P1.T3. Financial Markets & Products

Chapter 20. Swaps

Bionic Turtle FRM Study Notes

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- **Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows.**
- **Explain how a plain vanilla interest rate swap can be used to transform an asset or a liability and calculate the resulting cash flows.**
- **Explain the role of financial intermediaries in the swaps market.**
- **Describe the role of the confirmation in a swap transaction.**
- **Describe the comparative advantage argument for the existence of interest rate swaps and evaluate some of the criticisms of this argument.**
- **Explain how the discount rates in a plain vanilla interest rate swap are computed.**
- **Calculate the value of a plain vanilla interest rate swap based on two simultaneous bond positions.**
- **Calculate the value of a plain vanilla interest rate swap from a sequence of forward rate agreements (FRAs).**
- **Explain the mechanics of a currency swap and compute its cash flows.**
- **Explain how a currency swap can be used to transform an asset or liability and calculate the resulting cash flows.**
- **Calculate the value of a currency swap based on two simultaneous bond positions.**
- **Calculate the value of a currency swap based on a sequence of foreign exchange rates**
- **Identify and describe other types of swaps, including commodity, volatility, credit default and exotic swaps.**
- **Describe the credit risk exposure in a swap position.**

Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows

In a ***plain-vanilla interest-rate swap***, one company pays a predetermined fixed interest rate and receives a variable interest rate (*pay-fixed and receive-floating*), and their counterparty pays a variable rate and receives a fixed interest rate (*pay-floating and receive-fixed*).

- The counterparty **who pays the fixed rate is called the swap payer.** This counterparty profits from an ***increase*** in interest rates (and by convention this counterparty is *long the swap*, although because some use this term differently, long/short terms are discouraged in the swap context).
- The counterparty **who pays the floating rate is called the swap receiver**. This counterparty profits from a decrease in interest rates (and by convention, this counterparty is short the swap).

Here is an illustration given the following assumptions:

- ***Notional principal:*** $100 million. It is called *notional* principal because in the vanilla version of the swap **principal is not exchanged**.
- ***Swap agreement:*** Pay fixed rate of 5.0% and receive 6-month LIBOR rate
- ***Term (aka, tenor):*** 3 years with payments every six months

Hull Table 7.1: Cash flows (in millions of $) in an interest rate swap

Principal	**$100.00**
Fixed rate	**5.0%**

End of Period (6 months)	LIBOR at Start of Period	Cash Flows: Pay Fixed	Cash Flows: Receive Floating	Net Cash Flow
1	**4.2%**	(2.50)	+2.10	**(0.40)**
2 (Year 1)	**4.8%**	(2.50)	+2.40	**(0.10)**
3	**5.3%**	(2.50)	+2.65	**0.15**
4 (Year 2)	**5.5%**	(2.50)	+2.75	**0.25**
5	**5.6%**	(2.50)	+2.80	**0.30**
6 (Year 3)	**5.9%**	(2.50)	+2.95	**0.45**

The notional is not exchanged in the plain vanilla interest rate swap (keep this in mind for the exam). Also, the **first floating rate payment is known at inception** because the floating rate that applies is the rate that prevails at the start of the six-month swap interval though it is paid at the end of the period. In general, the floating rate is determined at the beginning of each period and paid at the end of each period.

A note on discounting in wake of the LIBOR scandal and financial crisis

Throughout the assigned readings and in the examples presented in these notes, the LIBOR rate is used both to *infer* the future cash flows, as well as the risk-free rate to *discount* the future cash flows. In practice this is not the way the market operates.

- In wake of the LIBOR scandal, Governmental agencies tasked with overseeing financial markets have investigated banks, and several banks have admitted to sending in artificially high or low LIBOR rates to the BBA during the financial crisis. In order to appear more creditworthy, the LIBOR rate has received a lot of negative attention. Moreover, it shed light on shoddy practices by banks, as well as the vulnerability of the LIBOR rate to be manipulated.

Banks and financial institutions today do not use LIBOR as the risk-free rate at which they discount cash flows. **Rather they use the Overnight Indexed Swap rate (OIS).**

- The OIS rate is perceived to be nearly risk-free, and the spread between LIBOR – OIS is closely monitored in markets to gauge banks' willingness to lend to one another, as well as overall liquidity and financial conditions.
- As Hull states in the assigned reading, "In normal market conditions, it [the LIBOR – OIS spread] is about 10 basis points." However, during and in the wake of the financial crisis the spread experienced unprecedented volatility, as well as spikes as high as several hundred basis points. Clearly, LIBOR rate is not risk-free by any means, as the risk-free rate is supposed to be fairly constant.

- The OIS rate on the other hand did remain fairly constant compared to LIBOR. As a result, banks today discount cash flows at the OIS rate. This has led to a phenomenon called *dual-curve stripping*.
- Dual curve stripping arises from the fact that, while the LIBOR $\pm$ any spread is used to *infer* the future cash flows on the floating leg of, e.g. a swap, the rate which is used to discount the future cash flows is the OIS rate, hence the name *dual-curve* stripping. As a consequence, at inception, the value of a swap may not equal zero, although it is likely to be fairly close.
- There is however a logical fallacy in Hull's statement. Although the historical average has been a LIBOR-OIS spread of roughly 10 basis points that does *not* imply that this will continue in the future. Moreover, the notion of, "normal market conditions" is at best highly stylized; it presupposes that there is such a thing as normal market conditions, AND that we as observers are able to infer what is and what is not *normal.* That is a bold assumption indeed.

Explain how a plain vanilla interest rate swap can be used to transform an asset or a liability and calculate the resulting cash flows

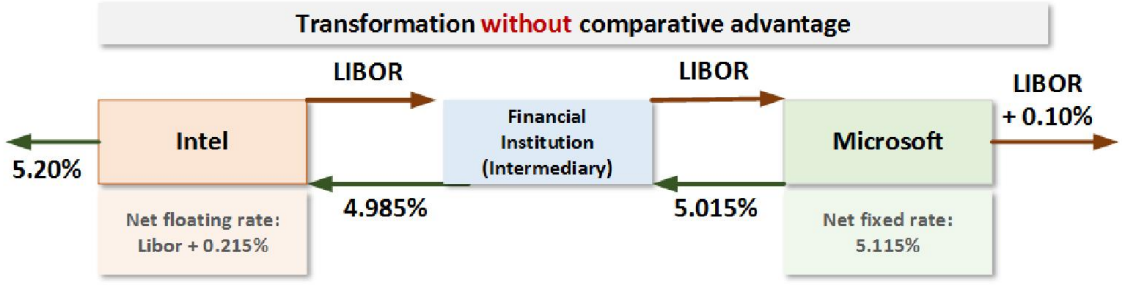
Using swap to transform a liability: A company could use a swap to transform a floating-rate loan into a fixed-rate loan. Suppose Microsoft (MSFT) can borrow $100.0 million *in the floating-rate market* at LIBOR plus 10 basis points. Assume Microsoft prefers to borrow instead at fixed rates. Microsoft enters the swap (illustrated below) such that:

- MSFT pays LIBOR plus 0.10% to its lenders.
- Under the terms of the swap, MSFT pays 5.015% fixed
- Under the terms of the swap, MSFT receives LIBOR

Thus, the swap effectively transforms borrowings at a floating rate of LIBOR plus 0.1% into borrowings at a **net fixed rate of 5.115%**; i.e., LIBOR cancels and MSFT pays 5.015% plus 10 basis points. Suppose Intel (INTC) is the swap counterparty. Intel borrows 5.20 in fixed rate markets but prefers to pay a floating rate. After Intel enters into the swap:

- Intel pays 5.20% to its lenders.
- Intel pays LIBOR under the terms of the swap.
- Intel receives 4.985% under the terms of the swap.

This transforms Intel's borrowing to a net floating rate of LIBOR + 215 basis point.



Explain the role of financial intermediaries in the swaps market

Usually two non-financial swap counterparties do not deal with each other directly. They deal through a financial institution. The financial intermediary may earn about 3 or 4 basis points (0.03% or 0.04%) on a pair of offsetting transactions of a “plain vanilla” LIBOR-for-fixed swaps. The spread earned is partly to compensate it for the risk that one of the two companies will default on the swap payments.

The potential uses of a swap for the same two companies discussed in the previous section is illustrated in the figure below. Here a financial intermediary(FI) enters into two offsetting swap transactions with both Intel and Microsoft.

- Assuming that both companies honor their obligations, the financial institution is certain to make a profit of $30,000 per year (0.03% times notional principal of $100 million).
- Microsoft ends up borrowing at 5.115% (instead of 5.1%), and Intel ends up borrowing at LIBOR plus 21.5 basis points (instead of at LIBOR plus 20 basis points) if they transact through an intermediary instead of directly entering into a swap with each other as explained in the previous section.

In practice, intermediary is prepared to enter a swap even without having offsetting swap, thereby acting as market makers (known as warehousing swaps).

Describe the role of the confirmation in a swap transaction

Confirmation is a legal agreement underlying a swap and is signed by representatives of the two parties. Drafting of confirmations is facilitated by the ISDA.

- ISDA has produced a number of master agreements and the so-called credit support annexes that include well-defined clauses.
- In the US, it is commonplace for companies to require an ISDA master agreement be entered into before entering into a swap transaction. This is then supplemented with a credit support annex, which stipulates further terms specific to the transaction.
- An ISDA agreement can include description of the terms of the swap contracts including netting arrangements, collateral and non-performance clauses. It would be highly unusual for a firm to enter into a swap transaction in the OTC market without some form of agreement with the ISDA.

Describe the comparative advantage argument for the existence of interest rate swaps and evaluate some of the criticisms of this argument

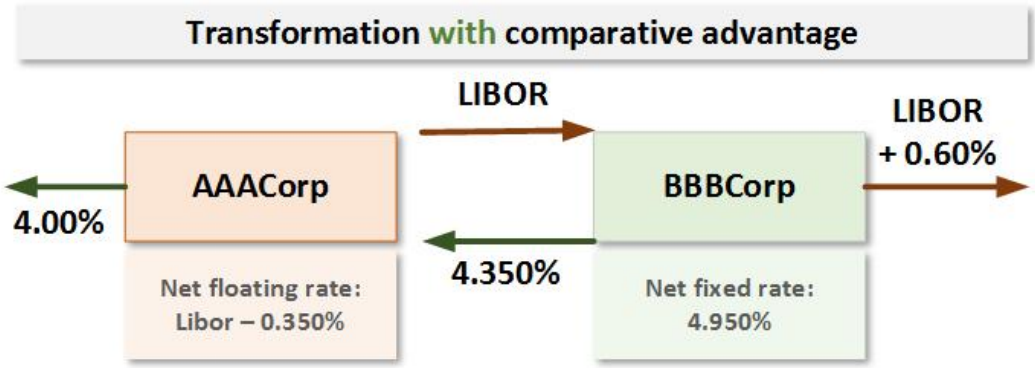
The comparative-advantage argument is used to explain the popularity (or utility) of swaps. Consider two companies: AAACorp has a higher credit rating than BBBCorp. Their respective borrowing rates are given below:

	Fixed	Floating
AAACorp	**4.0%**	**LIBOR - 0.1%**
BBBCorp	**5.2%**	**LIBOR + 0.6%**

Notice that AAACorp has an advantage in *both* the fixed and floating markets.

- When one company has an advantage in a market, it is called an ***absolute advantage***.
- Despite the *absolute* advantage of AAACorp in both markets, the fact that BBBCorp enjoys a ***comparative advantage*** in floating-rate markets implies they can achieve mutual gain!
- BBBCorp is said to have a *comparative advantage* in the floating-rate market (because BBBCorp borrows at only +0.70% more in floating rate markets, compared to 1.2% more in fixed rate markets). AAACorp is said to have a *comparative advantage* in fixed rate markets.
- The total advantage is given by the **difference between the respective rate differentials**. Specifically, in this case, the fixed rate differential equals 1.20% (= 5.20% - 4.00%) and the floating-rate differential equals 0.70% (= 0.60% + 0.10%). The total gain equals 0.70% = 1.20% - 0.70%.
- To generalize, we can say that a *comparative advantage* exists when two companies face different interest rate markets: the difference in fixed rate markets (i.e., between the companies; call this "a") is greater than the difference in floating rate markets (call this "b"). Under these circumstances, **a swap arrangement can produce a total gain, that is, to both parties, before any transaction costs, equal to: $a - b$**.

If AAACorp and BBBCorp want to share the advantage equally, they would swap as follows:



In this arrangement, AAACorp's cash flows, ignoring transaction costs are:

- It pays 4.00% per annum to outside lenders.
- It receives 4.35% per annum from BBBCorp.
- It pays LIBOR to BBBCorp.

BBBCorp's cash flows, ignoring transaction costs are:

- It pays LIBOR + 0.6% per annum to outside lenders.
- It receives LIBOR from AAACorp.
- It pays 4.35 % per annum to AAACorp.

Under this swap, notice that both have improved their cost of capital as they effectively pay:

- AAACorp pays LIBOR - 0.35%: 0.25% less than its "competitive" floating rate,
- BBBCorp pays 4.95% fixed: 0.25% less than its "competitive" fixed rate

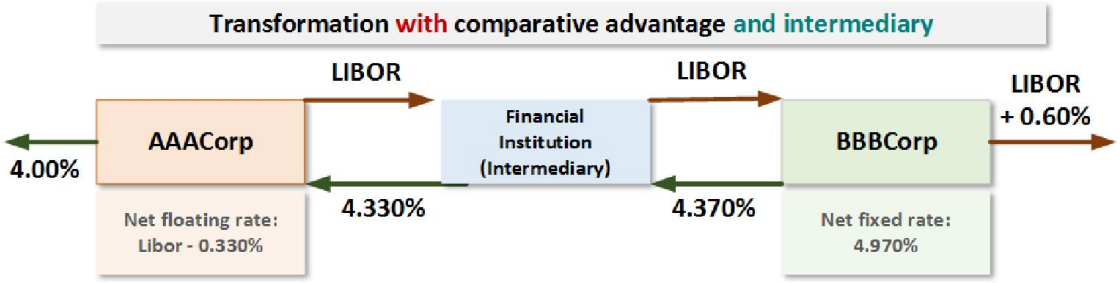
In this swap arrangement, the total gain $a-b$ should be 1.2- 0.7 = 0.5%. As we have seen above, the net gain of 0.25% on each side sums up so that the total gain is 0.5%.

IMPORTANT CONCEPT:

A *comparative advantage* exists when [two] companies face different interest rates in the market. Both companies benefit from entering into a swap, even if one company has an *absolute advantage* in both the fixed and the floating market. This is a common test question so be sure you know the difference, and how to calculate the gain to each party.

Inserting a financial intermediary into the swap

We can add an assumption that the two counterparties do not deal directly with each other but instead use a financial intermediary. In this case, we continue to follow Hull's example and assume the intermediary charges four basis point (0.04%). The reduces the total shared net advantage from 50 basis points to 46 basis points. The resulting swap is illustrated below, and on the next page (with our dynamic learning spreadsheet that solves for the swap given an assumption about the relative advantage share; in this case, we continue to assume the total gain is shared 50/50 between the counterparties).



Spreadsheet illustration of swap with financial intermediary:

	Fixed	Float: libor +	
AAACorp	4.00%	-0.10%	fixed advantage, but SEEKS to borrow floating
BBBCorp	5.20%	0.60%	floating advantage, but SEEKS to borrow fixed
	1.20%	0.70%	

1.20% - 0.70% = 0.50% ← Gross total advantage
0.04% ← Intermediary
0.46% ← Net total advantage

AAACorp	50%	of advantage
	0.230%	Gain to Company A
	4.000%	External (original) borrowing, where it has advantage
	-0.330%	= Libor + (-0.10% - 0.23%) is NET borrowing
	4.330%	In swap, pay Libor in exchange for this fixed rate

BBBCorp	50%	of advantage
	0.230%	Gain to Company B
	0.600%	L+x, External borrowing, where it has advantage
	4.970%	= 5.20% - 0.23% is NET borrowing
	4.370%	SWAP: receive Libor, pay this fixed rate
	4.370%	should be same as this

Criticism of the comparative advantage argument

The contrary view concerns arbitrage: if markets were efficient, we would expect the differentials that allow for the comparative advantage in the first place, to erode. The reason that spread differentials appear to exist is due to the nature of the contracts available to companies in fixed and floating markets.

- The floating rate is typically LIBOR + a spread, and is adjusted, or *reset*, every six months. Thus, if the borrower's creditworthiness has declined, the lender has the option of increasing the spread over LIBOR that is charged. This is not possible for fixed rate loans as they are set for a longer period of time.
- Also, in the short term, there is very little chance that either of the firms will default but as we look further ahead, the probability of a default by a company with a relatively low credit rating is liable to increase faster than the probability of a default by a company with a relatively high credit rating. So, the spread between the 5-year rates is greater than the spread between the 6-month rates.

The comparative advantage argument assumes floating rates will not adjust and converge, an assumption, which in practice does not hold up. A floating rate loan might seem to have transformed in to a fixed rate loan at which the swap is entered in to but it may not be fixed in the sense that it depends on the spread above LIBOR the company borrows at in the future.