

# Fixed Income Research

# Universe Bond Index

# Methodology

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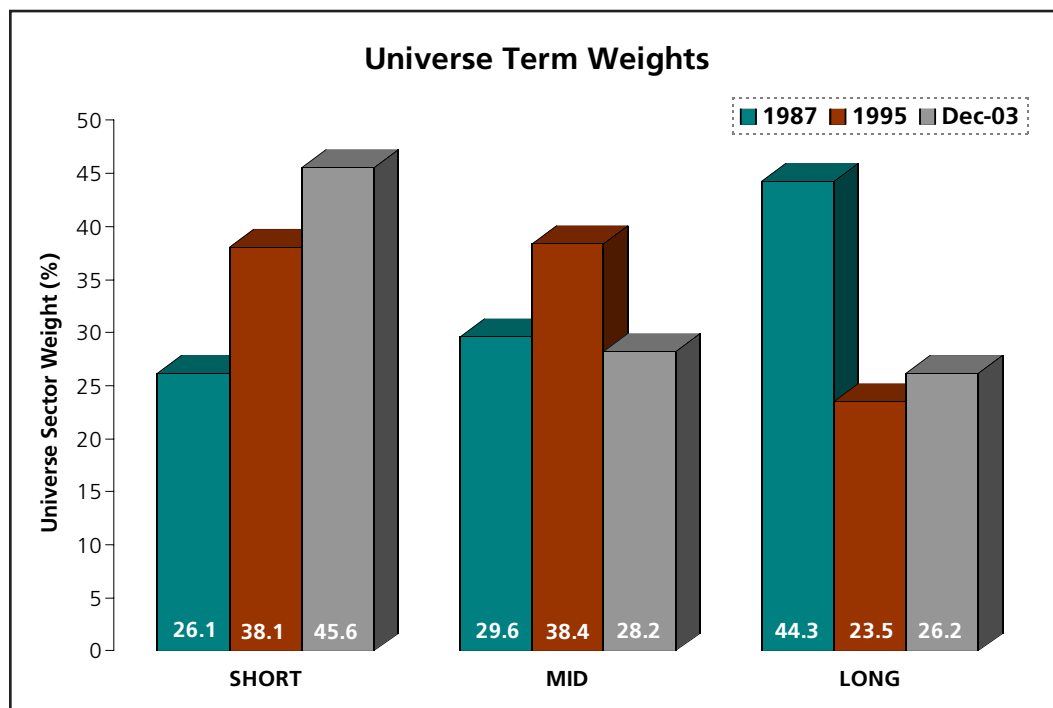
Scotia Capital has been publishing indices to measure the performance of the Canadian fixed income market since 1947. Our indices are the most widely used fixed income performance benchmarks in Canada. The best known of these indices is the Universe Bond Index, which tracks the broad Canadian bond market. In addition to the Universe, we publish a variety of sub-indices for different term and credit sectors, as well as indices for tracking other segments of the market, including High Yield, Euro, and Yankee bonds, inflation-indexed Real Return Bonds, T-Bills, and residential and commercial Mortgage-Backed Securities.

## Universe Bond Index Overview

The Universe Bond Index is designed to be a broad measure of the Canadian investment-grade fixed income market. As of December 31 2003, the Universe Index consisted of 921 securities, with a total market value of approximately \$528 billion. Returns are calculated daily, and are weighted by market capitalization, so that the return on a bond influences the return on the index in proportion to the bond's market value. The Universe Index has been published since 1979. It is intended to be a transparent index, with individual security holdings disclosed electronically each day.

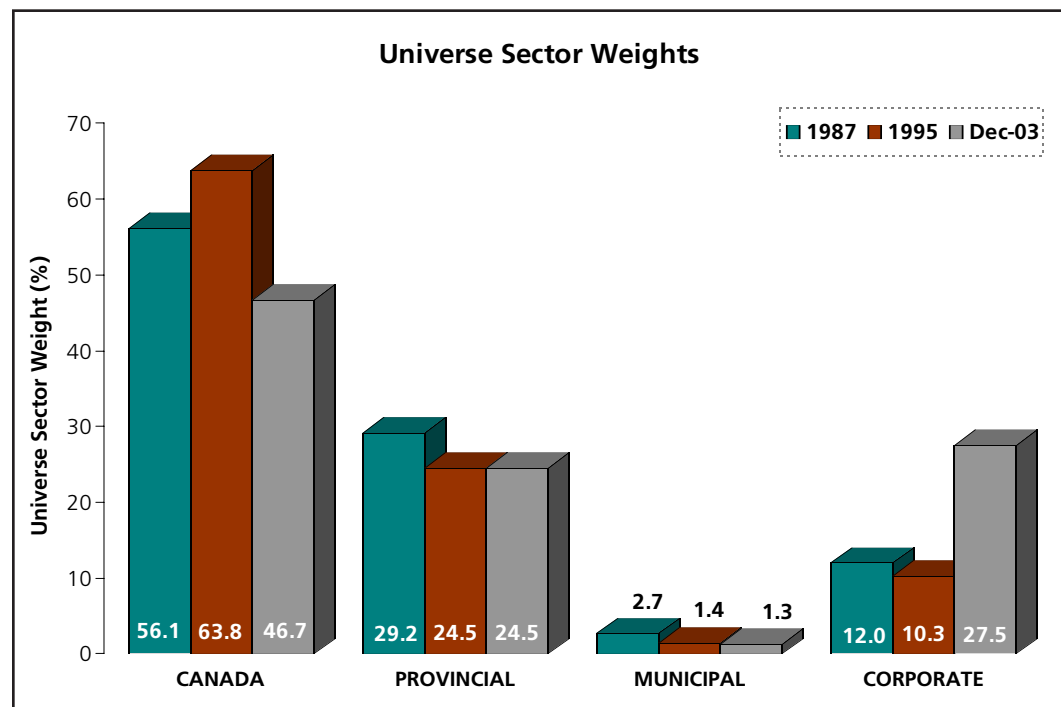
## Term and Credit Sub-Sectors

The Universe Index is divided into a variety of sub-indices according to term and credit. The main term sub-sectors are Short, Mid, and Long. The Short sub-indices include bonds with remaining effective terms greater than 1 year and less than or equal to 5 years. The Mid sub-indices include bonds with remaining terms greater than 5 years, and less than or equal to 10 years, while the Long sub-indices include remaining terms greater than 10 years. As of December 2003, the Short sector made up approximately 45.6% of the Universe Index, while the Mid and Long sectors made up 28.2% and 26.2%, respectively.



There are four main credit or borrower categories: bonds issued by the Government of Canada (including Crown Corporations), Provincial bonds (including provincially-guaranteed securities), Municipal Bonds, and Corporate Bonds. As of December 2003, the Canada and Crown Corporation sector accounted for approximately 46.7% of the Universe Bond Index. The Provincial sector was 24.5%, the Municipal sector was 1.3%, and the Corporate Sector was 27.5%.

The Corporate sector is further divided into sub-sectors based on major industry groups: Financial, Communication, Industrial, Energy, Infrastructure, Real Estate, and Securitization. The Corporate sector is also divided into sub-indices based on credit rating: a combined AAA/AA sector, a single-A sector, and a BBB sector.



### Eligibility Criteria

The Universe Bond Index consists of semi-annual pay fixed rate bonds issued domestically in Canada and denominated in Canadian dollars, with a remaining effective term to maturity of at least one year. It is an investment grade index, and thus only includes securities rated BBB and higher.

The majority of the bonds in the index are semi-annual pay bullet securities with no call or other option features. However, the index also includes the following: callable bonds, extendible/ retractable bonds, sinking funds, exchangeables, fixed-floaters, semi-annual amortizing securities, and certain asset-backed securities (ABS) that are structured as semi-annual pay bullet bonds. This latter category primarily consists of credit card ABS. Bonds with option features are assigned to index term sectors based on their effective maturity date (either the option exercise date or the final maturity date). Although most bonds in the index are public issues, private issues that meet the above criteria are also eligible for inclusion.

The index does not include floating-rate notes, convertible bonds, residential and commercial mortgage-backed securities (CMBS and MBS), other monthly-pay securities, other prepayable securities, inflation-indexed securities, or securities specifically targeted to the retail market. It also excludes securities that are not priced, which would typically be securities that are closely held and do not trade.

Securities must meet minimum size requirements to help ensure that the securities in the index are sufficiently liquid, and that it is possible for a fund manager to replicate the performance of the Index.

Effective July 15th 2003, the following minimum sizes apply for index inclusion, reflecting the shift

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toward larger issuance:

\$100 million for Corporate bonds

\$50 million for Government bonds

In both cases, there must be a minimum of 10 institutional buyers. These dollar amounts include the original issue amount plus re-openings. Note that for the purpose of calculating returns and risk measures, index holdings are adjusted to reflect buybacks, amounts held by the Bank of Canada, and the stripping and reconstitution of securities, but these adjustments do not affect index inclusion or exclusion.

#### *Superseded Minimum Size Rules*

Prior to July 15th 2003, the following size rules were in place. Public issues and MTNs required a minimum issue size of \$40 million, while private issues required a minimum issue size of \$100 million. A new issue required a minimum of 10 institutional buyers.

#### **Weighting**

The securities in all Scotia Capital Bond Indices are weighted by relative market capitalization. Thus, the return on a bond influences the return on the index in proportion to the bond's market value. Market value of a bond equals the adjusted amount outstanding, multiplied by the gross price (market price plus accrued interest), with the gross price expressed as a percentage.

The total amount outstanding of each issue is adjusted so that Bank of Canada holdings and stripped securities are excluded, and reconstituted securities are included.

Capitalization weighting effectively assumes an investor "buys the market." It thus reflects passive bond portfolio management better than other weighting schemes, and is therefore the most appropriate weighting scheme for a performance benchmark.

#### **Effective Term**

Bonds are classified into term sub-indices based on their effective terms, so that each term sub-index reflects securities that trade off of comparable parts of the yield curve. For a bond with an embedded option feature, including puttable, callable, extendible, and retractable securities, the effective term is either the option exercise date, or the bond's final maturity date, depending on where the bond is trading in the market. In the case of a fixed-floater, the effective term is the date of the final fixed coupon payment. Amortizing securities are classified based on final maturity.

#### **Re-Balancing: Handling New Issues, Coupon Payments, and Roll-Outs**

A market index has to be re-balanced periodically in order to account for routine events like coupon payments and new issues. All Scotia Capital Bond Indices are re-balanced on a daily basis, since daily re-balancing most closely reflects the dynamic investment environment faced by portfolio managers.

A new issue enters the index on the day it is issued or auctioned. The bond is included in the calculation of index risk statistics like duration on the day of issue, though it does not affect the return on the index until the following business day. The new security does not begin to accrue interest until the new issue settlement date.

A bond is removed from the index on the day its remaining effective term to maturity declines to one calendar year, whether that year has 365 or 366 days. For example, on December 1 2003, the index sells a bond maturing in one year, December 1 2004, at the 4:00 pm mark-to-market price. This bond therefore contributes to the return on the index from November 28 (the previous business day) to December 1, 2003. It does not contribute to index duration and other risk statistics calculated at the close on December 1st 2003. Analogous rules apply for the movement of bonds from one term sub-index to another, e.g. from Long to Mid.

For a bond with embedded option features, the rule for moving from one term category to another, and for rolling out of the index, is based on effective term (either the option exercise date, or the final

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maturity date), since these bonds are classified into index term categories according to effective term. Thus, a June 1 2008 bond callable as of June 1 2004 and trading to its call date would be removed from the index on June 1 2003.

Coupon income, realized and unrealized, is reinvested daily across all bonds in the index in proportion to their market values<sup>1</sup>.

A detailed example of how index returns are calculated when the index constituents change is provided in the appendix.

## **Valuation**

The securities that make up the Universe Bond Index are priced each day by the trading desk at 4:00 pm Eastern Standard Time. The 4:00 pm prices are automatically supplied to the index calculation system. The same 4:00 pm prices are electronically distributed to investors through a variety of channels, including the PC Bond software system, the ScotiaBond Performance Attribution System, the Fastquote service, and via third party data vendors. Thus, a portfolio valued using one of these sources can be compared on a consistent basis with the appropriate Scotia Capital bond index. The index is constructed using mid-market prices.

Valuation at the 4:00 pm close is based on the trader's judgment of where a security should be priced, taking into account such factors as where the security previously traded, liquidity, and any market-wide as well as security-specific developments that can be expected to affect the price. This policy is intended to reflect changing market conditions, even in cases where a security may not frequently trade.

For securities that trade actively, the closing price will generally be close to where the security last traded, if not the same. For securities that trade less frequently, however, there could be a larger difference between the closing price and the price where the security last traded. Consider the extreme case of a security that trades in the morning, is subsequently and unexpectedly downgraded, and does not trade for the rest of the day. When setting the 4:00 pm price, it is more accurate and conservative for the trader to reflect the expected impact of the credit rating downgrade, rather than simply rely on the latest available transaction.

## **Why 4:00 PM Valuation?**

Why isn't the index valued using prices as of 5:00 pm, when the market closes? The answer is liquidity. Passive investors who track the Universe Index closely often need to trade as close to the Index valuation time as possible in order to minimize tracking error, especially at times when the composition of the index is changing. Using prices from the 5:00 pm market close to value the index could therefore present problems of reduced liquidity. The use of 4:00 PM prices is the best compromise between the goal of end-of-day valuation, and maintaining sufficient market liquidity.

## **Settlement Conventions**

Accrued interest on bonds in the index is calculated assuming same day settlement. Most bonds in Canada accrue interest using an actual/365 day count convention. When the last calendar day in a month is not a business day, accrued interest is calculated to the last business day of the month. Same day settlement is used for calculating all index risk measures.

## **Credit Rating Categories**

Bonds in the index are classified into broad credit rating categories of AAA/AA, A, and BBB, based on information from Dominion Bond Rating Service, Standard and Poor's, and Moody's Investors Service.

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<sup>1</sup> It has occasionally been argued that the process of chain-linking returns (see Appendix) does not actually involve the reinvestment of coupons, and that therefore the return on the index does not include coupon reinvestment. The first of these statements is debatable; the second is false. The argument that coupons are not reinvested arises from the fact that the total market value of a bond in the index is not increased as a result of coupon reinvestment. This in and of itself is true: if a portfolio owns the total amount outstanding of every bond, it obviously cannot buy any more of each bond, and would have to look to other markets to invest coupon payments.

One should instead think of the index as measuring the performance of a portfolio that holds each bond in proportion to its market value. It is thus the relative market value that matters, and reinvesting coupons across all bonds in proportion to their market values has no effect on relative market values, though it of course makes a significant contribution to total return.

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Ratings data from these three agencies is transmitted electronically into our index database, requiring minimal user involvement

The index does not distinguish between minor ratings notches, such as plus or minus signs or their equivalent within a broad letter category. Thus, the ratings A+, A, and A- are viewed as equivalent for the purposes of the index. As well, the index does not take into account a rating agency's outlook for a credit rating, or whether a particular rating may be under review by an agency.

### Handling Split Ratings, Defaults and Downgrades below Investment Grade

In cases where the agencies do not agree on the credit rating, the bond will be classified according to the following rules:

- If two agencies rate a security, and the ratings are not equal, use the lower of the two ratings;
- If three agencies rate a security, use the most common rating;
- In the rare event that all three agencies disagree, use the middle rating<sup>2</sup>.

These rules mean that a bond rated by two or more agencies must have at least two investment grade credit ratings to be eligible for the Universe Bond Index. For example, a new issue rated BBB- by S&P and BB+ by DBRS would be assigned a rating of BB for the purposes of the index, and would not be eligible for inclusion in the index. Similarly, a bond in the index that is downgraded to BB+ by one agency would no longer be eligible for index inclusion. Additional examples are shown in the table below.

Example	DBRS	Moody's	S & P	Index Rating
1	BBB-	BBB-	BB+	BBB
2	BBB-	Not Rated	BB+	BB
3	A-	BBB+	BBB+	BBB
4	Not Rated	A+	AA-	A

When a bond defaults or is downgraded below BBB, it is removed from the index 90 days after the initial default or downgrade. Removal is delayed to help ensure that the full price impact of the default/downgrade is reflected in the Index before the bond is removed. If the bond were instead removed from the index before the full price decline had happened, and a portfolio continued to hold the bond, index returns would tend to be biased upward relative to actual portfolio returns. When a corporate bond is downgraded or upgraded from one investment grade category to another, for example from A to BBB, the change is made to the index on the following business day.

Unsolicited ratings will not be used when determining index rating categories.

#### *Superseded Split-Rating Rules*

Prior to July 15th 2003, credit ratings were based on information from Dominion Bond Rating Service and Standard and Poor's. A bond with a split credit rating was categorized in the index based on how the bond traded in the market, which was established in consultation with the trading desk and the Corporate research analysts.

### Index Risk Measures

Several risk measures are calculated for the Scotia Capital Indices each day. Modified duration, Macaulay duration, and convexity are calculated as market-value weighted averages of the respective measures for constituent bonds. Val01, which measures the dollar price sensitivity to a change in yield (in contrast to modified duration, which measures percentage price sensitivity), is calculated by weighting the individual bonds by their adjusted par values. All risk measures are calculated based on same-day settlement (prior to implementation of the new index system on July 15th 2003, published risk measures were based on normal settlement conventions).

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<sup>2</sup> The latter case is included for completeness, but would be very unusual in practice. For the index, ratings like A+, A, and A- are all considered equivalent. Therefore, disagreement between all three agencies would mean three different letter categories, for example AA, A, and BBB.

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Routine events like coupon payments and the addition or removal of bonds from the Index can cause significant changes in index duration. The payment of a coupon on an individual bond causes the duration of the bond to increase, holding yield constant. At the level of the index, the coupon payments on the first of June and December typically cause significant increases in index duration. As a typical example, the payment of \$5.6 billion in coupons on June 1 2001 caused the modified duration of the Index to increase approximately 0.08 years.

A large bond issue can also significantly affect index duration. Issuance of a bond that has a shorter duration than that of the index causes index duration to decline, whereas issuance of a longer duration bond causes index duration to increase. As a recent example of the typical impact, the issuance of \$3.5 billion 2-year Canada bonds on June 14 2001 caused the index modified duration to decline approximately 0.024 years. The \$1.9 billion re-opening of the long Canada on April 19 2001 caused the index modified duration to increase approximately 0.02 years.

### **Other Index Statistics**

The Price Index measures the return from capital gains, excluding coupon income and the reinvestment of coupons. The Yield Index measures the average yield of the constituent bonds, weighted by market value. A variety of other statistics is also calculated, including average coupon and term.

### **Data Quality**

The integrity of the prices in the index begins with the trading desk, which values directly virtually every security that goes into our database. All data inputs to the index, including price, credit rating, and amount outstanding, must pass through a scrubbing process each day that checks for data variances. The scrub results must be approved by the data analyst each day before the system will allow the index to run.

The data inputs into the index calculation are based on electronic transfer of information as much as possible, with minimal user involvement. This includes the electronic transfer of prices from the trading desk to the index system, PC Bond, ScotiaBond Performance Attribution, and Fastquote, as well as the transfer of ratings data from the ratings agencies to our database system. The electronic transfer of information speeds up the process, and minimizes the potential for data entry errors.

### **Revision of Index Rules Over Time**

The rules and practices for constructing the Universe and other fixed income indices necessarily change over time in order to reflect developments in the market. For example, the changes implemented effective July 15th 2003 take into account the increasing role played by Moody's Investor Service in the Canadian bond market, and the shift over time to larger issuance in the Corporate bond market. Some key historical changes have included the incorporation of MTNs, private placements, and certain types of asset-backed securities into the index.

We will endeavor to provide reasonable advance notice of any such changes, as well as an assessment of the expected impact on the index.

### **PC Bond**

The PC Bond system provides daily price updates for more than 4000 fixed income securities, and includes software modules for portfolio management and for analyzing price and yield data over time. For example, BondManXLC allows you to retrieve index holdings, and has a comparison feature that allows you to compare portfolio and index holdings. Prices in PC Bond are the same prices used to value the Scotia Capital indices each day. The PC Bond/ Data group also provides the Fastquote service, which gives users live access to the 4:00 pm bond prices used in the Index calculations and the PC Bond database.

### **ScotiaBond Performance Attribution**

ScotiaBond is an interactive Windows-based performance attribution system that can be used to decompose returns on a portfolio or index into several different factors. ScotiaBond computes and analyzes daily returns, breaking them down to sources such as the passage of time, changes in the yield

curve, changes in spreads, and transaction costs. Returns can be analyzed at the absolute level or relative to a benchmark such as the Universe Bond Index.

### Information Sources and Publications

The Scotia Capital Bond Indices can be monitored on a daily basis through a variety of electronic information channels. Our main internet site, [www.scotiacapital.com/sconline](http://www.scotiacapital.com/sconline), provides detailed information on our indices, including daily and monthly performance reports, important index announcements, and the daily disclosure of index holdings (Fixed Income → Library → Scotia Capital Indices). It also allows users to calculate historical index returns interactively by specifying a desired time period (Fixed Income → Tools → Index Analytics). Access to this site requires a user ID and password.

Our public internet site, [www.scotiacapital.com](http://www.scotiacapital.com), also provides daily index returns and statistics for our domestic Short, Mid, Long and Universe Bond Indices and for our Money Market Indices. In addition, this site provides general descriptions of the different indices.

Daily index performance is also available through electronic information sources like Bloomberg, Reuters, and Telerate, as well as major newspapers.

Bloomberg	<b>SMFR</b>		
Reuters	<b>pages SM2A to SM2N</b> SM2E: month to date returns SM2F: quarter to date returns SM2G: year to date returns	In print	<i>Globe and Mail, National Post, Bank of Canada Weekly, Monthly Financial Review</i>
Index Email	<b>pcbond@scotiacapital.com</b> Index Inquiries	Internet	<a href="http://www.scotiacapital.com/sconline">www.scotiacapital.com/sconline</a> (User ID and password required for access) <a href="http://www.scotiacapital.com">www.scotiacapital.com</a>

### Disclaimer

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The indices are based on data believed to be reliable. No guarantee is made as to the accuracy, timeliness, or completeness of the data used in the indices. In the event a data input to a published index calculation is subsequently believed to be in error, we may at our sole discretion declare the data error to be immaterial to the published index value, and are under no obligation to re-calculate an already published index value. Index construction rules, guidelines, and practices may be changed at any time at our sole discretion, though we will endeavor to provide reasonable advance notice of such changes.

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## Appendix: Index Return Calculation

The one day index return measures the total return on the constituent bonds, including capital gains, accrued income, and coupon payments. The one day return from time t-1 to time t is calculated as follows, where P and AI denote market price and accrued interest, respectively, Q denotes the adjusted amount outstanding, and CPN denotes the total coupon cash flow:

$$r_t = \frac{\sum_i Q_{i,t-1} \cdot (P_{i,t} + AI_{i,t}) / 100 + \sum_{i^*} CPN_{i,t}}{\sum_i Q_{i,t-1} \cdot (P_{i,t-1} + AI_{i,t-1}) / 100} - 1$$

Ignoring coupon payments, the equation says that the return on the index is calculated from the change in price and accrued from t-1 to t, holding the index constituents fixed as of t-1. The coupon cash flows are summed only for those bonds that pay coupons on day t.

Given the index value at day t-1 and the one-day return, the index value for day t is calculated as follows:

$$Index_t = Index_{t-1} \times (1 + r_t)$$

A series of one-day returns calculated as described above can be linked together geometrically to obtain the total return index over a longer time period:

$$Index_t = Index_{t-k} \times (1 + r_{t-k+1}) \times \dots \times (1 + r_{t-1}) \times (1 + r_t)$$

Given two index levels, the periodic rate of return can be calculated as follows:

$$r_{t-k,t} = \frac{Index_t}{Index_{t-k}} - 1$$

The above chain-linking procedure ensures that the measurement of market performance is not distorted by changes in index composition. Note that it is consistent with the Time-Weighted Rate of Return (with daily weighting) advocated by the Association for Investment Management and Research (AIMR) for measuring portfolio performance<sup>3</sup>.

### Calculation Example

To illustrate the index total return calculation, consider a simple 2-bond index, with prices and accrued as shown below. Assume there is initially 5 million outstanding of bond 1, and 10 million of bond 2. On day 2 an additional 5 million of bond 1 is issued, and bond 2 pays a coupon of 275,000. On day 3, the outstanding amount of bond 2 is reduced by 2.5 million to reflect amounts that have been stripped.

	Market Price		Accrued Interest	
	Bond 1	Bond 2	Bond 1	Bond 2
Day1	101.083	101.489	1.3089	2.7274
Day2	101.188	101.775	1.3233	0.0000
Day3	101.293	102.062	1.3377	0.0151
Day4	101.398	102.350	1.3521	0.0301

<sup>3</sup> AIMR Performance Presentation Standards Handbook 1997, Association for Investment Management and Research.

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The total return from day 1 to day 2 is calculated as follows. Note that the coupon payment is included in the return calculation, but that the 5 million re-opening of bond A is not included.

$$r_2 = \frac{\$5M \times (101.188 + 1.3233) / 100 + \$10M \times (101.775 + 0.00) / 100 + \$0.275M}{\$5M \times (101.083 + 1.3089) / 100 + \$10M \times (101.489 + 2.7274) / 100} - 1$$
$$= 0.23698\%$$

The total return from day 2 to day 3 is calculated as follows. Note that now the 5 million re-opening of bond 1 is included in the return calculation, and the day 2 coupon payment no longer appears.

$$r_3 = \frac{\$10M \times (101.293 + 1.3377) / 100 + \$10M \times (102.062 + 0.0151) / 100 + 0.0}{\$10M \times (101.188 + 1.3233) / 100 + \$10M \times (101.775 + 0.00) / 100} - 1$$
$$= 0.20630\%$$

From day 3 to day 4, the total return is calculated as follows, using the reduced amount of 7.5 million for bond 2 to reflect the 2.5 million of this bond that has been stripped.

$$r_4 = \frac{\$10M \times (101.398 + 1.3521) / 100 + \$7.5M \times (102.350 + 0.0301) / 100 + 0.0}{\$10M \times (101.293 + 1.3377) / 100 + \$7.5M \times (102.062 + 0.0151) / 100} - 1$$
$$= 0.19348\%$$

If we assume an index value of 100 on day 1, the index value for day 2 is:

$$Index_2 = 100 \times (1.0023698)$$
$$= 100.23698$$

Similarly, the index values for days 3 and 4 are:

$$Index_3 = 100.23698 \times (1.0020630)$$
$$= 100.44377$$

$$Index_4 = 100.44377 \times (1.0019348)$$
$$= 100.63811$$

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