Financial Derivatives and Risk Management
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Lecture 56
Swaps: Theory of Swaps

Theory of comparative advantage

Let us revisit our example:

Example: Designing a swap

Consider two entities BBB Ltd & AAA Bank. Each of them requires USD 100 million of funds. The nature of their requirement of funds and their sourcing costs are as follows:

		BBB Ltd	AAA Bank
Requirement		5 yr Fixed Rate $	Floating Rate $
Cost:	Fixed Rate	8%	6.5%
	Floating Rate	Prime+0.75%	Prime

If the two entities borrow as per their requirements:

BBB's cost of funds:	8.00%
AAA's cost of funds:	P
Aggregate cost of funds (A):	P+8.00%

If the two companies enter into a swap i.e. swap their sourcing:

BBB borrows floating rate at:	P+0.75%
AAA borrows fixed rate at:	6.5%
Aggregate cost of funds (B):	P+7.25%

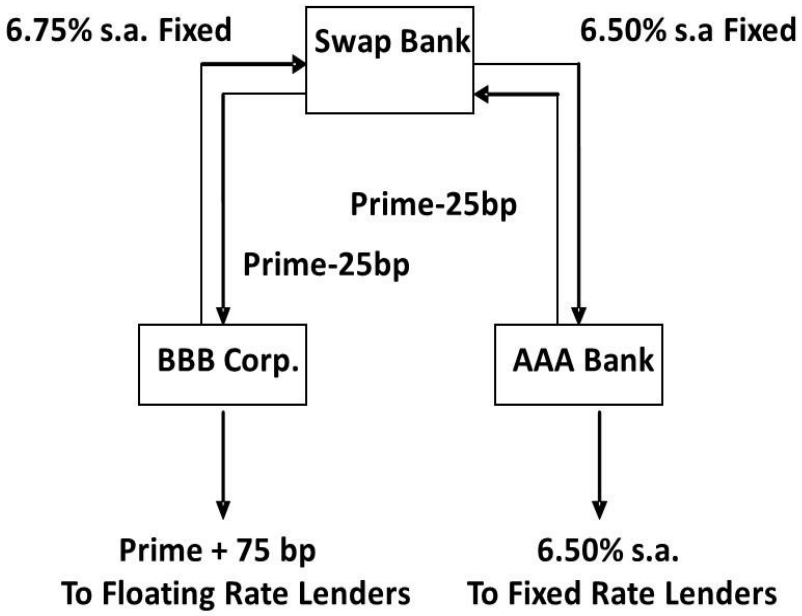
Gross saving (C)=(A)-(B): 0.75%

Let us assume that the swap was administered through a swap bank (broker) PQR who charged a commission of 0.25% for arranging & organizing the swap. Further, let us assume that BBB & AAA share the net savings equally. Then, we have:

Gross saving (C):	0.75%
Less broker commissions:	0.25%
Net saving:	0.50%
Share of either party:	0.25%

Hence, net of cost of funds: BBB: 7.75% AAA: P-0.25%

A possible design of the swap would be as follows:



(i) AAA borrows USD 100 million at 6.5% fixed. It receives 6.50% from the swap bank. It pays P-0.25% to the swap bank.

(ii) BBB borrows USD 100 million floating at P+0.75%. It receives P-0.25% from the swap bank. It adds 1.00% and passes on P+0.75% to its floating rate lenders. It also pays 6.75% to the swap bank.

(iii) Swap bank receives 6.75% from BBB, takes its cut of 0.25% and passes on 6.50% to AAA. It receives P-0.25% from AAA and simply passes on this stream to BBB.

It is seen in the above example that AAA enjoys cheaper borrowing rates in both fixed rate and floating rate markets. Thus, AAA has an absolute advantage over BBB in terms of its borrowing costs. The likely cause of this absolute advantage could be the superior credit rating of AAA. Let us assume that AAA Corp has a higher credit rating say, AAA while BBB Corp has a lower BBB credit rating.

However, it is seen that from the rates offered to AAA and BBB that the difference between the two fixed rates (8% for BBB vs 6.5% for AAA) is greater than the difference between the two floating rates (Prime for AAA vs Prime+0.75% for BBB). BBB pays 1.5% more than AAA in fixed-rate markets and only 0.75% more than AAA in floating-rate markets. That is to say, that the spreads in the fixed rate market (1.50%) exceed those in the floating rate markets (0.75%) insofar as the relative borrowings costs of AAA & BBB are concerned.

This brings forth the concept of comparative advantage. Although AAA has an absolute advantage over BBB on account of its superior credit rating, BBB is deemed to have a comparative advantage over AAA in floating-rate markets, whereas AAA has a comparative advantage over BBB in fixed-rate markets. BBB has a comparative advantage in the floating-rate market because the spread is lower in that market and AAA has a comparative advantage in the fixed-rate market because the spread is more here.

So it is a natural corollary then that an entity should borrow in that market in which it has a comparative advantage.

Both parties to a swap can achieve cost saving by each borrowing in the market where it has a comparative advantage and then doing a fixed-to-floating interest rate swap.

It is this apparent anomaly (comparative advantage) that justifies the swap. AAA borrows fixed-rate funds at 6.5% per annum. BBB borrows floating-rate funds at Prime+0.75%. They then enter into a swap agreement to ensure that AAA ends up with floating-rate funds and BBB ends up with fixed-rate funds, as per their respective requirements. BBB has a comparative advantage in the floating rate market i.e. it is at a relatively lesser disadvantage compared to the disadvantage that it faces in the fixed rate market and therefore it should borrow in the floating rate market. It therefore, borrows in the floating rate market and AAA having a comparative advantage in the fixed rate market borrows in the fixed rate market, and, thereafter they enter into a swap to cater to their preferred funding choices.

The next issue is the rationale behind the existence of the differential spreads i.e. that the spreads in the fixed-rate markets exceeding the spread in the floating-rate markets.

The reason that spread differentials appear to exist is probably the intrinsic character of the fixed and floating rates i.e. due to the nature of the contracts available to companies in fixed and floating markets.

Recall that the tenure of the loan is 5 years so that the 6.5% and 8.0% rates available to AAA and BBB in fixed-rate markets are 5-year rates (e.g., the rates at which the companies can issue 5-year fixed-rate bonds).

On the other hand, the floating rates viz Prime and Prime+0.75% available to AAA and BBB in floating-rate markets are 6-month rates.

Now, a covenant usually exists in floating rate contracts that the lender will have the opportunity to review the floating rates at every rollover (reset) stage i.e. every 6 months in the current case. In case the lender perceives a decline in the creditworthiness of a borrower on review at a reset date, it usually has the option to revise the rates upto the next reset date. Thus, if the creditworthiness of AAA or BBB is perceived to decline, the lender has the option of increasing the spread over benchmark that is charged at any reset point. Indeed, in extreme circumstances, the lender can refuse to roll over the loan at all.

On the other hand, the providers of fixed-rate financing do not have any such option whatsoever to change the terms of the loan in this way. They do not have an embedded option for a reconsideration of the interest rates over the entire tenure of 5 years. They have to maintain the same rate over the entire tenure irrespective of the change in the credit worthiness of the borrowing entity.

This is a fundamental difference. It is very easy for a lender to assess the credit worthiness of an entity over the next 6 months rather than the ensuing 5 years. Assessing credit worthiness over 5 years involves looking far in to the future. Therefore, the risk is significantly more for such lendings relative to lendings where the lender has the discretion to review and reassess the situation every 6 months.

The spreads between the rates offered to AAA and BBB are a reflection of the extent to which BBB is more likely than AAA to default. During the next 6 months, there is very little chance that either AAA or BBB will default. Hence, the spread for the first 6-months (floating rate) is

relatively small (0.75%). However, when we talk about the possibility of default over an extended period of 5 years, the relative difference in creditworthiness becomes more conspicuous, more magnified, and the probability of default for BBB is much higher than that for AAA. As a result, the spread on the 5 years fixed rates is significantly higher (1.50%). Recall that in fixed rates, no intermediate review of rates is contemplated.

If BBB has a lower credit worthiness then AAA, the perception is that as time passes there is a significant possibility that default could occur or its credit worthiness could deteriorate further. Therefore, the perception is that the rate that is being quoted today for the first 6 months may not hold over the entire life of 5 years of the loan. Given this likelihood of decline in creditworthiness, it is likely that the lenders of BBB could increase the floating rates on subsequent resets, as a result which the effective cost over the 5 years will not remain at Prime + 0.75%, it will increase more than that and it would be comparable to the 8 percent that is quoted as a fixed rate.

Now, the probability of a default by a lesser rated company is liable to increase faster than the probability of a default by a higher rated one. The relatively higher spread in the fixed rates (5-year fixed) compared to that in the floating rates (6-months fixed only) reflects this fact.

Obviously, in the event that BBB maintains its creditworthiness at the current level, it is likely to be able to continue borrowing at its current floating rate (Prime +0.75%). However, if a decline occurs in its rating, then it is quite possible that the floating rate for the next 6-months may be set higher by the lenders. Thus, the average effective cost to BBB would increase over the 5-year period. The same rationale holds for AAA as well, but the point is, that since AAA starts off at a better rating, the chances of its declining over the 5-year period are perceived to be relatively lower.

Indeed, the lower rating of BBB epitomizes the market expectation that its creditworthiness could fall later on and therefore its cost of borrowing could rise later on. As such, it anticipates that BBB's spread over AAA's rates will gradually rise (due to its likely decline in creditworthiness) and on average over the 5-year period would work out close to the spread that is being quoted upfront for a fixed 5-year loan (1.50%).

So that is the rationale that is given for this differential spread between the fixed rate and the floating rate. Because floating rate enables a review at the end of shorter intervals, the risk content is reduced. As a result, at the initial stage the lenders are willing to accept a lower interest rate compared to a single rate quote for the entire life of the loan.

Uses of swaps

(i) Converting a liability from fixed rate to floating rate and vice versa.
(ii) Converting an investment from fixed rate to floating rate and vice versa.

Motivation for swaps: Differences in preferences, needs and market access

Examples

(i) A manufacturing firm or utility may prefer fixed rate funding to finance its capital intensive projects involving a large proportion of fixed asset block. However, it may find that investors may not view its credibility very kindly and may only be willing to

provide floating rate funding at reasonable cost. On the other hand, a large multinational bank having high creditworthiness may be able to borrow fixed rate at excellent terms. However, the bank may prefer floating rate funds because it has a large portfolio of floating rate loans. The parties find that the spread in the fixed rate markets exceeds the spread in the floating rate markets. In such a situation, both parties could cut on their borrowing costs by interchanging their borrowing sources and thereafter entering into an interest rate swap to reclaim their desired borrowing options.

(ii) Consider a firm which has borrowed from a Japanese bank to finance imports of capital equipment from Japan. Its debt servicing is in Japanese yen. It exports to the Middle East and African markets to earn a steady income stream in US dollars. It may consider a currency swap to reduce its exchange rate risk by matching the currency of its income stream with that of its debt servicing.

(iii) A US firm desirous of Euro funding for financing its joint ventures in European may find that it enjoys high creditworthiness and reputation in the US markets and so it can raise funds easily in the US Dollar domestic market. However, because it is relatively unknown in Europe, its cost of raising Euro funds in the European markets is high. Again, a currency swap could be contemplated in such a situation.

(iv) An investor with a portfolio of fixed rate assets may have a strong perception that interest rates could rise in the near future. In case, this perception is not carried and hence, discounted by the market, he could implement his perception-based strategy by entering into an interest rate swap to convert his fixed rate asset portfolio to floating rate portfolio. If interest rates actually rise as per his perception (contrary, however, to the market perception) he could gain significantly.

Thus, at any one time in the market there exist investors and borrowers with differences in preferences, expectations and abilities of market access. Such situations may often arise from the firm's asset/liability mismatches.

Arguments for existence of swaps

(i) Quality spread differential
(ii) Market saturation
(iii) Differential financing norms
(iv) Differential objectives of market players

Quality spread differential (QSD)

		XYZ	ABC
Requirement		Fixed Rate USD	Floating Rate USD
Cost:	Fixed USD	8%	6.5%
	Floating USD	Prime+0.75%	Prime

We have talked about the comparative advantage theory. This theory is based on the quality spread differential.

Then there can be other contributors to the value addition in swaps. For example, if an entity is desirous of obtaining a particular type of funding and the financing market is saturated with

that type of lending instruments, it would be easier and more cost-effective for the entity to raise funds through a different instrument or a different source and then enter into a swap to obtain its desired form of funding.

Different financing norms in relation to raising of funds from institutions, banks, stock or other markets is very much in existence across industries as well as across countries. Regulatory provisions may mandate differing financing norms for raising funds by service companies vs manufacturing companies or even with respect to the project size or quantum of funding requirements. These differentials may result in asymmetries in the lending market.

Similarly, across countries the same situation may prevail. Japanese regulators may require lower debt-equity ratios relative to Indian institutions. These also contribute to value addition in swaps. X (that requires funds in instrument A) can borrow in a certain other instrument or currency (B) which is optimum for it in terms of cost, and then enter into a swap with some other party Y, who finds borrowing optimal in the instrument A. Thereby, the swaps generate value for both the parties.

There can also be different objectives of market players. Some entities prefer using swaps for hedging their risk exposures. Entities that are exposed to currency risk may use swaps to cut down the currency risk, as explained in an earlier example. Other entities prefer using swaps to optimize on costs of funding.

Swap quotations

Consider the following swap quotation:

2 yr USD fixed/floating: LIBOR+45/52
(Current LIBOR: 4.50%)
The dealer is saying:
"I am willing to be the fixed rate payer in a 2-year swap at a rate 45 bp above the current LIBOR i.e. 4.95%. I am also willing to be the fixed rate receiver at 52 bp above the current LIBOR i.e. 5.02%."

The above quote simply means that the party that is giving this quote i.e. the market maker who was giving this quote is willing to be the fixed rate payer at LIBOR plus 45 and is willing to be the fixed rate receiver at LIBOR plus 52 so that it is having a spread of 7 basis points between the bid and ask rates i.e. the bid-ask spread.

LIBOR

LIBOR is the rate of interest at which AA-rated banks borrow for periods between 1 and 12 months from other banks in the London inter-bank market.

Swap rate

A swap rate is the average of:

(a) the fixed rate that a swap market maker is prepared to pay in exchange for receiving LIBOR (its bid rate) and

(b) the fixed rate that it is prepared to receive in return for paying LIBOR (its offer rate).

Swap rate means that a bond with a principal of 100 units and a semi-annual coupon equal to swap rate per annum sells for par. Discounting for this purpose is at the LIBOR of appropriate maturity.

The 5-year swap (fixed) rate is an interest rate with a credit risk corresponding to the situation where 10 consecutive 6-month LIBOR loans to AA companies are made.

5-year swap rates are less than 5-year AA borrowing rates. The 5-year AA borrowing rate is that rate which operates unchanged (fixed) in respect of one 5-year continuous loan to one borrower who was AA at the start of the 5-year period without any opportunity of review or reassessment at any time over this entire 5-year period. However, as mentioned above, the 5-year swap rate is the interest rate with a credit risk corresponding to the situation where 10 consecutive 6-month LIBOR loans are made to companies each of which had a rating of AA at the commencement of the 6-month period during which it enjoyed the borrowing.

Consider the risk attached to:

(i) Lending money for successive 6-month periods to borrowers each of whom are AA at the beginning of each of these 6-month periods for which the loan is made to that particular borrower; and

(ii) Lending it to one borrower for the whole 5 years when all we can be sure of is that the borrower is AA at the beginning of the 5 years.

Clearly, the risk attached to the latter is more than that to the former whence the 5-year swap rate is usually less than the 5-year fixed rate etc.

In the case of a swap rate, there will be 10 consecutive lendings viz 0 to 6 months, 6 to 12 months and so on to different entities. The credit worthiness of each of these borrowing entities at the point at which the lending is assumed to be made to them must be at least AA.

Zero rate vs swap rate

The zero rate for a given maturity is the yield to maturity on a zero-coupon bond of the same maturity.

Swap rate is the fixed rate that receiver demands in exchange for the uncertainty of having to pay the short-term LIBOR (floating) rate over time.

Example

The market, on a particular day is quoting a swap rate of 5% for a swap whose payments are made s/a. Suppose that the 6-month, 12-month, and 18-month zero rates have been determined as 4%, 4.5%, and 4.8% with continuous compounding. What is the 2-year zero rate?

Solution

This 5% swap rate means that a bond with a principal of USD 100 and a semi-annual coupon of 5% per annum sells for par. It follows that, if R is the 2-year zero rate, then

$2.5e^{-0.04*0.5}+2.5e^{-0.045*1.0}+2.5e^{-0.048*1.5}+102.5e^{-2R} = 100$. Solving this, we obtain R: 4.953%.

So swap rate is that rate such that if a bond has a face value of 100 and the swap rate is equal to the coupon rate and if all the coupon and principal payments on the bond are discounted at the appropriate prevailing spot rates, we get the par value of the bond.

Day count issues

In general, a LIBOR-based floating-rate cash flow on a swap payment date is calculated as LRn /360, where L is the principal, R is the relevant LIBOR rate, and n is the number of actual days since the last payment date.

The fixed rate that is paid in a swap transaction is similarly quoted with a particular day count basis being specified. The fixed rate is usually quoted as actual/365. As a result, the fixed payments may not be exactly equal on each payment date.

The fixed rate is not directly comparable with LIBOR because it applies to a full year. To make the rates approximately comparable, either the 6-month LIBOR rate must be multiplied by 365/360 or the fixed rate must be multiplied by 360/365.

Trade date, effective date, reset dates and payment dates

(i) The trade date is the date on which the swap deal is concluded
(ii) Effective date is the date from which the first fixed and floating payment start to accrue.

For instance, a 5-year swap is traded on August 30,2019 the effective date is September 1, 2019 and ten payment dates from March 1, 2020 to September 1, 2024.

Floating rate payments in a standard swap are "set in advance paid in arrears" i.e. the floating rate applicable to any period is fixed at the start of the period but the payment occurs at the end of the period. Each floating rate payment has three dates associated with it:

(i) D(S), the setting date, is the date on which the floating rate applicable for the next payment is set.
(ii) D(1) is the date from which the next floating payment starts to accrue and
(iii) D(2) is the date on which the payment is due.

D(S) is usually two business days before D(1). D(1) is the day when the previous floating rate payment is made (for the first floating payment, D(1) is the effective date above).

If both the fixed and floating payment are semi-annual, D(2) will be the payment date for both the payments and the interval D(1) to D(2) would be six months. Therefore, a problem arises if the floating leg is quoted in terms of actual upon 360 and the fixed leg is quoted in terms of actual upon 365. In this case they are not directly comparable, either one converts the floating rate into an equivalent 365 convention basis by multiplying by 365 upon 360 or does the inverse with the fixed rate to make them comparable.