

## An Introduction to Swaps

- A swap is an agreement between counter-parties to exchange cash flows at specified future times according to pre-specified conditions.
- A swap is equivalent to a coupon-bearing asset plus a coupon-bearing liability. The coupons might be fixed or floating.
- A swap is equivalent to a portfolio, or strip, of forward contracts--each with a different maturity date, and each with the same forward price.

## A “Plain Vanilla” Interest Rate Swap, I.

- Party B agrees to pay a fixed payment and receive a floating payment, from counter-party A.
- Party B is the fixed rate payer-floating rate receiver (the “pay-fixed” party).
- Party A is the fixed rate receiver-floating rate payer (the “receive-fixed” party).
- Typically, there is no initial exchange of principal (i.e., no cash flow at the initiation of the swap).

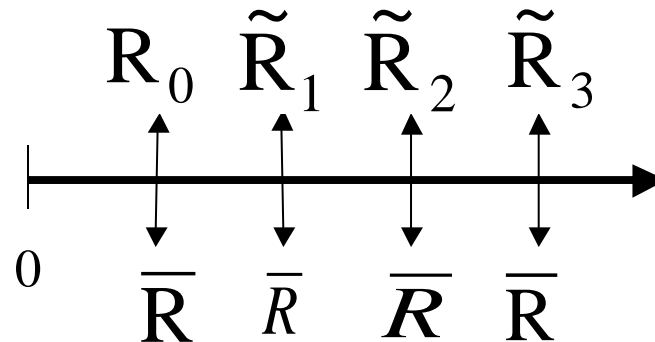
## A “Plain Vanilla” Interest Rate Swap, II.

- On 3/1/02, an agreement is struck wherein for the next 3 years, every six months, company B receives from company A, a payment on a notional principal of **\$100 million**, based on **6-mo LIBOR**. Company B makes a fixed payment on the same notional principal to company A, based on a rate of **5%** per annum.
- Define  $\bar{r}$  as the **fixed rate**.
- Define  $\tilde{R}$  as the **variable (floating) rate**.
- Define  $N$  as the **notional principal**.
- Note that 6-month LIBOR at origination is  $R_0 = 4.20\%$ .
- The next two slides illustrate the cash flows.

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Multiply each “R” by NP times #days between payments over 360

(or use a 365-day year)

- Each actual payment (“difference check”) equals the difference between the interest rates times NP times #days between payments over 360, or #days/365.
- The time t variable cash flow is typically based on the time t-1 floating interest rate.
- Thus, the first floating cash flow, based on the rate,  $R_0$ , is known: it is 4.20%.
- All subsequent floating cash flows are random variables as of time zero (but always known one period in advance).

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## The Cash Flows to Company B

-----Millions of Dollars-----

Date	LIBOR Rate	<i>FLOATING</i> Cash Flow	<i>FIXED</i> Cash Flow	Net Cash Flow
Mar.1, 2002	4.2%			
Sept. 1, 2002	4.6%	+2.10	-2.50	-0.40
Mar.1, 2003	5.1%	+2.30	-2.50	-0.20
Sept. 1, 2003	5.5%	+2.55	-2.50	+0.05
Mar.1, 2004	5.6%	+2.75	-2.50	+0.25
Sept. 1, 2004	4.9%	+2.80	-2.50	+0.30
Mar.1, 2005	4.4%	+2.45	-2.50	- 0.05

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## A Closer Look at the Cash Flows on September 1, 2002

- **Floating** Payment:
  - Based on the 6-month LIBOR rate that existed on March 1, 2002: 4.20%.
  - $(\$100,000,000)(0.042)(1/2) = +\$2,100,000$ .
- **Fixed** Payment:
  - Based on 5% rate.
  - $(\$100,000,000)(0.05)(1/2) = -\$2,500,000$ .
- Net Cash Flow:  $-\$400,000$ .

## Quoting Plain Vanilla Swaps

- Typically, the floating index, e.g. LIBOR, is bought or sold “flat.”
- If you buy LIBOR (pay-fixed), you pay a spread over the most recently issued Treasury with the same maturity as the swap (the asked swap spread).
- If you receive fixed (sell LIBOR) then you receive the Treasury rate plus the bid swap spread, which is smaller than the asked swap spread.
- Example:
  - For a 5-year swap, a dealer might quote 20 (bid) and 24 (asked).
  - Suppose the yield midpoint of the most recently issued 5-year T-note is 5.40%.
  - Then, the pay-fixed party will pay 5.64%, and receive LIBOR.

## Typical Uses of an Interest Rate Swap

- To convert a liability from:
  - a fixed rate to floating rate.
  - a floating rate to fixed rate.
- To convert an investment (asset) from:
  - a fixed rate to floating rate.
  - a floating rate to fixed rate.



## Other Interest Rate Swap Structures

- Off market swaps: The fixed rate may be away from the market; an initial payment will have to be negotiated.
- Amortizing swap: varying NP according to a predetermined schedule.
- Index amortizing swap: The NP, or term of the swap, varies according to some randomly changing interest rate index.
- Basis swap: The two interest rates both float (e.g., LIBOR and the prime rate; or 2-year Treasury rate and 10-year Treasury rate).
- Forward swap: The first cash flow takes place in the “far” future, “long” after the terms of the swap have been negotiated.

## Currency Swaps

- There are four types of basic currency swaps:
  - fixed for fixed.
  - fixed for floating.
  - floating for fixed.
  - floating for floating.
- N.B.: It is the *interest* rates that are fixed or floating.
- Typically, **the NP is exchanged** at the swap's initiation and termination dates.

## Typical Uses of a Currency Swap

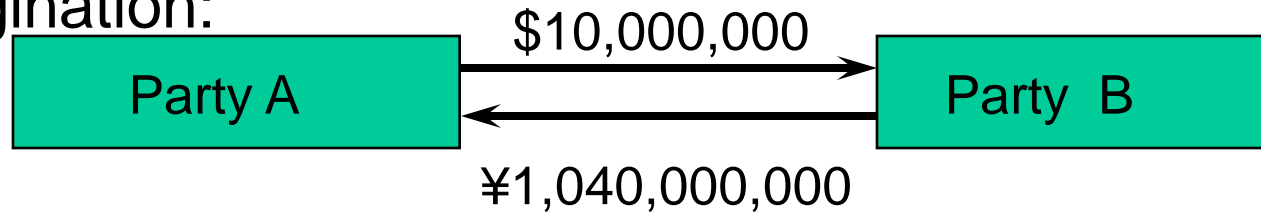
- To convert a liability in one currency into a liability in another currency.
- To convert an investment (asset) in one currency to an investment in another currency.

## An Example of a Fixed for Fixed Currency Swap

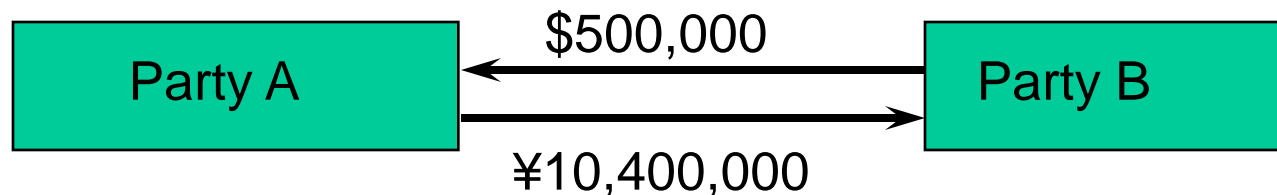
- An agreement to pay 1% on a Japanese Yen principal of ¥1,040,000,000 and receive 5% on a US dollar principal of \$10,000,000 every year for 3 years.
- ***In a currency swap, unlike in an interest rate swap, the principal is exchanged at the beginning and at the end of the swap.***
- Note that in currency swaps, the direction of the cash flows at time zero is the opposite of the direction of the subsequent cash flows in the swap (see the next slide).

## Cash Flows in a Fixed-for-Fixed Currency Swap

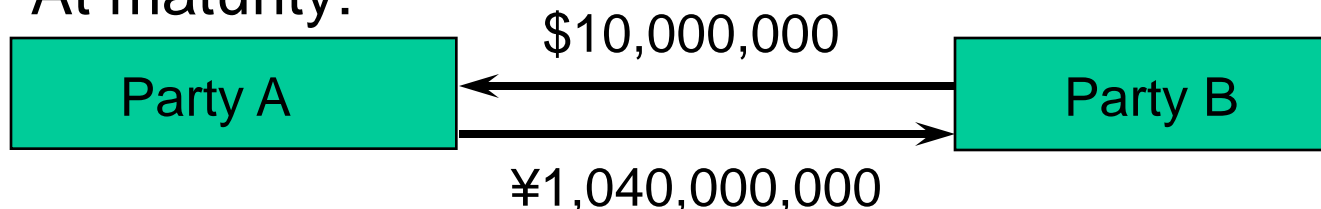
At origination:



At each annual settlement date:

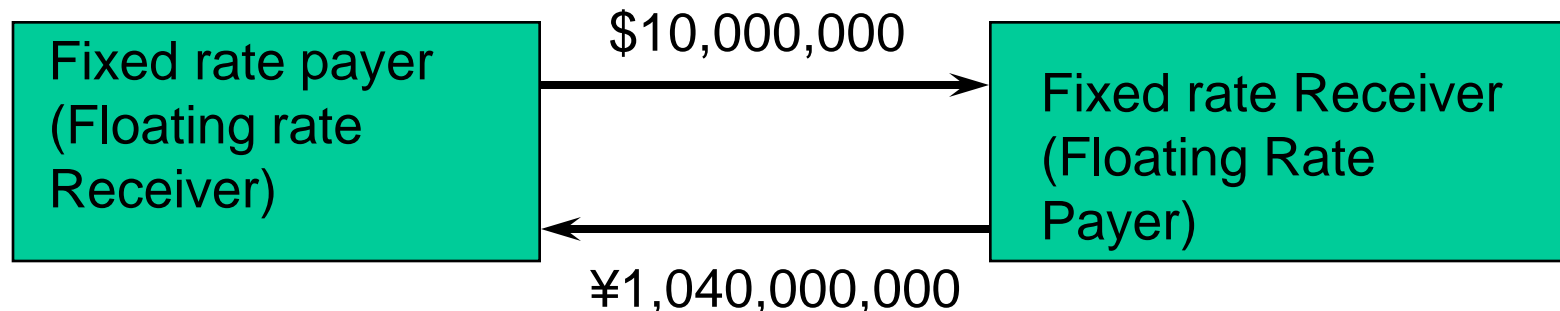


At maturity:



## Cash Flows in a Fixed-for-Floating Currency Swap

- On the origination date:
  - The fixed rate payer pays \$10,000,000 to the fixed rate receiver.
  - The fixed rate receiver pays ¥1,040,000,000 to the fixed rate payer.



## Calculating Subsequent Cash Flows for this Fixed-for-Floating Currency Swap

- Tenor is three years.  $NP_1 = \text{¥}1,040,000,000$  yen, and  $r_1 = 1\%$  fixed in yen.  $NP_2 = \$10,000,000$ , and  $r_2 = 6$  month \$-LIBOR (floating). Settlement dates are every 6 months, beginning 6 months hence.
- On the origination date, 6 month LIBOR is 5.5%.
- Assume that subsequently, 6 mo. LIBOR is:

<u>Time</u>	<u>6 mo. LIBOR</u>
0.5	5.25%
1.0	5.50%
1.5	6.00%
2.0	6.20%
2.5	6.44%

## All Cash Flows for this Fixed-for-Floating Currency Swap

6-mo. <u>time</u>	<u>LIBOR</u>	Fixed rate <u>Payment</u>	Floating rate <u>Payment</u>
0.0	5.50%	\$10MM	¥1,040MM
0.5	5.25%	¥5.2MM	\$275,000
1.0	5.50%	¥5.2MM	\$262,500 <sup>1</sup>
1.5	6.00%	¥5.2MM	\$275,000
2.0	6.20%	¥5.2MM	\$300,000
2.5	6.44%	¥5.2MM	\$310,000
3.0	----	¥5.2MM	\$322,000
		¥1,040MM	\$10MM

N.B. The time t floating cash flow is determined using the time t-1 floating rate.

<sup>1</sup> Time 1.0 floating rate payment is  $(0.0525/2)(\$10,000,000) = \$262,500$ .



## Credit Risk: Currency Swaps

- Note that there is greater credit risk with a currency swap when there will be a final exchange of principal.
- This means that there is a higher probability of a large buildup in value, giving one of the counter-parties (the one who is losing) the incentive to default.

## Credit Risk

- No credit risk exists when a swap is first created.
- The credit risk in a swap is greater when there is an exchange of principal amounts at termination.
- Only the winning party (for whom the swap is an asset) faces credit risk. This risk is the risk that the counter-party will default.
- Many vehicles exist to manage credit risk:
  - Collateral (or collateral triggers)
  - Netting agreements
  - Credit derivatives
  - Marking to market

## Other Currency Swap Structures

- See the different interest rate swap structures presented earlier. They all apply to currency swaps, too.
- Index differential swaps, or “diff” swaps:
  - The cash flows are based on two floating rates in different countries, but they are applied to the NP of *one* of the currencies.
  - For example, pay €-based LIBOR, and receive \$-based LIBOR, on a NP of \$20MM. All payments are in \$.

## Commodity Swaps

- Equivalent to a strip of forward contracts on a commodity.
- Define NP in terms of the commodity; e.g., 10,000 oz. of gold.
- The NP is not exchanged.
- Define  $P_{\text{fixed}}$  as the fixed price.
- Payments are made by comparing the actual price of the commodity on the settlement date (or an average price over the period, or the actual price one period earlier) to the fixed price.

## Commodity Swaps: an Example, I.

- A gold mining firm wants to fix the price it will receive for the gold it will mine over the next 3 years.
- A gold user wants to fix the price it will have to pay for the gold it needs for the next 3 years.
- $NP = 10,000$  oz.
- $P_{\text{fixed}} = \$320/\text{oz.}$
- Settlement is semi-annual, based on average price of gold during the past six months.

## Commodity Swaps: an Example, II.

Subsequently:

<u>Time</u>	<u>Avg. gold price during past pd.</u>	Producer <b>pays (-)</b> or <b>receives (+)</b>
0.5	\$305	<b>+\$150,000</b>
1.0	\$330	<b>-\$100,000</b>
1.5	\$368	<b>-\$480,000</b>
2.0	\$402	<b>-\$820,000</b>
2.5	\$348	<b>-\$280,000</b>
3.0	\$300	<b>+\$200,000</b>

## References:

- srivastava, r. (2017). *financial derivative and risk management*. new delhi: oxford university press.
- hull, j. c. (1988). *options, futures and other derivatives*. (9th, Ed.) pearson.

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**Thank you**

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