Reset Fixed Cashflow Specification

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Chapter 1

Reset Fixed Cashflow

1.1 Properties of Cashflow

There are two currencies in a reset cashflow – **constant currency** and **variable currency**. The **variable currency amount** is an amount equal to the **constant currency amount** converted to the **variable currency** by reference to the **relevant FX rate** between the **constant currency** and the **variable currency**. On the **flow date**, there are two transfers:

1) the underlying fixed cashflow in **variable currency**, and

2) the principal adjustment amount in **variable currency**.

1.2 Definitions

In this section, we define terms that are specific to the fixed cashflow.

accrual day count fraction is the day count fraction of the **accrual period**.

accrual end date is the end date of the **accrual period**.

accrual period is the tenor period over which the **fixed rate** applies.

accrual start date is the start date of the **accrual period**.

constant currency is currency that the **constant currency amount** is quoted in.

constant currency amount is the notional amount in **constant currency** of the cashflow.

fixed rate is the per annum fixed interest rate that applies to the cashflow.

flow date is the date that the cashflow transfer occurs.

next principal reset date is the **principal reset date** for the next reset flow in the **variable currency** leg, or if the current cashflow is the last one in the leg, the date the final principal exchange occurs.

principal reset date is the date that the **relevant FX rate** is set.

relevant FX rate is the FX rate between **constant currency** and **variable currency**, observed on the **principal reset date**. Together with the **constant currency amount**, it determines the **variable currency amount**.

variable currency is currency that the transfer is in.

variable currency amount is the notional amount in **variable currency** of the cashflow, which is determined from the **constant currency amount** and the **relevant FX rate**.

1.3 Cashflow Inputs

A fixed cashflow is specified by the mandatory fields in Table 1.1, the optional field in Table 1.2, with their restrictions in Table 1.3.

Field	*Description*	*Data Type*	*Symbol*
PayReceive	The pay/receive direction of the cashflow	string	direction
FlowDate	The date of the cashflow payment, i.e. the **flow date**	date	FD
ConstantCurrency	The **constant currency**	string	c
Currency	The **variable currency**	string	v
InterestStyle	The interest style of the cashflow	string	style
AccrualDayCount	The day count convention for the **accrual period**	string	dcc
Amount	The **constant currency amount**	double	N_c
FixedRate	The fixed interest rate, i.e. the **fixed rate**	double	R
AccrualStartDate	The **accrual start date**	date	ASD
AccrualEndDate	The **accrual end date**	date	AED
PrincipalResetDate	The **principal reset date**	date	PRD
NextPrincipalResetDate	The **next principal reset date**	date	NPRD

Table 1.1: Mandatory fields for Reset Fixed Cashflow

Field	*Description*	*Data Type*	*Symbol*	*Default Value*
DiscountReference	Alternative discounting curve for *Currency*	string		
FXRateQuoteStyle	Quote style for *FXRateOnResetDate* and *FXRateOnNextResetDate*	string		
FXRateOnResetDate	The **relevant FX rate** fixed on *PrincipalResetDate* quoted in *FXRateQuoteStyle*	double	E_{PRD}	
FXRateOnNextResetDate	The **relevant FX rate** fixed on *NextPrincipalResetDate* quoted in *FXRateQuoteStyle*	double	E_{NPRD}	
DiscountRate	For Discount flow, standard discounting method applies. This specifies the discount rate. If not specified, the flow will be discounted with the **fixed rate**.	string	D	R
DiscountRateDayCount	For Discount flow, standard discounting method applies. This specifies the day count convention for the discount rate. If not specified, it takes the value of the **accrual day count fraction**.	string	$\mathrm{dcc_D}$	dcc
LegID	The identifier of the leg	string		
Description	The description of the flow	string		

Table 1.2: Optional field for Reset Fixed Cashflow

1.3.1 Required Curves

The following curves are required by a reset fixed cashflow:

- *ConstantCurrency FX spot curve*: FX Spot Curve — (FX.PRICE.ConstantCurrency.BaseCurrency),
- *Currency FX spot curve*: FX Spot Curve — (FX.PRICE.Currency.BaseCurrency),
- *Currency discounting curve*: FX Zero Curve — (FX.ZERO.Currency.ReserveCurrency),
- *ConstantCurrency FX implied curve*: FX Zero Curve — (FX.ZERO.ConstantCurrency.ReserveCurrency), and
- *Currency FX implied curve*: FX Zero Curve — (FX.ZERO.Currency.ReserveCurrency).

Field	*Restriction*
PayReceive	Pay, Receive, P, R
VariableCurrency	$\mathrm{v} \neq \mathrm{c}$
InterestStyle	Simple, Discount
Amount	$N_{\mathrm{c}} > 0$
AccrualEndDate	AED > ASD
PrincipalResetDate	PSD < NPSD
NextPrincipalResetDate	NPSD < FD
FXRateQuoteStyle	CurrencyPerConstantCurrency, ConstantCurrencyPerCurrency

Table 1.3: Field restrictions for Reset Fixed Cashflow

The ConstantCurrency FX implied curve and the Currency FX implied curve are used to forecast the **relevant FX rate**.

In the case of the optional field DiscountReference is provided, the reference curve is used as the Currency discounting curve instead.

1.4 Formula

The transfer in **variable currency** on the **flow date** of a reset fixed cashflow is

$$\begin{cases} N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} \times \mathbb{I}_{\mathrm{pr}} \times R\tau + N_{\mathrm{c}} \times \mathbb{I}_{\mathrm{pr}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right), & \text{if style is `Simple'}, \\ N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} \times \mathbb{I}_{\mathrm{pr}} \times \dfrac{R\tau}{1 + D\tau_D} + N_{\mathrm{c}} \times \mathbb{I}_{\mathrm{pr}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right), & \text{if style is `Discount'}, \end{cases} \tag{1.1}$$

where

- N_{c} is the **constant currency amount** in **constant currency**,
- R is the **fixed rate**,
- τ is the **accrual day count fraction**, from **accrual start date** to **accrual end date**, according to the day count convention for the **accrual period** (dcc),
- $E_{\mathrm{PRD(v/c)}}$ is the **relevant FX rate** on **principal reset date** in **variable currency** per **constant currency**,
- $E_{\mathrm{NPRD(v/c)}}$ is the **relevant FX rate** on **next principal reset date** in **variable currency** per **constant currency**,
- D is the discount rate,
- τ_D is the day count fraction from **accrual start date** to **accrual end date**, according to the discount day count convention ($\mathrm{dcc_D}$), and
- the indicator for pay or receive direction is

$$\mathbb{I}_{\mathrm{pr}} = \begin{cases} 1, & \text{if direction is `R'}, \\ -1, & \text{if direction is `P'}. \end{cases}$$

Note that $N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}}$ is the **variable currency amount** and $N_{\mathrm{c}} \times \mathbb{I}_{\mathrm{pr}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right)$ is the principal adjustment amount.

1.5 Examples

This section provides some deal examples of reset fixed cashflow.

Example 1.1. A reset fixed cashflow:

- PayReceive: Pay
- Currrency: AUD
- ConstantCurrrency: GBP
- InterestStyle: Simple
- AccrualDayCount: ACT365(FIXED)
- FlowDate: 2013-11-15
- ConstantCurrencyAmount: 60,000,000
- FixedRate: 0.0315
- AccrualStartDate: 2013-08-15
- AccrualEndDate: 2013-11-15
- PrincipalResetDate: 2013-08-14
- NextPrincipalResetDate: 2013-11-14
- FXRateQuoteStyle: CurrencyPerConstantCurrency
- FXRateOnResetDate: 1.6667
- FXRateOnNextResetDate: 1.6545

There are 92 days from the **accrual start date** (2013-08-15) to the **accrual end date** (2013-11-15). The **accrual day count fraction** of the cashflow is calculated using the Actual/365 (Fixed) day count convention to give

$$\tau = \frac{92}{365}.$$

Given the FX rate quote style is CurrencyPerConstantCurrency, we do not need to adjust the provided FX rates. The **variable currency amount** is

$$N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} = 60,000,000 \times 1.6667 = \$100,002,000 \text{ AUD},$$

and the principal adjustment amount is

$$N_{\mathrm{c}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right) = 60,000,000 \times (1.6667 - 1.6545) = \$732,000 \text{ AUD}.$$

Using (1.1), on 2013-11-15, there is a payment of

$$\begin{aligned}
&N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} \times R\tau + N_{\mathrm{c}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right) \\
&= 100,002,000 \times 0.0315 \times \frac{92}{365} + 732,000 \\
&= 793,988.48 + 732,000 \\
&= \$1,525,988.48 \text{ AUD},
\end{aligned}$$

which consists of \$793,988.48 AUD for the interest payment and a principal adjustment amount of \$732,000 AUD.

Example 1.2. A reset fixed cashflow:

- PayReceive: Receive
- Currrency: USD
- ConstantCurrrency: JPY
- InterestStyle: Simple
- AccrualDayCount: 30360
- FlowDate: 2013-11-15
- ConstantCurrencyAmount: 1,000,000,000
- FixedRate: 0.0145
- AccrualStartDate: 2013-08-15
- AccrualEndDate: 2013-11-15
- PrincipalResetDate: 2013-08-14
- NextPrincipalResetDate: 2013-11-14
- FXRateQuoteStyle: ConstantCurrencyPerCurrency
- FXRateOnResetDate: 99.65
- FXRateOnNextResetDate: 99.59

Using 30/360 day count convention, there are 90 days from the **accrual start date** (2013-08-15) to the **accrual end date** (2013-11-15). The **accrual day count fraction** of the cashflow is

$$\tau = \frac{90}{360} = 0.25.$$

Given the FX rate quote style is ConstantCurrencyPerCurrency, we need to invert the provided FX rates.

The **variable currency amount** is

$$N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} = 1,000,000,000/99.65 = \$10,035,122.93 \text{ USD},$$

and the principal adjustment amount is

$$N_{\mathrm{c}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right) = 1,000,000,000 \times (\frac{1}{99.65} - \frac{1}{99.59}) = -\$6,045.86 \text{ USD}.$$

Using (1.1), on 2013-11-15, one receives

$$\begin{aligned} & N_{\mathrm{c}} \times E_{\mathrm{PRD(v/c)}} \times R\tau + N_{\mathrm{c}} \times \left(E_{\mathrm{PRD(v/c)}} - E_{\mathrm{NPRD(v/c)}}\right) \\ &= 10,035,122.93 \times 0.0145 \times 0.25 - 6,045.86 \\ &= 36,377.32 - 6,045.86 \\ &= \$30,331.46 \text{ USD}, \end{aligned}$$

which consists of $36,377.32 USD for the interest payment and a principal adjustment amount of -$6,045.86 USD.

Glossary

Base Currency The currency that the risk engine is configured to return values in.

Reserve Currency The currency that all cross currency basis is benchmarked against.