MDX Swap Pricing

Intercontinental Exchange

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1 MDX Index Series

A new *MDX Index Series* (series index i) is launched every 6 months (on the 8th business day of March and September of each year). The associated *Index Factor* $F_i(t)$ is based on a poll of mortgage loans initiated in the past 6 months. The index factor measures the proportion of loans which have not experienced a credit event

$$F_i(t) = 1 - \frac{\textit{Cumulative number of loans experiencing a credit event}}{\textit{Total number of loans in the MDX series pool}} \tag{1}$$

It starts at a level of 1 and is updated on the 8th business day of each month, based on the performance of the loans in the pool. Since it is updated monthly, we express its levels as $F_{i,j}$, where j is the index of the month, and T_j is the 8th business day of the j-th month. We define the index factor for each date as

$$F_i(t) = F_{i,j} \text{ , for } T_j \leq t < T_{j+1} \tag{2}$$

2 MDX Swap Pricing

An MDX swap is associated with a specific MDX index in the series. The swap starts at the index series start date and has a maturity of 5 years and 3 months.

The *floating leg* of the swap represents the monthly decrease in the index factor. The *current notional amount*, which equals the swap *initial notional amount* N times the index factor $N_i(t) = N \cdot F_i(t)$, is set on the *effective date*, the date on which the index is re-fixed every month. We can express the *Present Value* of the floating leg on valuation date t as

$$PV_{i,\text{float}}(t) = \sum_{j=1}^{J_i} I_{T_j>t} \cdot (N_{i,j-1} - N_{i,j}) \cdot DF(T'_j) \tag{3}$$

where T_j is the accrual end date for period j, $I_{T_j>t}$ is an indicator function such that

$$I_{T_j>t} = \begin{cases} 0 & T_j < t \\ 1 & T_j \geq t \end{cases} , \tag{4}$$

$DF(t)$ is the discount function, and T'_j is the payment date for period j given the payment delay.

The *fixed leg* represents monthly payments based on the interest accrued on a fixed coupon C_i between two successive effective dates on the current notional amount, and its *Present Value* is expressed as

$$PV_{i,\text{fixed}}(t) = C_i \cdot \sum_{j=1}^{J_i} I_{T_j>t} \cdot N_{i,j-1} \cdot \text{dcf}\,(T_{j-1}, T_j) \cdot DF(T'_j) \tag{5}$$

where $\text{dcf}\,(T_{j-1}, T_j)$ is the ACT/360 day-count fraction between the two dates.

For dates following the next upcoming fixing of the index factor (on the 8th business day of the month following the valuation date), the fixing values are not yet known. To determine these future fixing values of the index factor we assume that there is a fixed *Credit Event Rate* h, such that future index factors beyond the last known fixing F_{i,j^*} are given by

$$F_{i,j} = F_{i,j^*} \cdot \exp\left(-h \cdot \text{dcf}\,(T_{j^*}, T_j)\right) \tag{6}$$

A similar assumption of a fixed *hazard rate* is used in the *Standard CDS Model*.

The *Net Present Value* of the swap is given by

$$NPV_i(t) = \pm(PV_{i,\text{fixed}}(t) - PV_{i,\text{float}}(t)) \tag{7}$$

where the sign is determined by whether it is a deal to buy or sell protection. The *Accrued Interest* on the fixed leg is given by

$$AI_i(t) = C_i \cdot N_{i,j^*-1} \cdot \text{dcf}\,(T_{j^*-1}, t) \tag{8}$$

where $T_{j^*-1} \leq t < T_{j^*}$. We can rewrite Eqs. (3) and (5) using the index j^* as

$$PV_{i,\text{float}}(t) = \sum_{j=j^*}^{J_i} (N_{i,j-1} - N_{i,j}) \cdot DF(T'_j) \tag{9}$$

and

$$PV_{i,\text{fixed}}(t) = C_i \cdot \sum_{j=1}^{J_i} N_{i,j-1} \cdot \text{dcf}\left(T_{j-1}, T_j\right) \cdot DF(T_j') \tag{10}$$

The NPV is a *dirty price* for the MDX swap which includes accrued interest. The *clean price* for the swap (excluding accrued interest) is called the *Upfront Payment*

$$UP_i(t) = NPV_i(t) \mp AI_i(t) = \pm\left(PV_{i,\text{fixed}}(t) - AI_i(t) - PV_{i,\text{float}}(t)\right) \tag{11}$$

The *Upfront Fee* represents the Upfront Payment as a percentage of the current notional amount

$$UF_i(t) = \left(UP_i(t)/N_i(t)\right) \cdot 100 \tag{12}$$

The *Conventional Spread* is the fixed coupon which makes the upfront payment zero: $UP_i(t) = 0$

$$CS_i(t) = \frac{\sum_{j=j^*}^{J_i} \left(N_{i,j-1} - N_{i,j}\right) \cdot DF(T_j')}{\sum_{j=j^*}^{J_i} N_{i,j-1} \cdot \text{dcf}\left(T_{j-1}, T_j\right) \cdot DF(T_j') - N_{i,j^*-1} \cdot \text{dcf}\left(T_{j^*-1}, t\right)} \tag{13}$$

The Clean Price of the MDX swap is defined as

$$CP_i(t) = 100 - UF_i(t) \tag{14}$$

The Par Rate is the fixed coupon which makes the swap NPV zero

$$PR_i(t) = \frac{\sum_{j=j^*}^{J_i} \left(N_{i,j-1} - N_{i,j}\right) \cdot DF(T_j')}{\sum_{j=j^*}^{J_i} N_{i,j-1} \cdot \text{dcf}\left(T_{j-1}, T_j\right) \cdot DF(T_j')} \tag{15}$$

3 MDX Data

The MDX calculator uses two sources of data:

- A monthly file generated by Black Knight (BK) which contain updated fixings of the various MDX indices. The files are generated no later than the evening of the 7$^{\text{th}}$ business day of the month, so that the data is available for the MDX index effective date on the 8$^{\text{th}}$ business day of the month. The file is generated once a month, but in some cases there are updates to the file.
- A daily file generated by ICE Data Derivatives (IDD) containing values of OIS par swap rates for selected currencies at the London 16:15 cutoff. We use yesterday's SOFR curve to price MDX swaps today.

4 MDX Swap Conventions

The following table summarizes the conventions used for building the swap cashflows [1] [2] .

Variable	**Value**
Calendar	NYB (New York Banking)
Index Effective Dates	8th business day of each month
Start Date	Index effective date on March or September of each year
End Date	Index effective date 63 months after the start date
Payment Frequency	Monthly
Accrual Start date	Index effective date at the start of the accrual period
Accrual End date	Index effective date at the end of the accrual period
Fixed Coupon Daycount Convention	ACT/360
Coupon Payment Delay	5 business days
Trade Settlement Delay	3 business days

[1] Unless otherwise specified the NYB calendar is identical to the Federal Reserve Bank of New York calendar.

[2] In order to maintain consistency with the CDS Standard Model code, we apply a 0 day coupon payment delay in the MDX Swap converter.

5 Yield Curve Construction Conventions

The following table summarizes the conventions used for yield curve construction.

Variable	**Value**
Swap tenors	1M, 2M, 3M, 6M, 9M, 1Y, 2Y, 3Y, 4Y, 5Y, 6Y, 7Y, 8Y, 9Y, 10Y
Interpolation method	Step-function forward
Day count convention	ACT/360
Roll convention	Modified Following
Payment Frequency	1 period for tenor up to 1Y; annual for tenor greater than 1Y
Payment delay	0 days
Calendar	NYB (New York Banking)