Bloomberg Barclays Bond Index Methodology

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We describe the calculation methodology of index-level return and duration for Bloomberg Barclays bond index, as presented in (Bloomberg LP, 2017.3.17.).

1 Main Steps

1. Calculate month-to-date (MTD) index return.
   1) Calculate security-level MTD returns.
   2) Calculate security-level market value weights at the beginning of a month (BOM).
   3) Using returns obtained in 1) and weights obtained in 2) to calculate MTD index return:

$$Index\ Return_{MTD} = \sum (Bond\ Return_{MTD} \times Bond\ Weight_{BOM})$$

2. Use monthly compounding to calculate index return over any period.
3. For any statistics like duration, yield and OAS, index-level statistics are weighted by the daily market value of each index-eligible bond in the "Projected Universe", which is a dynamic set of bonds that changes daily to reflect the latest set of index-eligible securities.

2 Details

2.1 Security-level returns over a period

Convention:

1) All the prices used below are clean prices (clean price = PV of future cash flows – accrued interest).
2) Concepts presented in this sub-section are applicable to any period, not just periods whose beginnings are the beginning of a month.

Notation:

- P_b: beginning price of a bond during a period.
- P_e: ending price of a bond during a period.
- A_b: accrued interest of a bond at the beginning of a period.
- A_e: accrued interest of a bond at the ending of a period.
- *IntPayment*: interest payment made during a period.
- *PrincPayment*: principal payment made during a period, applicable to amortizing or partially called bonds.
- MV_b: beginning market price of a security, defined as $P_b + A_b$ (also known as *dirty price*).

- $Outstand_b$: balance outstanding at the beginning of a period.
- $MarketValue_b$: market value at the beginning of a period, defined as $MV_b \times Outstand_b$.

Price return over a period:

$$price\ return = \frac{P_e - P_b}{MV_b}$$

Coupon return over a period:

$$coupon\ return = \frac{A_e - A_b + IntPayment}{MV_b}$$

Paydown return over a period: return due to scheduled and unscheduled payments of principal.

$$paydown\ return = \frac{PrincPayment}{Outstand_b} \times \frac{100 - P_e - A_e}{MV_b}$$

Currency return over a period: omitted for our purpose.

Bond total return over a period: (omitted additional return terms that are only applicable to CMBS)

$$bond\ total\ return = price\ return + coupon\ return + paydown\ return + currency\ return$$

2.2 Security-level market value weights for a period

Notation:

- *RU*: **Returns Universe** of a bond index.
  "Returns Universe is a static set of securities that is determined at the beginning of each month and is not reset until the beginning of the next month. This fixed universe is used to calculate daily and monthly index returns and is the basket of bonds against which index users are officially measured against. The Returns Universe is not adjusted for securities that become ineligible for inclusion during the month or for issues that are newly eligible." (Bloomberg LP, 2017.3.17., p. 49)

For each bond in the index university, its market value weight in % for a period is calculated as

$$market\ value\ weight\ in\ \% = \frac{MarketValue_b}{\sum_{RU} MarketValue_b} = \frac{MV_b \times Outstand_b}{\sum_{RU} MV_b \times Outstand_b}$$

2.3 Month-To-Date index return

The month-to-date (MTD) index return is calculated as

$$Index\ Total\ Return_{MTD} = \sum (Bond\ Return_{MTD} \times Bond\ Weight_{BOM})$$

Where we have used concepts in Section 2.1, with "beginning" = beginning of a month and "ending" = a date after the beginning of a month but before or equal to the ending of that month.

2.4 Index return over any period

For a given index, let TR_n denote the index total return over the *n*th month since index inception. The since-inception-total-return (SITR) is defined as

$$SITR = 100(1 + TR_1)(1 + TR_2)\cdots(1 + TR_n)(1 + TR_{MTD}) - 100$$

Where current date falls within the *(n+1)*th month since index inception. Then the index total return over a period is given by

$$\frac{(1 + TR_1)(1 + TR_2)\cdots\left(1 + TR_{n(e)}\right)\left(1 + TR_{MTD,ending}\right)}{(1 + TR_1)(1 + TR_2)\cdots\left(1 + TR_{n(b)}\right)\left(1 + TR_{MTD,beginning}\right)} \times 100 - 100$$

Where the period beginning is assumed to fall within the *(n(b)+1)*th month since index inception and the period ending is assumed to fall within the *(n(e)+1)*th month since index inception.

2.5 Index-level statistics at any point in time

Notation:

- *PU*: **Projected Universe** of a bond index.
  "The Projected (Statistics) Universe is a dynamic set of bonds that changes daily to reflect the latest set of index-eligible securities. Indicative changes to securities are reflected daily in both the Projected and Returns Universes of the index and may cause bonds to enter or fall out of the Projected Universe, but will affect the composition of the Returns Universe only at month-end." (Bloomberg LP, 2017.3.17., p. 49)

Index-level statistics such as duration, yield and OAS, are weighted by the daily or "Ending" market value of each index-eligible bond in the Projected Universe. (Bloomberg LP, 2017.3.17., p. 66)

$$Projected\ Universe\ Market\ Value\ \% = \frac{Security\ Market\ Value_{ending}}{\sum Security\ Market\ Value_{ending}}$$

3 Data Requirement for Methodology Replication

To replicate the above methodology of calculating index return and other statistics (like duration), we itemize the data requirement as follows:

- Index return
  - Price return and coupon return over a period: daily bond price, daily bond accrued interest.

    - Market value weight for *Return Universe*: daily bond price, daily bond accrued interest, daily bond amount outstanding.
- Index duration
    - Daily bond duration.
    - Market value weight for *Projected Universe*: daily bond price, daily bond accrued interest, daily bond amount outstanding.

4 Bibliography

Bloomberg LP. (2017.3.17.). *Bloomberg Barclays Index Methodology.* New York: Bloomberg LP.