

FTSE Goldman Sachs ESG-Enhanced Global Bond Index

v2.0

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Section 1

Introduction

1. Introduction

1.1 FTSE Goldman Sachs ESG-Enhanced Global Bond Index

1.2 The FTSE Goldman Sachs ESG-Enhanced Global Bond Index (the index) is a multi-sector, multi-currency benchmark, which provides a broad-based measure of the global fixed income markets. The index is denominated in USD.

1.2.1 The index is created from the FTSE World Broad Investment-Grade Bond Index (WorldBIG) as the starting universe (the “Base Index”). It includes investment-grade debt from four (4) asset class sectors: sovereign/sovereign guaranteed, government-sponsored/regional government, corporate and collateralized, where collateralized consists of mortgage-backed securities (MBS), asset-backed securities (ABS) and covered bond sectors and across 22 currencies.

1.2.2 The index seeks to deliver stable performance for a given level of risk relative to the WorldBIG. This is achieved through a series of screens and weight allocation adjustments aimed at return optimization and/or volatility minimization in the three largest sectors of the Base Index, namely the governments, MBS and corporate sectors. Securities in each of these three sectors are selected and the weights adjusted in accordance to methodology relevant to that sector – being liquidity, ESG and/or fundamental weighting adjustments and term structure optimisation for governments and corporates, and liquidity and prepayment risk screens for MBS. The governments, corporate and MBS sectors are each individually duration adjusted and reweighted to match the Base Index in the resulting index composition. The ABS and covered bond sectors are market capitalisation weighted consistent with the WorldBIG Index.

1.3 The FTSE Goldman Sachs ESG-Enhanced Global Bond Index does take account of ESG factors in its design.

1.4 FTSE Russell

1.4.1 FTSE Russell is a trading name of FTSE International Limited, Frank Russell Company, FTSE Global Debt Capital Markets Limited (and its subsidiaries FTSE Global Debt Capital Markets Inc. and FTSE Fixed Income Europe Limited), FTSE Fixed Income LLC, FTSE (Beijing) Consulting Limited, Refinitiv Benchmark Services (UK) Limited, Refinitiv Limited and Beyond Ratings.

1.4.2 FTSE Russell hereby notifies users of the index that it is possible that factors, including external factors beyond the control of FTSE Russell, may necessitate changes to, or the cessation, of the index and therefore, any financial contracts or other financial instruments that reference the index or investment funds which use the index to measure their performance should be able to withstand, or otherwise address the possibility of changes to, or cessation of, the index.

- 1.4.3 Index users who choose to follow this index or to buy products that claim to follow this index should assess the merits of the index's rules-based methodology and take independent investment advice before investing their own or client funds. No liability whether as a result of negligence or otherwise is accepted by FTSE Russell or any members of the FTSE Russell Policy Advisory Board (or any person concerned with the preparation or publication of these Ground Rules) for any losses, damages, claims and expenses suffered by any person as a result of:
- any reliance on these Ground Rules;
 - any inaccuracies in these Ground Rules;
 - any non-application or misapplication of the policies or procedures described in these Ground Rules; and/or
 - any inaccuracies in the compilation of the Index or any constituent data.

Section 2

Management responsibilities

2. Management responsibilities

2.1 FTSE Fixed Income LLC (FTSE)

2.1.1 FTSE is the benchmark administrator of the index¹.

2.1.2 FTSE is responsible for the daily calculation, production and operation of the index series, and will:

- maintain records of all the constituents;
- be responsible for the addition and deletion of bonds and changes of nominal amounts, in accordance with the Ground Rules; and
- disseminate the indices.

2.2 Amendments to these Ground Rules

2.2.1 These Ground Rules shall be subject to regular review (at least once a year) by FTSE Russell to ensure that they best reflect the aim of the index series. Any proposals for significant amendments to these Ground Rules will be subject to consultation with FTSE Russell advisory committees and other stakeholders if appropriate. The feedback from these consultations will be considered by the FTSE Russell Index Governance Board before approval is granted.

2.2.2 As provided for in the Statement of Principles for FTSE Russell Fixed Income Indices, where FTSE Russell determines that the Ground Rules are silent or do not specifically and unambiguously apply to the subject matter of any decision, any decision shall be based as far as practical on the Statement of Principles. After making any such determination, FTSE Russell shall advise the market of its decision at the earliest opportunity. Any such treatment will not be considered as an exception or change to the Ground Rules, or to set a precedent for future action, but FTSE Russell will consider whether the Ground Rules should subsequently be updated to provide greater clarity.

¹ The term administrator is used in this document in the same sense as it is defined in Regulation (EU) 2016/1011 of the European Parliament and of the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds (the European Benchmark Regulation). FTSE Fixed Income LLC administers the index S=series in line with the third country transitional provisions contained within the Article 51(5) of that regulation.

Section 3

FTSE Russell index policies

3. FTSE Russell index policies

These Ground Rules should be read in conjunction with the following policy documents, which can be accessed using the links below or by contacting info@ftserussell.com. These policies are reviewed annually and any changes are approved by the FTSE Russell Index Governance Board.

3.1 Statement of Principles for FTSE Fixed Income Indices (the Statement of Principles)

Indices need to keep abreast of changing markets and the Ground Rules cannot anticipate every eventuality. Where the Ground Rules do not fully cover a specific event or development, FTSE Russell will determine the appropriate treatment by reference to the Statement of Principles for FTSE Fixed Income Indices, which summarises the ethos underlying FTSE Russell's approach to index construction. The Statement of Principles is reviewed annually and any changes proposed by FTSE Russell are presented to the FTSE Russell Policy Advisory Board for discussion before approval by the FTSE Russell Index Governance Board.

The Statement of Principles for Fixed Income Indices can be accessed using the following link:

[Statement of Principles Fixed Income Indices.pdf](#)

3.2 Queries and Complaints

FTSE Russell's complaints procedure can be accessed using the following link:

[Benchmark Determination Complaints Handling Policy.pdf](#)

3.3 Recalculation Policy and Guidelines

The Recalculation Policy and Guidelines for Fixed Income Indices document is available from the FTSE Russell website using the link below or by contacting info@ftserussell.com.

[Fixed Income Recalculation Policy and Guidelines.pdf](#)

3.4 Index Policy in the Event Clients are Unable to Trade a Market or a Security

3.4.1 Details of FTSE Russell's treatment can be accessed using the following link:

[Index Policy in the Event Clients are Unable to Trade a Market or a Security.pdf](#)

3.5 Policy for Benchmark Methodology Changes

Details of FTSE Russell's policy for making benchmark methodology changes can be accessed using the following link:

[Policy for Benchmark Methodology Changes.pdf](#)

3.6 FTSE Russell Governance Framework

3.6.1 To oversee its indices, FTSE Russell employs a governance framework that encompasses product, service and technology governance. The framework incorporates the London Stock Exchange Group's three lines of defence risk management framework and is designed to meet the requirements of the IOSCO Principles for Financial Benchmarks², the European benchmark regulation³ and the UK benchmark regulation⁴. The FTSE Russell Governance Framework can be accessed using the following link:

[FTSE Russell Governance Framework.pdf](#)

3.7 Real Time Status Definitions

3.7.1 Please refer to the following guide for details of real time status definitions for indices that are calculated in real time.

[Real Time Status Definitions.pdf](#)

² IOSCO Principles for Financial Benchmarks Final Report, FR07/13 July 2013.

³ Regulation (EU) 2016/1011 of the European Parliament and of the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds.

⁴ The Benchmarks (Amendment and Transitional Provision) (EU Exit) Regulations 2019.

Section 4

Composition and design criteria

4. Composition and design criteria

- 4.1 The FTSE Goldman Sachs ESG-Enhanced Global Bond Index is made up of four fixed income asset class sectors that follow the design criteria and calculation methodology for each of the sectors described in this methodology document – sovereign/sovereign-guaranteed, sponsored/regional government, corporate and collateralized, where collateralized consists of MBS, ABS and covered bond sectors. For each sector, the composition, minimum issue size, pricing source and weighting reconstitution methodology are additionally detailed in Figure 2 through Figure 5.
- 4.1.1 After each sector is assessed, the overall index is then composed in accordance with the detail outlined in Figure 1.
- 4.1.2 The eligible universe of bonds for the index is subject to changes to the Base Index, the WorldBIG, which uses the FTSE World Government Bond Index (WGBI) as the core sovereign exposure. Therefore, new market entrants will be subject to the same entry criteria already established for the WGBI.
- 4.1.3 In addition, the WorldBIG includes credit market coverage for the four largest currency sectors, namely the US Dollar (USD), Euro (EUR), Japanese Yen (JPY) and UK Sterling (GBP). Other credit sectors may be added as market coverage expands.

Figure one: FTSE Goldman Sachs ESG-Enhanced Global Bond Index design criteria and calculation assumptions

| | |
|---------------------------|--|
| Coupon | Fixed rate, no zero-coupon bonds except for domestic sovereign bonds (WGBI) |
| Base currency | USD |
| Minimum maturity | At least one year |
| Market size | The following market size criteria apply to the WGBI-portion of the index. For the remainder of the index components have no market size constraints. Entry: the outstanding amount of a market’s eligibility issues must total at least USD 50 billion, EUR 40 billion and JPY 5 trillion for the market to be considered eligible for inclusion. Exit: to remain eligible for the index, a market must maintain a minimum market size of at least half of all the entry-level market size criteria. |
| Minimum issue size | Issue size by currency: US Dollar Domestic sovereign: USD 5 billion public amount outstanding (excludes Federal Reserve purchases) US agency/supranational: USD 1 billion Credit/asset backed: USD 500 million Mortgage coupon: USD 5 billion (origination year minimum: USD 1 billion) Eurodollar: US agency and supranational: USD 1 billion; other: USD 500 million Japanese Yen Domestic sovereign: JP 500 billion for bonds with maturity less than 20 years; JPY 450 billion for bonds with maturities equal to or greater than 20 years (excludes Bank of Japan and Ministry of Finance Holdings) Euroyen: JPY 50 billion |

| | |
|-----------------------------------|---|
| | <p><u>Euro</u> Eurozone sovereign: EUR 2.5 billion or the equivalent for non-redenominated bonds Other: EUR 500 million or the equivalent for non-redenominated bonds</p> <p><u>UK Sterling</u> Domestic sovereign: GBP 2 billion (excludes perpetual and Bank of England purchases) Eurosterling: GBP 300 million</p> <p><u>Other domestic sovereign</u> Australian Dollar: domestic sovereign: AUD 750 million Canadian Dollar: domestic sovereign: CAD 2.5 billion Danish Krone: domestic sovereign: DKK 20 billion Malaysian Ringgit: domestic sovereign: MYR 4 billion Mexican Peso: domestic sovereign: MXN 10 billion New Zealand: NZD 750 million (excludes holdings of the Reserve Bank of New Zealand) Norwegian Krone: domestic sovereign: NOK 20 billion Polish Zloty: domestic sovereign: PLN 5 billion Singapore Dollar: domestic sovereign: SGD 1.5 billion South African Rand: domestic sovereign: ZAR 10 billion Swedish Krona: domestic sovereign: SEK 25 billion</p> |
| Minimum credit quality | BBB- by S&P or Baa3 by Moody's |
| Composition | WGBI (entire index) USBIG (minimum issue size for credit/asset-backed: USD 500 million; no zero-coupon bonds) EuroBIG (entire index) Euroyen (entire index) Eurodollar (minimum issue size: corporate/financial/asset-backed: USD 500 million; no zero-coupon bonds) Eurosterling (minimum issue size GBP 300 million) |
| Redemption features | Bullet, sinking fund, puttable, extendable or callable |
| Weighting | Market capitalization, subject to the adjustments for the sovereign, corporate and MBS sectors. Once each of the sectors are adjusted per the methodology specified in figures two to five, the sector weights are adjusted to match the relevant sector weight in the base index. |
| Rebalancing | Once a month on the last business day of the month (pricing as of the last business day of the monthly and settlement as of the last calendar day of the month.) (Additional screening details to follow.) |
| Reinvestment of cash flows | Intra-month cash flows from interest and principal payments are not reinvested as part of monthly index total return calculations ⁵ . |
| Calculation frequency | Daily |
| Settlement date | Monthly: settlement is on the last calendar day of the month. Daily: same-day settlement except if the last business day of the month is not the last calendar day of the month; then, settlement is on the last calendar day of the month. |
| Fixing date | Each month, the upcoming month's base index constituents are fixed on the profile fixing date ⁶ . Each year's scheduled fixing dates are published on the website. The index is fixed on fixing date+1. |
| Pricing | US Treasury: Refinitiv mid 16:00 New York Sovereign/sovereign-guaranteed, government sponsored/regional government, corporate, other collateralized (ABS, Pfandbrief/covered bond) excluding US Treasury Waterfall pricing: <ul style="list-style-type: none"> – Americas: Refinitiv mid 16:00 New York – EMEA: Refinitiv mid 16:15 London – APAC: Refinitiv mid 18:00 Tokyo US mortgage-backed securities: Refinitiv mid 15:00 New York |
| Volatility | US non-mortgages: 10% single volatility; US mortgages: market-implied volatility (LMM skew model) |
| Base date | 30 June 2015 |

⁵ Prior to November 1, 2022, reinvestment income was included in the total return calculation.

⁶ Fixing dates provide a clear reference point for index users to know in advance of any changes to the composition of the index for the upcoming month. On each fixing date, publicly available securities information is used to determine index eligibility and indicative values for the following month's index profile.

Section 5

ESG data inputs

5. ESG data inputs

5.1 The following ESG datasets are used in the construction of the indices.

| ESG data inputs | Details | Used for selection, weighting or exclusion ⁷ |
|---------------------------------------|---|---|
| Product related data - Sustainalytics | Sustainalytics Product Involvement data identifies the nature and extent of a company's involvement in a range of product and business activities. More information can be found here: https://www.sustainalytics.com/investor-solutions/esg-research/esg-screening/esg-criteria | Exclusion |
| Conduct related data - Sustainalytics | Sustainalytics Global Standards Screening (GSS) assess companies' impact on stakeholders and the extent to which a company causes, contributes or is linked to violations of international norms and standards. More information can be found: https://www.sustainalytics.com/investor-solutions/esg-research/esg-screening/global-compact-norms-based-screening | Exclusion |
| World Bank Indicators | The World Bank World Development Indicators (WDI) provides cross-country comparable data on development. More information can be found: https://datatopics.worldbank.org/world-development-indicators/ The World Bank Worldwide Governance Indicators (WGI) report on six broad dimensions of governance for countries. More information can be found: WGI 2022 Interactive > Home (worldbank.org) | Exclusion |

5.2 Further information on ESG data provided by FTSE Russell and third parties used in this index (index series) can be found in the following guide:

[Guide to FTSE and Third Party ESG Data used in FTSE Russell Indices](#)

This includes information on the data and standards used for these ESG data inputs. These data sets may include estimated data.

⁷ Definitions

Selection- ESG data is used to select or rank constituents, or calculate minimum scores or thresholds
 Weighting- ESG data is used to calculate the weight of a constituent in an index
 Exclusion- ESG data is used to exclude securities from the index

Section 6

Global sovereigns

6. Global sovereigns

The global sovereigns sector selects securities from a starting universe of the WorldBIG Sovereign governments/government-sponsored sector to provide a broad representation of the global sovereign bond market after applying an ESG re-weighting and an optimization process to maximize projected return across the term structure by currency and country.

6.1 ESG screen

6.1.1 The WorldBIG governments/government-sponsored issuers are initially screened based on issuance and security type (e.g. sukuk bonds) to represent the more liquid portion of the market and then applying indicators from The World Bank (see Appendix A).

6.1.2 The liquid universe is ranked within their respective currency and country sector using year-on-year difference of average governance pillar factors as provided by The World Bank. 10% of the market capitalization is then removed where bonds from the lowest-ranked issuers are reduced by 50% of market capitalization, subject to a cap of no more than 5% reduction of the overall market capitalization.

6.2 Optimization

6.2.1 An optimization process is applied to ESG screened universe to select securities relative to the WGBI index⁸ (“Base Sovereigns Index”) and to determine weights such that projected return, net of transaction costs, for a given level of risk is maximized. The approach aims to maximize one-month projected return net of estimated transaction costs by ensuring the return volatility of the sector remains below a preset level, the term structure is constrained within a band relative to the Base Sovereigns Index and the duration matches the Base Sovereigns Index.

Figure two: design criteria and calculation assumptions for the FTSE Goldman Sachs Global Sovereigns Sector

| | |
|--------------------|---|
| Market size | <p>The following market size criteria apply to the WGBI portion of the index. For the remainder of the index components, there are no market size constraints.</p> <p>Entry: the outstanding amount of a market’s eligible issues must total at least USD 50 billion, EUR 40 billion and JPY 5 trillion for the market to be considered eligible for inclusion.</p> <p>Exit: to remain eligible for the index, a market must maintain a minimum market size of at least half of all the entry-level market size criteria.</p> |
|--------------------|---|

⁸ For more information on the FTSE World Government Bond Index – Developed Markets (WGBI-DM), refer to the FTSE Fixed Income Indices Guide at www.lseg.com/en/ftse-russell/

| | |
|-------------------------------|--|
| Minimum issue size | <p>Americas Canada: CAD 2.5 billion (excludes Bank of Canada Cash Management bond buybacks) Mexico: MXN 10 billion United States: USD 5 billion public amount outstanding (excludes Federal Reserve holdings); USD 500 million for non-domestic sovereigns</p> <p>Europe, Middle East and Africa Denmark: DKK 20 billion Eurozone markets: EUR 2.5 billion; EUR 500 million non-domestic sovereigns Norway: NOK 20 billion Poland: PLN 5 billion South Africa: ZAR 10 billion Sweden: SEK 25 billion United Kingdom: GBP 2 billion (excludes Bank of England holdings); GBP 300 million for non-domestic sovereigns</p> <p>Asia-Pacific and Japan Australia: AUD 750 million Japan: JPY 500 billion; 20+ year bonds: JPY 450 billion (excludes Bank of Japan holdings and Ministry of Finance buybacks); JPY 50 billion for non-domestic sovereigns Malaysia: MYR 4 billion New Zealand: NZD 750 million (excludes holdings of the Reserve Bank of New Zealand) Singapore: SGD 1.5 billion</p> |
| Minimum issuer size | At least two bonds per issuer |
| Country cap | <p>Optimization:</p> <p>Country inclusions: 3.5% market value of Base Sovereigns Index Country exclusions: less than 2.5% market value of Base Sovereigns Index</p> |
| Composition | <p>Securities included: fixed rate, no zero-coupon bonds except for domestic sovereign bonds (WGBI)</p> <p>Sectors included: sovereigns, sovereign guaranteed, government sponsored and regional governments</p> <p>Sectors excluded: Sukuk</p> <p>Securities excluded: variable rate, floating rate, index-linked, retail directed, bills, stripped zero coupon, convertibles, savings, and private placements</p> <p>Additional securities excluded: domestic sovereigns with bonds with less than six-month seasoning are excluded where the country is from a developed market and where the market value is greater than 3.5% (in optimization step). No seasoning exclusions on emerging market sovereigns.</p> |
| Weighting | Alternatively weighted according to reconstitution/optimization. |
| Term structure sectors | <p>For duration match, two sectors are used: Dynamic based on the weighted average life</p> |
| ESG screen | <p>ESG country scoring applied annually in May of each year.</p> <p>On monthly basis:</p> <ol style="list-style-type: none"> 1. Apply sector/bond exclusions and minimum issuer screen. 2. Duration match to base index (WorldBIG sovereigns + regional governments). 3. Calculate ranks for each country using governance factors (i.e. YoY difference of average Worldwide Governance Indicator ranks) (refreshed annually) – see Appendix A. 4. Re-weight bottom 10% of countries by reducing market value weight by 50%, subject to 5% country limit reduction. 5. Duration match to base index. |

| | |
|---|---|
| <p>Reconstitution/optimization</p> | <p>Optimizer only applied to the domestic sovereign bonds (not to the government sponsored, regional governments which will only be subject to country capping and screening).</p> <p>Each month eligible bonds are divided into currency, country and maturity sectors based on their weighted average life (WAL) in years as of the month-end date (maturity sectors) as follows: one to three, three to five, five to seven, seven to 10, 10 to 15, 15 to 20 and 20+.</p> <p>The countries and bonds included/excluded are as follows:</p> <p>Country inclusions: 3.5% market value of Base Sovereigns Index.</p> <p>Country exclusions: less than 2.5% market value of Base Sovereigns Index. The bonds are added back in at market value in the base index.</p> <p>Excludes bonds from large developed markets with less than six months' seasoning.</p> <p>The bond weights are optimized with a goal to maximize projected one-month return net of transaction costs. Projected returns for each security are computed by setting the settlement date forward by one month and assuming constant yield curve and OAS.</p> <p>The optimization selection constraints include:</p> <ol style="list-style-type: none"> 1. Each maturity sector's market value can vary from 0% to 200% relative to the corresponding maturity sector of the base index. 2. Allocations to the bonds within a maturity bucket is weighted in proportion to the security's market capitalization). 3. Index return variance (weekly over the prior year) is not to exceed 125% of that of the base index in USD. 4. The modified duration and total market value of the index is set to the base index. <p>In the case where optimization produces a lack of feasible results, constraints will be loosened to achieve a solution. First the volatility cap will be repeatedly increased by multiplying by 1.02. If that optimization fails to find a feasible result, the sector caps are repeatedly increased by 0.05% until a viable solution is found.</p> <p>The results are also checked to adhere to issuer capping at the country level.</p> <p>Optimization utilizes pricing and amounts outstanding of the base index in order to reconstruct index holdings and weights.</p> |
| <p>Transaction costs</p> | <p>The transaction costs are calculated at the security level, as the product of the increase in market value (compared to the previous month's market value), times a cost factor of the relevant WAL bucket for the bond.</p> <p>The cost factor is assessed on an annual basis each December by simple averaging of the relative spread between bid price and ask price of securities in the index profile on the assessment date.</p> <p>Cost factor may be periodically reviewed and adjusted for market conditions.</p> |
| <p>Pricing</p> | <p>US Treasury: Refinitiv mid-market 16:00 (New York)⁹</p> <p>Sovereign/sovereign-guaranteed, government sponsored/regional government excluding US Treasury:</p> <p>Waterfall pricing:</p> <ul style="list-style-type: none"> – Americas: Refinitiv mid 16:00 New York – EMEA: Refinitiv mid 18:00 London – APAC: Refinitiv mid 18:00 Tokyo |

⁹ Back-tested data from base date to May 30, 2020 uses pricing in figure one.

Section 6

Global investment grade corporates

7. Global investment grade corporates

7.1 The Global Investment Grade Corporates sector selects securities from the starting universe of the WorldBIG Corporate Index (Base Corporate Index) to provide a broad representation of the global investment grade corporate bond market after applying ESG exclusions. This universe then applies a fundamental screening based on fundamental financial data and then utilizing an optimization process to select securities relative to the Base Corporates Index and to determine weights such that projected return is maximized across the term structure based on currency and country weighted average life sectors. The sector is comprised of four currencies (USD, EUR, GBP, JPY). Japanese Yen-denominated bonds form a small segment of the corporate universe and are omitted from the ESG screening, fundamental screening and optimization and remain market value weighted. Screening of Japanese Yen corporate bonds to these screens will be subject to review should the JPY corporate exposure increase significantly.

7.2 Liquid ESG screen

7.2.1 Issuers are screened based on amount outstanding and minimum bond issuance to represent the more liquid portion of the market, from which a subsequent ESG screening is applied.

Where issuers are excluded if they are:

- non-compliant with the United Nations Global Compact (UNGC) Principles;
- exceed the revenue thresholds in the following Product Involvement (PI) areas: weapons, civilian firearms, tobacco, thermal coal and oil sands. The exclusions criteria are outlined in Appendix B; and
- missing PI data.

7.2.2 The World Investment Grade corporates sector does not apply screens to issuers that are missing UNGC assessments.

7.3 The UNGC assessments and PI data are provided by Sustainalytics¹⁰.

7.4 Fundamental screen

7.4.1 The liquid ESG universe is ranked based on year-on-year change in fundamental indicators within the respective country of risk and which would represent 90% of the remaining corporate issuers after the fundamental screen. For issuers domiciled in countries of risk that constitute at least 3% of the market capitalization, bonds from the lowest ranked 10% of issuers are excluded¹¹. The remaining bond subset, along with bonds of issuers that satisfy the size screening criteria but have neither fundamental indicator available nor are domiciled in countries of risk that constitute less than 3% of the market capitalization are included in the final bond subset. Furthermore, a final issuer capping is performed to help manage the concentration risk.

¹⁰ UNGC and PI Involvement assessment is conducted against Sustainalytics Research Universe. Issuers not in scope for SA research are included in the benchmark.

¹¹ For issuers subject to screening domiciled in countries of risk that are at least 3% of market capitalization, those issuers remain screened until the next rebalancing quarter (e.g. end of February, May, August and November) when new fundamental rankings will be calculated. For screened issuers, in the event that the size of the country of risk they are domiciled decreases below 3% between rebalancing quarters, the issuers remain screened until the next rebalancing quarter.

7.5 Optimization

7.5.1 The optimization aims to maximize one-month projected return by ensuring the return volatility of the sector remains below a preset level, the term structure is constrained within a band relative to the Base Corporates Index and the duration matches the Base Corporates Index.

Figure three: design criteria and calculation assumptions for the global IG corporates sector

| | |
|--|--|
| Coupon | Fixed rate |
| Currency | USD |
| Minimum maturity | At least one year |
| Minimum issue size and bond count | USD 500 million EUR 500 million GBP 300 million JPY 50 billion Minimum two bonds per issuer |
| Composition | US and non-US Corporate securities issued in registered form and bonds issued under Rule 144A with registration rights (excludes convertibles). |
| Weighting | Market capitalization subject to capping and duration adjustments as described in reconstitution. |
| Term buckets | For duration match, two term sectors around the weighted average life. |
| Capping | Issuer weights are capped at currency level at: 5% for issuers where fundamental indicators are applied; or 3% for issuers where fundamental indicators are not observable. |
| ESG screen | Issuers are screened based on: – non-compliance with UNGC Principles; and – exceeding revenue thresholds in the following PI activities: weapons, firearms, tobacco, thermal coal and oil sands (see Appendix B). |
| Reconstitution | Applies to corporates denominated in USD, EUR, GBP. Corporates denominated in all other currencies will retain the market weight of the base index. If and when new currencies are added to WorldBIG corporate universe, the re-weighting methodology may expand to new currencies when the currency exposure exceeds 1% of the WorldBIG corporate universe. Liquid universe and ESG screen 1. Apply minimum issue/issuer screen per currency group of the Base Corporate Index. 2. Removal of non-compliant issuers from PI screening and UNGC screening. Issuers are screened on a quarterly basis (February, May, August, November). On the non-quarterly rebalance months, a monthly reconstitution will occur whereby newly issued bonds will be mapped to existing issuers and based on the issuer inclusion/exclusion will permit new bonds entering. New issuers will be excluded until such time data permits and included on quarterly review. Each month, after filtering for minimum issue, issuer size and PI/UNGC screening, securities are ranked, capped and weighted through an iterative process to make sure all criteria are met and apply a fundamental screen. 1. Issuer capping – issuer weights are capped at 5% for issuers with fundamental indicators and 3% for issuers where fundamental indicators are not observable ¹² . The capping is applied within the currency groups of issuers subject to screening and optimization detailed below. 2. Duration adjustment – bonds are divided into currency groups and maturity buckets based on the weighted average life. The weight of each currency bucket and maturity bucket is adjusted to match the weighted average effective duration of the relevant currency maturity bucket in the WorldBIG Corporate Index. Within each maturity bucket, constituents are assigned weights in proportion to their market capitalization. 3. Repeat steps three and four until duration and cap criteria is met. |

¹² If an issuer has at least one bond with available fundamental data, all bonds of that issuer are subject to the 5% cap. The cap is first assessed by currency group (e.g., USD, EUR and GBP bonds) for the fundamental screen, then once again in aggregate for the carry and roll-down optimization.

| | |
|--|---|
| | <p>4. Fundamental screening¹³ and ranking – the bond universe is initially screened for issuers with a country of risk greater than 3%. These issuers are then subject to further screening by two fundamental indicators reported by the issuers: by looking at improvements on a year-on-year absolute change in (1) operating margin and (2) leverage. Operating margin is measured by earnings before interest and taxes margin (EBIT margin), while leverage is measured by debt to enterprise value (debt to EV). The issuers are ranked within their respective country of risk – positively by operating margin and negatively by leverage, accounting for market capitalization. The percentile rankings of individual indicators are combined to calculate each issuer’s composite rank. When only a single indicator is available, that single indicator will be used to calculate the issuer’s composite rank. The issuers within the lowest 10% composite rank are excluded and the index is formed with the remaining 90% of bonds captured post initial ESG liquidity screening.</p> <p>5. The remaining bond subset, along with bonds of issuers that satisfy the size screening criteria but have neither fundamental indicator available are included in the final bond subset, in accordance with their market capitalization¹⁴.</p> <p>6. The iterative process is repeated to meet criteria – market capitalization weights are duration-adjusted and issuer weights are capped at 5% for issuers with fundamental indicators and 3% for issuers where fundamental indicators are not observable.</p> <p>7. Finally, the currency components are kept in line with the currency exposure in the WorldBIG Corp.</p> <p>8. For the non-quarter-end months, bonds that no longer meet the liquidity, rating or maturity requirements are removed from the profile. Newly issued bonds from the qualified issuers of the most recent quarterly rebalancing will be included. The monthly profiles will reflect the latest par amount and market value of all included bonds.</p> <p>Final index</p> <p>1. Carry and roll down optimization (detailed in next section).</p> <p>Screening utilizes pricing and amounts outstanding of the base index in order to reconstruct index holdings and weights.</p> |
| <p>Reconstitution/ optimization</p> | <p>Each month eligible bonds are divided into currency, country and maturity sectors based on their weighted average life (WAL) in years as of the month-end date (maturity sectors) as follows: one to three, three to five, five to seven, seven to 10, 20 and 20+, except for GBP, where the 10 to 20 and 20+ maturity sectors are combined. JPY-denominated bonds are excluded from the optimization and are included at market value.</p> <p>The bond weights are optimized with a goal to maximize projected one month return. Projected returns for each security are computed by setting the settlement date forward by one month and assuming constant yield curve and OAS.</p> <p>The optimization selection constraints include:</p> <ol style="list-style-type: none"> 1. Each currency maturity sector’s (e.g. GBP one to three years) market value can vary from 50% to 200% relative to the corresponding maturity sector of the base index. 2. Allocations to the bonds within a maturity bucket is weighted in proportion to the security’s market capitalization). 3. Index return variance (weekly over the prior year) is not to exceed 125% of that of the base index in USD. 4. The modified duration and total market value of the index is set to the base index. 5. Each currency is market value and duration matched to the base index. <p>In the case where the optimization produces lack of feasible results, constraints will be loosened to achieve a solution. First the volatility cap will be repeatedly increased by multiplying by 1.02. If that optimization fails to find a feasible result, the sector caps are repeatedly increased by 0.05% until a viable solution is found.</p> <p>Optimization utilizes pricing and amounts outstanding of the base index in order to reconstruct index holdings and weights.</p> |

¹³ Fundamental screen data determined in February, May, August and November of each year, while also being applied for monthly rebalancing.

¹⁴ Issuers with neither fundamental indicator available are first included in the June 2018 index.

| | |
|---------------------------------------|---|
| Transaction costs¹⁵ | Transaction costs are calculated at the security level, as the product of the increase in market value (compared to the previous months market value) times a cost factor of the relevant WAL bucket for the bond. The cost factor is assessed on an annual basis each December by averaging the relative spread between bid price and ask price of securities in the index profile in that month and applied in subsequent rebalances. Cost factor may be periodically reviewed and adjusted for market conditions. |
| Pricing | Americas: Refinitiv mid 16:00 New York EMEA: Refinitiv mid 18:00 London APAC: Refinitiv mid 18:00 Tokyo |

¹⁵ Transaction costs were not considered in the optimization prior to the December 2021 profile.

Section 7

Mortgage-backed securities

8. Mortgage-backed securities

- 8.1 The MBS sector of the FTSE USBIG Mortgage Index (Base Mortgage Index) comprises of 30-year and 15-year to be announced (TBA) deliverable pass-through mortgage-backed securities guaranteed by the Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac), the Federal National Mortgage Association (FNMA or Fannie Mae) and the Government National Mortgage Association (GNMA or Ginnie Mae). The MBS sector is represented by cohorts that are constructed by aggregating mortgage pools by coupon, agency, program and origination year, and is rebalanced each month to reflect new issuance and principal pay-downs. Freddie Mac Uniform Mortgage Back Securities and Freddie Mac Participation Certificates are tracked by separate index cohorts.
- 8.2 The MBS selection seeks to mitigate prepayment risk by screening out 10% of the issues based on seasoning and convexity that are (1) the most recently issued mortgage securities based on loan age and (2) the most negatively convex bonds. If a 10% reduction in market capitalization is not met after initial screen, the most negatively or least convex bonds are removed until the 10% reduction in market capitalization is achieved. After screening, the index is duration adjusted to match the duration of the Base Mortgage Index.

Figure four: design criteria and calculation assumptions for the mortgage-backed securities sector

| | |
|----------------------------------|---|
| Minimum issue size | <p>Entry: USD 1 billion minimum amount outstanding per origination year generic when the coupon has a minimum amount outstanding of USD 5 billion.</p> <p>Exit: an origination year generic will exit when its amount outstanding falls below USD 1 billion. If the amount outstanding for the coupon falls below USD 2.5 billion, all corresponding origination year generics will be removed from the index.</p> <p>Minimum amount outstanding thresholds based on coupon for Freddie Mac cohorts are applied across both Freddie Mac PCs and UMBS36.</p> |
| Composition | 30-year and 15-year TBA deliverable pass-through MBS guaranteed by Freddie Mac, Fannie Mae and Ginnie Mae |
| Index cohort construction | Index cohorts are constructed by aggregating mortgage pools by coupon, agency, program and origination year. Freddie Mac UMBS and Freddie Mac PCs are tracked by separate index cohorts. |
| Weighting | Market capitalization subject to capping and duration adjustments as described in reconstitution. |
| Reconstitution | <p>Each month, MBS securities are screened based on two criteria: (1) seasoning, as represented by the most recently issued mortgage securities based on loan age and (2) convexity measured for most negatively convex securities. Following the screening process, securities are divided by issuer agency and reweighted according to market capitalization to match the duration of the same agency sector in the Base MBS Index.</p> <ol style="list-style-type: none"> 1. Seasoning screen: securities are grouped by each issuer agency and ranked within each issuer agency group based on months seasoned. MBS securities with a loan age of six months or less are excluded, starting with the most seasoned securities, to remove up to 10% within the issuer agency group. 2. Convexity screen: in the event less than 10% of securities are removed due to the new issue screen, a convexity screen is applied where the most negatively or least convex securities per issuer agency group are removed, subject to a 10% aggregate cap. |

| | |
|----------------|---|
| | <p>3. Weight calibration: the weight of each issuer agency group is adjusted to match the weighted average effective duration of the relevant issuer agency group in the Base Mortgage Index. The weight of each issuer agency bucket is further adjusted to match the relative weight of that issuer agency in the Base Mortgage Index. Within each group, constituents are assigned weights in proportion to their market capitalization.</p> <p>Screening and calibration utilizes pricing and amounts outstanding of the base index in order to reconstruct index holdings and weights.</p> |
| Pricing | Refinitiv mid-side 15:00 (New York) |

Section 8

Other collateralized

9. Other collateralized (ABS, Pfandbrief/covered bond)

9.1 The other collateralized sector is market capitalization weighted and made up of the constituents of the other collateralized sector in the FTSE WorldBIG Index.

Figure five: design criteria for asset-backed securities and covered bonds

| | |
|---------------------------|--|
| Minimum issue size | US agencies and supranationals: USD 1 billion Non-US sovereign and provincial: USD 500 million Asset-backed: USD 250 million |
| Composition | US agencies (excluding callable zeros and bonds callable less than one year from issue date); supranationals |
| Weighting | Market capitalization |
| Pricing | Americas: Refinitiv mid 16:00 New York EMEA: Refinitiv mid 18:00 London APAC: Refinitiv mid 18:00 Tokyo |

For more information on the FTSE WORLDBIG Index, please see the [FTSE Fixed Income Index Guide](#).

Appendix A

Global sovereigns governance

At each annual review (set in May of each year), FTSE Russell will apply an ESG governance screen to the sovereigns from the underlying eligible universe of the FTSE Goldman Sachs Global Sovereigns Index. This data is provided by third-party data vendor, The World Bank.

Figure five: core governance indicators

1. Voice and accountability
2. Political stability and absence of violence
3. Government effectiveness
4. Regulatory quality
5. Control of corruption
6. Rule of law

For more information, go to: <http://info.worldbank.org/governance/wgi>.

Appendix B

Global corporates exclusions

On a quarterly basis (February, May, August, November), FTSE Russell will exclude companies from the underlying eligible universe of the FTSE Goldman Sachs Global IG Corporate Bond Index. This data is provided by third-party data vendor, Sustainalytics.

| Exclusions | Threshold |
|---|--|
| Weapons | |
| Anti-personnel mines, nuclear weapons, cluster weapons, biological and chemical weapons, depleted uranium and white phosphorus munitions | Greater than 0% of revenues |
| Companies providing core weapon systems or components/services of the core weapon system that are considered tailor-made and essential for these weapons. | |
| Firearms | |
| Civilian assault and non-assault production | Greater than 0% of revenues |
| Civilian assault and non-assault retail | Greater than or equal to 5% of revenues |
| Tobacco | |
| Tobacco production | Greater than 0% of revenues |
| Tobacco retail | Greater than or equal to 5% of revenues |
| Coal | |
| Thermal coal extraction | Greater than 0% of revenues |
| Companies generating electricity from thermal coal | Greater than or equal to 25% of revenues |
| Oil sands | |
| Oil sands extraction | Greater than or equal to 5% of revenues |
| UN Global Compact (UNGC) violation | |
| Companies responsible for egregious and severe violations of commonly accepted international norms related to human rights, labor rights, the environment and business ethics | All companies deemed to be non-compliant |

Additional index references – classifications

FTSE World Broad Investment-Grade Bond Index – asset classes

The WorldBIG is divided into three main asset classes: (1) government/government-sponsored; (2) collateralized; and (3) corporate. In addition, all Pfandbrief and Pfandbrief-like securities, which are predominant in the Euro region, are classified as covered bonds.

| Sovereign/sovereign-guaranteed | Government-sponsored/regional government | Collateralized |
|--------------------------------|--|----------------------------|
| Domestic sovereign (WGBI) | Agency | Asset-backed securities |
| Foreign sovereign | Regional government | Covered |
| Sovereign-guaranteed | Regional government-guaranteed | – Jumbo Pfandbrief |
| Other utility | Regional government-sponsored | – Other covered |
| | Supranational | Mortgage-backed securities |
| | Other sovereign-sponsored | |

FTSE Euro Broad Investment-Grade Bond Index – industry sector classification

The industry classification of the EuroBIG reflects the current structure of the market and is in line with the structure of the FTSE World Broad Investment-Grade Bond Index (WorldBIG).

| Corporate – utility | Corporate – industrial | Corporate – financial |
|---------------------|------------------------|-----------------------|
| Electric | Consumer | Banks |
| Gas | Energy | Independent finance |
| Telecommunication | Manufacturing | Insurance |
| Other utility | Service | Other finance |
| | Transportation | |
| | Other industrial | |

FTSE US Broad Investment-Grade Bond Index – industry sector classification

| | |
|----------------------------------|---|
| Industrial manufacturing | Aerospace/defense, auto manufacturers, building products, chemicals, conglomerate/diversified manufacturing, electronics, information/data technology, machinery, metals/mining, paper/forest products, textiles/apparel/shoes, vehicle parts and manufacturing – other |
| Industrial energy | Gas – pipelines, oil and gas, and oilfield machinery and services |
| Industrial service | Cable/media, gaming/lodging/leisure, healthcare supply, pharmaceuticals, publishing, restaurants, retail – food/drugs, retail stores – other and service – other |
| Industrial transportation | Airlines, railroads and transportation – other |
| Industrial consumer | Beverage/bottling, consumer products, food processors and tobacco |
| Industrial other | Industrial – other |
| Utility | Electric, power, telecommunications, gas – local distribution and utility – other |
| Finance | Banking, independent finance, life insurance, mortgage banking, property and casualty, REITs, securities and finance – other |

Additional index references – index pricing, conventions and analytics

Reliable pricing of each security is necessary to ensure reliable index values and returns. A combination of third-party pricing providers that vary based on asset class are used to price the indices. A robust vendor selection process is applied to pricing inputs to ensure that the quality of valuations within the indices remains high. This selection process includes both a qualitative review of the pricing methodology and operational capabilities of the provider and a quantitative review of coverage metrics, historical pricing data and statistical analysis.

The remainder of this section provides further details on specific sources and conventions used within the FTSE fixed income indices.

Index price sources and snap times

Figure 4 shows the local market pricing source and snap time used for the pricing of the fixed income indices. Prices are bid-side with the exception of Mexican government bonds for which mid-prices are used in order to conform to market conventions.

Verification and price challenges

Statistical techniques are used to identify pricing anomalies based on day-over-day changes and comparisons across peer groups by maturity, asset type, etc. Any price challenges from index users and possible outliers from the verification process are reviewed with our third-party pricing providers. In the event that an issue is not able to be resolved in a timely manner, FTSE Russell may exercise expert judgement and roll prices from the previous day. Any exercise of expert judgement is recorded.

Index holiday calendars

The indices are calculated Monday through Friday except Christmas Day (observed) and New Year's Day (observed). When a market observes a holiday, the closing prices from the previous available day are used as the closing prices for index calculations on such holiday for that market.

Each local market will observe its own holiday calendar: if a local market is on holiday, the closing prices used for that day will be the closing prices from the previous day. For example, USD-denominated indices such as the US Broad Investment-Grade Bond Index, Eurodollar Bond Index, Sukuk Index and Emerging Markets US Dollar Government Bond Index follow the holiday calendar applicable to New York. On any day where the US observes a holiday, the closing prices used for these indices are the prices from the previous available day.

Eurozone countries are considered as a single bloc and they use the European Central Bank's Trans-European Automated Real Time Gross Settlement Express Transfer (TARGET2) calendar in place of the local market calendars to determine holidays. As such, the closing prices used for all Eurozone countries on any holiday under the TARGET2 closing days calendar are the previously available closing prices of the respective countries.

Settlement

For daily calculations, it is assumed that indices settle on a same-day basis except if the last business day of the month is not the last calendar day of the month; then, settlement is on the last calendar day of the month. The last business day of the month is based on the local market holiday calendar. Monthly holding periods, therefore, are exactly one calendar month. For example, the January return period would run from the close on December 31 to the close on January 31, regardless of the last business day.

Index quality

An index quality is assigned to each index bond as of profile fixing. The quality is first mapped to the Standard & Poor's Financial Services LLC (S&P) rating. If a bond is not rated by S&P but it is rated by Moody's Investors Service, Inc (Moody's), the S&P equivalent of the Moody's rating is assigned to the index quality. If a bond is rated by neither S&P nor Moody's, the bond is not assigned an index quality. If a bond is rated as investment grade by one rating agency and high yield by the other, the S&P equivalent of the investment-grade rating is assigned to the index quality. These ratings remain unchanged for the entire performance month.

Defaults

When an issuer defaults, is assigned a D rating by S&P regardless of whether that issuer has filed for bankruptcy protection or enters into Chapter 7 or Chapter 11 bankruptcy protection in the US (or equivalent in its local market), its bonds remain in the index until the end of the month. However, the bonds will not be included in the calculation of the current month's average profile statistics of the index. The returns are calculated without coupon payment or accrued interest, where applicable.

FTSE fixed income index analytics

Index users rely on single security analytics to assess the risk profile of their investments, provide insights into the behavior of the fixed income markets and drive their investment decisions. FTSE fixed income indices rely on analytics provided by The Yield Book Inc., which is a leading analytics platform with 30 years of experience in providing single security, risk and performance data for fixed income. While some calculations are relatively straightforward in nature, others rely on sophisticated models, which are rigorously tested by market participants who provide feedback into their evolution and development. A description of the major types of analytics calculated for FTSE fixed income indices can be found below. For more details on their calculations, please see the Glossary of Terms in appendix 4.

Duration generally represents the sensitivity in price of a security to changes in the interest rate environment. FTSE Russell publishes a number of duration measures, including effective duration, modified duration and Macaulay duration. The most widely used measure, effective duration, is a measure of sensitivity to yield for bonds with optionality, such as callable bonds and agency mortgages with prepayment optionality.

Spread metrics provide investors with a relative measure for the riskiness of a fixed income instrument and are often quoted to a comparable risk-free asset, such as a Treasury bond or curve. The most commonly used spread metric, option-adjusted spread (OAS), accounts for embedded optionality in a bond and the variability of future cash flows. FTSE Russell also published gross spread, which compares the yield of a bond to the interpolated yield of two Treasury bonds at the same weighted average life point.

Yield represents the expected return of a security given a certain set of assumptions. Yield to maturity is computed as the single yield, which equates the sum of the discounted expected cash flows to the current price of the bond. Since it is not guaranteed that an investor will be able to hold a bond to its maturity date, yield to worst is calculated to quantify the lowest yield that could be realized by an investor given its optionality.

Model-driven analytics, such as those calculated for the FTSE Mortgage Index, utilize prepayment models maintained by The Yield Book. In addition to the incorporation of these models into standard risk measures, such as duration, spread and yield, these models also produce asset-class specific measures, such as projected prepayment rates for agency MBS.

For further information about The Yield Book, please visit <https://www.yieldbook.com>.

Additional index references – index return calculations

Return computation

For treasury, government-sponsored, corporate and ABS securities, total returns are computed on the assumption that each security is purchased at the beginning of the period and sold at the end of the period. An issue's total rate of return is the percentage change in its total value over the measurement period. The components of total return are price change, principal payments, coupon payments and accrued interest. The total returns are market capitalization weighted using the security's beginning-of-period market value (see Figure 4).

Figure seven: total rate of return calculation methodology

Beginning-of-period value

(Beginning Price + Beginning Accrued) x Beginning Par Amount Outstanding

End-of-period value

[(Ending Price + Ending Accrued) x (Beginning Par Amount Outstanding - Principal Payments)] + Coupon Payments + Principal Payments

Total rate of return (%)

$$\left[\left(\frac{\text{End-of-Period Value}}{\text{Beginning-of-Period Value}} \right) - 1 \right] \times 100$$

A note on precision: returns are computed to at least six decimal places but reported to a maximum of five. In addition, owing to rounding errors inherent in computer floating-point arithmetic, the last digit in any reported value may sometimes be off by one from its true value.

Additional index references – mortgage index definitions and calculations

FTSE US Mortgage Index pricing

Same-day settlement prices from Refinitiv for individual MBS pools are averaged based on each pool's current amount outstanding to arrive at an index cohort price. The price for all the pools that underlie a given cohort, including both specified and non-specified pools, are included in the average. The amount outstanding each pool contributes to the average index price are updated on the same cycle as the index factor updates. Prices represent a 15:00 (NY snap time) bid side valuation.

Definition of current coupon

Each month the current coupon origination year generic for the 30-year GNMA I, GNMA II, FNMA, FHLMC and UMBS is selected based on the carry-adjusted price in the preliminary profile, pricing as of the fixing date and settlement as of the last calendar day of the month. Each of the three chosen current coupon origination year generics must be in the upcoming profile and is priced closest to USD 100 (100% of par). If there are multiple origination year generics within a program and coupon, with the carry-adjusted price within USD 0.10 of each other, the most recent origination year generic is selected as the current coupon origination year generic.

FTSE US Mortgage Index return methodology

The principal payment component of the total rate-of-return computation for the FTSE USBIG Mortgage Index includes both scheduled principal amortization and unscheduled principal prepayment. The FTSE USBIG Mortgage Index accounts for all mortgage payments (principal plus interest) at the end of each month to reflect the monthly cash flow characteristics inherent in the instruments.

For example, during the January measurement period, most mortgage securities generate cash flow (principal and interest). The index assumes that cash flow is reinvested at the monthly average of the daily one-month Eurodeposit rate. For the January returns, information on the January pay-down, applicable to a December 31 to January 31 holding period is available by the third week of January.

The compensation investors receive for exchanging Freddie Mac PCs for UMBS issued by Freddie Mac as part of the Single Security Initiative is not reflected in index return.

Return calculation for mortgage securities

Total rate of return (%)

$$\left[\frac{(C+X) \times \left(1 + \frac{\left(\frac{R_m}{200} \right) \times N}{180} \right) + (EP+EA) \times \left(1 - \frac{X}{100} \right)}{(BP+BA)} - 1 \right] \times 100$$

BP: Beginning price

EP: Ending price

BA: Beginning accrued interest

EA: Ending accrued interest

X: Principal payment as percent of beginning balance

C: Coupon rate/12

R_m : Reinvestment rate on intra-month payment (average of daily one-month Eurodeposit rate)

N: Number of days between date of receipt of coupon and principal payment and calendar month-end

Additional index references – index currency returns and hedging methodology

Currency-hedged returns calculation

In addition to returns expressed in local currency terms, the fixed income indices returns are also computed in base currency terms, with and without the effects of currency hedging. The monthly currency-hedged returns are based on the assumption of a rolling strategy of buying the foreign currency at the beginning of each month and selling the foreign currency one-month forward. The source for spot and forward rates is the published WM/Reuters closing rates.

The convention used in the foreign exchange market for computing and quoting one-month forward rates results, from time to time, in a forward period that is longer (never shorter) than the actual number of calendar days in the month in question. This is inconsistent with the common index convention of using last-calendar-day settlement for the calculation of accrued and re-investment income in computing monthly returns.

Furthermore, the use of one-month forwards poses philosophical questions relating to the interpretation of intra-month currency-hedged returns.

To address and simplify both of these issues, FTSE Russell calculates monthly and intra-month currency-hedged returns.

Spot settlement convention

Spot rates quoted on the screen are for settlement on a day that is calculated using the following steps:

1. The date on which the quotes are displayed is taken to be the trade date.
2. Spot settlement date is two days after the trade date in the local (non-USD) currency. It must be a valid trading and settlement date for both currencies; furthermore, the intervening days must be valid trading and settlement dates for the local currency¹⁶.

One-month forward settlement convention

One-month forward rates quoted on the screen are for settlement on a day that is calculated using the following steps:

1. The date on which the quotes are displayed is taken to be the trade date.
2. Spot settlement date is calculated as above.
3. Move forward from the spot settlement date to the same date in the following calendar month.
4. If this is a valid settlement date in BOTH currencies, then it is the forward settlement date.
5. If it is not, then the forward settlement date is the first date after that which is valid for both currencies.

Thus, from step five, it is clear that, from time to time, the number of calendar days between the spot settlement date and the forward settlement date will exceed (but never be less than) the number of calendar days in the month.

¹⁶ Prior to February 1, 2011, the spot settlement date must be a valid trade and settlement date for both currencies but the intervening days only needs to be a valid trade date for the local currency. It does not have to be a valid settlement date.

Take the USD/CAD one-month forward contract for the month of August 2010 as an example. For the month-end currency forward rates quoted on July 31, 2010, the spot settlement date is August 4, 2010. Because September 4 and 5, 2010 is the weekend and September 6 is a Canadian holiday, the settlement date for the one-month forward contract is bumped to September 7, 2010. Thus, the number of calendar days between the spot settlement date and the forward settlement date is 34 days, in contrast to the 31 calendar days in August 2010.

Impact on monthly returns

The effect of this bumping of settlement dates is material because the difference between the quoted spot and forward rates (the drop) is calculated by applying the one-month interest rates in each currency, over the actual number of days between the two settlement dates and not over the number of calendar days in the month. The implicit assumption in the monthly currency-hedged returns is that the foreign currency is purchased spot at the beginning of the month and sold forward to the end of the month and, furthermore, that the following month's spot purchase coincides with the previous month's forward sale. Due to the incorporation of settlement day bumping into the calculation of the quoted forward rates, the forward drops will occasionally exaggerate the correct calendar-based premium or discount of a true calendar month hedge. The extent of this impact will depend on the number of instances when bumping occurs in any given year and the magnitude of the difference between the two currencies' short-term interest rates. In any one month, however, the difference rarely exceeds one to two basis points.

Adjusting the forward rates

In order to correct for the bumping of settlement dates effect, the published forward drops will be adjusted for the US Dollar-based forward rates to reflect a drop that corresponds to the number of actual calendar days in the month. This will be achieved by determining the number of convention days used to calculate the published drops and then scaling the drops by the ratio of the number of days in the month to the number of convention days. This scaled drop will then be applied to the quoted spot rate to produce the adjusted one-month forward rate. The adjusted forward rates will also be used to derive adjusted forward cross rates. The following table illustrates this process.

| Adjustment of USD/CAD one-month forward rate for August 2010 | |
|--|--|
| Spot: 1.02995 | Spot settlement date: August 4, 2010 |
| Forward: 1.03032 | Forward settlement date: September 7, 2010 |
| Forward drop (%): -0.0359 | Drop days: 34 |
| Days in the calendar month for August: 31 | |
| Adjust forward drop = $-0.00037 \times 31/34 = -0.00037$ | |
| Adjusted forward rate = $1.02995 + 0.00037 = 1.030287$ | |
| Adjusted forward drop (%): -0.03275 | |

The spot and forward settlement dates and the adjustment factor are published monthly. They are available by subscription on the website: www.yieldbook.com/m/indices.

Month-to-date and daily currency hedged returns

Intra-month index levels and returns are helpful for return attribution calculations when money enters or leaves the benchmarked portfolio but they pose the following philosophical dilemma:

- Should the month-to-date return on the 10th, for example, be calculated as if one had hedged only 10 days forward – as if planning to liquidate the fund on the 10th?
- Should the return from the 10th of the month to the end of the month reflect the effect of a forward hedge entered into on the 10th out to the end of the month – as if setting up the fund on the 10th?
- Should the daily currency-hedged return on the 10th of the month reflect only an overnight forward contract entered into on the 9th?

It is evident that a single time series of intra-month index levels cannot incorporate more than one of these.

The month-to-date returns and index levels are calculated to reflect approach (a) (e.g. for the 10th of the month, as if a 10-day forward had been entered into at the beginning of the month). Rather than derive the 10-day forward rate from the forward rate term structure at the end of the previous month, the one-month drop (adjusted when necessary to a calendar month, as described earlier) will simply be scaled to a 10-day drop and the 10-day forward rate will be computed using this. Thus, the intra-month forward rates will linearly converge to the rate used for the full month. This will have a minimal impact on the month-to-date returns and these will still converge to the monthly returns.

The daily currency-hedged returns are calculated simply as the ratio of successive daily month-to-date returns, as described in the previous paragraph. This, by construction, ensures consistency between successive month-to-date returns and the daily returns and that daily returns compound to the monthly return.

How much is hedged?

Clearly, one cannot know at the beginning of the period what the market value of a security holding will be at the end of the period. Instead, an assumption must be made: sell this amount forward and convert any end-of-period excess or shortfall at the end of period spot rate.

Below is a summary of the methodology determining the amount of foreign currency sold forward for each security:

1. Reduce the par amount of the bond by any sinking fund payments, calls, prepays, etc.
2. Allow for these cash receipts plus any re-investment income on these amounts to the end-of-period date.
3. Add any coupons that will be paid during the period, together with re-investment income.
4. Re-price the remaining par amount, using the beginning-of-month yield and the end-of-period date as the new settlement date, including Accrued Interest on this date.
5. The sum of these amounts (2, 3 and 4) will be the amount of foreign currency sold forward.
6. This amount, converted back to base currency at the appropriate forward rate to give the assumed hedged value, will be the predominant component of the end-of-period value in currency-hedged base-currency terms.

If the actual end-of-period price is higher than this assumed price, the excess in foreign currency is converted back to the base currency at the end-of-period spot rate and added to the assumed hedged value. If the price is lower, the shortfall is converted back to base currency at the end-of period spot rate and subtracted from the assumed hedged value. This gives the actual end-of-period hedged value.

The beginning-of-month value is the full market value of the security converted to the base currency at the beginning-of-month spot rate. The currency-hedged month-to-date return is the ratio of the end-of-period hedged value and beginning-of-month value, minus 1.

It is worth pointing out that the approach described in Step 4 does mean that the size of the hedge used in calculating the month-to-date currency-hedged return for, say, the 10th of the month is different from the size of hedge used in calculating the month-to-date currency-hedged return for the 20th of the month, and different again from that used for the full month. As noted earlier, the forward rate used for each of these dates is also different. Both of these effects are consistent with the idea that the month-to-date returns should reflect an intention to hedge only out to the date in question.

Additional index references – index data and data correction policy

Ticker for the FTSE Goldman Sachs ESG-Enhanced World Broad Investment Grade Bond Index Currency-Hedged Index

| Ticker | Index |
|---------|---|
| CFIIEGB | FTSE Goldman Sachs ESG-Enhanced Global Bond Index, in USD terms |

Appendix C

Further information

A Glossary of Terms used in FTSE Russell's ground rule documents can be found using the following link:

[Fixed Income Glossary of Terms.pdf](#)

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