19. Interest Rate Swaps

Reading: Stigum 19 on Swaps. See also Hull who builds from the idea (mentioned in Stigum) that swaps are like a portfolio of forward contracts. Daily Financial Times includes bid-ask of swaps in 5 currencies, all maturities from 1 year to 30, "swap curve" vs. yield curve.

Lots of kinds of swaps. I'm going to focus on interest rate swaps, both medium term and short term. Basis swaps, currency swaps, are easy to understand by analogy. Ignore swaptions because we are ignoring options.

A Swap is a swap of IOUs, or a parallel loan

A good place to start is p. 880, *Street Speak in Swap Land*, which is about interest rate swaps, fixed for floating. If we think of the notional principal as actual, we can understand what is going on better. Suppose two counterparties AA and BBB, one is able to borrow fixed rate but wants to borrow floating rate, the other is able to borrow floating rate but wants to borrow fixed. They can help one another by swapping IOUs, fixed for floating, in a parallel loan structure as follows.

	AA		BBB	
	Seller of swap		Buyer of swap	
	Short swap		Long swap	
	Payor of Floating		Payor of Fixed	
	Asset	Liability	Asset	Liability
Original		**Fixed rate borr.**		**Floating rate borr.**
Parallel Loan	[Fixed	floating]	[floating	fixed]
Swap		Swap	Swap	

In the parallel loan arrangement AA still pays its original creditor a fixed rate over the life of its original loan, and BBB still pays its original creditor a floating rate over the life of its original loan. The swap of IOUs between AA and BBB means that AA receives a fixed rate payment from BBB, while BBB receives a floating rate payment from AA; these receipts match the promised payments on their original loans. In this way, AA achieves floating rate financing while BBB achieves fixed rate financing.

The parallel loan structure solves the problem for the two companies, but it does so by expanding both balance sheets, and so the apparent leverage and counterparty risk exposure. Since money is going both ways, it is natural to net the two payments and pay only the net, from AA to BBB or from BBB to AA, whichever is larger. (In most cases, BBB will be paying AA because the short term interest rate is lower than the long term interest rate.) This netting goes

some way toward reducing counterparty risk. The swap contract goes even farther by netting the principal payments as well, both at the beginning and at the end of the contract. The net payment flows on a swap contract are the same as in the parallel loan structure, but now everything is off-balance sheet.

In the swap arrangement, note well the market lingo convention. A long swap position pays fixed and receives flex, and a short swap position is just the opposite. (One way to remember this is to observe that the long swap position increases in value when the floating rate of interest rises; another is to think of the swap as a kind of insurance contract that hedges floating rate risk, so a liability for insurer and an asset for the insured.) In deference to the market lingo, I'll treat long swap positions as assets and short swap positions as liabilities when we put them on the balance sheet. This should cause no confusion as long as we remember the parallel loan interpretation.

Swaps and Other parallel loans

To help link the swap idea to other things we already know, it might be helpful to think of "selling a swap," or taking a short swap position, as like buying a five-year fixed rate bond and financing the position by borrowing short term, using the bond as collateral for the loan. From this point of view, we see the swap as similar to a repo. The difference is that with swaps we are dealing with corporate liabilities not governments, and also with much longer maturities both of the bond (say five years rather than 3 month Tbill) and of the financing (say 6 month LIBOR rather than overnight repo).

Further, it is common in the finance literature to analyze the swap as a strip of forward interest rate contracts, one for every time-dated payment on the underlying notional fixed rate loan. (Note: forward not futures contracts, because payments are periodic, not marked to market.) BBB is in effect locking in the a future borrowing rate, and AA is in effect locking in a future lending rate. WARNING: being long a swap is like being short a portfolio of forwards, so you hedge a long swap with long futures, which is rather counterintuitive (to say the least!)

As always, keeping in mind the parallel loan interpretation will allay any confusion. When we were talking about interest rate forwards, we saw how a forward can be understood as a parallel loan as follows:

Long forward		Short forward	
Assets	Liabilities	Assets	Liabilities
6 month loan R(0,6)	3 month deposit R(0,3)	3 month deposit R(0,3)	6 month loan R(0,6)

If we compare this to the parallel loan interpretation of the interest rate swap, we see that exposure on the first payment of the short swap is just like the long forward. The later swap payments are analogously like more distant forwards.

Why swap? Comparative advantage

In Stigum's example (p. 874), BBB borrows floating and AA borrows fixed, then they swap. The reason they do this is that by assumption BBB can borrow relatively more cheaply in

floating, and AA can borrow relatively more cheaply in fixed (though absolutely more cheaply in all markets). Each however would like to be borrowing in the market that is relatively more expensive. Here is the structure of rates Stigum assumes:

	Term Loan floating	5 year fixed Eurobond
BBB	6 month LIBOR + 1/4	5.85
AA	6 month LIBOR + 1/8	5.375
Difference	12.5 bp	47.5 bp

There are 35 bp to play with (47.5-12.5). In Stigum's example (Table 19-1, p. 875) AA gets 25 of them and so achieves LIBOR – 1/8 (original floating – 25 bp), and BBB gets 10 and so achieves 5.75 Eurobond (original fixed – 10 bp). We can understand this better by putting her numbers into our parallel loan interpretation, as follows:

AA		BBB	
Assets	Liabilities	Assets	Liabilities
[5 year fixed, 5.50	5 yr bond, 5.375 LIBOR]	[LIBOR	LIBOR + ¼ 5 year fixed, 5.50]

Why does this apparent free lunch exist? One reason is market imperfection. Stigum tells the story about British capital controls that were evaded by parallel loans which were in effect currency swaps. Something like this might be happening, if Triple B is for some reason locked out of the Eurobond market. Stigum notes also that US interest rate swaps have their origin in 1981, in the midst of the Volcker tight money period, when some lesser credits would have been locked out of certain markets completely.

But another possible reason for this structure of rates is counterparty risk, and that suggests that the lunch might not be so free. A bank may be willing to lend short term to Triple B because it thinks it can reassess the situation every 6 months, perhaps raising the markup over LIBOR if BBB gets into trouble. The higher markup for longer term lending compensates for the fact that there is a lot more that can go wrong in five years than in six months. The swap gives Triple B long term financing, but leaves AA holding the credit risk. If things go bad for Triple B, it will roll over its term loan at higher and higher markups over LIBOR, but it is receiving only LIBOR flat. It will have to pay its bank and also Fuji. Possibility of default to both the bank and to AA.

Market making in Swaps

Whatever the reason for this apparent free lunch, the important point is that the 35 bp attract not only AA and BBB, but also brokers and dealers who take a few of the bp to set up and manage the swap. Thus AA could borrow in the Eurobond market and swap fixed for floating by selling a swap to a dealer. Triple B likewise could borrow in the floating market and swap floating for fixed by buying a swap. The dealer would take 1bp each way, subject to credit check.

From the dealer's perspective, the net result is a growing book of swap positions, hopefully matched book. Dealers make markets in swaps by taking positions and hedging them, either by taking opposite positions in the same or similar swaps or by taking opposite positions in related instruments (like forwards and futures).

AA		Investment Bank		BBB	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
	AA swap	AA swap	BBB swap	BBB swap	

In general dealers will not be able to match longs and shorts perfectly with the business that naturally comes to them, so they must resort to imperfect hedging. The kind of position that works as a hedge gives us further insight into the nature of the swap contract.

Stigum likes to say that a swap is a synthetic corporate bond (p. 906). What she means is that a short position in interest rate swaps is similar to a long bond position financed by repo. Looked at in this way, it is clear that such a position can be hedged with a short bond position. Treasuries or Euros are the most liquid instruments, so one might look for a hedge there, either in the cash market or the futures markets. It is important however to recognize that such a hedge involves continued exposure to basis risk because the swap rate is a corporate not a government rate. Also, the dealer faces counterparty risk on both sides. Other hedges will be necessary to shelter from basis and counterparty risk.

Supposing that the position can be hedged satisfactorily, we can see the **swap dealer as doing essentially the same thing as a government security dealer**, but in corporate bonds instead of governments. There is a term structure in swaps, as a markup over Treasuries. Just as we found it useful to distinguish private repo from Fed Funds, international Eurodollar futures from Treasury futures, so also we have the private swap term structure versus the Treasury term structure. At every maturity there is a rate of interest determined in the private credit markets and there is one determined in the government credit market. We can think of the swap term structure as a markup on Treasuries, or the Treasury term structure as a discount from the swap term structure. Speculators on the spread at various maturities keep the markets in touch.

The swap market is huge, now larger than the bond market itself (as measured by size of notional swap principal). The deep question raised by the enormous success of this market is whether in some sense it is coming to replace the government market. In good times, it seems there is just as much liquidity in swaps as in governments, but in bad times (tight liquidity) the hierarchical structure is restored. Swap dealers are apparently market makers at a lower level in the hierarchy of money than government bond dealers, who are themselves below the banks that make markets in money, who are themselves below central banks.

Money market swaps

The short term swap market is more of an interbank (rather than intercorporate) market. For example (p 895-6), a bank AA may take in a one-year deposit and swap fixed for 3mo LIBOR, by selling the IMM money market swap. Morgan buys the swap (and hence is short fixed) and immediately hedges with a long futures position. Why? 897 "A swap is a strip of FRAs, and a FRA is a single-set swap". A swap is like a portfolio of financial forward contracts. This is important, forwards not futures, so the futures hedge involves exposure to liquidity risk. Hence the futures contract is there only temporarily as a hedge, until Morgan can maybe make a one year loan to an LBO and close out the futures contract. LBO borrows at 3mo LIBOR, swaps flex for fixed, and we're done. In this way the one-year fixed rate deposit winds up financing Morgan's one year flex rate loan. The swap between the banks hedges interest rate exposure.

Read through the example in Stigum and try to work out the final balance sheet relationships, as follows:

AA		Morgan		LBO	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
	1 yr deposit				
[1 year fixed	3 mo floating]	[3 mo floating	1 year fixed]		
	Swap at 4.44	Swap at 4.44			
					3 mo floating
		[1 year fixed	3 mo floating]	[3 mo floating	1 year fixed]
			Swap at 4.47	Swap at 4.47	

You can see the first swap between AA and Morgan (I show the implicit parallel loan in brackets above the swap), and then the second swap between LBO and Morgan. (I've left off the futures hedge which is there only temporarily in the time between doing the first swap and doing the second.) Basically AA is borrowing fixed but wants to borrow flex, and LBO is borrowing flex but wants to borrow fixed. Instead of doing a swap with each other, they each separately do a swap with Morgan. Morgan winds up with equal and opposite swap exposures, i.e. matched book.

How does Morgan make money if it is short a swap at 4.47 and long a swap at 4.44? Here the parallel loan interpretation makes everything clear. Morgan is paying Libor and receiving Libor, so these flows net out. But on its long swap it is paying 4.44 fixed and on its short swap it is receiving 4.47 fixed. This is a 3 bp net profit.

Significance

What is going on here? In the marketplace as a whole, there are a range of borrowers and lenders, each with its own preferences about maturity (and currency), and each with its own market access. What is happening in the swap market is that they are each finding lowest cost financing by matching up their needs with the market as a whole.

The effect of the swap market is to spread stresses in one place and at one time, across the system and across time, and to unite the individual markets into one big market. In this way, any imperfections in the markets caused by regulation or intervention can be evaded. If central banks raise short rates in one area, making it unattractive for short term lending, then borrowing can happen elsewhere and swap into the desired currency.

There is a very significant passage on p. 900:

"Money market swaps occur in what could rightly be called arbitrage land. Traders arbitrage swaps against futures, swaps against cash, swaps against FRAs, FRAs against futures, and so on. Arbitrage opportunities keep arising because these related markets are constantly affected by many different events. Maybe an Asian bank does a big cash-and-swap arbitrage, which drives up the swap market; this creates profit in the swap-FRA arbitrage, so someone does the swap-FRA arbitrage, which drives up FRAs; this creates profit in the FRA-futures arbitrage, so someone does the FRA-futures arbitrage, which drives up futures. An event that moves one rate causes a rate ripple that creates some basis points for every play except may the futures player if he is an unhedged spec. Clearly, someone loses, usually the spec player in the futures pit."

Note the hierarchical structure of the sequence of trades portrayed here: swap market (OTC) to FRA (interbank forward) to futures. We have already seen that the flexibility of this system depends on ability to hedge immediately in highly liquid futures markets. Now we see also that, although in one sense the system works to spread stresses, in another sense it concentrates stresses. Everything comes back to futures.