Asian Commodity Swap

A commodity swap is a deal where counter-parties exchange fixed payments for floating payments monthly based on a specific commodity, for example, West Texas Intermediate (WTI) crude oil. The fixed payments are specified as a given quantity times a fixed price; the floating payments are specified as a given quantity times the spot value of the commodity on the payment date. The floating payments may also be based on the arithmetic average of spot commodity price (Asian commodity-price) over the payment period or LIBOR plus a spread.

The commodities swaps are based on crude and refined oil products and these swaps are typically Asian commodity-price swaps. A typical deal where one party pays fixed and receives floating is specified as follows:

On party pays monthly *NQ* * *fp* where,

· *NQ* is the notional volume specified in barrels (BBL) for the month, and

· *fp* is the fixed price.

The party receives monthly:

$$NQ \times \left(\frac{1}{N_B} \sum_{BusDays} \tfrac{1}{2} \cdot \left(S_i^M + S_i^m \right) \right)$$

where,

· *NB* is the number of business days in the month,

· *SiM* is the daily commodity price high, and

· *Sim* is the daily commodity price low.

Let $\{T_i\}_{i=1}^{N}$ denote the sequence of payments dates and $\{NQ_i\}_{i=1}^{N}$ denote the sequence of fixed notional commodity amounts for the various payment periods; typically $NQ\ i\ = NQ\ j$ for all $i, j = 1, , N$, but equality need not hold in general.

The present value of the floating rate payment for a forward period and paid at T is given by the risk-neutral expectation of

$$\left(NQ/N_B\right)\cdot \sum_{BusDays} \tfrac{1}{2}\cdot\left(S_i^M + S_i^m\right)$$

We approximate this expectation as follows:

$$\frac{NQ}{N_B}\sum_{BusDays} \tfrac{1}{2}\cdot E_0\left[\left(S_i^M + S_i^m\right)\cdot \mathrm{B}^{-1}(T)\right] \approx DF(0,T)\frac{NQ}{N_B}\cdot\left(W_F F_u^1 + W_B F_u^2\right)$$

where

· *Fu*1 is the commodity futures price for a contract expiring in the forward period and *Fu*2 is the commodity futures price for a contract expiring in the next forward period,

· *WF* is the number of business days between the period start and *Fu*1 expiration counting the *Fu*1 expiration date,

· *WB* is the number of business days between *Fu*1 expiration and the period end not counting the *Fu*1 expiration date,

· *DF*(0,*T*) is the discount factor from *T* .

B(T) is the money-market account and is the value of continuously re-investing one dollar to T .

The present value of the floating rate payment for the current payment period and paid at T is the sum of the risk-neutral expectation of the floating rate payment over the remainder of the current period plus the floating rate payment over the current period that has already passed. The required expectation is approximated similarly as to what is described above so that the present value of the floating payment for the current period is given as follows:

$$V_o = V + DF(0,T)\frac{NQ}{N_B}\sum_{\substack{Accrued \\ BusDays}}\frac{1}{2}\cdot\left(S_i^M + S_i^m\right)$$

Where

·V is given by equation (1) with *WF* and *WB* calculated using the unaccrued time in the current period but with *NB* as the sum of the accrued and unaccrued business days

The current value of the end of the period fixed rate payment paid at T is given by

$$V = \hat{DF}(0,T)\cdot NQ\cdot fp$$

It should be noted that futures contracts are not traded on the entire range of crude and refined oil products for which one party does commodity swaps. For example, one party has done commodity swaps based on fuel oils such as New York Harbor (NYH) 1% for which there are no futures contracts. In such cases, the price of floating payments for forward months are generated from swap prices (see https://finpricing.com/lib/FxCompound.html) obtained from various brokers. These prices may be given as a spread to value of floating payments for commodities on which futures contracts are written; for instance, this would be the case for TAPIS-Malaysian crude oil-which is given as spread to WTI.