Swaps: complex structures

Complex swap structures refer to non-standard swaps whose coupons, notional, accrual and calendar used for coupon determination and payments are tailored made to serve client's perspectives and needs in terms of risk management, accounting hedging, asset re-packaging, credit diversification and or speculation rationale.

Complex swap structure are often part of more complex structures issued via a special purpose vehicle, referred to as an SPV, which combines a swap, a bond, and many other potential elements, like credit related instruments. This total package is called in structurers' jargon a structured note.

On the risk engineering side, exotic (also called non-generic) swaps structures can be quite involving in terms of pricing risk management and product applications. Compared to vanilla interest rate swaps, exotic swaps offer the additional challenge of modeling accurately the yield curve, the skew and correlation of the various forward Libor and longer maturity rates involved in the product. Exact estimation of the number of factors needed to price a given exotic swap is also crucial.

The first generation of non-generic swap, which by today's standards have become vanilla products, includes:

- Simple structures:

- Forward starting swap, for protection in the future. On the liability side, this allows to pre-hedge anticipated debt like a bond issue, or loan while on the asset side, to lock in the expected revenues of the sell of an asset like in a asset swap and so on.
- Amortizing and rollercoaster swaps. Compared to vanilla swaps, these structures offer the additional advantage to match their notional with the one of the liabilities or assets payment, following the same schedule. A typical example is the case of a swap against a pool of mortgages.
- Deferred coupon, predefined stepped coupon and zero coupon swaps, whose coupons are designed to provide additional pick-up to clients as well as appropriate duration of cash flows.
- Non-generic cross currency swap: cross currency swap with off market rates.

- Structures requiring some adjustment on the forwards like convexity correction and quanto correction:
  - Constant Maturity Swaps (CMS) and Constant Maturity Treasury Swaps (CMT) swaps: designed to risk manage yield curve exposure, these swaps needs to be priced with appropriate convexity correction due to the mismatch between the payment and the swap rate (see CMS/CMT swaps).
  - CMS, CMT caps/floors, swaptions. Compared to vanilla swaptions, these options are based on longer maturity rates to risk manage long maturity interest rates risks.

- In-Arrears Swaps: swaps whose Libor rates reset and are paid at the same time. Because of the mismatch between the payment schedule of the Libor and the one of the swap, the pricing of the In-arrear Libors are equal to the standard forward plus a convexity correction (see in-arrear swaps).
- Differential Swaps, which are quanto swap. The quanto feature enables to get exposure to foreign market without any foreign exchange exposure. The quanto risk depends on the joint movement of the Libor rates and the forward fx, hence the terminology of correlation product.
- Power swap: swap whose floating leg pays Libor square, Libor cubic and more generally a power function of the Libor rate.

- Non standard underlyings like inflation related, equity and asset swap:
  - CPI (Real Interest Rate) Swaps paying an inflation-linked index, often in a zero coupon swap form.
  - Asset swap: one leg pays the cash flows of a bond, while the floating leg pays a spread over Libor to make the two legs equal.
  - Equity swap: it follows a similar logic to an asset swap.
  - Credit related swap like Credit default swap (see Credit derivatives). Although this is a swap, it is often risk managed and traded by the desk of credit derivatives and not the swap and exotic swap desk.

This first generation of non-generic swap has been widely used for asset and liability management as well as simple trading strategies[1]. However, interest rates derivatives dealers have developed more exotic swaps to answer a need for higher sophistication of interest rates risk exposure. The second generation refers to more exotic option requiring modeling of the evolution of the yield curve but also the correlation and the distribution between its various components (both conditional and terminal distributions).

- Index amortizing swaps, whose notional amortization schedule is linked to a floating rate. This swap are of great use when hedging pool of liabilities whose notional can amortize according to early redemption mainly influenced by the overall level of the interest rate. This type of swap requires a good modeling of the dependence between the different floating rates.
- Bermudan structures: used for instance to hedge structured (callable, putable) bonds, as well as providing additional flexibility when to exercise the Bermudan swaption (either receiver or payer Bermudan swaptions).
- Range accrual Swaps: swaps whose notional accretes when a certain floating rate, often a different rate from the one used to pay, lies within a range. Accrual swaps are in fact a strip of digital options.
- Asian swap, whose Libor fixing are averaged to get smoother payment. Often used in combination of other exotic features.
- Digital (Binary) options: swap that pays a certain fix amount if the rates is above or below a certain level. Binaries can be completely replicated.

[1]Zero cost structures are very popular among investors. Typical example is zero cost collars where the purchase of the call is financed by the sale of a put or vice versa.

However, for practical hedging, one needs to aggregate the static hedge across a few instruments and get the best approximating hedge.

- Barrier option structures, also referred to a trigger swaps and swaptions, whose payoff is activated or dis-activated when a certain floating rate goes above or below a certain threshold. The attractive cheaper premium is a logic consequence of the upside given up.
- Chooser swap/swaptions, where the option holder can choose to enter into a receiver or a payer swap. Other forms of choose swap/swaptions allow the user to specify when to fix the floating rate, during an observation window.
- Extendible and cancelable swaps (callable and putable swaps): very similar to Bermudan swaption, this structure allows extending or terminating a given swap. Useful to hedge liabilities whose termination date is uncertain.

Complex swap structures are widely used for additional flexibility to match better liabilities whose notional and payment dates can be very uncertain. Complex swap can be a combination of the above individual component, like for instance power Libor, quanto, knock out swap. Complex swap structures can be used to get additional leverages for relative value trading and quasi arbitrage on the yield curve.

When designing a complex swap structure, structurers and financial engineers need to get a good understanding of the client's situation and

needs and to perform a thorough analysis of the impact of the structured product on her portfolio. To analyze risk, one decomposes the derivative into simple hedgeable components to isolate the various optionality and risk. The structurer makes also the difference between asset and liability point of view, as investor and borrower strategies have very different needs.

Entry category: swaps

Scope: types of complex swaps; pricing; uses

Related articles: Interest rate and cross-currency swaps; Swap futures

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