Analytical Research Series

INTRODUCTION TO ASSET SWAPS

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Summary

An asset swap is a synthetic structure which allows an investor to swap fixed rate payments on a bond to floating rate while maintaining the original credit exposure to the fixed rate bond. The pricing of asset swaps is therefore primarily driven by the credit quality of the issuer and the size of any potential loss following default. This article gives a simple overview of the mechanics of asset swaps, explains the risks inherent in the structure and how these affect the pricing and describes some of the reasons for buying and selling asset swaps.

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Introduction

An asset swap enables an investor to buy a fixed rate bond and then hedge out the interest rate risk by swapping the fixed payments to floating. In doing so the investor retains the credit risk to the fixed-rate bond and earns a corresponding return. The asset swap market was born along with the swap market in the early 1990s. It continues to be most widely used by banks which use asset swaps to convert their long-term fixed rate assets to floating rate in order to match their short-term liabilities (depositor accounts).

There are several variations on the asset swap structure with the most widely traded being the par asset swap. Other types include the market asset swap and the cross-currency asset swap. We begin by focussing on the most standard: the par asset swap.

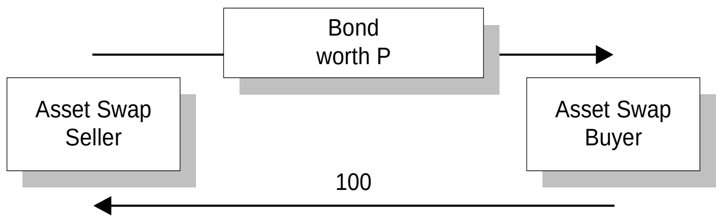
Mechanics of a par asset swap

A par asset swap is really two separate trades:

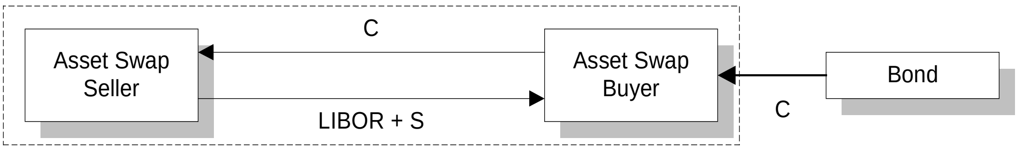
- The asset swap buyer purchases a bond from the asset swap seller in return for a full[1] price of par.
- The asset swap buyer enters into a swap to pay fixed coupons to the asset swap seller equal to the fixed rate coupons received from the bond. In return the asset swap buyer receives regular payments of Libor plus (or minus) an agreed fixed spread. The maturity of this swap is the same as the maturity of the asset.

Figure 1 Mechanics of a par asset swap

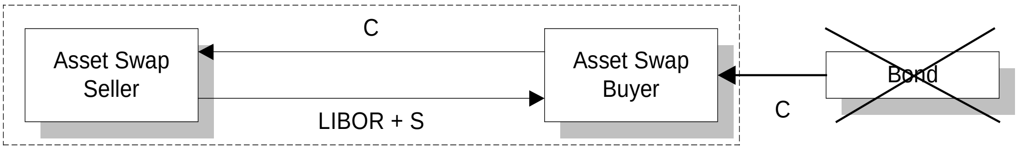
At initiation Asset Swap buyer purchases bond worth full price P in return for par



and enters into an interest rate swap paying a fixed coupon of C in return for LIBOR plus asset swap spread S



If default occurs the asset swap buyer loses the coupon and principal redemption on the bond. The interest rate swap will continue until bond maturity or can be closed out at market value.



[1] Full price, also known as the dirty price, includes the accrued interest.

This transaction is shown in Figure 1. The fixed spread to Libor paid by the asset swap seller is known as the asset swap spread and is set at a breakeven value so the net value of the sale of the bond plus the swap transaction is zero at inception. In the Appendix we show how to calculate the par asset swap spread.

The cash flows associated with an example asset swap are shown in Figure 2. The bond has a maturity date of 20 May 2002, an annual coupon of 5.625% and is trading at a price of 101.70. The frequency on the floating side is semi-annual. The breakeven value of the asset swap spread makes the net present value of all the cash flows equal to par, the up-front price of the asset swap.

Figure 2 **Cashflows of a typical par asset swap**

Notional	$10,000,000	Bond price	101.70%
Value date	20 October 1999		
		Floating frequency	Semi-annual
Bond maturity	20 May 2002	Floating basis	ACT365
Bond coupon	5.625%		
Bond frequency	Annual	Last coupon date	20 May 1999
Bond basis	BOND	Bond accrued	$234,375
Par ASS (bp)	52.40		

Cashflow date	**Fixed coupon bond**	**Swap fixed side**	**Forward Libor**	**Spread (bp)**	**Swap floating side**
20 Oct 1999					
20 Nov 1999			2.742%	52.40	$27,738
20 May 2000	$562,500	$(562,500)	3.771%	52.40	$214,163
20 Nov 2000			3.699%	52.40	$212,905
20 May 2001	$562,500	$(562,500)	4.385%	52.40	$243,409
20 Nov 2001			4.846%	52.40	$270,719
20 May 2002	$10,562,500	$(562,500)	5.312%	52.40	$289,387

Bond full price	**104.047%**
Fixed side of swap	**–15.834%**
Floating side of swap	**11.787%**
Total	**100.000%**

Credit considerations

In an asset swap the asset swap buyer takes on the credit risk of the bond. If the bond defaults, the asset swap buyer has to continue paying on the swap — which can no longer be funded with the coupon from the bond — or the swap can be closed out at market value. The asset swap buyer also loses the par redemption of the bond, receiving whatever recovery rate the bond issuer pays. As a result the buyer has a default contingent exposure to the mark-to-market on the swap and to the redemption on the asset. The buyer is exposed to the loss of the coupons and redemption on the bond - the difference between the bond price and recovery value. In economic terms the purpose of the asset swap spread is to compensate the asset swap buyer for taking these risks.

Since the asset swap spread is quoted as a spread to Libor, for assets of better credit quality than AA-rated banks the asset swap spread may be negative.

Table 1 demonstrates an example of the default contingent risk assumed by the asset swap buyer. In the example the bond is trading at $90. Assume we are at the moment just after trade inception so that the value of the swap has not changed. If the bond defaults with a $10 recovery price, the asset swap buyer loses $90 as he has just paid par to buy a bond now worth $10. However he is also the payer of a fixed rate in a swap which is 10 points in his favour. The net loss is therefore $80, the difference between the full price of the bond and the recovery price.

Table 1 Asset swap on a discount bond

	Bond	Swap	Total
Value at inception	$90	+$10	+$100
Value following default	+$10	+$10	+$20
Loss	–$80	$0	–$80

However, consider what happens if the bond is trading 20 points above par (Table 2). This time if the bond defaults immediately with a recovery price of $10, the asset swap buyer will have lost a total of $110 - the asset swap buyer paid par for a bond now worth $10 and is party to a swap which has a negative mark to market of $20. As a result the investor has actually leveraged his credit exposure and can lose more than his initial investment. However the investor is compensated for this with a higher asset swap spread.

For a par bond the maximum loss the asset swap buyer can make is par minus the recovery price. In terms of expected loss, this makes an asset swap similar to a default swap spread since a default swap pays out par minus recovery to the protection buyer following default. It should also make it close to the value of a par floater spread since the expected loss on a floater which trades at par is also par minus recovery.

Table 2 Asset swap on a premium bond

	Bond	Swap	Total
Value at inception	+$120	–$20	+$100
Value following default	+$10	–$20	–$10
Loss	–$110	$0	–$110

However, in practice this comparison is mostly academic since there will be wide differences between these spreads due to liquidity, availability, market size, funding costs, supply and demand and counterparty risk.

Interest rate risk of an asset swap

As time passes and interest rates and credit spreads change, the mark to market on the asset swap will change. To understand exactly the sensitivities of an asset swap, recall that for the asset swap buyer, the different legs of the trades are

1. Receive coupons from the bond plus redemption valued off the bond issuer curve.
2. Pay coupons on the fixed side of the swap equal in amount to the bond coupons. Cash flows are present-valued off the Libor curve.
3. Receive payments of Libor plus the asset swap spread from swap counterparty. These payments are priced off the Libor curve.

To best understand the Libor and credit spread sensitivities from the perspective of the asset swap buyer, we use the PV01, defined as the change in price for a one basis point upward shift in the par curve.

For example, consider a 10-year bond with a par floater spread of 50bp and an annual coupon of 6.0%. As the bond is trading close to par, it will have an asset swap spread of about 50bp. We use the euro swap curve from 12 October 1999. The PV01 sensitivities are shown in Table 3. The net PV01 is small but definitely not zero.

Table 3 **PV01 sensitivities**

Leg	PV01
Fixed rate bond	–7.540
Swap	+7.710
Net	**+0.170**

The key point here is that the sensitivity of the bond price to parallel movements in the yield curve will be less than the sensitivity of the fixed side of the swap to parallel shifts in the Libor curve. This is only true provided the issuer curve is above the Libor curve. The asset swap buyer therefore has a residual exposure to interest rate movements. In practice this sensitivity is small and only becomes apparent when Libor spreads widen significantly.

The swap rate and Libor spread sensitivity of an asset swap from the perspective of the asset swap buyer are summarised in Table 4.

While the sensitivity to changes in Libor swap rates is almost negligible (unless Libor spreads are very wide), the sensitivity to changes in the Libor spread is equivalent to being long the bond.

The asset swap buyer also has an exposure to credit-induced interest rate risk. If the credit quality of the asset improves so that the asset swap buyer has a positive mark-to-market, this mark-to-market will have an interest rate sensitivity which will need to be hedged. In this respect the asset swap is very much like a floating rate note.

Cashflow matching risk

If the asset swap buyer is a bank and is using the structure to match the outgoing floating rate payments which they make to depositors, the bank will also be exposed to an unexpected withdrawal of deposits.

Table 4 **Swap rate and Libor spread sensitivity**

Event	Swap	Bond	Net
Payments	Pay fixed coupon; receive Libor plus asset swap spread	Receive coupons and par redemption	
Swap rates increase (Libor spread constant)	Present value of swap increases	Bond price decreases	Small increase due to larger PV01 of swap
Swap rates fall (Libor spread constant)	Present value of swap decreases	Bond price increases	Small decrease due to larger PV01 of swap
Libor spread increases (swap rates constant)	No change	Bond price falls	Decrease proportional to PV01 of bond
Libor spread falls (swap rates constant)	No change	Bond price increases	Increase proportional to PV01 of bond

Funding risk

Funding also poses a serious risk to the asset swap buyer who will have an exposure to the cost of funding the asset on balance sheet. If there is a credit crisis, as there was following the Russian default in late 1998, the cost of holding the asset may increase and this will reduce the profitability of the trade.

Counterparty risk

An important consideration in par asset swaps is counterparty default risk. Paying par to buy a bond which is trading at a discount results in the asset swap buyer having an immediate exposure to the asset swap seller equal to par minus the bond price. The opposite is true when the bond is trading at a premium to par. One way to reverse this exposure is to use a market asset swap structure.

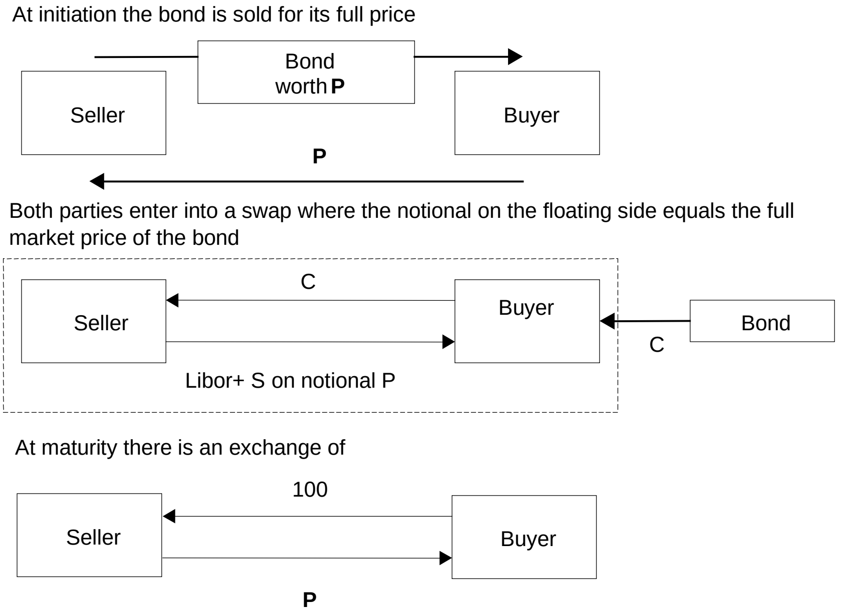
Market asset swap

In the market asset swap, the bond is purchased in return for payment of the full price. The notional of the Libor leg is then scaled by the full price, and the resulting value of the asset swap spread is different (see the Appendix). The transaction is shown in Figure 3.

The differences between this and the par asset swap are:

- The bond is purchased at its full price, not for par.
- For a bond trading above par, the counterparty exposure is taken by the asset swap buyer, and vice-versa. Compare this to the standard asset swap where the counterparty exposure for a premium bond is taken by the asset swap seller.
- In a market asset swap the counterparty exposure starts at zero and increases to its maximum at maturity. Compare this to the standard asset swap package where any counterparty exposure is greatest at initiation and falls to zero at maturity.
- At the maturity of the market asset swap there is an exchange of par for the original price of the bond, as shown in Figure 3.

Figure 3 **Market asset swap**



Note that the credit exposure of a market asset swap remains the same as a par asset swap.

Uses of asset swaps

Clearly the main reason for doing an asset swap is to enable an investor to take exposure to the credit quality of a bond with minimal interest rate risk.

Tax and accounting reasons may also make it advantageous for investors to buy and sell non-par assets at par through an asset swap. Asset swaps can be used to take advantage of mispricings in the floating rate note market.

Variations on asset swaps:

Forward asset swaps

It is possible to go long a credit at some future date and at a known price using forward asset swaps. In this case the investor agrees today to buy the bond on the forward date at par and then enter into an interest rate swap where the asset swap spread paid on the floating side has been agreed today. If the bond defaults before the forward date is reached, the asset swap terminates. The investor does not take on the default risk until the forward date. Since credit curves are generally upward sloping, a forward asset swap can often make it cheaper for an investor to go long a credit, on a forward basis, than to buy the credit today.

Cross-currency asset swaps

Another variation is the cross-currency asset swap. This enables the investor to buy a bond denominated in one currency, pay on the swap in this currency but receive the floating rate payments in their base currency. The cash flows are converted at some predefined exchange rate. In this case there is an exchange of principal at the end of the swap. This structure enables the investor to gain exposure to the credit while reducing their interest rate risk and currency risk.

Callable asset swaps

For callable bonds, where the bond issuer has the right to call back the bond at a pre-specified price on a sequence of specified dates, an asset swap buyer will need to be hedged against any loss on the swap since they will no longer be receiving the coupon from the asset. In this case the asset swap buyer will want to be able to cancel the swap on any of the call dates by buying a Bermudan-style receiver swaption. This package is known as a cancellable asset swap. Most US agency callable bonds are swapped in this way.

Convertible asset swaps

Callable asset swaps may also be used to strip out the credit and equity components of convertible bonds. Fixed income investors can therefore use asset swaps to take advantage of the enhanced returns available in the convertible bond market.

The asset swap market is an over-the-counter market where most trades can be structured to match the needs of the investor. There are, therefore, many possible variations on the structures described above.

Asset swap spread as a measure of credit risk

The asset swap spread is a bond specific measure of the expected loss following default. This is a function of the probability that the issuer defaults, the price at which the bond is trading and the expected recovery price paid by the issuer following default. Because it also depends on the price of the bond, the asset swap spread cannot readily be used for comparing the market's view of credit quality across different bonds and different issuers. The only way to use the asset swap spread to compare the credit quality of two issuers is to choose bonds with the same price, and this is not always possible.

A better measure for comparing the credit quality of different issuers, and for comparing the relative value of bonds which should have the same credit quality, is to use the zero volatility spread (ZVS). This is defined as the continuously compounded spread to the Libor curve which allows us to present value a bond to its market price. A formal definition is provided in the Appendix.

In the case when the bond is trading close to par, both the asset swap spread and the zero volatility spread are close in value, the difference due to the different compounding methodologies.

Summary

- A par asset swap is a combination of the sale of a bond for par plus an off-market interest rate swap where the coupon on the fixed leg equals the coupon on the bond.
- It enables investors to reduce their interest rate risk on a fixed rate bond while maintaining their exposure to the credit.
- If the bond in the asset swap defaults, the investor loses the par redemption on the bond (minus any recovery rate) and the mark-to-market on the swap.
- The asset swap spread on the floating leg compensates the investor for this default contingent risk.
- The asset swap spread is a bond specific measure of credit risk. For purposes of comparison between issuers, a better choice is the zero volatility spread.
- Market asset swaps can be used to reduce counterparty risk.

- In an upward sloping credit curve environment, forward asset swaps can enable investors to go long a credit more cheaply on a forward basis than on a cash basis.
- Cross currency asset swaps enable the investor to eliminate both interest rate and currency risk.

Appendix

Computing the asset swap spread

For the purpose of the following, we assume we have constructed a market curve of Libor discount factors where *z*(t) is the price today of $1 to be paid at time *t.*

From the perspective of the asset swap seller, they sell the bond for par plus accrued interest. The net up front payment has a value 100 – P where P is the full price of the bond in the market. Both parties to the swap are assumed to be AA bank credit quality and so these cash flows are priced off the Libor curve. We cancel out the principal payments of par at maturity. For simplicity we assume that all payments are annual and are made on the same dates. The breakeven asset swap spread *A* is computed by setting the present value of all cash flows equal to zero. From the perspective of the asset swap seller the present value is:

$$\underbrace{100 - P}_{\substack{\text{Upfront payment to} \\ \text{purchase asset in} \\ \text{return for par}}} + \underbrace{\underbrace{C \sum_{i=1}^{N(FIXED)} z(t_i)}_{\text{Fixed payments}} - \underbrace{\sum_{i=1}^{N(FLOAT)} \Delta_i (L_i + A) z(t_i)}_{\text{Floating payments}}}_{\text{Interest rate swap}} = 0$$

where C equals the annually paid coupon, L_i is the Libor rate set at time t_{i-1} and paid at time t_i, Δ_i is the accrual factor in the corresponding basis. The fixed and floating sides may have different frequencies. We solve for the asset swap spread A.

On a technical note, when the asset swap is initiated between coupon dates, the asset swap buyer does not pay the accrued interest explicitly. Effectively, the full price of the bond is at par. At the next coupon period the asset swap buyer receives the full coupon on the bond and likewise pays the full coupon on the swap. However, the floating side payment, which may have a different frequency and accrual basis to fixed side, is adjusted by the corresponding accrual factor. Therefore, if we are exactly half way between floating side coupons, the floating payment received is half of the Libor plus asset swap spread. This feature prevents the calculated asset swap spread from jumping as we move forward in time through coupon dates.

Market asset swap

In the market asset swap, the net upfront payment is zero. Instead the notional on the Libor side equals the price of the bond and there is an exchange of notionals at maturity. Using the notation defined above and using *M* to denote the market asset swap spread, from the perspective of the asset swap seller the present value of all the cashflows is:

$$\underbrace{\underbrace{C\sum_{i=1}^{N(FIXED)} z(t_i)}_{\text{Fixed payments}} - \underbrace{\frac{P}{100}\sum_{i=1}^{N(FLOAT)} \Delta_i (L_i + M) z(t_i)}_{\text{Floating payments}}}_{\text{Interest rate swap}} + \underbrace{(100 - P) z(t_N)}_{\text{Final payment}} = 0$$

Solving for M, we find $M = 100\frac{A}{P}$.

Zero volatility spread

The ZVS is the continuously compounded constant spread to the Libor curve required to re-price a bond. If we denote the ZVS by Θ then we have:

$$P = C\sum_{i=1}^{N(FIXED)} z(t_i)\exp(-\Theta \cdot t_i) + z(t_N)\exp(-\Theta \cdot t_N)$$

We solve for Θ using a root finding algorithm (Newton-Raphson).

Publications: L. Pindyck, Anne DiTizio, Christine Triggiani, Brent Davenport, Sue Bryant