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Last Week

Derivatives Products: Futures

- What is a future?
- Contract specifications
- Settlement Price, Volume and Open interests in futures markets
- Types of Orders
- Clearinghouse Margins
- Uses of Futures / Hedging using futures contracts
- Basis risk
- Advantages and Disadvantages of Futures



This Week





Week 4: Derivatives Products: Swaps

Bahattin Buyuksahin, CoMeX Consulting and Advising

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Forward or futures contracts settle on a single date



However, many transactions occur repeatedly



You can enter into a separate forward contract for each payment you wish to hedge.



However, transaction cost will be higher.



Swaps

Swaps are agreements between two companies to exchange cash flows in the future according to prearranged formula.

Swaps may be regarded as portfolio of forward contracts.

Swaps are common in interest rates, currencies and commodities.

They often extend much further into the future than exchange contracts.

Swaps are generally intermediated by banks.

Swaps



One party makes a payment to the other depending upon whether a price turns out to be greater or less than a reference price that is specified in the swap contract.

For example by entering into oil swap, an oil buyer confronting a stream of uncertain oil payments can lock in a fixed price for oil over a period of time. The swap payments would be based on the fixed price and for oil and a market price that varies over time.





HEDGING AND TRANSFORMING A LIABILITY OR ASSET SPECULATION

?





A Simple Commodity Swap

- Suppose United Airlines is going to buy 100,000 barrels of jet fuel oil 1 year from today and 2 years from today. Suppose that forward price for delivery in 1 year is \$75 per barrel and in 2 years is \$90 per barrel. Suppose 1 year and 2 year zero coupon bond yields are 5% and 5.5%.
- UA can use forward contract to guarantee the cost of buying jet fuel oil for the next 2 years. The present value of this cost will be

$$\frac{\$75}{1.05} + \frac{\$90}{1.055^2} = \$152.29$$



UA could invest this amount to buy jet fuel oil in 1 and 2 year

Or UA could pay an jet fuel oil supplier \$152.29 and jet fuel oil supplier would commit delivering one barrel in each of the next two years. This is prepaid swap

Credit risk? Oil might not be delivered or default in payment

More attractive solution for both parties is to defer payment until the oil is delivered. . If the payment is determined in advance and paid in arrears , this is postpaid swap.



• Typically, a swap will call equal payments in each year as long as any payment stream with a present value of \$152.29

 $\frac{x}{1.05} + \frac{x}{1.055^2} = \152.29

- To satisfy this equation, the payments must be \$82.28 in each year. We then say that the 2-year swap price is \$82.28.
- However, any payments that have a present value of \$152.29 are acceptable.



A simple Swap: Physical Delivery





Physical versus Financial Settlement

- What if swap settled in cash?
- With cash settlement, jet fuel oil buyer, UA, pays the swap counterparty the difference between \$82.28 and the spot price (if the difference is negative, the counterparty pays the buyer), and jet fuel oil buyer then buys the jet fuel oil in the spot market.
- For example, if the spot price is \$90, the swap counterpart pays the buyer



• If the spot price is \$80, then oil buyer makes a payment to the swap counterparty

Swap price – Spot price=\$82.28-\$80=\$2.28

• Whatever the spot price, the net cost to the buyer is the swap price, \$82.28





For a swap on 100,000 barrels, we simply multiply all cash flows by 100000. In this example, 100,000 multiplied by the spot price of oil is the notional amount of the swap.

Although, swap price is close to mean of forward prices (\$82.5), it is not exactly same. Why? Suppose swap price \$82.5, then the oil buyer would then be committing to pay \$7.5 more than forward price the first year and would pay \$7.5 less than the forward price the second year. Thus relative to the forward curve, the buyer would have made an interest-free loan to counterparty.



Swap price \$82.28, then we are overpaying 7.28 in the first year and underpaying \$7.72 in the second year, relative to forward curve.

Swap is equivalent to being long the two forwards contracts, coupled with an agreement to lend 7.28 to the counterparty in the first year, receive \$7.72 in 2 years.

The interest rate on this loan is 7.72/7.28-1=6%. Where does 6% come from? 6% is the 1 year implied forward yield from year 1 to year 2.



Swap Counterparty

Swap counterparty is a dealer, who hedges the oil price risk resulting from swap.

The dealer can hedge in several ways. Suppose oil seller also lock in a fixed price. In this case dealer serves a go between for the swap, receiving payment from one party, passing them to another. In practice, the fixed price paid by buyer is higher than the fixed price received by the seller. This price difference is a bid-ask spread and is the dealer's fee.



Interest Rate Swaps

Interest Rate Swaps



- "Plain Vanilla" interest rate swap: party B agrees to pay cash flows equal to the *interest* at a
 predetermined *fixed rate* on a *notional principal* for a number of years. Party A agrees to pay party B
 cash flows equal to a floating rate on the same notional principal for the same period of time (the life
 of the swap can usually range from 2 years to over 15 years).
- Example: A 3-year swap is initiated on March 5, 2015 company B agrees to pay to company A a rate of 5% per annum on a notional principal of \$100 million and company A agrees to pay to company B the six-month LIBOR rate on the same notional principal.





Interest Rate Swap

- The notional principal of the swap is \$100m. The life of the swap is called swap term or swap tenor.
- Borrowing rate is known at the beginning of the year, interest payment on the loan is due at the end of the year
- Only net swap payment are actually made between swap counterparties. If one party defaults, they owe to the other party at most the present value of net swap payments. This implies swaps generally have less credit risk than bond



An Example of a "Plain Vanilla" Interest Rate Swap

- An agreement by Microsoft and Intel
- Microsoft receives 6-month LIBOR from Intel & pays a fixed rate of 5% per annum (which is quoted with semiannual compounding) to Intel every 6 months for 3 years on a notional principal of \$100 million
- Intel pays a fixed rate of 5% per annum to Microsoft & receives 6-month LIBOR from Microsoft every 6 months for 3 years on a notional principal of \$100 million
- Microsoft is the fixed rate payer, Intel is the floating rate payer



Cash Flows to Microsoft



| | Millions of Dollars | | | |
|---------------|---------------------|-----------|-----------|-----------|
| | LIBOR | FLOATING | FIXED | Net |
| Date | Rate | Cash Flow | Cash Flow | Cash Flow |
| Mar.5, 2020 | 4.2% | | | |
| Sept. 5, 2020 | 4.8% | +2.10 | -2.50 | -0.40 |
| Mar.5, 2021 | 5.3% | +2.40 | -2.50 | -0.10 |
| Sept. 5, 2021 | 5.5% _ | +2.65 | -2.50 | +0.15 |
| Mar.5, 2022 | 5.6% | +2.75 | -2.50 | +0.25 |
| Sept. 5, 2022 | 5.9% _ | +2.80 | -2.50 | +0.30 |
| Mar.5, 2023 | 6.4% | +2.95 | -2.50 | +0.45 |



Using the Swap to Transform Liability

- For Microsoft the swap could be used to transform a floating-rate loan into a fixed-rate loan. Suppose that Microsoft borrowed \$100 million at LIBOR + 80 basis point (0.8%). After Microsoft has entered into the swap, it has 3 sets of cash flows:
 - It pays LIBOR + 0.8% to the outside lender
 - It receives LIBOR (Swap)
 - it pays 5% (Swap)
 - Net effect: (Fixed) interest rate payment of 5.8%
- For Intel the swap could have the effect of transforming a fixed-rate loan into a floating-rate loan. Suppose that Intel has a \$100 million loan on which it pays 5.2%. After A has entered into the swap, it has 3 sets of cash flows:
 - It pays 5.2% to the outside lender
 - It pays LIBOR (Swap)
 - it receives 5% (Swap)
 - Net effect: (Floating) interest rate payment of LIBOR + 0.2%.

Using the Swap to Transform Liability





Using the Swap to Transform an Asset



- Microsoft: The swap could have the effect of transforming an asset earning a fixed rate of interest into an asset earning a floating rate. Suppose that Microsoft owns \$100 million in bonds that will return 4.7% over the next three years.
- Intel: The swap could have the effect of transforming an asset earning a floating rate of interest into an asset earning a fixed rate. Suppose that Intel has an investment of \$100 million that yields LIBOR minus 25 basis points.



Financial Intermediary



 Usually, two financial companies do not get in touch with each other directly ==> they deal with a financial intermediary. Plain vanilla swaps are structured so that the financial institution earns about 3 or 4 basis points.



- In each case the FI has two separate contracts. If one company defaults the financial institution still has to honour its agreement with the other company. The 3 basis point spread partly compensate the financial institution for the default risk it is bearing.
- If both parties honor their obligations, FI gets 0.03% per year multiplied by the notional amount of \$100 million, meaning \$30,000 per year for the three year period. That is payment for taking the risk!



Forex Swaps



Currency Swaps

- Firms sometimes issue debt denominated in a foreign currency.
- Firms might use forward contracts to hedge exchange rate risk
- Firms might use a currency swap, in which payments are based on the difference in debt payments denominated in different currencies
- One popular type of currency swap is known as a fixed –for fixed currency swap.
 - Exchanging principal and interest payments at a fixed rate in one currency for principal and interest rate payments at a fixed rate in another currency



Exchange of Principal

- In an interest rate swap the principal is not exchanged
- In a currency swap the principal is usually exchanged at the beginning and the end of the swap's life



• An agreement to pay 2% on a sterling principal of £10,000,000 & receive 3% on a principal of \$15,000,000 every year for 5 years



• IBM pays a fixed rate of interest of 2% in sterling and receives a fixed rate of 3% in dollars from BP. Interest rate payments are made once a year and the principal amounts are 15 million Dollar and 10 million Euro



An Example of a Fixed-for-Fixed Currency Swap

- IBM lends its \$15 million to BP and gets 3% interest annually for the next five years
- BP lends its £ 10 million to IBM and gets 2% interest annually for the next five years
- On the contract signed date or swap initiation date of March 5, 2015, principals are exchanged but no interest payments until next year
- For the following four year each party remits only interest payments , for example IBM receives \$0.45 million (=3%*\$15 million) from BP and pays £ 0.20 million to BP
- At the end of swap life, both party pays last interest payments as well as return the principals to the lender

The Cash Flows to IBM



| | Dollars | Pounds | |
|------|----------|--------|--|
| | \$ | £ | |
| Year | millions | | |
| 2015 | -15.00 | +10.00 | |
| 2016 | +0.45 | -0.20 | |
| 2017 | +0.45 | -0.20 | |
| 2018 | +0.45 | -0.20 | |
| 2019 | +0.45 | -0.20 | |
| 2020 | +15.45 | -10.20 | |

Typical Uses of a Currency Swap

- Conversion from a liability in one currency to a liability in another currency
- Conversion from an investment in one currency to an investment in another currency
- Similar to interest rate swaps



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- Some companies have a comparative advantage in borrowing in the fixed-rate market, while other companies have a comparative advantage in the floating-rate market. When obtaining a new loan it is convenient for a company to go to the market where it has a comparative advantage. This may lead to a company borrowing fixed when it wants floating and vice versa. The swap is used to transform the fixed-rate loan into a floating-rate loan or vice versa.
- Likewise, currency swaps can be motivated by comparative advantage.



Advantages of Swaps



Disadvantages of Swaps and Crisis Induced Reforms



| Disadvantages | Reforms |
|---|------------------------------|
| Lack of liquidity | Standardization and SEFs |
| Credit risk | Margin requirements and CCPs |
| Not as transparent as exchange traded instruments | Reporting requirements, SEFs |
| Still have exposure to market risk | |



Next Week





Thank You

