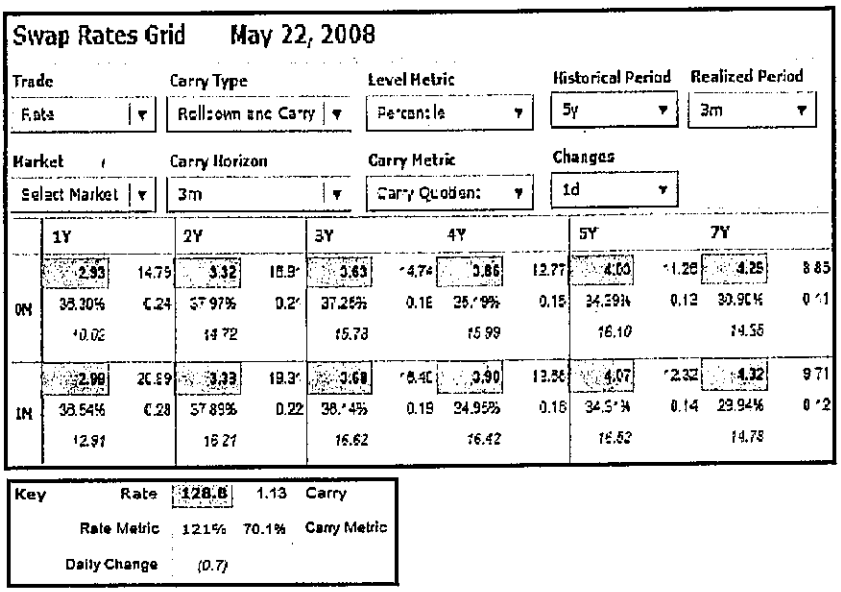
- **Agency callable issuance being hedged**
  - FHLBs hedge callable issuance
- **Corporate call monetization (sell the calls they effectively buy when issuing a callable bond)**
- **Puttable and cancelable swaps**
  - FHLBs provide puttable loans that are then hedged with dealers
- **Structured notes**
  - Investors are typically selling volatility to enhance yield

Demand

- **Mortgage portfolios (largely FHLMC and FNMA)**
  - Combined portfolio of approximately $1.5 trillion in MBS
  - Issue callable debt and purchase OTC options to hedge the mortgage portfolio's negative convexity
- **Mortgage servicers (CMS floors)**
- **Bank balance sheet management (LIBOR caps, swaptions)**

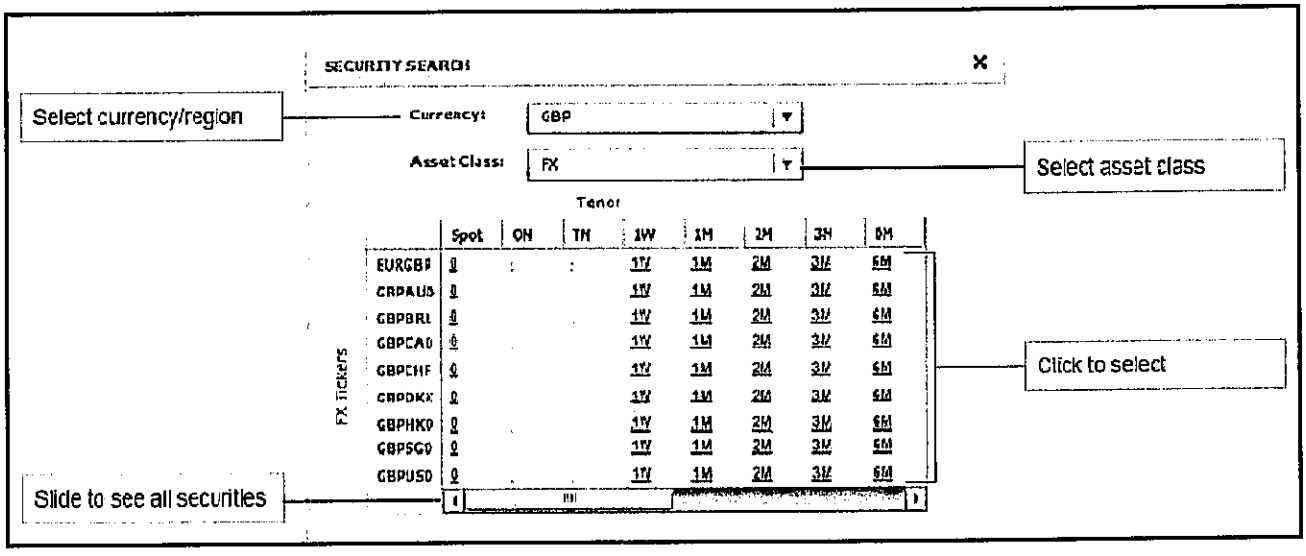
Morgan Stanley Quotient
Interactive Rates Grid

- **The MSQ Interactive Rates Grid allows the user to understand the swap rate surface**
- **Expiries range from 0M to 30Y while maturities range from 1Y to 30Y**
- **The user can select the type of metric to evaluate the level of rates (Percentile, Z-score), how to measure carry and over what period to measure it**
- **The period over which to measure changes can also be customized**
- **The user can also select specific rates and use the 'Add to Plotting Tool' Feature to plot the historical rates**



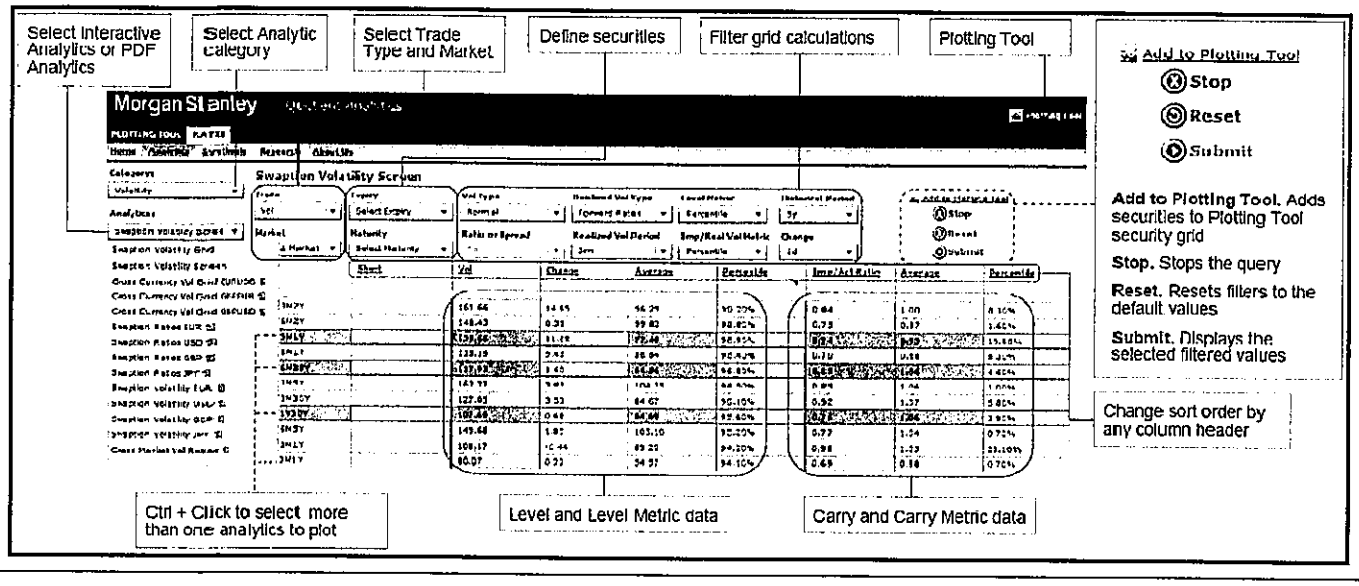
Morgan Stanley Quotient
Security Lookup Tool

- Access the Security Lookup Tool by click the Lookup icon (magnifying glass) on the Entry Palette in the MSQ Plotting Tool



Morgan Stanley Quotient
Interactive Analytics

- The MSQ Interactive Analytics allow the user to sort through a wide range of customizable metrics on swap rates and swaption volatility



You should now be able to:

- **Use swap duration and convexity to measure your risk and determine your exposure**
- **Explain the uses of Interest Rate Options, who uses them and why**
- **Converse with your clients about various trading strategies they can execute using Interest Rate Derivatives, including duration, curve, swap spread, forward, and butterfly strategies**

HKM790, $i_2 > i_1$

$$\frac{C/2}{(1+i_1)} + \frac{C/2}{(1+i_1)^2} + \frac{P}{(1+i_1)^2} = \frac{C}{(1+i_2)} + \frac{P}{(1+i_2)}$$

$$\frac{C}{2}\cdot(1+i_2)(1+i_1) + \frac{C}{2}(1+i_2) + P(1+i_2) = C(1+i_1)^2 + P(1+i_1)^2$$

$$C(1+i_2)(1+i_1) + C(1+i_2) + 2P(1+i_2) = 2C(1+i_1)^2 + 2P(1+i_1)^2$$

$$C(1+i_2)(1+i_1) + (C+2P)(1+i_2) = (C+2P)(1+i_1)^2 \qquad (1+2i_1+i_1^2)(C+P)$$

~~$C(1+i_2)\cdot$~~ ~~$C(1+i_2)(C+2P)$~~

~~$(1+i_2)(C+Ci_1+C+2P) = (2C+2P)(1+i_1)^2$~~

$$C(1+i_1+i_2+i_1i_2) + C+Ci_2+2P+2Pi_2 = 2C+2P+4Ci_1+4Pi_1+2i_1^2C+2i_1^2P$$

$$C+Ci_1+Ci_2+Ci_1i_2+C+Ci_2+2P+2Pi_2 = 2C+2P+4Ci_1+4Pi_1+2i_1^2C+2i_1^2P$$

~~$2i_1(C+C)+3Ci_1+2Pi_1$~~

$$2Pi_1^2 + 2Ci_1^2 + 3Ci_1 + 4Pi_1 - 2Pi_2 - Ci_2 - Ci_1i_2 = 0.$$

$(-D+2C)i_1^2$