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Lecture Note 2.3: Return Swaps

To conclude our tour of swaps, we will look at two more types of swap agreements that play a major role in financial engineeering. Even though these claims at first look completely different from commodities swaps and interest rate swaps, we will see that there is common valuation idea behind all of them. This new idea will lead us to some deep insights.

Last, we will revisit our assumption of riskless counterparties, discuss what counterparty risk means in reality, and see how markets are evolving to cope with it.

Outline:

I. Return swaps.

II. Credit swaps.

III. More about counterparty risk.

IV. Summary

I. Return Swaps.

- Last time we saw that interest rate swap valuation formulas are natural generalizations of the results we found for commodity swaps.
- Now I want to point out a *completely different* way that they can be valued as derivatives – by changing what we view as the underlying security.
- To start, re-write the first formula that we found for the value of a plain vanilla swap whose swap rate was set at s:

$$\begin{aligned} V(s) &= 1 - B_{0,T} - s \sum_{t=1}^{T} B_{0,t} \\ &= 1 - \left[s \cdot \sum_{t=1}^{T-1} B_{0,t} + (1+s) B_{0,T} \right]. \end{aligned}$$

- notice that the last term (inside the brackets) is the value of a risk-free coupon bond, with coupon s, maturing at T.
- The first term (i.e. 1) is also the value of a bond: *it is the value of a risk-free floating-rate note (FRN) paying the t-bill rate.*
  - ▶ Why? No-arbitrage again.
  - ▶ If such a fund had a higher price that 1.0, short it and invest 1.0 in t-bills and have zero net cash flows at all future dates (plus money today). If it had a lower price...do the reverse.

- In other words, another way to look at our plain vanilla interest rate swap is as the exchange of cash-flows from investment in a FRN – or in a fund that just rolls-over t-bills – for those of a risk-free coupon bond.

- Most swaps do originate from one party wanting to off-set cash-flows from a coupon bond or a floating-rate note.

- When these underlying bonds really exist, we can view the swap as a *derivative of them*.

- This insight gives us **a third way of valuing swaps:** value the assets whose cash-flows are being exchanged.
  - **No-arbitrage pricing applies if the two assets are traded** even if there are no forward prices for anything!
  - The value of the swap must be the difference in the prices of the two underlying assets (or investments).
    - Implicit assumption: both assets can be sold short (at the same cost).
  - **Any swap of cash-flows from equal-value assets must be fair.**

- Viewing swaps as derivatives of some underlying investment asset allows us to analyze a new class of products – **return swaps** – that are more complex than our basic commodity-swap framework can handle.

- There are two common types of return swaps:

  Equity swap in which the payouts from two given investments are swapped for each other, with (risky) principal difference exchanged at the end.

  Performance swap in which the total returns from the two investments are periodically exchanged, and the investments are re-calibrated to unit value.

- **N.B.** We are maintaining the assumption that the obligations of the swap are certain to be performed. But that is unrelated to the performance of the underlying investments.

- We just saw that, for any two traded assets, the value of an equity swap must just be the difference in values of the two assets, by no-arbitrage.

- So it is always fair to swap equal dollar value investments in *anything.*
  - For example, the value of this swap must be zero:
    - you pay me dividends and final value of £1 invested today in the FTSE 100 and held for one year.
    - I pay you dividends and final value of £1 invested in the Nikkei 225, converting the currency as necessary.
  - Notice that the cash-flows don't necessarily match up in time anymore.

- That was a typical 1-year equity swap.
- Now, if that swap is fair today, it will be fair in one year to enter another one just like it.
  - So committing today to do so then must also be fair.
- But that is exactly what a (2 year) performance swap is.
  - A commitment to enter into a series of equity swaps.
  - (In practice, one would lump the dividends in with yearly payments; net two performances and just pay the difference.)
- **Conclusion:** They are always fair too!
- Value of an existing return swap is zero only at the re-balancing dates. In between, value is just the difference in returns since last re-balancing.
- Other examples:
  - Small stock returns for big stock returns
  - Junk bonds for municipals
  - Managed portfolio return (*any strategy!*) for index fund returns.
- **Remember:** Conclusion (for performance swaps) assumes the underlyings are traded
  - ... and shortable;
  - ...and will continue to be.

II. Credit default swaps (a first look).

- What are they?
  - ▶ You pay me fixed fee $\$C$ until T;
  - ▶ I pay you nothing, unless a specified third party (call it Company X) goes bankrupt before T, in which case I pay you a lump-sum $\$L$.
  - ▶ Just an insurance policy.
    - ∗ Typically the fee is quoted as a percentage of the face value of some bond of company X.
    - ∗ And then the payout L is typically the loss-upon-default of that bond, i.e., face value minus recovery value.
- Later on in the course we'll study the pricing of credit risk in a lot more detail.
- For now, I just want to point out that these swaps can be viewed as another type of return swap: the exchange of cash-flows from particular portfolios.
- So, to the extent that we can trade the underlying portfolios, there's really no mystery to pricing them.

- Consider the following equity swap to time T.
  - You pay me the cash-flow from a portfolio that is long a coupon bond of company X maturing at T.
  - I pay you the cash-flow from a portfolio holding a riskless bond of the same maturity and principal.
  - Assume the coupon rates are such that the bonds are both worth par today.
  - At T we exchange the difference in market values of the two bonds.
  - I've sold you credit insurance!
  - Why?
  - If company X never defaults, I get the net coupon difference between riskless and risky bonds, i.e. a fixed fee.
  - If X dies, then the terminal payoff you get is worth (roughly) the same as a CDS payoff: face value minus recovery value of the defaulted bond.

- So if credit swaps are just return swaps, we can apply what we just learned.

- First, the net value of the above swap is the difference in the time t prices of the two portfolios.
  - ▶ Clearly, if the face value of the two investments is the same, the market value of the junky bond is less, so the swap is a net winner for the side that pays that value.

- Likewise, a new swap can be made fair (i.e. no arbitrage opportunity) by setting the principal amounts of the bonds differently, or just making the riskless portfolio pay a somewhat lower coupon amount.

- Remember though that our no-arbitrage conclusions require you to be able to sell-short X's debt.

- Can you see any ways in which my hypothetical return swap differs from a true CDS?

III. Risky counterparties.

- Swaps can tie you to one counterparty for a (potentially) very long time. This makes the non-performance issue much more important for swaps than for forwards.

- Suppose you are valuing the promise of a risky counterparty to deliver a stream of some good (in exchange for your cash).
  - ▶ Even if forward contracts are available on the good to all dates, now that's not enough to allow valuation using no-arbitrage arguments.
  - ▶ A perfect hedge is no longer possible.
  - ▶ The issue is: your replicating portfolio will consist of contracts with *different* counterparties. They could default and the swap could default, but the two events are not likely to coincide.
  - ▶ So the default risk does not net out.

- **Beware:** don't confuse:
  - ▶ the riskiness of the cash-flows being swapped with the riskiness of the counterparty performing the swap.
  - ▶ For example, a BB-rated entity could promise to pay you the 10 year treasury bond return in a return swap.

- What actually happens when your counterparty (CP) defaults? Usually both parties will have agreed to be governed by a version of the ISDA Master Agreement (possibly with amendments).
  - ▶ Both sides stop exchanging cash-flows.
  - ▶ Counterparty goes into reorganization.
    - (**A**) If value of swap is positive (to CP), you – the non-defaulting party (NDP) – must pay the administrators that sum within 20 days of serving notice of default to the defaulting counterparty.
    - (**B**) If value is negative (i.e. favorable to you), your claim to that amount is classed with other business creditors, and, ultimately, you receive the same fractional value that they do.
    - (**C**) If you have multiple swaps *or other OTC derivatives* with CP, the obligations are supposed to be netted first to come up with one omnibus obligation.
      - ∗ This is called the "Safe Harbor" rule for OTC derivatives.
    - (**D**) Your Master Agreement may have contained provisions for each side collateralizing the swap value through time, possibly resulting in a senior claim.
  - ▶ Note: not clear what "value" is in (A). The ISDA standard is "replacement value" as determined by the market. But for whom?

Peregrine haunts Isda

The liquidators of Peregrine Investment Holdings – the Hong-Kong-based investment bank that collapsed in January 1998 – are to go court in London to clarify documentation relating to more than $1 billion of derivatives transactions. PricewaterhouseCoopers is seeking an interpretation of the Master Agreement produced by industry body the International Swaps and Derivatives Association, which threatens to delay the collection of more than $1.3 billion owed to Peregrine Fixed Income, a Peregrine subsidiary, on derivatives trades.

The outcome of the dispute turns on whether credit quality should influence the value assigned to an interest rate swap contract when one of the counterparties has defaulted. PWC will argue that the swap should be settled using a credit risk-free rate. An unnamed debtor, believed to be a non-financial sector Asian company, will argue that credit is a consideration. The debtor's credit quality has deteriorated since the swap was transacted, and it could therefore expect its debt to be slashed if successful in court.

PWC will use the court ruling to settle the rest of the claims. And creditors will be fervently hoping for a PWC victory. Anything else could cut potential recoveries.

If the court rules in favour of the debtor, the liquidators will be facing "a nightmare scenario", admits Simon Copley, Hong Kong-based partner with PWC's global risk management solutions division. In fact, the firm's calculations would be completely derailed. Copley says that even a small tweak in pricing could result in companies that believe they are owed money by Peregrine suddenly becoming debtors, and vice versa. "The ramifications could be hugely significant," says Copley. "It could even end up making Peregrine look technically solvent."

Copley claims that market participants agree with PWC's interpretation. "Maybe the words [in the Isda documentation] don't match up with what some people want; we believe our reading is the right one," he says.

Isda is keeping an eye on the situation. Quentin Hills, co-chairman of Isda's steering committee for Hong Kong and South-east Asia, maintains that the Master Agreement is operating as intended.

Isda's Master Agreement uses "replacement value" methodology in these situations. If one counterparty in a swap contract defaults, then Isda documentation assumes that the non-defaulting counterparty will need a replacement. The new swap will have to be transacted at current market prices, which will be determined by factors such as liquidity and credit quality, says Hills. The Master Agreement works on the principle that the replacement cost should be factored into the close-out value of the terminated swap, but Hills contends that credit factors alone should not dramatically affect this value.

Of the total $2 billion owed to Peregrine, PWC has separated the debtors into those that are able to pay, and those which are not. Top-rated international banks fall into the first category, and account for some $500 million of debt. The other $1.5 billion was transacted largely with entities in Indonesia (around $1.1 billion) and Thailand (around $300 million). Most of these cannot pay, says Copley. "We're talking to them now," he says. "We're trying to work something out."

PWC hopes to pay a first dividend to Peregrine creditors in August. By mid-June, Copley and his team had recovered 20%, roughly $400 million, of the money owed to Peregrine. This was mostly from bank debtors. Recoveries ahead of the first dividend payment are expected by Copley to range between $475 million and $775 million. Working from those figures, Copley says creditors can expect the dividend to be between 20% and 40% of the money owed to them. ■

Duncan Wood

- In 2002 ISDA changed its master agreement to specify a particular methodology for computing the "Close-out amount."
  - It still allows NDP to determine the value, and they are still allowed to use market quotes that take into account their own risk.
  - But their way of doing so has to be "commercially reasonable" – whatever that means!
  - See `http://www.isda.org/isdacloseoutamtprot/isdacloseoutamtprot.html`
- Also note that if NDP is on the losing side of a swap he can BOTH stop paying required cash-flows AND delay – possibly forever – the close-out value simply by never issuing notice of default!
  - In the case of Lehman Brothers (2008), the bankruptcy court may have closed this loophole for now (in the U.S.) by allowing Lehman to sell its winning permission to non-defaulting third parties without getting permission for assignment from NDPs.
    - As a matter of interest, Lehman had about 930,000 swaps and other OTC contracts that had to be settled via the ISDA process with over 6,000 counterparties.

Example of default losses

- You do a 10-year swap paying T-bills (annual) for 6% fixed on \$100m. Then rates jump.

New interest rate flat term-structure:	3%	4.5%	6%	9%	12%
Value of swap (riskless c/p):	+\$24.6m	+\$11.9m	0	-\$19.3m	-\$33.9m
... if CP defaults:	0	0	0	-\$19.3m	-\$33.9m

(Recall formula: $V = 1.06 \sum_{t=1}^{10} B_{0,t} - \sum_{t=0}^{9} B_{0,t}$.)

- Counterparty risk only arises from times when *both* the counterparty fails *and* you are a winner on your side of the trade.
  - ▶ When these two events are correlated, you are said to face "wrong way risk."

- Your *extra* loss when counterparty defaults is zero if swap has gone against you (assuming no benefit from your own imperfect credit). But the size of any loss is unknown at initiation: itdepends on rates at the time, remaining life, recovery rate, etc.

- The "insurance" you would need to buy to make the swap riskless would be more complicated than a lump-sum payoff.
  - ▶ Need something that blends credit protection with an option-like payoff.

- To truly have a no-arbitrage value for our position, this is the insurance we would have to price.
- The cost of such insurance would depend on the correlation between the counterparty's credit risk and the underlying variable(s) in your swap.

- Most major dealers now attempt to price such risk and incorporate a "credit value adjustment" (CVA) into the swap prices they quote customers.
  - They then have to run special CVA trading operations to dynamically adjust the size of their default insurance as underlying values move *and* as their exposure to each counterparty evolves with further trading activity.
  - Basel 3 capital standards actually now require banks to calculate CVA for each trading counterparty and reserve regulatory capital against it.
    - There are lots of jobs in this area at the moment!
  - Note the importance of the safe harbor (netting) rules here: a particular customer trade may actually lower a firm's overall exposure to that customer if it off-sets existing positions.
    - This could produce a negative CVA. If there were no netting, every trade would incur a positive CVA.

- Because of the enhanced awareness in the market of the role of counterparty risk in determining swap values, different dealers may quote very different prices for a trade with a client *depending on whether it increases or decreases their overall credit exposure to that client* and on their perception of that client's credit risk.

- **Question:** What happens if two parties, A and B, are both risky? Do the credit risks cancel? What is the "fair" swap rate?
  - Let s be the default insurance (CVA) cost (assume same for both parties).
  - Let S be the risk-free swap rate (against T-bills,say).
  - A will only pay $S - s$ against floating to take B's credit.
  - B needs $S + s$ fixed in order to pay floating to A.
- If they just trade at the mid-point rate, neither side receives enough to purchase a replicating portfolio for his/her obligations. So no swap is "fair" as we have defined it.
  - How can they trade?

- This example shows the economic logic of putting a riskless intermediary in between the two parties.

- As we have seen, governments are increasingly imposing central clearing on swaps markets.
  - SwapClear and the CME group are currently the two biggest operations providing central clearing to large market participants.
  - Smaller players then have to have one of these larger banks act as their "prime broker" and have their transactions cleared via them.

- And for non-cleared bilateral deals it is becoming much more common to stipulate that that the contract will be marked-to-market periodically using a third-party to value it and with collateral or actual cash being exchanged accordingly.
  - The standard way to do this is to sign an amendment to the ISDA master agreement known as a Credit Support Annex (CSA).

- As for the theoretical results, if counterparty risk is eliminated all the formulas are fine....
  - ...except that marking-to-market raises some complications with uncertain reinvestment rates, as in the case of futures versus forwards.

IV. Lecture Summary.

- We looked at swaps in a new way today: as the difference in cash-flows (or returns) between two pre-specified securities or portfolios.
- When the two portfolios consist of tradeable (shortable) assets, no-arbitrage pricing applies even where forwards and futures don't exist and can't be replicated.
- Any two payment streams can be swapped:
  - ▶ if we can value each, we can value the swap;
  - ▶ if each is the cash-flow from an investment whose value today is \$1, the value of the swap must be 0;
- Return swaps, interest rate swaps, and even some types of credit default swaps can be priced like this.
- Counterparty default risk is really a *joint* risk that your counterparty defaults *at a time when you are a net winner on the swap.*
- Pricing a swap in which your counterparty is risky requires you to value a dynamic default risk strategy whose size varies with contract mark-to-market value.
- Quantifying the resulting extra cost of hedging/replication is still an evolving science.
- With luck, central counterparties will save us from some of the headaches!

Lecture Note 2.3: Summary of Notation

Symbol	Page	Meaning
C,L	*p6*	*annual fee and payout on credit default swap on entity* X
S	*p14*	*interest rate swap rate for riskless counterparties based on riskless floating rate*
s	*p14*	*cost of purchasing right to replace a swap if original risky counterparty defaults*