

# California Debt and Investment Advisory Commission

*presents*

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## Swap Math: What Are Your Swaps Worth?

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## Overview

Interest rate swaps are financial tools used by many local government agencies to manage interest rate risk. The swap market at times provides issuers the opportunity to lower their cost of financing versus traditional alternatives in the bond market. Swaps remain an important tool in managing an issuer's debt service obligations and exposure to interest rate risk. For many, swap pricing is often viewed as a "black box". This webinar is intended to provide an understanding of swap math and includes:

- Information on the swap market
- Valuation methodologies
- Swap dealer's pricing conventions
- Formulas and examples of pricing
- Review of variables affecting market prices

## Part I: Before we get started....why look at swaps at all?

- Issuer has two general choices when selling fixed rate debt
  - Option A: Sell traditional fixed rate bonds
  - Option B: Sell variable rate bonds and swap to a fixed rate
- Why is there a difference in fixed rates under options A and B?
- Structural imbalance in the tax-exempt market (the neighborhood theory)
  - Supply Side – Tax-exempt issuers are financing **long** lived assets (toll roads, office buildings, power plants, stadiums, etc.). The liability structure matches the average lives (i.e. 30 to 40 year amortization).
  - Demand Side – The largest buyers of long term fixed income products (pension funds and foreign sovereigns) don't buy tax-exempt bonds. "Mom and Pop" retail focus on **short** maturities.

## Part I: Before we get started....why look at swaps at all?

### Typical tax-exempt amortization

GRAB

Muni CDRA

<MENU> to Return

97) Options

Page 1/1 NEGOTIATED

CA HLTH FACS FIN AUTH

ST: CA

TAX: FED & ST TAX-EXEMPT

View Attachments

Summary	MATURITY	AMT(M)	CPN	P/Y	CUSIP
Amount 100,000,000.00	1) 08/13	1545.0	3.250	1.390	13033LUG0
Sale Date 11/07/11	2) 08/14	1565.0	3.500	1.760	13033LUH8
MGR BANC OF AMERICA MERR	3) 08/15	1625.0	3.750	2.230	13033LUJ4
Bond Type REVS	4) 08/16	1690.0	4.000	2.620	13033LUK1
Dated 11/22/11	5) 08/17	1760.0	5.000	2.950	13033LUL9
1st Coupon 02/15/12	6) 08/18	1845.0	3.000	3.310	13033LUM7
Rating/Enhancement	7) 08/19	1905.0	4.750	3.550	13033LUN5
Moody's A2	8) 08/20	1970.0	5.000	3.830	13033LUP0
S&P	9) 08/21	2130.0	5.000	3.970	13033LUQ8
Fitch A+	10) 08/22	1140.0	4.000	4.140	13033LUR6
ENH	11) 08/22	1065.0	5.000	4.140	13033LUV7
Schedules	12) 08/26	9985.0	5.500	4.780	13033LUS4
Prem Call	13) 08/31	17370.0	5.000	5.220	13033LUT2
Par Call 08/15/21 ERP	14) 08/33	8820.0	5.500	5.230	13033LUW5
Other Notes	15) 08/41	45585.0	5.250	5.430	13033LUU9
1st Settle 11/22/11					
BOOK-ENTRY,DTC					
PRICE STATUS FINAL					

RADY CHILDRENS HOSPITAL

NOMS : \$5M

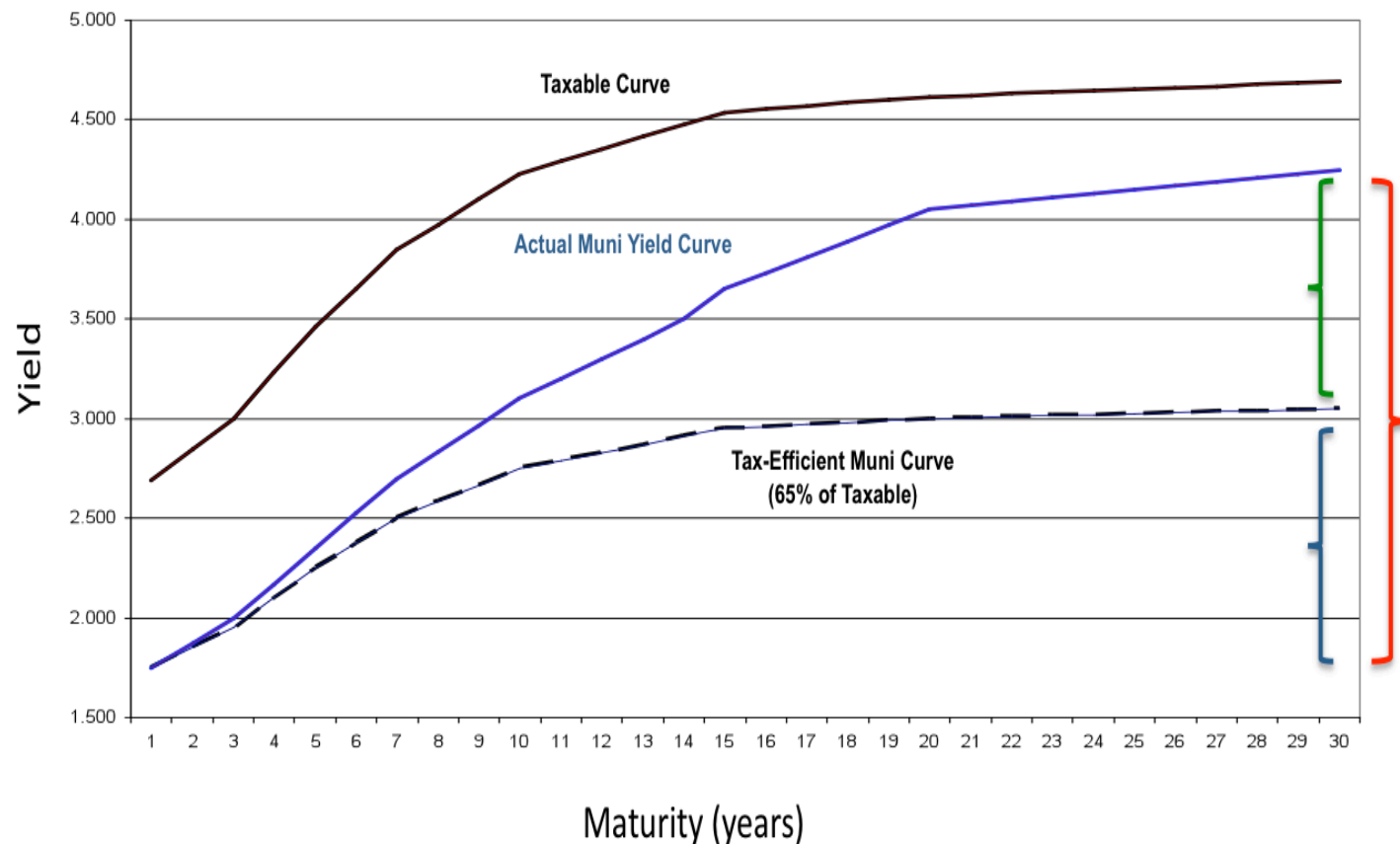
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000  
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2011 Bloomberg Finance L.P.  
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## Part I: Before we get started....why look at swaps at all?

- Result
  - Lots of long term supply and limited long term demand
  - Limited short term supply and lots of short term demand.
- Impact on Tax-Exempt Yield Curve: STEEP!
  - The tax-exempt yield curve has NEVER inverted and is consistently steeper than the taxable yield curve.
  - Short end of the tax-exempt yield curve is priced efficiently relative to the taxable yield curve and the long end of the tax-exempt yield curve is priced inefficiently when compared on a pre-tax equivalent basis.

## Part I: Before we get started....why look at swaps at all?

### The Slope of the Municipal Yield Curve is Steeper than the Taxable Yield Curve

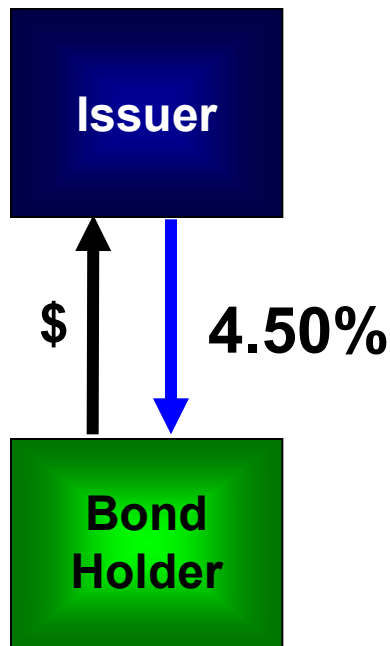


## Part I: Before we get started....why look at swaps at all?

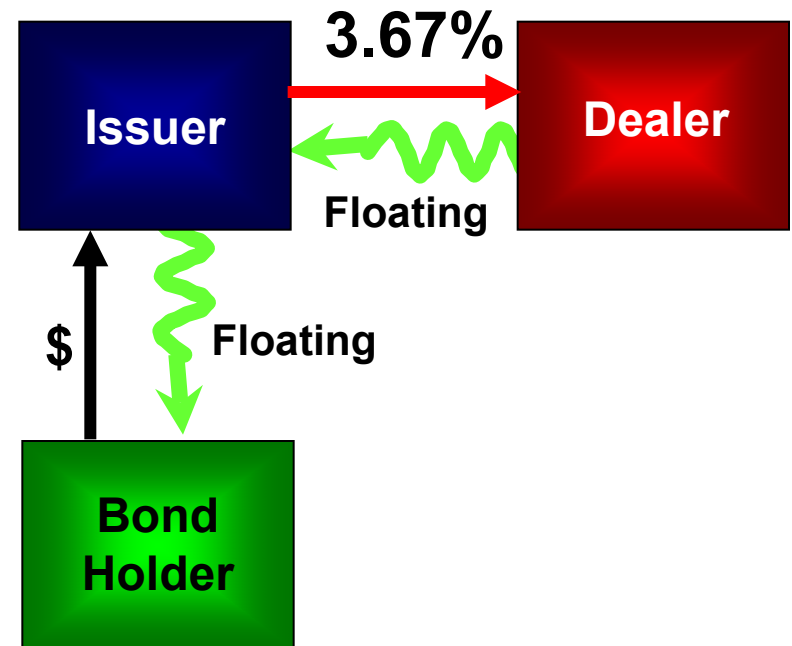
- Short Efficiency and Long Inefficiency results in swap opportunity
  - How do tax-exempt issuers capture the benefits associated with a swap based structure?
    - Issue efficiently priced variable rate bonds
    - Enter into fixed payer swaps

# Why swap?

## Fixed Rate Bond



## Synthetic Fixed Rate





## Part II: Where does the taxable swap curve come from?

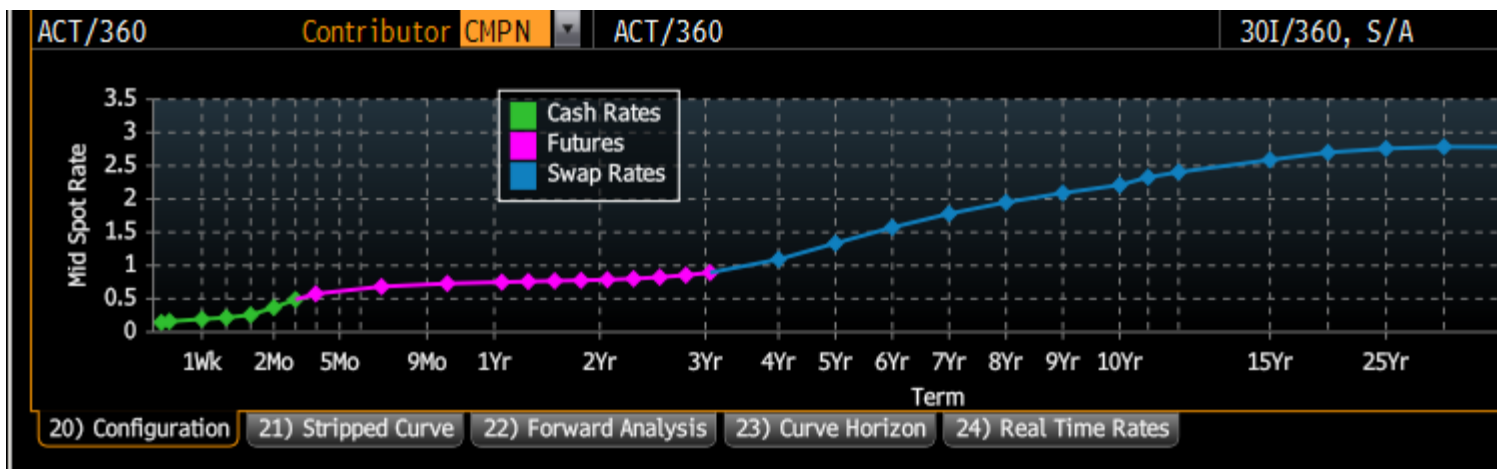
- Broker/Dealers provide quotes, which are published real time through services such as Bloomberg.
- Bid Ask Quotations are for vanilla transactions (fully collateralized, standardized ISDAs).
- Swap Rate Quotes: Pay fixed | Receive floating 3 month LIBOR

Fixed Income Trading			
90) Markets ▾ 91) Workflow ▾ 92) Setup			
FIT > IRS			
20) EUR 21) USD 22) GBP 23) CHF			
10) Semi 3M 11) Annual 3M 12) Spreads 13) C			
USD Semi vs 3M Libor			
1 Year (A/M)	0.742 / 0.748	+0.028	
2 Year	0.795 / 0.801	+0.027	
3 Year	0.902 / 0.907	+0.022	
4 Year	1.105 / 1.110	+0.011	
5 Year	1.344 / 1.349	+0.001	
6 Year	1.570 / 1.575	-0.005	
7 Year	1.761 / 1.767	-0.013	
8 Year	1.917 / 1.923	-0.018	
9 Year	2.043 / 2.049	-0.025	
10 Year	2.152 / 2.158	-0.027	
12 Year	2.326 / 2.332	-0.030	
15 Year	2.489 / 2.494	-0.032	
20 Year	2.598 / 2.603	-0.033	
25 Year	2.647 / 2.652	-0.031	
30 Year	2.675 / 2.681	-0.031	
40 Year	2.681 / 2.696	-0.028	
50 Year	2.647 / 2.655	-0.038	

ALLQ for Swaps (CDS/IRS)			
USD SWAP SEMI 30/360 10Y			
12:42:29 Suspend Sorting			
PCS	Firm Name	Bid	Ask
CMPN	Composite(NY)	2.1510	2.1560
CBBT	SwapTrader Comp	2.1500	2.1560
HSBC	HSBC Bank	2.14875	2.15625
BXSU	BARCLAYS CAPITAL	2.14800	2.15800
CMT3	Tokyo 3PM Comp.	2.1580	2.1620
CMPN	Composite(NY)	2.1510	2.1560
BGN	Bloomberg BGN	2.1492	2.1567
LAST	Last Update	2.1488	2.1563
TIRS	TRADITION NA	2.1460	2.1580
BMOD	Nesbitt Burns	2.1420	2.1740
BGCU	BGC Partners	2.1350	2.1750
PREB	TP US	2.1350	2.1750
TPRA	TP Rates	2.1340	2.1740
MTRT	Meitan Real Time	2.1210	2.1610
ICUS	ICAP PLC US	2.1330	2.1730

## Part II: Where does the taxable swap curve come from?

- Complete LIBOR swap curve is derived from:
  - LIBOR Fixings: Inter-bank lending rates up to 3 months
  - Eurodollar futures: greater than 3 months and up to 3 years
  - Quoted Swap rates: greater than 3 years
- Both new and existing swaps are priced and valued from the curve.
- Curve is constructed as 0% coupon, or 'spot' rates. Why?
  - Individual cash flows can be discounted
  - Forward rates can be extrapolated, or 'bootstrapped'



## Part III: Pricing and Valuing Swaps

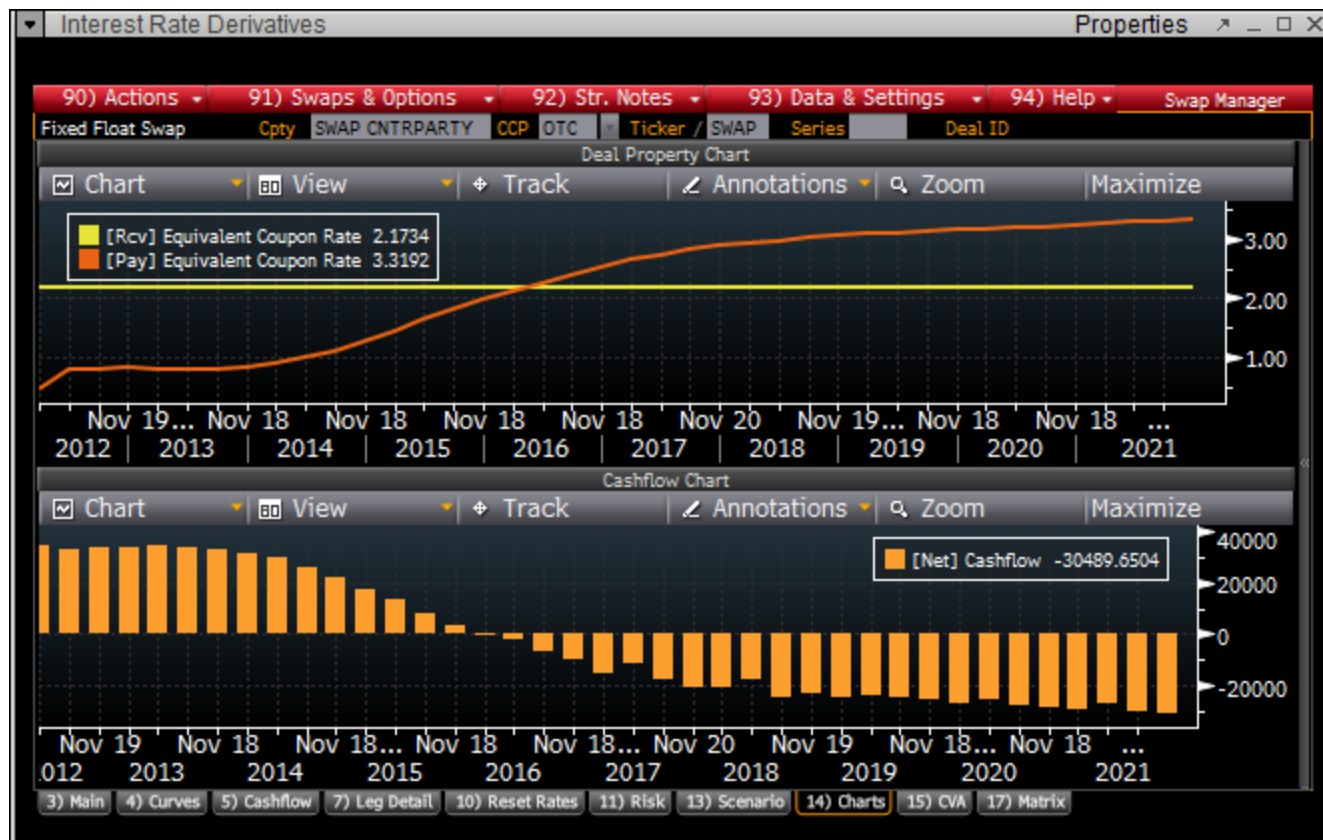
- Swaps are valued using the present value (PV) cash flow method
- Value of a swap as of any date is equal to the:
  - PV of the Future Fixed Cash Flows *minus*,
  - PV of the Future Floating Cash Flows
- Each (fixed or floating) cash flow is PV'd using discount factor derived from the 0% coupon or spot rate matching the date of the cash flow.
- I know the future fixed payments, but floating?
  - Future floating payments are also determined using the spot rates:
    - Future, or “forward” rates are mathematically ‘bootstrapped’
  - Example: If one-month rates today are 0.26%, and two-month rates today are 0.37%...what are one-month rates one-month forward?

$$\left(1 + \frac{.26\%}{12}\right)^1 \times \left(1 + \frac{x\%}{12}\right)^1 = \left(1 + \frac{.37\%}{12}\right)^2$$

- Solving for x, tells us that the forward rate is .48%
- This process is repeated to compute all forward rates under a swap

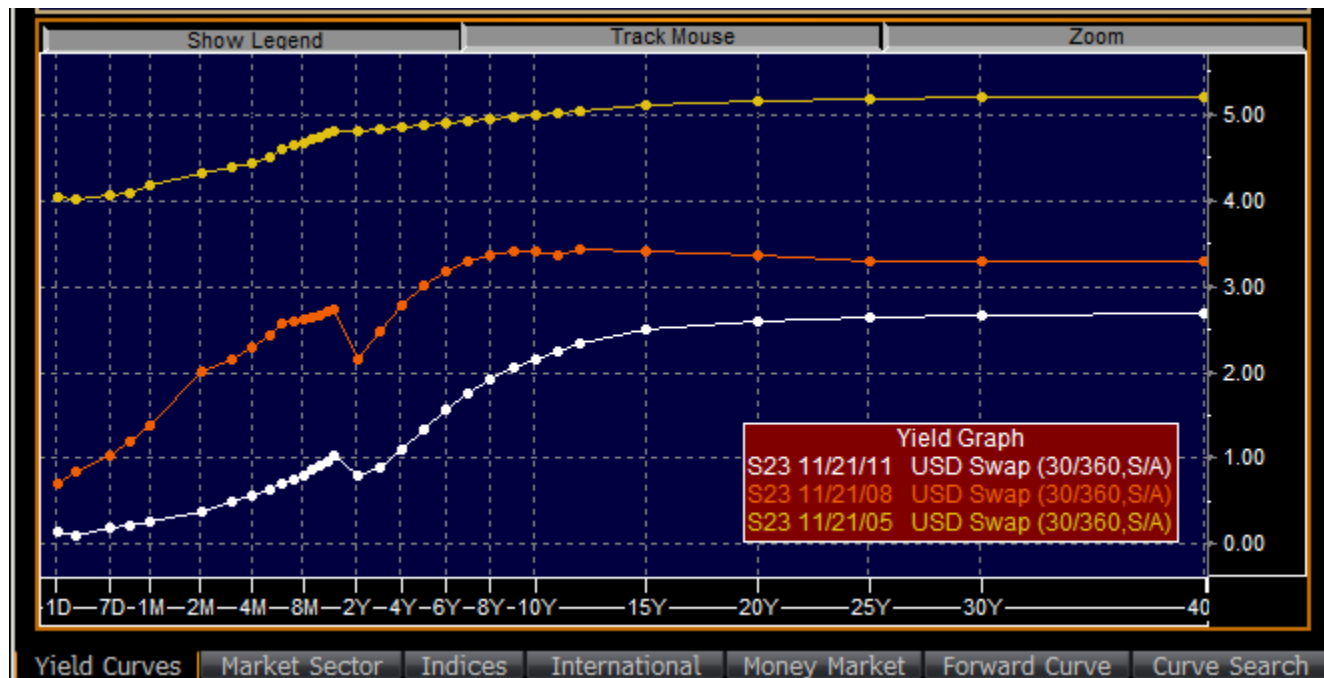
## Part III: Pricing and Valuing Swaps

- Example: 10,000,000 | 10 Year Swap | 2.173% Fixed Rate vs. 3M LIBOR
  - Forward rates and net swap cash flows are highlighted below








## Part III: Pricing and Valuing Swaps

- On-Market vs. Off-Market Swap
  - New swaps are generally 'on-market', where you solve for the fixed rate in order to make the value (the MTM) of the swap equal to \$0 (ignoring the dealer's 'spread')
  - 10 Yr. Swap example has a fixed rate of 2.173%, which causes the PV of the fixed leg to equal the floating leg, hence is the on-market rate.
  - Off-market swaps are new swaps that have up-front payments. Also, as of any date, virtually every swap entered into previously is now 'off-market'.
- Historical Rates: LIBOR swap curve today, 3 yrs. ago, and 6 yrs. ago



## Part III: Pricing and Valuing Swaps

- How do interest rate changes affect my swap?
  - Assume pay 2.173% fixed rate, receive 3M LIBOR floating rate swap
  - On valuation date, assume our previously highlighted historical yield curves

Curve Date	Change in Rates	Change in Value	On-Market Rate	Off-Market Rate Portion
Nov 2011	None 	None	2.173	0.000
Nov 2008	Higher 	 +\$1,388,000	3.818	1.645
Nov 2005	Higher, Flatter 	 +\$2,229,000	5.010	2.837

- Conversely, if rates were lower on any of these dates, the change in value would be negative. (No examples since rates never been lower than today!)

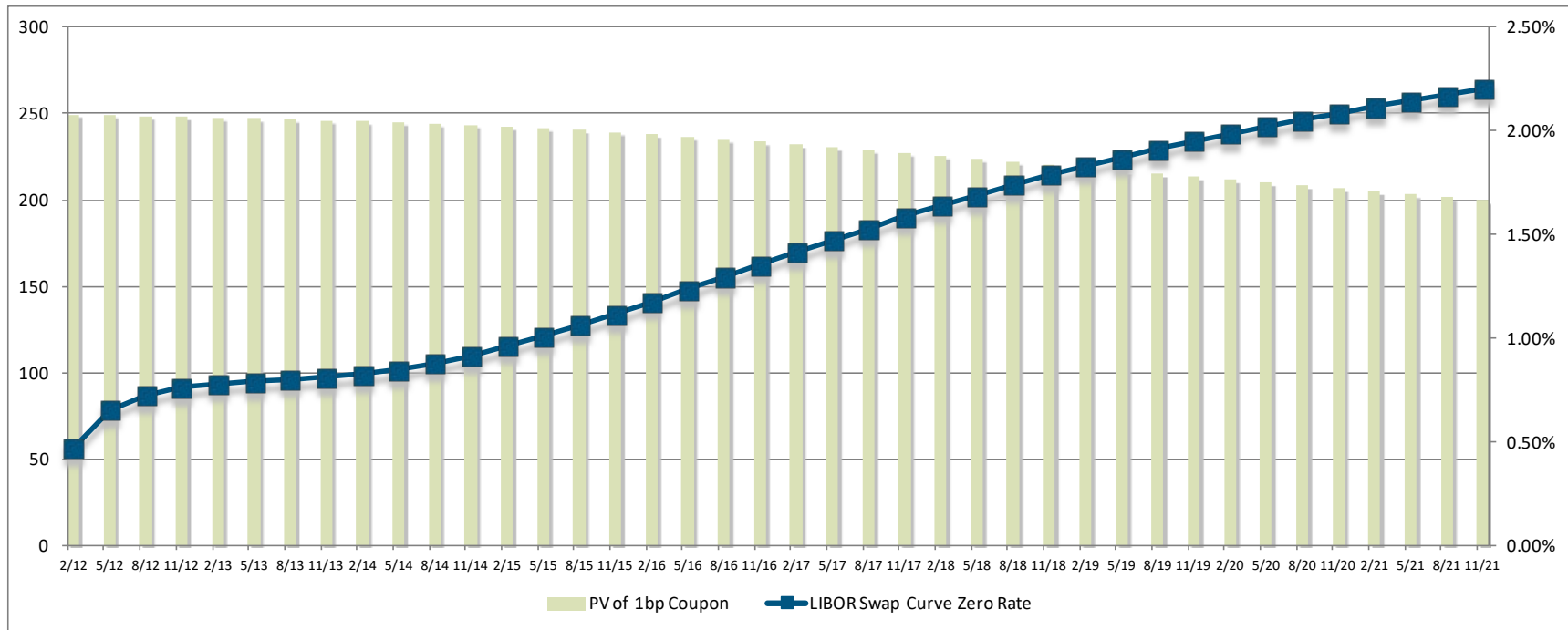
## Part III: Pricing and Valuing Swaps

- PV01: A revealing and important data point....
  - PV01 is the present value of a fixed leg with a .01% coupon. Since discount rates used (recall spot rates), PV01 for a given swap is yield curve dependent.
    - In our example, as of November 2011, the PV01 equal to \$9,193
    - November 2008 , \$8,439 and as of November 2005, \$7,858.
- For a given swap:

$$\frac{\text{MTM}}{\text{PV01}} = \text{Off-Market Rate (in bp)} \quad \text{and} \quad \text{Fixed Rate} + \text{Off-Market Rate} = \text{On-Market Rate}$$

- In our example, assuming November 2008, then
  - $\frac{1,388,000}{8,439} = 164.5$        $2.173\% + 1.645\% = 3.818\%$
  - Note, if MTM was negative, on-market rate would be less than fixed rate
- PV01 also known simply as a 'basis point'. This is the term a dealer will use to express the dealer spread, or compensation (e.g., 15bps) . Knowing the PV01 allows the spread to be expressed in present value dollars, e.g.,  $15 \times \$9,193 = \$137,895$

## Part III: Pricing and Valuing Swaps



$$PV01 = \sum 249.69 + 249.21 \dots + 199.85 = 9,193.04$$



## Part III: Pricing and Valuing Swaps

- Estimating the Change in Value for Your Swaps From PV01 and DV01
  - $PV01 = \text{PV of } .01\% \text{ coupon}$
  - $DV01 = \text{Change in value for a } .01\% \text{ parallel shift in yield curve.}$
- What's the difference?
  - For a vanilla swap, where the floating leg is 1M LIBOR or 3M LIBOR (not a % of 1M or 3M), then PV01 and DV01 are in fact the same.
  - Therefore, if you know the PV01, and the average life of the swap, then you can estimate the change value given a change in the LIBOR swap curve.
    - In our example, if 'rates are up today by 2bp', then you could estimate that the swap increased in value by \$18,386 ( $2 \times \$9,193$ )
  - However, if the swap floating leg is 67% (or other percentage) of 1M/3M LIBOR, then  $DV01 = 67\% \times PV01$ .
    - If our example was a 67% LIBOR swap, then if rates up by 2bp, change in value equal to \$12,318 ( $67\% \times 18,386$ ).
    - Note, you can ignore the floating leg margin (or spread) if one exists

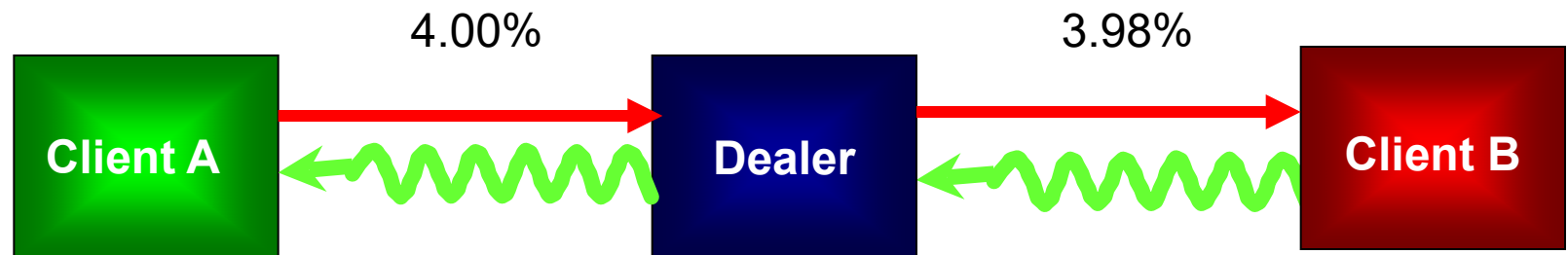
## Part III: Pricing and Valuing Swaps

- Practical Application of Pricing Tools
  - Ask swap provider for the PV01. This is a noncontroversial figure- it's just math.
  - Find swap rates at [www.wsj.com](http://www.wsj.com) or [www.federalreserve.gov](http://www.federalreserve.gov)
- Know limitations of PV01 and estimating values and/or on-market rates
  - Average life is reasonable but imperfect measurement of a swap's amortization.
  - Standard quotes from subscription services (e.g., Bloomberg, Reuters, etc.) as well as from public sources (e.g., WSJ, Fed) are semi-Annual, 30/360 fixed and quarterly, act/360 3M LIBOR floating
  - Any differences will cause the on-market rate of your swap to be different.
  - For example, impact of changing from act/360 to act/act reduces the fixed rate by about 1.3% (simply,  $1 - \frac{360}{365}$ ), or about 4bp if the fixed rate were 3% otherwise
  - Compounding: The more frequent the payment, the lower the nominal fixed rate
  - 1M vs 3M LIBOR: Different pricing for 1M LIBOR.

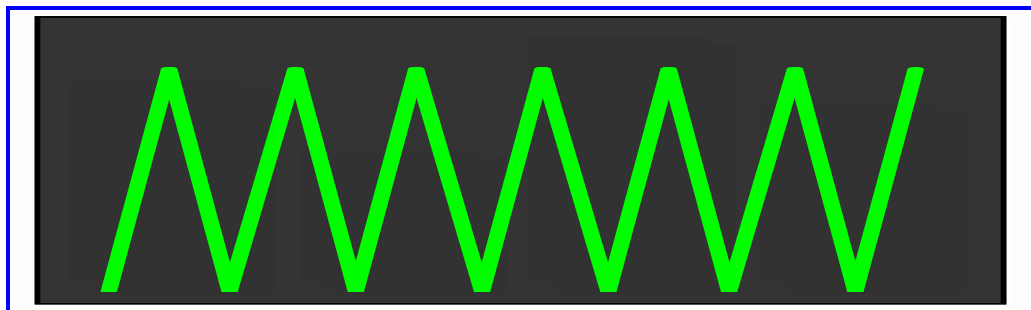
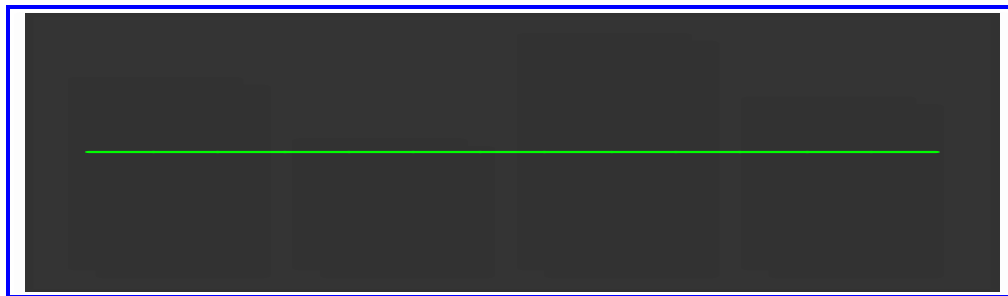
## Part IV: How does a dealer manage their swap position?

- Governmental issuers are 'end users' while broker/dealers and banks are generally and financial intermediaries
  - As an end-user, the governmental is typically using the swap as a tool to hedge a bond or similar debt, or asset.
  - A broker/dealer typically does not have a natural use for the swap and so will enter into an offsetting transaction (a "Matched Book")
    - Not interested in taking on interest rate risk
    - Hedges on a portfolio basis, not a one to one basis.
    - Stays in business by charging a spread on each swap, as mentioned earlier

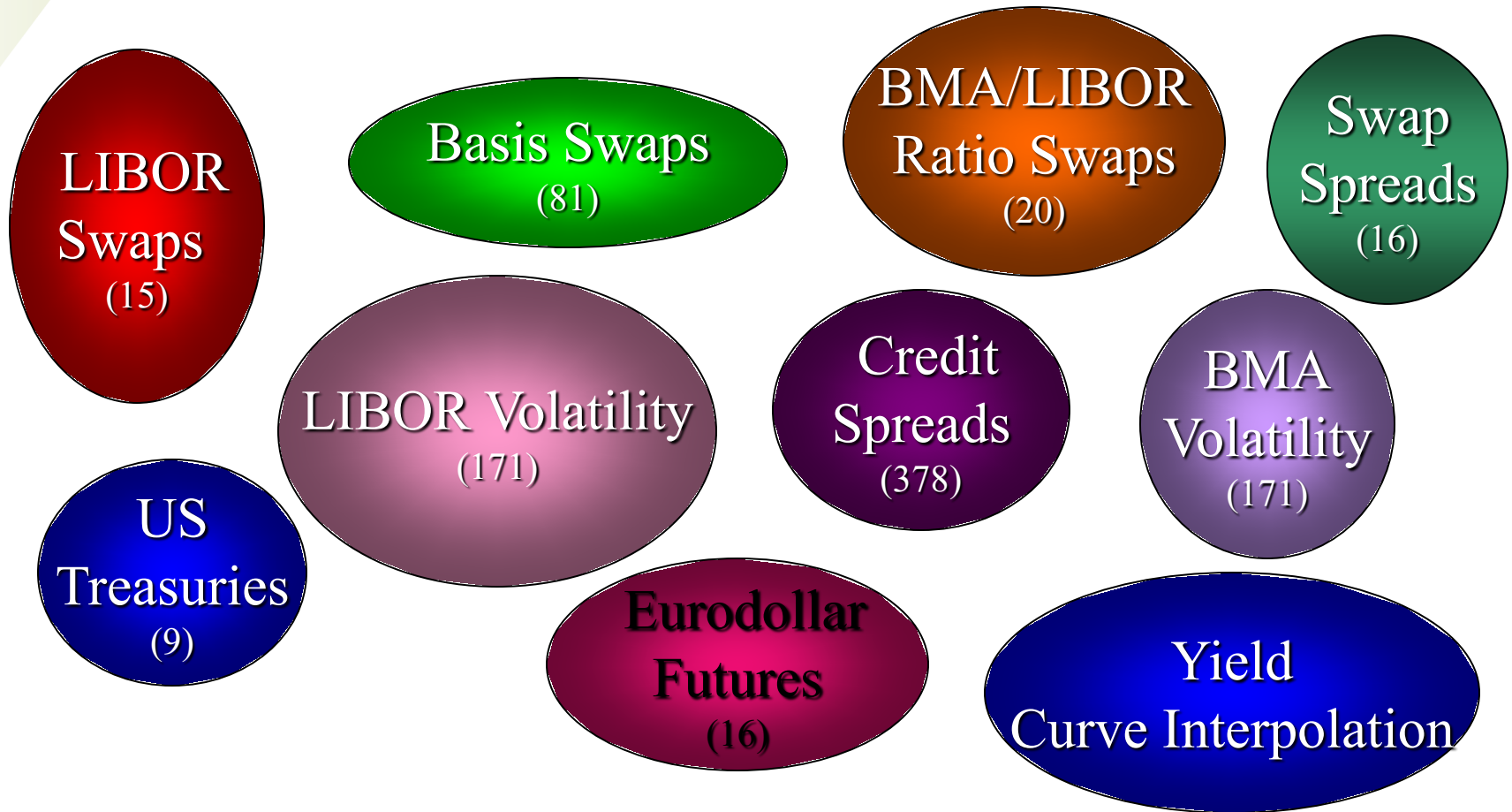
# A Matched Book



## How Does Market Volatility Affect a Portfolio?



Value of a derivative contract/portfolio =  $f(\text{underlying hedges})$



## Part IV: How does a dealer manage their swap position?

Exotika Trade #3 (Tradeld:BMA\_OPTION)

File Maint View Help

Trade ID **BMA\_OPTION** C/P 02/24/05 derprod NY dersys18

AsOfDate **02/24/05** Proxy ☐ Link ☐ Currency **USD** Curve ID

Symbol  StartDate  Sprd(%) **0.00** Go Fee 0.00 Solve...

Model **BK** Edit VolType **Skew Vol**  Calib **AvgLif**

Gamma 1.000 VolShift 0 Use Custom Calib ☐ Edit...

CurveShift 0.00000 VolMatrix **Bermudan**  Pricing **BackInduction**

+ Asset  Copy

1	R	03/01/10	03/01/30	200.0M	USD	FIXED	5.00	Q
2	P	03/01/10	03/01/30	200.0M	USD	PSA	0.00	Q

+ Amort

Option ◆

OptType **ENTER**  Start **1-Mar-2010** ExecAmt

BuySell **BUY**  End **1-Mar-2030** NonExecAmt

Freq **Qtrly**  BDayRule **MF**  Cal **NYL**  Gap **-30**  CalDay  Schedule

Price  Price-SGI  Hedge  Vega  Env  Fee  Param

Gross	Accrual	NPV	BPV	Avg. Life
<b>11,298,357</b>	<b>0</b>	<b>11,298,357</b>	<b>0</b>	<b>0.00</b>

## Part IV: How does a dealer manage their swap position?

Exotika Asset #2 (Tradeld:BMA\_OPTION)

File Edit View Flows

Asset #2 ☐ Pay ☐ Avg ☐ COT ☐ Cap ☐ Floor ☐ PCap ☐ PFloor ☐ RA

Stub Start  Fwd USD  PSA

Start 1-Mar-2010 Notl 200,000,000

End 1-Mar-2030 Sprd 0

Stub End  NPV 0

Gross 0 Accrual 0

Pay

Qtrly  Arr  MF  NY

ACT  Adj

Reset

Qtrly  Adv  MF  NY

Simple  NoCmp  Gap -2 Term 3M

Close Defaults Terse Custom Sched

Exotika Asset Schedule Window (Tradeld:BMA\_OPTION)

Asset #2 MortgageAmort Observations Override Default

From	To	PayDate	Notional	CpnReset	CpnIndex	Spr
03/01/10	06/01/10	06/01/10	200,000,000	02/25/10		0.00
06/01/10	09/01/10	09/01/10	200,000,000	05/27/10		0.00
09/01/10	12/01/10	12/01/10	200,000,000	08/30/10		0.00
12/01/10	03/01/11	03/01/11	200,000,000	11/29/10		0.00
03/01/11	06/01/11	06/01/11	193,305,000	02/25/11		0.00
06/01/11	09/01/11	09/01/11	193,305,000	05/27/11		0.00
09/01/11	12/01/11	12/01/11	193,305,000	08/30/11		0.00
12/01/11	03/01/12	03/01/12	193,305,000	11/29/11		0.00
03/01/12	06/01/12	06/01/12	186,375,000	02/28/12		0.00
06/01/12	09/04/12	09/04/12	186,375,000	05/30/12		0.00
09/04/12	12/03/12	12/03/12	186,375,000	08/30/12		0.00
12/03/12	03/01/13	03/01/13	186,375,000	11/29/12		0.00
03/01/13	06/03/13	06/03/13	179,170,000	02/27/13		0.00
06/03/13	09/03/13	09/03/13	179,170,000	05/30/13		0.00
09/03/13	12/02/13	12/02/13	179,170,000	08/29/13		0.00
12/02/13	03/03/14	03/03/14	179,170,000	11/27/13		0.00
03/03/14	06/02/14	06/02/14	171,700,000	02/27/14		0.00
06/02/14	09/02/14	09/02/14	171,700,000	05/29/14		0.00
09/02/14	12/01/14	12/01/14	171,700,000	08/28/14		0.00
12/01/14	03/02/15	03/02/15	171,700,000	11/26/14		0.00
03/02/15	06/01/15	06/01/15	163,960,000	02/26/15		0.00
06/01/15	09/01/15	09/01/15	163,960,000	05/28/15		0.00
09/01/15	12/01/15	12/01/15	163,960,000	08/28/15		0.00
12/01/15	03/01/16	03/01/16	163,960,000	11/27/15		0.00
03/01/16	06/01/16	06/01/16	155,905,000	02/26/16		0.00
06/01/16	09/01/16	09/01/16	155,905,000	05/27/16		0.00
09/01/16	12/01/16	12/01/16	155,905,000	08/30/16		0.00
12/01/16	03/01/17	03/01/17	155,905,000	11/29/16		0.00
03/01/17	06/01/17	06/01/17	147,530,000	02/27/17		0.00
06/01/17	09/01/17	09/01/17	147,530,000	05/30/17		0.00
09/01/17	12/01/17	12/01/17	147,530,000	08/30/17		0.00
12/01/17	03/01/18	03/01/18	147,530,000	11/29/17		0.00
03/01/18	06/01/18	06/01/18	138,810,000	02/27/18		0.00
06/01/18	09/04/18	09/04/18	138,810,000	05/30/18		0.00
09/04/18	12/03/18	12/03/18	138,810,000	08/30/18		0.00
12/03/18	03/01/19	03/01/19	138,810,000	11/29/18		0.00
03/01/19	06/03/19	06/03/19	129,730,000	02/27/19		0.00
06/03/19	09/03/19	09/03/19	129,730,000	05/30/19		0.00
09/03/19	12/02/19	12/02/19	129,730,000	08/29/19		0.00
12/02/19	03/02/20	03/02/20	129,730,000	11/27/19		0.00
03/02/20	06/01/20	06/01/20	120,275,000	02/27/20		0.00

Apply SaveToFile LoadFromFile PC Copy Cancel



## Part IV: How does a dealer manage their swap position?

Exotika Report Text Window

File Name: /a/akuhns/spool/hedge\_iloggui\_0224.001

1.0BP	01 Value	Theoretical Hedge	Actual Hedge	EU\$ Strip For Treas	Difference
2D	-1.11	-17.32			17.32
1W	-1.94	0.00			-0.00
1M	-8.57	0.00			-0.00
3M	-25.18	3.30			-3.30
SubTotal		-14.02			
MAR05	-25.00	2.68			-2.68
JUN05	-25.00	5.19			-5.19
SEP05	-25.00	4.27			-4.27
DEC05	-25.00	3.80			-3.80
MAR06	-25.00	3.79			-3.79
JUN06	-25.00	3.32			-3.32
SEP06	-25.00	2.73			-2.73
DEC06	-25.00	2.71			-2.71
MAR07	-25.00	2.02			-2.02
JUN07	-25.00	1.89			-1.89
SEP07	-25.00	1.32			-1.32
DEC07	-25.00	1.31			-1.31
MAR08	-25.00	0.64			-0.64
JUN08	-25.00	0.53			-0.53
SEP08	-25.00	0.02			-0.02
DEC08	-25.00	-1.05			1.05
SubTotal		35.18			
5Y	-444.17	64.54			-64.54
6Y	-525.07	6.51			-6.51
7Y	-599.63	-1.44			1.44
8Y	-670.32	-1.93			1.93
9Y	-737.21	-2.28			2.28
10Y	-794.85	-3.69			3.69
11Y	-863.94	-1.33			1.33
12Y	-925.28	-8.52			8.52
15Y	-1,081.86	-18.49			18.49
20Y	-1,300.56	-32.15			32.15
25Y	-1,467.37	-22.84			22.84
30Y	-1,564.90	2.16			-2.16
35Y	-1,699.46	-0.46			0.46
40Y	-1,784.99	0.09			-0.09
45Y	-1,852.65	-0.01			0.01
SubTotal		-19.83			
SubTotal		0.00			
Total		1.33			
BPV		-75,358.55			

Close

## Part IV: How does a dealer manage their swap position?

Exotika Report Text Window

File Name: /a/akuhns/spool/hedge\_iloggui\_0224.001

02/24/05 BSC Run at 14:03

Interest Rate: USD/PSA, Date: 02/24/05

Selected Trades Are:  
BSO in ILOGGUI book  
Status:

1.0BP	01 Value	Theoretical Hedge	Actual Hedge	EU\$ Strip For Treas	Difference
3M	-73.29	0.00			-0.00
6M	-157.31	0.00			-0.00
1Y	-340.67	-0.00			0.00
2Y	-732.67	0.00			-0.00
3Y	-1,128.59	0.00			-0.00
4Y	-1,520.12	0.00			-0.00
5Y	-1,907.10	-74.96			74.96
6Y	-2,293.22	-7.22			7.22
7Y	-2,669.36	-2.59			2.59
8Y	-3,035.32	-0.37			0.37
9Y	-3,390.41	1.29			-1.29
10Y	-3,733.83	0.25			-0.25
12Y	-4,383.95	4.02			-4.02
15Y	-5,252.36	18.63			-18.63
20Y	-6,403.94	35.65			-35.65
25Y	-7,248.20	27.59			-27.59
30Y	-7,887.56	0.01			-0.01
SubTotal		2.30			
Total		2.30			
BPV		381,561.56			

\*\*\* End of Report \*\*\*

/usr/derivs/prod/apps/bin/exotika 02/24/05 -ALL -RECALIB -F ILOGGUI -M SGI16 -PORT 7999

Close

## Part IV: How does a dealer manage their swap position?

Exotika Report Text Window

File Name: /a/akuhns/spool/vega2\_iloggui\_0224.001

Interest Rate Products Group  
Vega Risk Report for Account IL06601 (CvId: )  
AsOf: 02/24/05  
Volatility: USD/PSA

Exec Date	3M	1Y	2Y	3Y	4Y	5Y	7Y	10Y	15Y	20Y	30Y	Total
2D	0	0	0	0	0	0	0	0	0	0	0	0
1M	0	0	0	0	0	0	0	0	0	0	0	0
3M	0	0	0	0	0	0	0	0	0	0	0	0
6M	0	0	0	0	0	0	0	0	0	0	0	0
9M	0	0	0	0	0	0	0	0	0	0	0	0
1Y	0	0	0	0	0	0	0	0	0	0	0	0
18M	0	0	0	0	0	0	0	0	0	0	0	0
2Y	0	0	0	0	0	0	0	0	0	0	0	0
3Y	0	0	0	0	0	0	0	0	0	0	0	0
4Y	0	0	0	0	0	0	0	0	0	0	0	0
5Y	0	0	0	0	0	0	0	229,546	148,922	0	0	378,468
7Y	0	0	0	0	0	0	1,045	103,551	10,044	0	0	114,640
10Y	0	0	0	0	0	(440)	(10,200)	15,098	0	0	0	4,458
15Y	0	0	0	2,133	34,512	27,561	(17,344)	(1,212)	0	0	0	45,651
20Y	0	0	0	8,646	29,509	21,115	(383)	0	0	0	0	58,888
Total	0	0	0	10,780	64,021	48,236	(26,881)	346,983	158,966	0	0	602,104

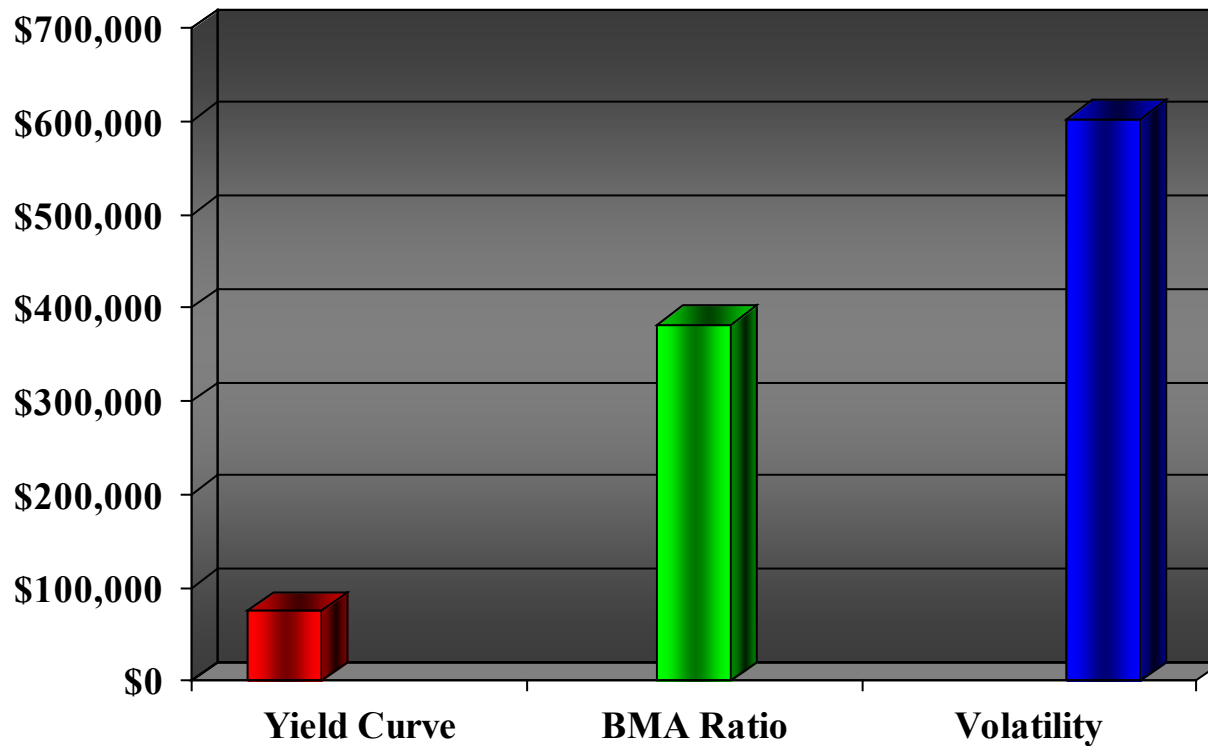
Flat Vega: 0

Total Vega (Flat + Curve) 602,104

Close

## Trade Example: Trading System Output

- Exposure to Parallel Shift of Underlying Variables



## Trade Example: Trading System Output after Hedging

- Exposure After Hedging

