Class 23: Fixed Income, Interest Rate Swaps

This Version: December 1, 2016

1 Interest Rate Swaps

- **Fixed and Floating:** A USD interest rate swap is a private agreement between two counterparties to exchange cashflows in US dollar. One counterparty receives fixed and pays floating, while the other counterparty pays fixed and receives floating. For convenience, let's call one counterparty receiver and the other payer, with reference, in both cases, to their activities on the fixed leg. Later, we will see that the receiver is long duration and the payer is short duration.

  Figure 1 is a Bloomberg screenshot made for me by a former MBA student. It provides a nice description in terms of the fixed and floating legs of an interest rate swap.
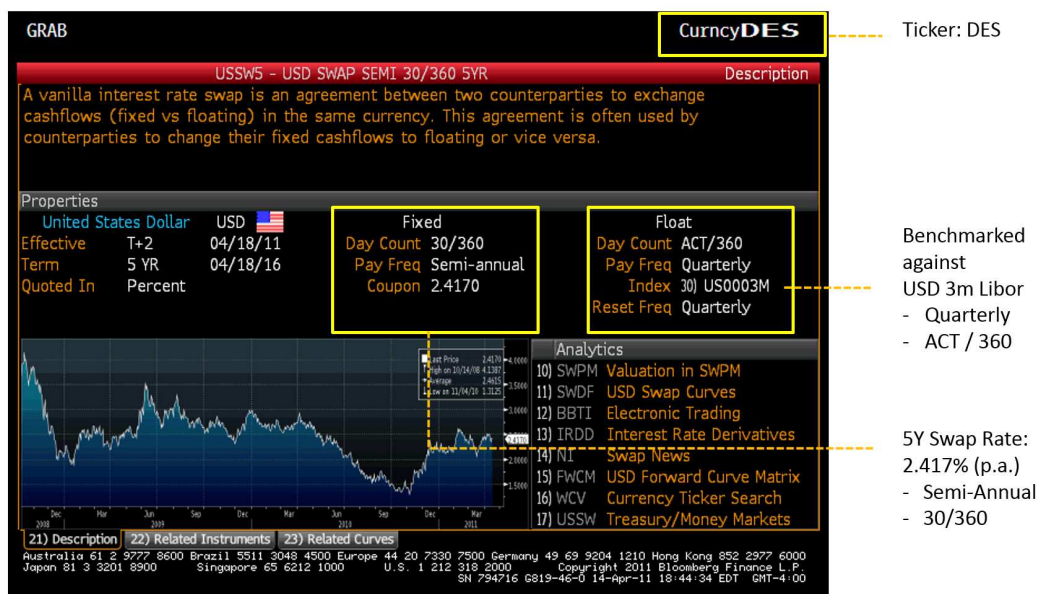

Figure 1: Description of a Standard Swap Quote from Bloomberg.

The fixed leg is referenced to the swap rate. For example, on November 19, 2015,

the five-year swap is quoted at 1.55%, implying a fixed payment of $1.55\%/2 \times$ notional amount, to be delivered every six month, from the payer to the receiver, until the end of contract maturity, which, in this case, is year five. This structure is exactly the same as the coupon payments in Treasury bonds, and this is so by design. The notional amount in the swap market is typically quite large, say $10M per contract. For our analysis, let's make the notional amount $100 so as to match the $100 principal amount we've been using for Treasury bonds. By now, it should be obvious that the notional amount or the principal amount is scalable and its absolute value does not really matter for our analysis. Of course, it will matter when we think in terms of the size of our portfolio and calculate profit/loss in dollar.

The floating leg is referenced to the short-term interest rate. For most of the floating rate instruments, the standard reference rate is the LIBOR rate (London Interbank Offered Rate). Unlike TBill rates, LIBOR is not based on actual transactions. Prior to September 2012, it was calculated by BBA (British Bankers' Association), compiled from quotes given by 16 major banks (eliminating the highest and lowest our bank quotes and then averaging the remaining eight). Effectively, the 3M LIBOR is an indication of the average rate a leading bank can obtain unsecured funding for three months. It is a vital benchmark interest rate to which hundreds of trillions of dollars of financial contracts are tied, including CME Eurodollar futures and interest rate swaps. Figure 2 plots the time-series of the spread between the 3M LIBOR and 3M TBill rates. As you can see, the LIBOR spread tends to spike up during financial crises, reflecting the increased concerns on banks' credit quality.

The scandal on LIBOR fixing is an event that reflects very poorly on Wall Street. Even before the collapse of Lehman, questions about the accuracy of LIBOR showed up in articles published in *FT*, *WSJ*, and others. As we now know, LIBOR manipulation has been perceived as business as usual and were even encouraged in some banks. As of now, regulators in the US, UK, and EU have fined banks more than $9 billion for rigging LIBOR. The scandal cost the Chairman and CEO of Barclays their respective jobs, sent one trader to jail on a fourteen-year sentence, and the trials and investigations are still ongoing.

Coming back to the floating leg, in a standard swap contract, the floating leg is referenced to the 3M LIBOR rate and resets every quarter. For example, at time 0, we enter into a swap. The floating leg takes the prevailing 3M LIBOR rate at that time, r_0^{3M}, as a reference rate. Three months later, the floating payment is $r_0^{3M}/4\times$ notional amount. Now the prevailing 3M LIBOR rate becomes $r_{0.25}^{3M}$, which will be used as the

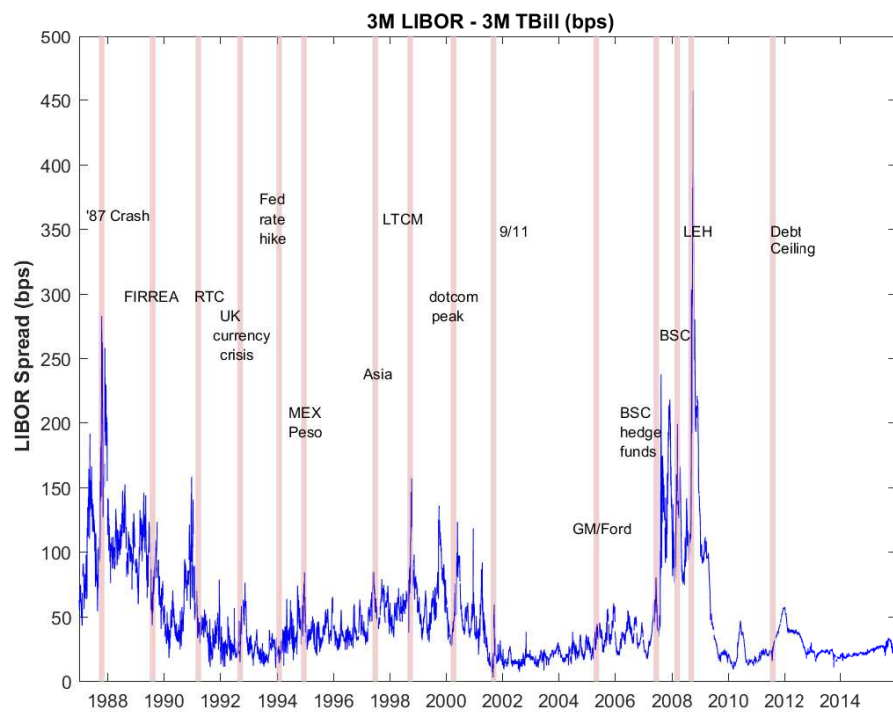Figure 2: Time Series of the Spread between the 3M LIBOR and 3M TBill Rates.

reference rate for the next floating payment: $r^{3M}_{0.25}/4\times$ notional amount. As you will see, this feature, often called payment in arrears, is very important design for interest rate swaps.

- **Interest Rate Swap Rates:** A swap is structured so that the present value of the future cashflow equals to zero for both counterparties. As a result, the both counterparties enter into a swap without having to put up any capital initially. This is true in theory. In practice, because of concerns over counterparty credit risk, upfront payments are required for some counterparties for some type of contracts (e.g., credit default swaps).

  At the time 0, when two counterparties enter into an interest rate swap, the swap rate s is set so that the present value of the future cashflow equals to zero for both counterparties. Once set, this swap rate will be fixed to the contract until its maturity in year T. To see how we can set this swap rate s, let's add the notional amount, say $100, back to both the fixed and floating legs. Remember, this notional amount never exchanges hand, but adding it back serves a purpose for our understanding.

  Now, the fixed leg looks exactly like a Treasury bond of maturity T. The only difference is that instead of paying at the Treasury par-coupon rate c, the payer is paying the swap rate s. So the present value of this fixed cashflow is the same as the market price of a bond paying at a coupon rate of s. And what is the present value of the floating leg? For a bank whose three-month financing rate is the 3M LIBOR rate, it is ... $100. The present value of these two cashflows should equal. So the present value of the fixed leg should equal to the present value of the floating leg, which is $100. In other words, s should be the coupon rate of a par coupon bond.

- **Duration:** It is really as simple as this. If you know how to do bond math for coupon-bearing bonds, you should be quickly at home with calculating swap rates. Because entering into a five-year interest rate swap as a receiver is the same as buying a five-year par-coupon bond and selling a five-year floating rate bond.

  As soon as we enter into the swap, the real effect on our portfolio is our exposure to interest-ate risk. By buying a five-year par-coupon bond, we load up on duration. For example, the modified duration for a five-year par-coupon bond is about 4.74 when the interest rate is at 2%. By selling the five-year floating rate, what is your interest rate exposure? Very little. The initial duration is 3 months, decreases to zero just before the next quarterly settlement, and reset to 3 months at the next quarterly settlement.

So if you would like to buy duration, you enter into an interest swap as a receiver; if you would like to sell duration, you enter as a payer.

Thinking in terms of duration is the most effectively way to understand this product. In fact, duration is the reason of existence for interest rate swaps.

• **Swap Spreads:** By now, it is obvious that interest rate swaps parallel Treasury bonds. In fact, the Wall Street Journal used to publish two curves everyday, as shown in Figure 3.
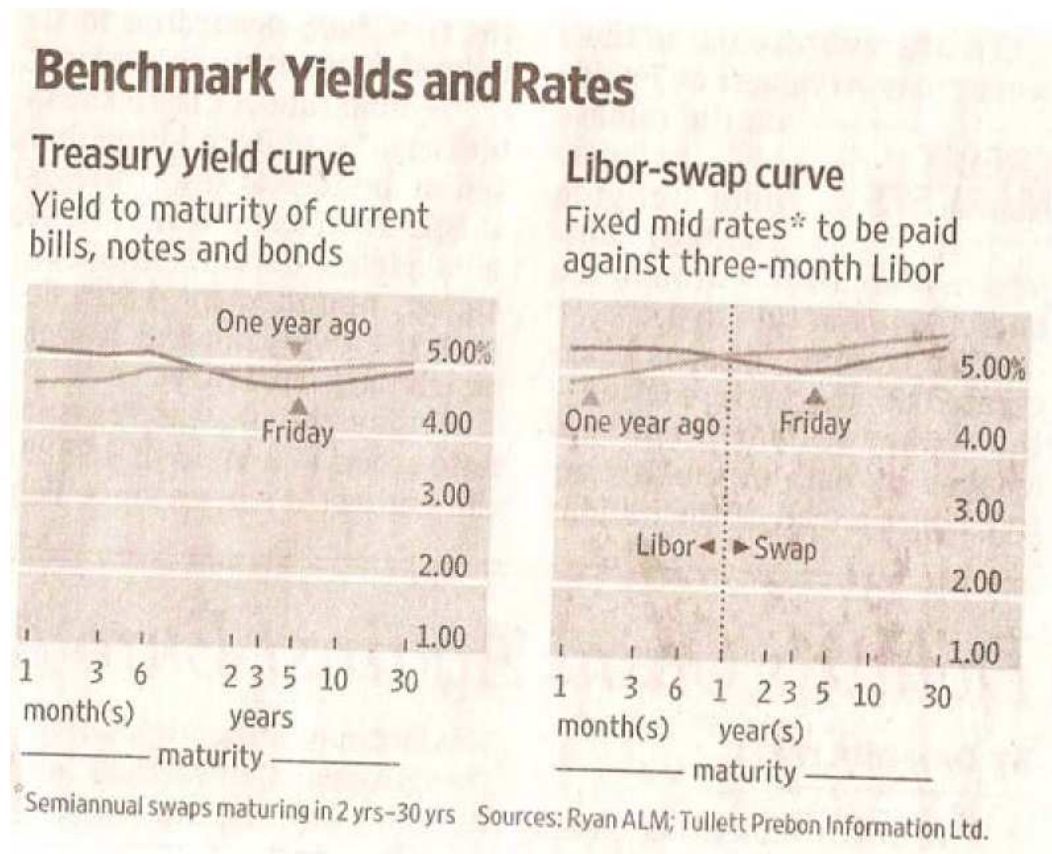

Figure 3: Treasury and Swap Curves, April 2007.

Figure 4 plots the time-series of the Swaps rates and Treasury rates. As you can see, these two markets are closely connected. In fact, it is a common practice to calculate the spread of swap minus Treasury rates of the same maturity and look at the swap spread, which is plotted in Figure 5.

The time-variation of the swap spreads is a very interesting topic, which we will not have time to talk too much about. The negative swap spreads at the longer maturity,
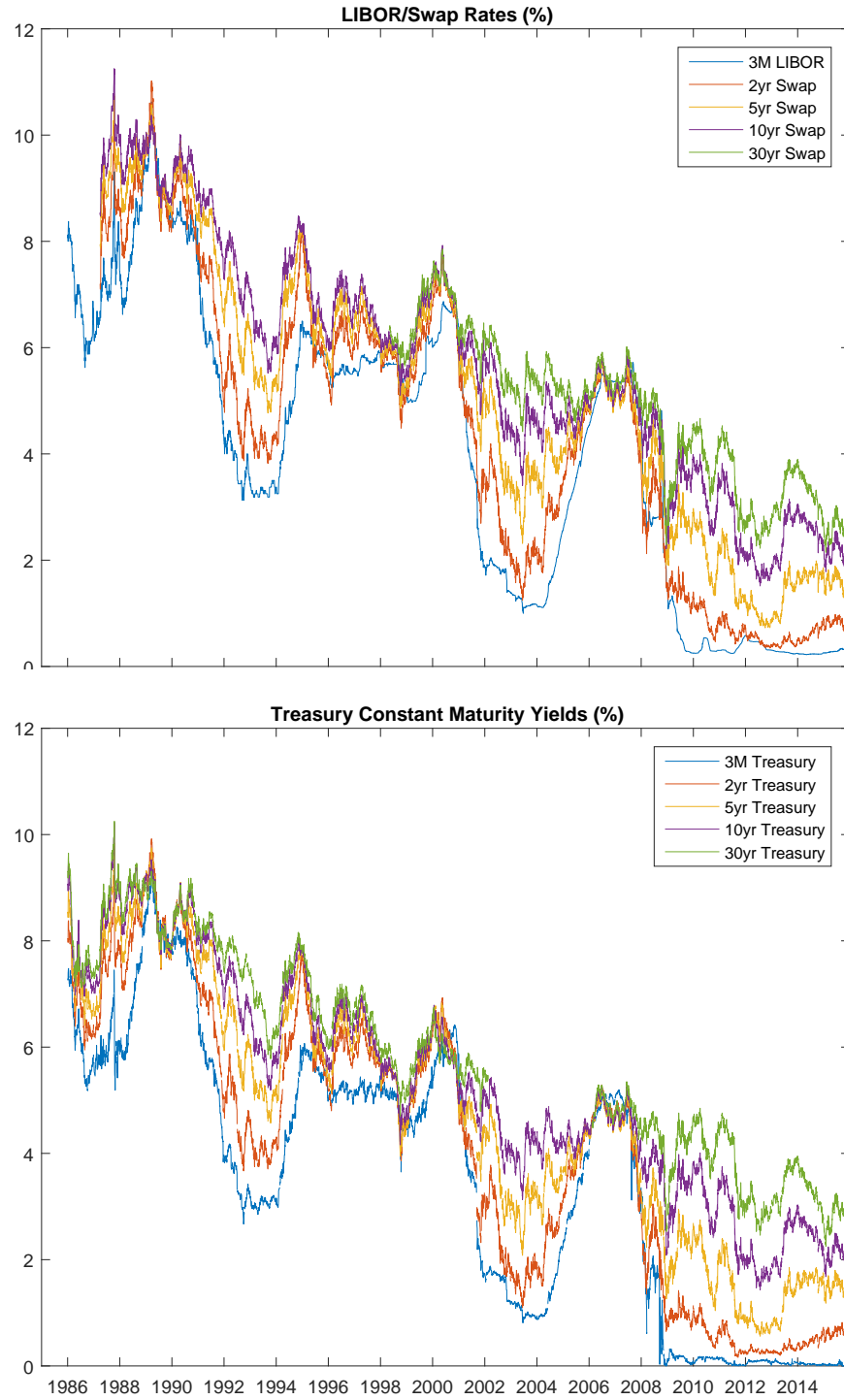
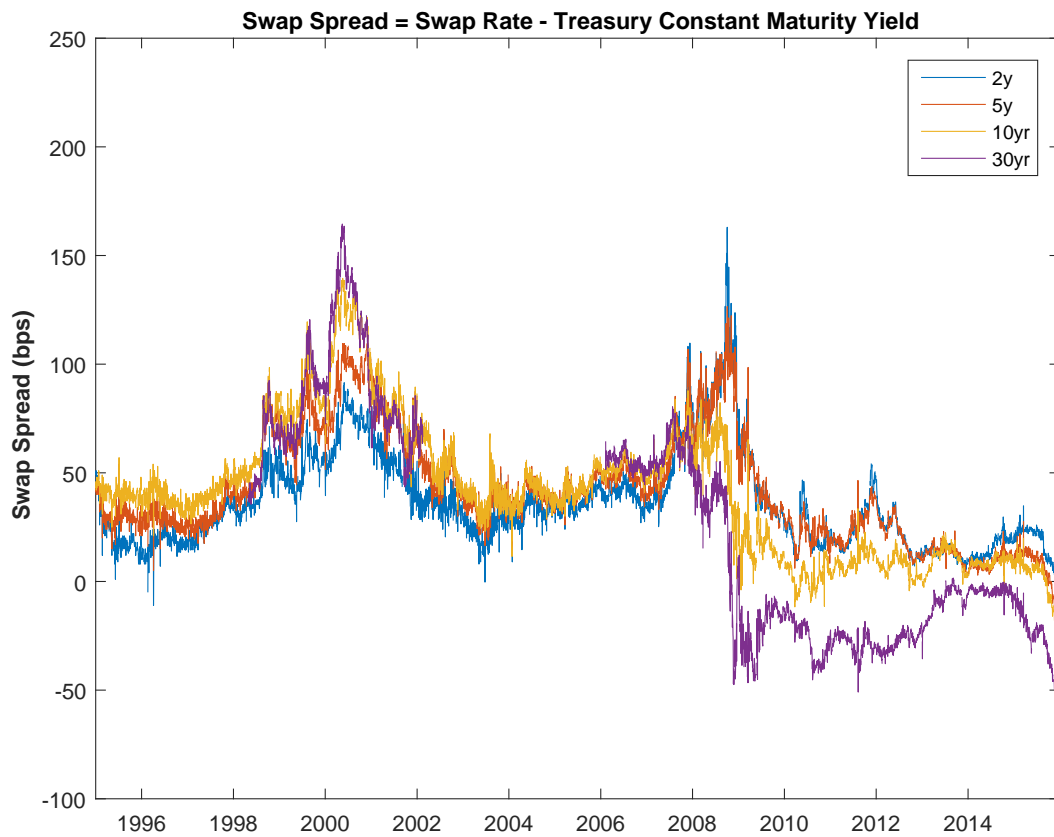Figure 4: Time-Series of Treasury and Swap Rates.

Figure 5: Time-Series of Treasury and Swap Rates.

especially for the 30yr, has been an interesting phenomenon after the Lehman default. If you asked me back in 1995, can spread spreads can negative, I would say very unlikely. But the 30yr swap spreads has been in the negative territory for the past 7 years.

2 Using Interest Rate Swaps

As discussed earlier, interest rate swaps are vehicles for duration. We enter into an interest rate swap as a receiver to buy duration, and as a payer to sell duration. To emphasize on this point, let's look at a specific example.

- **Negative Convexity of MBS:** Because of the prepayment options given to home-owners and mortgage borrowers, mortgage-backed securities (MBS) have negative convexity. Let me quote Fannie in its 2010 10K report,

  > Our mortgage assets consist mainly of single-family fixed-rate mortgage loans that give borrowers the option to prepay at any time before the scheduled maturity date or continue paying until the stated maturity. Given this prepayment option held by the borrower, we are exposed to uncertainty as to when or at what rate prepayments will occur, which affects the length of time our mortgage assets will remain outstanding and the timing of the cash flows related to these assets. This prepayment uncertainty results in a potential mismatch between the timing of receipt of cash flows related to our assets and the timing of payment of cash flows related to our liabilities.
  >
  > Changes in interest rates, as well as other factors, influence mortgage prepayment rates and duration and also affect the value of our mortgage assets. When interest rates decrease, prepayment rates on fixed-rate mortgages generally accelerate because borrowers usually can pay off their existing mortgages and refinance at lower rates. Accelerated prepayment rates have the effect of shortening the duration and average life of the fixed-rate mortgage assets we hold in our portfolio. In a declining interest rate environment, existing mortgage assets held in our portfolio tend to increase in value or price because these mortgages are likely to have higher interest rates than new mortgages, which are being originated at the then-current lower interest rates. Conversely, when interest rates increase, prepayment rates generally

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slow, which extends the duration and average life of our mortgage assets and results in a decrease in value.

Effectively, when interest rates fall, mortgage borrowers take advantage of the prepayment option by refinancing their mortgage. As a result of this refinancing activity, some of the mortgage loans with nice looking duration (e.g., 30-year or 15-year maturity) are suddenly turned into cash (with zero duration). And this happens when interest rate is falling, exactly when a bond holder expects duration to work in his favor. For the entire pool of mortgages, the net effect is that the average duration is a function of the probability of prepayment. With falling interest rates, the probability of prepayment increases and the expected average duration shortens; With increasing interest rates, the probability of prepayment decreases and the expected average duration lengthens.

Figure 6 plots the time-series of MBS rates and durations for the Barclays US MBS Index. As you can see, when rates decrease, there are sharp declines in MBS duration; when rates increase, MBS duration increases. As a result, the convexity of MBS is negative. Also plotted in Figure 6, is the time-series of yields and duration for Barclays 5-year Treasury index. As you can see, the duration increased slightly over time as the interest rate decreased after the 2008 crisis. This is the effect of positive convexity. The small periodic variation in duration was due to periodic rebalance of the index composition in order to main the maturity of the portfolio close to five years.

- **Hedging Interest Rate Risk at Fannie and Freddie:** For Fannie and Freddie, holing MBS implies positive exposure to duration risk as well as exposure to negative convexity. In order to manage the interest rate exposure, Fannie and Freddie issue debt (i.e., agency debt) that is a mixture of short- and long-term, non-callable debt and callable debt. The varied maturities and callability of their debt (i.e., liabilities) give them the flexibility to deal with the variation of duration (i.e., negative convexity) in their mortgage assets. At the day-to-day level, however, this flexibility on the issuance side does not match the more frequent change in duration on the asset side. For this reason, Fannie and Freddie use interest rate derivatives extensively for hedging purpose. For example, as of December 31, 2010, a hypothetical increase of 50 basis points in LIBOR rate cost Fannie $0.9 billion before derivatives and $0.2 billion after derivatives. In other words, using interest rate derivatives helped Fannie hedge out a large portfolio of its interest rate exposure. The benefit of hedging is more significant in 2014: before derivatives, a hypothetical increase of 50 basis points in LIBOR cost Fannie $1.9 billion before derivatives and $0.3 billion after derivatives.
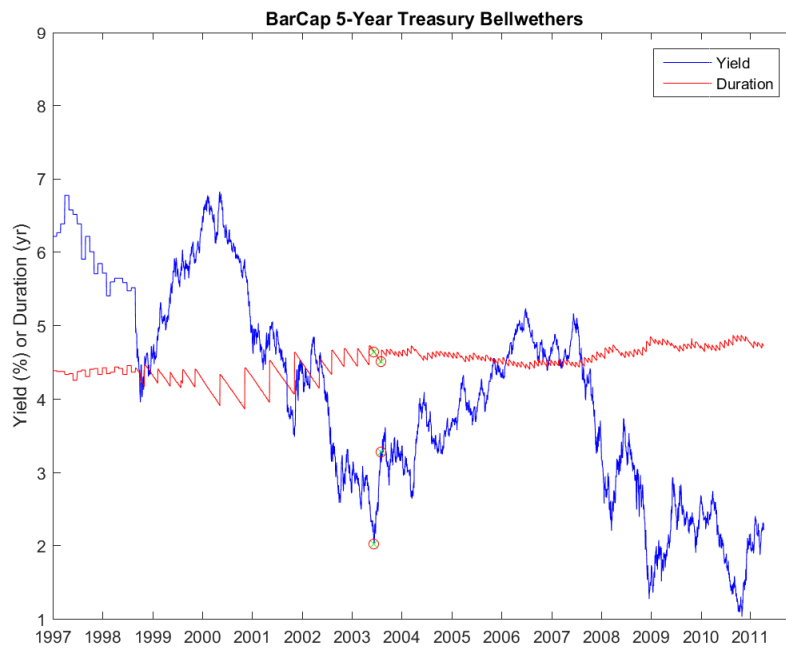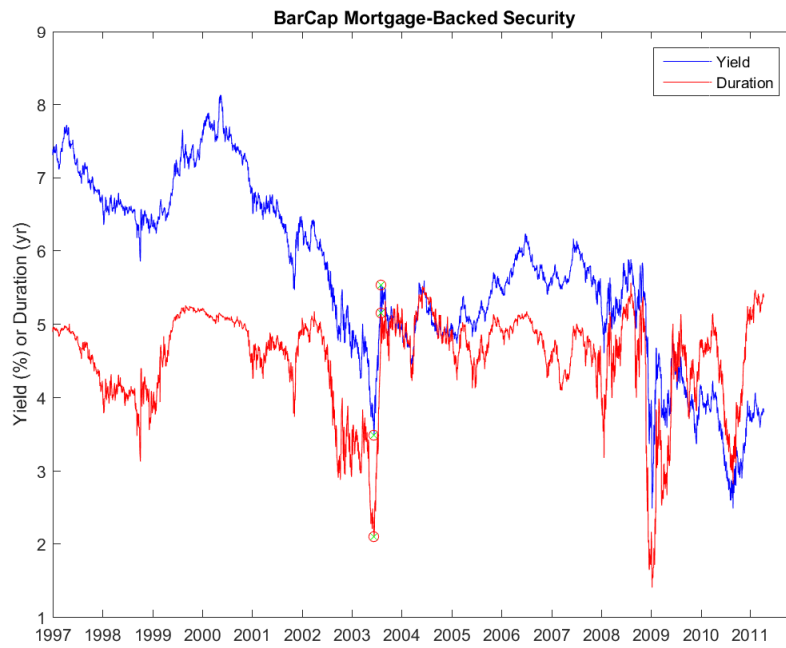
Figure 6: Time Series of Yield and Duration for Barclays US MBS Index and 5-Year Treasury Bellwethers Index.

| | Interest Rate Swaps | | | | Interest Rate Swaptions | | | | | |
	Pay-Fixed	Receive-Fixed[2]	Basis[3]	Foreign Currency[4]	Pay-Fixed	Receive-Fixed	Interest Rate Caps	Futures	Other[5]	Total
					(Dollars in millions)					
Notional balance as of December 31, 2008	$ 546,916	$ 451,081	$ 24,560	$1,652	$ 79,500	$ 93,560	$ 500	$ —	$827	$1,198,596
Additions	297,379	279,854	2,765	577	32,825	19,175	6,500	—	13	639,088
Terminations[6]	(461,695)	(455,518)	(24,100)	(692)	(13,025)	(37,355)	—	—	(92)	(992,477)
Notional balance as of December 31, 2009	$ 382,600	$ 275,417	$ 3,225	$1,537	$ 99,300	$ 75,380	$7,000	$ —	$748	$ 845,207
Additions	212,214	250,417	55	636	51,700	51,025	—	598	—	566,645
Terminations[6]	(317,587)	(301,657)	(2,795)	(613)	(53,850)	(47,790)	—	(353)	(59)	(724,704)
Notional balance as of December 31, 2010	$ 277,227	$ 224,177	$ 485	$1,560	$ 97,150	$ 78,615	$7,000	$ 245	$689	$ 687,148
Future maturities of notional amounts:[7]										
Less than 1 year	$ 70,656	$ 14,200	$ 50	$ 386	$ 20,750	$ —	$ —	$ 125	$ 75	$ 106,242
1 to less than 5 years	90,788	168,000	35	—	35,300	4,500	7,000	120	593	306,336
5 to less than 10 years. . . .	96,400	29,632	100	511	10,200	20,970	—	—	21	157,834
10 years and over.	19,383	12,345	300	663	30,900	53,145	—	—	—	116,736
Total	$ 277,227	$ 224,177	$ 485	$1,560	$ 97,150	$ 78,615	$7,000	$ 245	$689	$ 687,148

Figure 7: Risk Management Derivatives Held by Fannie Mae, from Fannie Mae's 2010 10K.

| | As of December 31,[2] | |
	2014	2013
	(Dollars in billions)	
Rate level shock:		
-100 basis points	$ 0.4	$ 0.1
-50 basis points	0.1	0.0
+50 basis points	(0.1)	(0.1)
+100 basis points	(0.1)	(0.5)
Rate slope shock:		
-25 basis points (flattening)	0.0	0.0
+25 basis points (steepening)	(0.0)	0.0

| | For the Three Months Ended December 31, 2014[3] | | |
	Duration Gap	Rate Slope Shock 25 bps	Rate Level Shock 50 bps
		Exposure	
	(In months)	(Dollars in billions)	
Average	0.1	$ 0.1	$ 0.0
Minimum	(0.3)	0.0	—
Maximum	0.5	0.1	0.1
Standard deviation.	0.2	0.0	0.0

Figure 8: Interest Rate Sensitivity of Net Portfolio to Changes in Interest Level and Slope of Yield Curve, from Fannie Mae's 2014 10K.

Figure 7 reports the derivatives used for hedging in Fannie's 2010 10K form. I am using the 2010 10K form in this plot because the reporting in Fannie's 2014 10K form is not as nice (in my personal opinion) as it was before. As of end 2010, Fannie's interest rate swap positions involve:

– Payer with notional amount $277 billion.

– Receiver with notional amount $274 billion.

In addition, Fannie also have positions on basis swaps, interest rate swaptions (options on swaps), interest rate caps (portfolio of options on floating interest rates, with each caplet providing the cap buyer the option to cap the short-term interest rate at a pre-arranged fixed level), and others.

Figure 8 also reports the overall interest rate sensitivity of Fannie's portfolio, including derivatives hedging, in 2014. As you can see, the average duration gap of Fannie was very small, only around 0.2 months, with a standard deviation around 0.2 months. The largest swings in duration gap were only in the range of -0.6 to 0.3 months. In addition to measuring its portfolio's sensitivity to interest rate (dollar duration and modified duration), Figure 8 also reports Fannie's sensitivity to change in the slope of the yield curve.

• **MBS Footprint on Swaps:** Going back to Figure 6, we see how changes in interest rate could affect the duration of MBS via the probability of prepayment. In June 2003, there was a sudden increase in interest rates. On June 13, 2003, the 10YR Treasury yield was at 3.13%, a result of a steady decline of interest rate. Over the next month and half, however, the 10yr rate increased steadily to 4.44% on August 1. As shown in Figure 6, the increase in the MBS rate was more dramatic, from 3.48% on June 13 to 5.53% on August 1, and the corresponding modified duration for the MBS increased from 2.09 to 5.15 years.

This was an event that took the MBS market by surprise. With the increasing interest rate, the MBS holders found themselves to be long in duration through their MBS holdings. The liabilities side of their balance sheet does not match this sudden increase in duration. So they need to sell duration, fast. Otherwise, this unwanted duration will show up as a positive duration gap on their portfolio. Recall that the average duration gap for Fannie was 0.2 months in 2014. Selling duration means paying fixed in the interest rate swap market. In other words, selling swap "bonds." If this demand from MBS holders to sell duration arrives simultaneously in the swap market, how would
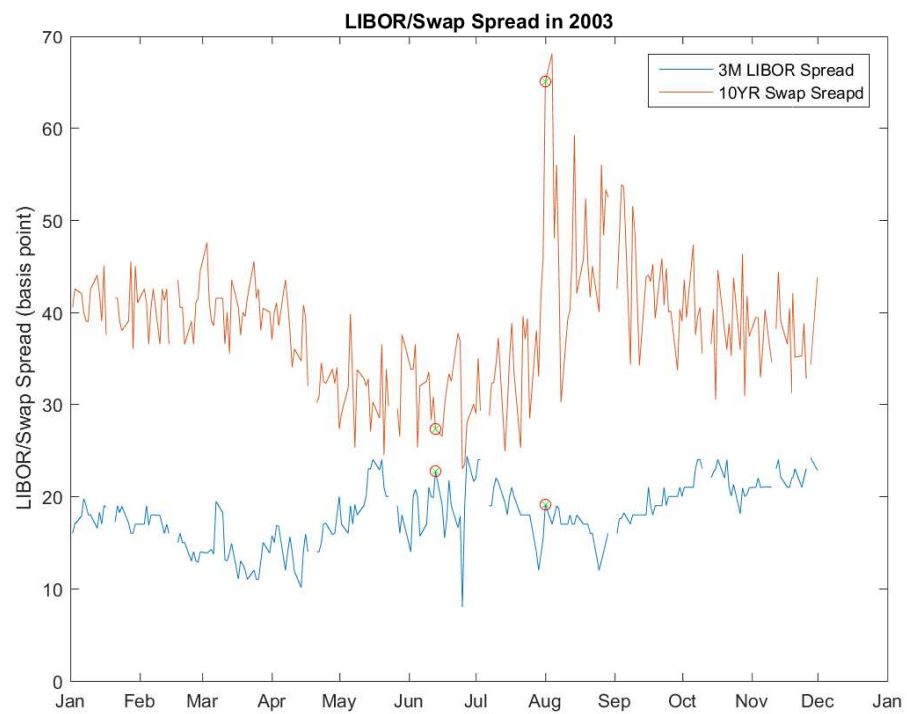
Figure 9: Time-Series of 3M LIBOR and 10YR Swap Rates in 2003.

it affect the price? The selling pressure on the swap "bond" would lead to decreasing "price" in the swap "bond" and increasing yield. As shown in Figure 9, this hedging activity resulted in a temporary spike in the 10yr swap spread just prior to August 1, 2013. For your viewing convenience, I've marked those two dates (June 13 and August 1) by a combined sign of green 'x' and red 'o'. Recall that the 10yr Treasury yield also increased during that period. So the increase in swap spread implies an increase in the 10yr swap rate that is more severe than the 10yr Treasury yield. By comparison, the 3M LIBOR spread was not affected during this period.

In going through this example of MBS hedging, we learn a few lessons. First, the negative convexity of MBS. Second, the wide usage of interest rate swaps as a hedging instrument. Third, the supply and demand in the swap market as a driver to the changes in swap spreads.

3 OTC Derivatives

- **An Overview:** The global OTC derivatives market had its beginning in the mid-1980s. Over the past 30 years, it has grown into an important part of the global financial markets, allowing business to manage and hedge financial risk. By far, the most important segment of this market is interest-rate product. As such, most of the hedging activities on interest rate risk have migrated from Treasury bonds to interest rate swaps. In addition, it also provides derivatives on currency, credit, equity, and commodities.

  This is a privately organized market, with transactions taking place bilaterally between dealers and end users, or dealers and other dealers. As such, the dealers function as market makers, engaged in either side of the transaction and keeping an inventory when necessary. The most active dealers are called the G14 dealers, comprising Bank of America-Merrill Lynch, Barclays Capital, BNP Paribas, Citi, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JP Morgan, Morgan Stanley, RBS, Societe Generale, UBS and Wells Fargo Bank.

  Because of the OTC nature of this market, trading information is very much limited. The lack of transparency in this market is in direct contrast to exchange-traded products such as equity, options, and futures, where trading information is readily available. For this market, the most comprehensive information available to the public is through the semi-annual and triennial surveys conducted by the Bank of International Settlements (BIS). This is a link to the most recent statistical release from BIS.

The OTC nature of this market also introduces potential systemic risk. Through their market-making activities in OTC derivatives, major dealers put themselves in the middle, creating an extra layer of interconnectedness in the financial system. At the time of its bankruptcy in September 2008, Lehman was a counterparty to 6,500 different institutions and corporations, across 1.2 million derivative transactions. The tangled web of deals took years to unwind and points to the obvious problem of this market.

Under Dodd-Frank, new rules are to be implemented with the objective of increasing transparency and reducing systemic risk in the derivatives markets:

- Reporting swap transactions to a swap data repository;
- Clearing sufficiently liquid and standardized swaps on central counterparties;
- Where appropriate, trading standardized swaps on trading platforms; and
- Setting higher capital and minimum margin requirements for uncleared swaps.

- **Notional Amount, Gross Market Value, and Credit Exposure:** After the 2008 crisis, the growth of this market has slowed down quite significantly. Figure 10 reports the total notional amount, surveyed semi-annually by the BIS, from 1998 through 2014. One potential contributing factor for the slowdown in the notional amount is compression. After the 2008 crisis and Dodd-Frank, some OTC trades were moved to CCPs (central clearing party), which facilitate the compression process. (Compression is a process for tearing up trades that allows economically redundant derivative trades to be terminated early without changing each participant's net position.)

Figure 11 focuses on the more recent data. At end-June 2015, the total notional amount is at $553 trillion, the fourth consecutive semiannual decline of this market. As we see in this class, the notional amount of a derivatives contract is ... notional, never exchanging hands during the transaction.

In order to measure the amounts at risk (or loss/profit), it is more useful to look at the gross market value of outstanding derivatives contract. At end-June 2015, the market was at $15.5 trillion, down from $20.9 trillion at end-2014 and $35 trillion at end-2008. The variation of gross market value is influenced by both the variation in notional amount as well as the variation in the underlying risk. A derivatives contract is structured so that, when the two counterparty enters into the contract, the gross market value equals to zero for both parties. Later, as the underlying risk fluctuates over time, the gross market value moves away from zero. The profit of one party equals
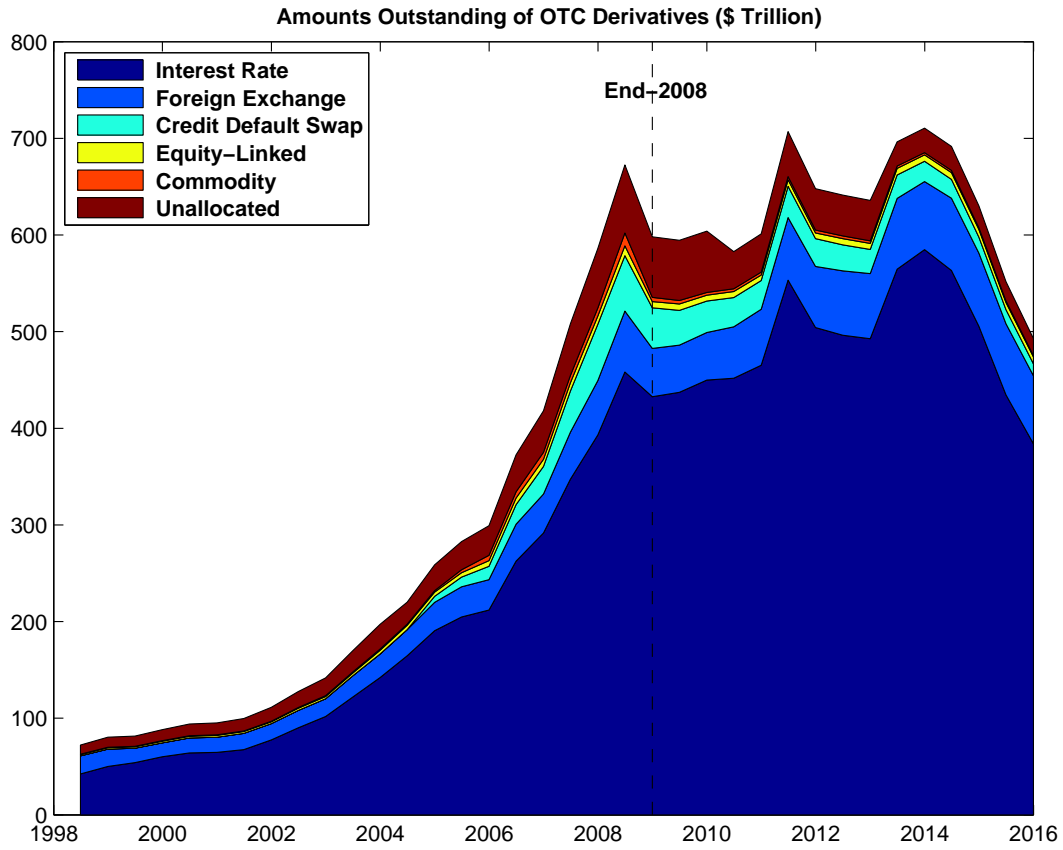
Figure 10: Global OTC Derivatives Markets, Notional Amount, Gross Market Value, and Gross Credit Exposure.
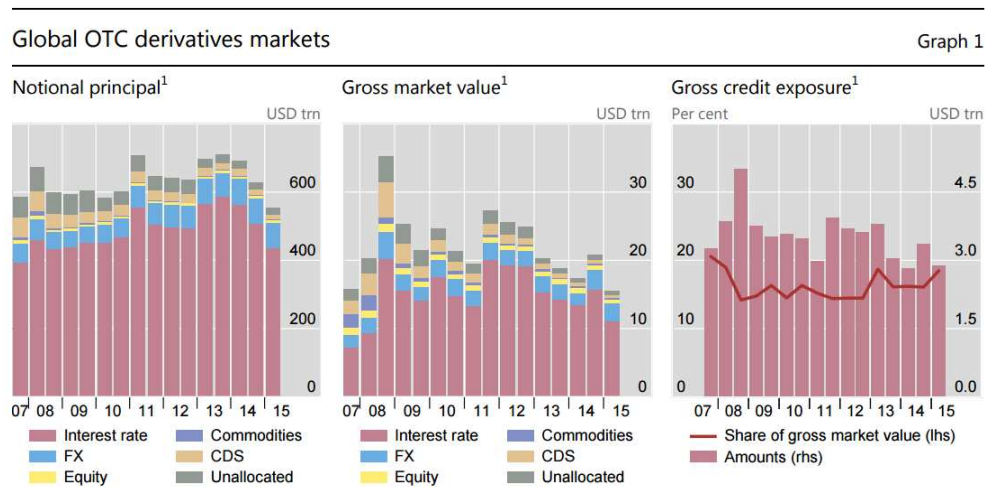

Figure 11: Global OTC Derivatives Markets, Notional Amount, Gross Market Value, and Gross Credit Exposure.

the loss of the other party, making the derivatives contract zero-sum as far as the two counterparties are involved.

If the underlying risk factor, say the interest rate, stays constant throughout the life of the contract, there the gross-market value stays at zero. If the gap between the initial interest rate and the current interest rate is close to zero, then the gross-market value will also be close to zero. In this sense, the gross-market value is also not the best way to capture the risk exposure. For the current example of interest rate exposure, a better measure of market risk exposure will be duration, as discussed early.

In addition to market risk exposure, counterparty credit exposure is also an important consideration in OTC derivatives. Again, this is due to the bilateral OTC nature of the market. Just imagine that you enter into a swap with Lehman and the gross market value of your position is positive and then Lehman went into bankruptcy. In order to reduce their exposure to counterparty credit risk, market participants can do two things. First, through netting agreements. For example, the last panel in Figure 11 reports the gross credit exposure, which adjusts the gross market value for legally enforceable bilateral netting agreements. With netting, the gross value of $15.5 turns into a net value of $2.9 trillion, accounting for 18.5% of the gross market value at end-June 2015.

Another way for market participants to reduce their counterparty exposure is through collateral. For example, suppose Goldman bought credit default swap (CDS) from AIG to insure against mortgage defaults. Initially, the contract was structured so that the present values are zero for both counterparties. After entering into the swap, the mortgage default started to increase, and Goldman's position is in the money. In a situation like this, Goldman would ask AIG to post more collateral against the gross market value of its CDS position. Often, the amount of the collateral is linked to the credit quality of the counterparty. A lower quality counterparty typically has to put up more collateral for the same amount of market exposure. This is why during the 2008 crisis, the downgrade of AIG was like throwing salt on the wound (although AIG totally deserved the treatment).

- **Goldman's Derivatives Book:** After the above discussions, we are now in a better position now to understand Figure 12, which was reported in Goldman's 10K report in 2014. First, it reports Goldman's derivatives positions by major product type on a gross basis. For example, the gross value of interest-rate derivatives totals to $786,362 million in assets and $739,607 million in liability with a total notional amount of

$47,112,518 million. In the language of derivatives, the assets are those derivatives on which Goldman is currently making money and the liability are those on which Goldman is losing money.

Just to compare with the broader market, as of December 2014, the total notional amount of interest-rate OTC derivatives was $505 trillion, making Goldman (total notional amount of $47 trillion) an important participant in this market.

To get to the $63 billion derivatives assets and $63 billion derivatives liabilities that eventually showed up in Goldman's financial statement as part of its financial instruments, counterparty netting was an important step. On the assets side, the gross value was $1,039,047 million and the counter party netting reduces it by $886,670 million, giving us $152,377 million, which corresponds to the gross credit exposure in the above discussion. Interestingly, $152,377 million accounts for 17.19% of the gross value $886,670 million, in line with the ratio reported in Figure 11 for the broader market in 2014.

The various components of the counterparty netting reported in Goldman's 10K is also interesting. In particular, "OTC-cleared" are done through central counterparties, which most likely is a product of Dodd-Frank. Also, the cash collateral netting also contributes to the reduction of the gross value to the net value used to measure counterparty exposure.

- **Interest Rate Swaps:** The interest rate segment accounts for the majority of the OTC derivatives activity. At end-June 2015, the notional amount of outstanding interest rate derivatives contract totaled $435 trillion, which represented 79% of the global OTC derivatives market. Within this segment, interest rate swaps, with total notional amount of $319 trillion, is by far the largest component. In term of market gross market value, interest rate swap was at $9.8 trillion by end-June 2015, a near 30% reduction from the gross market value of $13.9 trillion at end-2014. By comparison, the reduction in notional amount over the same period was 16%. As discussed earlier, the variation of gross market value is influenced by both the variation in notional amount as well as the variation in the underlying risk. The narrow gap between the initial interest rate and the current interest rate contributes to the low gross-market value.

Figure 13 reports the interest rate derivatives by currency, maturity and counterparty. As we can see, the USD and Euro are the two major currencies for interest rate derivatives. Most of the swaps seem to be of less than five years in maturity. The longer maturity swaps accounts for less than 25% in 2015. The distribution of interest rate

$ in millions	As of December 2014		
	Derivative Assets	Derivative Liabilities	Notional Amount
Derivatives not accounted for as hedges			
Interest rates	$ 786,362	$739,607	$47,112,518
Exchange-traded	228	238	3,151,865
OTC-cleared	351,801	330,298	30,408,636
Bilateral OTC	434,333	409,071	13,552,017
Credit	54,848	50,154	2,500,958
OTC-cleared	5,812	5,663	378,099
Bilateral OTC	49,036	44,491	2,122,859
Currencies	109,916	108,607	5,566,203
Exchange-traded	69	69	17,214
OTC-cleared	100	96	13,304
Bilateral OTC	109,747	108,442	5,535,685
Commodities	28,990	28,546	669,479
Exchange-traded	7,683	7,166	321,378
OTC-cleared	313	315	3,036
Bilateral OTC	20,994	21,065	345,065
Equities	58,931	58,649	1,525,495
Exchange-traded	9,592	9,636	541,711
Bilateral OTC	49,339	49,013	983,784
Subtotal	1,039,047	985,563	57,374,653
Derivatives accounted for as hedges			
Interest rates	14,272	262	126,498
OTC-cleared	2,713	228	31,109
Bilateral OTC	11,559	34	95,389
Currencies	125	16	9,636
OTC-cleared	12	3	1,205
Bilateral OTC	113	13	8,431
Commodities	—	—	—
Exchange-traded	—	—	—
Bilateral OTC	—	—	—
Subtotal	14,397	278	136,134
Gross fair value/notional amount of derivatives	$1,053,444 [1]	$985,841 [1]	$57,510,787
Amounts that have been offset in the consolidated statements of financial condition			
Counterparty netting	(886,670)	(886,670)	
Exchange-traded	(15,039)	(15,039)	
OTC-cleared	(335,792)	(335,792)	
Bilateral OTC	(535,839)	(535,839)	
Cash collateral netting	(103,504)	(36,155)	
OTC-cleared	(24,801)	(738)	
Bilateral OTC	(78,703)	(35,417)	
Fair value included in financial instruments owned/ financial instruments sold, but not yet purchased	$ 63,270	$ 63,016	

Figure 12: Goldman's Derivatives Positions.

OTC interest rate derivatives

Notional principal[1]   Graph 3

By currency

By maturity

By sector of counterparty

By currency legend:
— US dollar   — Sterling
— Euro   — Yen

By maturity legend:
■ One year or less
■ Over 1 year and up to 5 years
■ Over 5 years

By sector of counterparty legend:
Lhs: — Share of other financial institutions
Rhs: ■ Reporting dealers
     ■ Other financial institutions
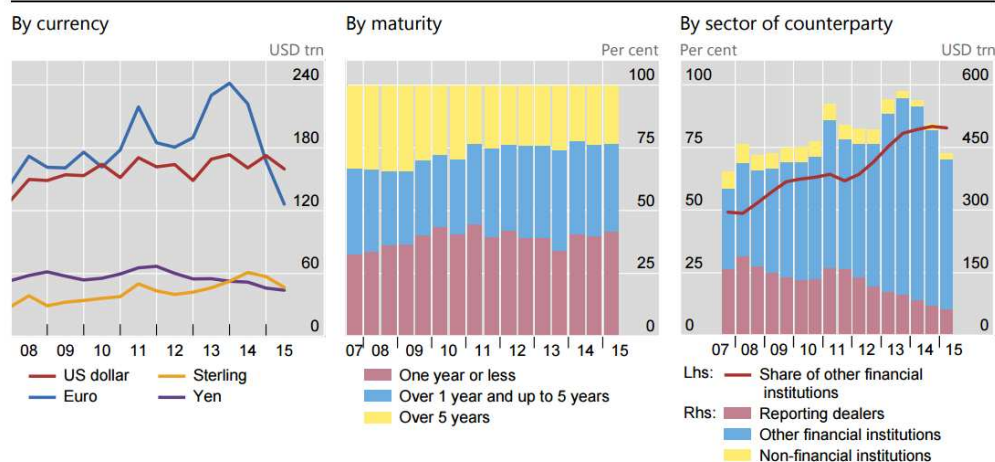   ■ Non-financial institutions

Figure 13: Interest Rate Derivatives by Currency, Maturity, and Counterparty.

derivatives by counterparty points to a continued shift in activity towards financial institutions other than dealers, including CCPs (central clearing party). It is also interesting to see that the need for non-financial institutions to hedge interest rate risk decreased significantly during the second half of 2013.

• **History of Swaps:** Although some swaps were arranged in the late 1970s, the first widely publicized swap took place in 1981 when IBM and the World Bank agreed to exchange interest payments on debt denominated in different currencies, an arrangement known as a currency swap. The first interest rate swap was a 1982 agreement in which the Student Loan Marketing Association (Sallie Mae) swapped the interest payments on an issue of intermediate-term, fixed-rate debt for floating-rate payments indexed to the three-month Treasury bill yield.

Interest-rate swaps have existed since April 1987. In that time, these agreements between two parties to exchange periodic interest payments have risen from being an innovative means of transferring financial risk to providing a new "benchmark" for interest rates in the United States.

Most swaps are entered with dealers, who then seek to limit their exposure to interest rate risk by entering into netting swaps with other counterparties. At end-June 2015, the notional amount of outstanding interest rate derivatives contract totaled $435 trillion, which represented 79% of the global OTC derivatives market. Within this

segment, interest rate swaps, with total notional amount of $319 trillion, is by far the largest component. In term of market gross market value, interest rate swap was at $9.8 trillion by end-June 2015.

In addition to swap dealers, major market participants include financial institutions and other corporations, international organizations such as the World Bank, government-sponsored enterprises, corporate bond and mortgage-backed securities dealers, and hedge funds. Hedging interest rate risk is one important motive for trading interest rate swaps. Swaps constitute the most common instrument in asset-liability management and in portfolio and debt management. A large universe of fixed-income securities including corporate bonds and mortgaged-back securities use interest rate swap spreads as a key benchmark for pricing and hedging. They are also widely used as a benchmark, as an index, and as an underlying asset for options (e.g. swaption).