RISKMETRICS® RISKMANAGER®

FIXED INCOME RISK ATTRIBUTION (FIRA)

User Guide for running Fixed Income Risk Attribution in *RiskMetrics* RiskManager.

Vikram Josyula, Tamás Mátrai, Balázs Székely

October 2015

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INTRODUCTION TO FIRA

Fixed Income Risk Attribution (FIRA) is a module embedded in *RiskMetrics* RiskManager that allows for the decomposition of Tracking Error into active portfolio management decisions. These decisions take the form of allocation and selection decisions relative to the Benchmark, as well as adjustments to the overall portfolio duration and spread duration.

This feature is accessible by running the statistic called **<fixedIncomeRiskAttributionVaR>.** While the name alludes to a VaR-based risk decomposition, the statistic can be configured to run using standard deviation as the risk measure. Return generation for the risk factors can be set to Historical, Parametric and Monte Carlo. Instrument returns are computed from risk factor returns by multiplying the as-of-analysis-date sensitivity of the instrument to the risk factor – e.g. duration or spread duration – with the risk factor return.

The purpose of this guide is not to rehash the methodology described in the MSCI Research technical note "Fixed Income Risk Attribution – Nov 2013" and will instead focus on the meaningful interpretation of FIRA output. We will also provide some caveats and guidelines around setting up FIRA reports in *RiskMetrics* RiskManager.

We remark that the numerical examples presented below are corner cases, set up to demonstrate that the output of the FIRA module can be unintuitive if the module is misused. As long as the Active Portfolio is consistent with the Benchmark – the intended use case of FIRA – the output of the module is valid and interpretable.

NOTATION

Throughout the body of this paper we will rely on the following notation to refer to elements of the FIRA framework:

A	Active Portfolio
B	Benchmark Portfolio
RP_1	Reference Portfolio 1
RP_2	Reference Portfolio 2
W_i^B	Weight of a security in the Benchmark
W_i^P	Weight of a security in the Portfolio
D_i	Duration of a security
SD_i	Spread Duration of a security
IR_i	Interest Rate Return of a security
SR_i	Spread Return of a security
C_i	Currency Return of a security
DA	Duration Attribution Risk
SA	Sector Allocation Risk
SS	Security Selection Risk

1 Interest Rate Tracking Error

Interest Rate Tracking Error is the sub-component of total tracking error caused by exposure to interest rates. This can be further subdivided into Duration Attribution Risk, Sector Allocation Risk, and Security Selection Risk.

Interest Rate Tracking Error = Duration Attribution Risk + Sector Allocation Risk + Security Selection Risk

As we introduce these risk buckets in the subsections below, we illustrate the decomposition procedure on a simple Active Portfolio benchmarked to a hypothetical index, using standard deviation as risk measure, and incremental standard deviation as risk decomposition. The Active Portfolio and the Benchmark are parametrized as follows. Let the investment universe consist of four instruments $\{A_1, A_2, A_3, A_4\}$ driven by three risk factors $\{r_1, r_2, r_3\}$ with the following properties

$$\Sigma = cov([r_1, r_2, r_3]) = \begin{pmatrix} 100 & 45 & 30 \\ 45 & 25 & 10 \\ 30 & 10 & 64 \end{pmatrix} (\text{in } bps^2)$$

Instrument	Price, in $	Driving risk factor	Exposure (Duration)
A_1	100	r_1	1
A_2	100	r_2	3
A_3	100	r_2	4
A_4	100	r_3	3

The risk factors $\{r_1, r_2, r_3\}$ are assumed to belong to distinct sectors $\{S_1, S_2, S_3\}$, i.e. only A_2 and A_3 belong to the same sector. Let the Active Portfolio (A) and the Benchmark (B) contain the following dollar amounts of these securities and therefore have the following exposures to risk factors:

Instrument	A, in $	B, in $
A_1	30	50
A_2	0	50
A_3	40	0
A_4	30	0

Risk factor	D_A, in $	D_B, in $
r_1	30	50
r_2	160	150
r_3	90	0

Since the dollar values of A and B are the same 100, the Tracking Error, reported relative to the Active Portfolio PV, is equal to

$$TE = \frac{std(A-B)}{100} = \frac{\sqrt{(D_A - D_B)' \cdot \Sigma \cdot (D_A - D_B)}}{100} = 6.73\ bps.$$

1.1 Duration Attribution Risk

Duration Attribution Risk serves to answer the question of how much Tracking Error is produced by lengthening or shortening the Active Portfolio duration versus that of the Benchmark. Duration adjustment decisions offer portfolio managers an additional decision factor that is missing from non-fixed income portfolios. Duration Attribution Risk (DA) is calculated as:

(DA) = Interest Rate Return of RP_1 - Interest Rate Return of B

It is important to remember that Reference Portfolio 1 is a constant multiple of the Benchmark, i.e. it is constructed by using **only securities which appear in the benchmark**. Since any further decomposition of Duration Attribution Risk is in effect the decomposition of the total risk of RP_1-B, **zero Duration Attribution Risk will be reported for every security which is in the Active Portfolio but does not exist in the Benchmark** (i.e. $W_i^B = 0$). Despite of this fact, **the duration of non-benchmark securities do have an impact on the total Duration Attribution Risk vis-à-vis the duration of *RP_1*** which is equal to the duration of the Active Portfolio. Therefore, if the weight or duration of a non-benchmark security were to change, this change would affect the total Duration Attribution Risk of the portfolio.

1.1.1 Numerical Example

The total duration of the Active Portfolio and the Benchmark are:

$$D_A = \frac{30 \cdot 1 + 40 \cdot 4 + 30 \cdot 3}{30 + 40 + 30} = 2.8,\ \ D_B = \frac{50 \cdot 1 + 50 \cdot 3}{50 + 50} = 2.$$

Hence Reference Portfolio 1 is the Benchmark scaled up by 1.4, i.e.

Instrument	RP_1, in $
A_1	70
A_2	70
A_3	0
A_4	0

Note that the dollar value of RP_1 does not equal the dollar value of the Active Portfolio anymore. Now the Duration Attribution risk, reported relative to the Active Portfolio PV, is equal to

$$DA = \frac{cov(RP_1 - B, A - B)}{100 \cdot TE} = \frac{cov(0.4 \cdot B, A - B)}{100 \cdot TE} = 0.56\ bps.$$

1.2 Sector Allocation Risk

Sector Allocation Risk serves to answer the question of how much tracking error is produced by overweighting or underweighting various sectors relative to the Benchmark's allocation to those sectors. Portfolio managers will often use this tactic as a way to capitalize on their views of sector performance. Sector Allocation Risk (SA) is calculated as

(SA) = Interest Rate Return of *RP₂* - Interest Rate Return of *RP₁*

Interest Rate Return *Ref Portfolio 2 (RP_2):* Same Duration as A Same Sector Alloc. as A Same Security Selec. as B	−	Interest Rate Return *Ref Portfolio 1 (RP_1):* Same Duration as A Same Sector Alloc. as B Same Security Selec. as B

Reference Portfolio 2 (RP_2) is identical to RP_1 except that RP_2 has the same duration in each sector present in the Benchmark as the Active Portfolio (*A*). Similar to Duration Attribution Risk, since RP_2 is also built from Benchmark securities, if a security does not exist in the Benchmark then zero contribution to Sector Allocation Risk is reported for it even if its weight/duration impacts the total Sector Allocation Risk

When running FIRA reports in RiskManager, **a "sector" is defined as any dimension in the row group that sits above SecurityName.** For example; in the row group *positionType by SecurityName* the sectors are the position type categories (generic bond, credit default swap, etc.). Dimensions can be nested together to form subsectors as well. For example, in the row group *gicSector by Moody's Rating by SecurityName,* the *Moody's Rating* dimension forms a sub-sector within the parent sector *Industry.*

1.2.1 Numerical Example

Reference Portfolio 2 (RP_2) should have the same Sector Allocation as the Active Portfolio for each sector present in the Benchmark. These sectors are S_1 and S_2. By definition, the weight of sector S_i in RP_2 is equal to its weight in the Active Portfolio scaled by the ratio of its duration in the Active Portfolio over its duration in the Benchmark. For S_1, since the Active Portfolio and the Benchmark contain the same instrument, namely A_1, this ratio of durations is one. For S_2, this ratio is the duration of A_3 divided by the duration of A_2, i.e. 4/3. This gives the dollar amounts 30 and 160/3 for A_1 and A_2:

Instrument	RP_2, in $
A_1	30
A_2	53.33
A_3	0
A_4	0

The Sector Allocation Risk, reported relative to the Active Portfolio PV, is then equal to

$$SA = \frac{cov(RP_2 - RP_1, A - B)}{100 \cdot TE} = -0.87\ bps.$$

Note that the Active Portfolio has a duration in S_3 while the Benchmark has zero duration there, **the duration of RP_2 cannot match that of the Active Portfolio**; in fact, the duration of RP_2 is 1.9.

1.3 Security Selection Risk

Security Selection Risk serves to answer the question of how much tracking error is produced by holding securities that are not in the Benchmark. Portfolio Managers will often look to generate alpha by investing in those securities which they believe are undervalued and reside outside the benchmark universe. Security Selection Risk is calculated as

(SS) = Interest Rate Return of *A* - Interest Rate Return of *RP_2*

The tracking error due to securities belonging to sectors not present in the benchmark is reported as Security Selection Risk. As explained above, for any non-benchmark security the contributional risk number reported can only be non-zero for the Security Selection Risk component. This number should be interpreted as **the risk contribution of the security to the total Security Selection Risk (e.g. risk of *A*-*RP_2*)** and should **NOT** be mistaken for the risk contribution to the Tracking Error (e.g. the risk of the *A*-*B*). This fact alone limits the meaningfulness of FIRA output on active portfolios that significantly deviate from the Benchmark, or have no benchmark at all

1.3.1 Numerical Example

With Reference Portfolio 2 at hand, the Security Selection Risk is computed as

$$SS = \frac{cov(A - RP_2, A - B)}{100 \cdot TE} = 7.04\ bps.$$

Note that, with the notation introduced above, $TE = DA + SA + SS$.
To shed some light to the rationale behind the outcome of the risk decomposition, let's collect the exposures of the portfolios in the decomposition $A - B = (A - RP_2) + (RP_2 - RP_1) + (RP_1 - B)$ to the risk factors, in $:

Risk factor	$A - B$	$A - RP_2$	$RP_2 - RP_1$	$RP_1 - B$
r_1	-20	0	-40	20
r_2	10	0	-50	60
r_3	90	90	0	0

Notice that $A - RP_2$ has zero exposure to r_2 despite the fact that the Active Portfolio and the Benchmark contain distinct instruments in S_2. This is because even Security Selection Risk numbers depend on risk factor exposures rather than on instrument particulars. The sizeable Security Selection Risk is explained by the appearance of the exposure to r_3 at this final step of the risk decomposition.

2 Credit Risk

Credit Risk is the sub-component of total tracking error caused by exposure to credit spreads. Similar to Interest Rate Tracking Error, Credit Risk can be further subdivided into Spread Duration Attribution Risk, Spread Market Allocation Risk, and Spread Security Selection Risk

Credit Risk = Spread Duration Attribution Risk + Spread Market Allocation Risk + Spread Security Selection Risk

The methodology applied here is identical to the one used for Interest Rate Tracking Error (i.e. construction of the relevant Reference Portfolios) but instead focuses on spread durations and spread returns. We will therefore not list the same formulas, but just emphasize that for those securities without a spread time series or that do not have a credit model enabled, Credit Risk should be zero.

3 FX Risk

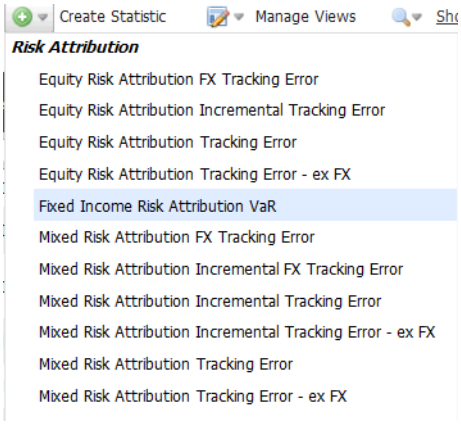
FX Risk is the sub-component of total tracking error caused by exposure to exchange rates. The currency contribution is fully captured by the difference of the FX return of the Active Portfolio minus the FX Return of the Benchmark. There are NO further decompositions within the FX Risk category.

4 Report Setup

The FIRA statistic should be added to RiskManager reports with the appropriate row groups in place. The most common dimensions we see employed in row groups are *Duration Bucket, Maturity Bucket, gicsSector, Industry, Moody's Rating, positionType, and SecurityName, etc*. If using nested row groups then the dimension *SecurityName* should always be set to the bottom level in the row group.

The guidance here is to select row groups whose dimensions reflect the nature of the portfolio's investment strategy. For instance, the dimension Moody's Rating has more relevance and explanatory power on relative value credit strategies than on traditional fixed income portfolios containing treasuries.

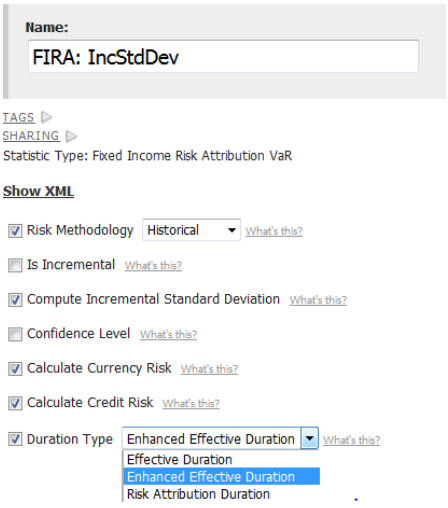
The FIRA statistic can be configured by first creating the statistic called **<fixedIncomeRiskAttributionVaR>** from the statistics drop down page



There are many different ways to configure the FIRA statistic, but the most common practice is run FIRA as **<incrementalStandardDeviation>** with the **<calculateCreditRisk>** and **<calculateCurrencyRisk>** fields both enabled. If <incrementalStandardDeviation> is not checked, then FIRA will run using a standalone VaR methodology. Selecting the <isIncremental> flag enables FIRA to be run in IVaR mode

For portfolios that contain a large number of derivatives such as Bond Futures, Cap/Floors, CDS Options, etc. users should select **<EnhancedEffectiveDuration>** from the Duration Type dropdown. This will ensure that derivatives with small or zero PVs will be handled correctly by the FIRA framework. In the case when PV = 0, RiskManager will use the Risk Attribution Present Value as the denominator in the FIRA calculations

The below screenshot shows the typical statistic configuration:



5 Common Errors & Caveats

5.1 Drilldowns & Tagging

The most common problem encountered when running FIRA reports occurs when choosing row groups. Users should select dimensions in their row group that correspond to **tags** found in **both** the Active Portfolio and the Benchmark. If a tag is chosen that belongs to the Active Portfolio only (e.g. *Strategy, Manager*, etc.) then securities which are missing the tag will appear as "Unspecified" and the explanatory power of the FIRA decomposition is reduced.

In the below example we show one such case where the Benchmark securities are missing the tag *Manager* and are therefore labeled "Unspecified". The tag *Manager* acts as the sector used to compare the Active Portfolio with the Benchmark, and since no sector called "Unspecified" can be found in the Active Portfolio the Sector Allocation Risk gets misstated because the Active Portfolio and Benchmark are thought to be 100% sector mismatched.

BEFORE: "Manager by SecurityName"

Manager by SecurityName Run What-If

Expand One Level / Collapse One Level

Results 1 to 3 of 3

	Weight (% Portfolio PV)			FIRA: IncStdDev									
Name	Total	portfolio	benchmark	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Total	**-0.00**	**100.00**	**-100.00**	**21.19**	**10.47**	**4.24**	**-4.78**	**11.00**	**10.72**	**0.74**	**-0.77**	**10.75**	**0.00**
*Unspecified	-100.00		-100.00	4.99	4.24	4.24	0.00	0.00	0.74	0.74	0.00	0.00	0.00
Fixed Income Manager	100.00	100.00		16.21	6.23	0.00	-4.78	11.00	9.98	0.00	-0.77	10.75	0.00

In reality the Active Portfolio and Benchmark will likely have many mutually common sectors and therefore the dimensions in the row group should reflect those common threads. When we replace the tag *Manager* with the tag *positionType* (which exists on both the Active Portfolio and Benchmark), the FIRA results have more explanatory power. Now the sectors used to compare the Active Portfolio with the Benchmark become the positon type categories (genericBond, MortgageBackedSecurity, etc.) and users can see the contribution of each of these sector mismatches to the total Sector Allocation Risk.

AFTER: "positionType by SecurityName"

positionType by SecurityName Run What-If

Expand One Level / Collapse One Level

Results 1 to 4 of 4

	Weight (% Portfolio PV)			FIRA: IncStdDev									
Name	Total	portfolio	benchmark	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Total	**-0.00**	**100.00**	**-100.00**	**21.19**	**10.47**	**4.24**	**-1.74**	**7.97**	**10.72**	**0.74**	**1.27**	**8.70**	**0.00**
Generic Bond	21.00	99.18	-78.18	18.94	8.70	1.50	-0.77	7.96	10.24	0.74	0.79	8.70	0.00
Generic Mortgage Backed Security	-9.56	0.82	-10.38	1.72	1.24	1.94	-0.71	0.01	0.48	0.00	0.48	0.00	0.00
Mortgage Backed Security	-11.44		-11.44	0.53	0.53	0.80	-0.27	0.00	0.00	0.00	0.00	0.00	0.00

5.2 Importance of SecurityName

Another common error is forgetting to include the dimension ***SecurityName*** as the last level in the row group. As previously mentioned, *SecurityName* is the linking dimension that will allow RiskManager to identify securities that are common to both the Active Portfolio and Benchmark. Without *SecurityName*, RiskManager cannot correctly measure the duration (and spread duration) of the Active Portfolio which is a required input to construct the reference portfolios. As a result the FIRA decomposition becomes unstable and attribution results are untrustworthy.

Notice how in the below example; when using the row group *gicsSector by Moody Rtg* the total tracking error result is reasonable but the FIRA decomposition is not with inflated results appearing the Spread Duration Risk and Spread Market Allocation Risk buckets.

BEFORE: "gicsSector by Moody Rtg"

gicsSector by Moody Rtg Run What-If

Expand One Level / Collapse One Level

Results 1 to 12 of 12

	Weight (% Portfolio PV)	FIRA: IncStdDev									
Name	Total	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Total	**-0.00**	**28.83**	**30.27**	**10.19**	**-0.17**	**20.25**	**-1.44**	**2,050.47**	**-2,068.83**	**16.93**	**0.00**
*Unspecified	-98.05	2,080.12	11.70	10.19	0.00	1.51	2,068.42	2,050.47	0.00	17.95	-0.00
Consumer Discretionary	8.78	166.67	5.09	0.00	-0.06	5.15	161.58	0.00	161.61	-0.03	0.00
Consumer Staples	4.79	0.47	0.05	0.00	-0.00	0.05	0.43	0.00	0.46	-0.03	0.00
Energy	10.74	-1,380.23	4.79	0.00	-0.02	4.81	-1,385.02	0.00	-1,385.54	0.52	0.00
Financials	54.84	-846.56	8.19	0.00	-0.08	8.27	-854.76	0.00	-853.59	-1.17	0.00
Health Care	0.51	7.35	0.37	0.00	-0.00	0.37	6.98	0.00	7.23	-0.25	0.00
Industrials	4.98	1.01	0.08	0.00	-0.00	0.08	0.93	0.00	1.00	-0.07	0.00
Information Technology	0.54										
Materials	9.48										
Telecommunication Services	1.75										
Utilities	1.65										

Once the dimension *SecurityName* is introduced, these inflated results disappear and the correct attribution is computed while still preserving the total tracking error.

AFTER: "gicsSector by Moody Rtg by SecurityName"

gicsSector by Moody Rtg by SecurityName Run What-If

Expand One Level / Collapse One Level

Results 1 to 12 of 12

Name	Weight (% Portfolio PV) Total	FIRA: IncStdDev Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Total	**-0.00**	**28.83**	**30.27**	**0.10**	**-0.09**	**30.26**	**-1.44**	**0.00**	**0.00**	**-1.44**	**0.00**
*Unspecified	-98.05	10.47	10.48	0.10	-0.00	10.38	-0.00	0.00	0.00	-0.00	-0.00
Consumer Discretionary	8.78	1.32	1.89	0.00	-0.01	1.90	-0.57	0.00	0.00	-0.57	0.00
Consumer Staples	4.79	1.72	1.55	0.00	-0.01	1.55	0.17	0.00	0.00	0.17	0.00
Energy	10.74	2.19	2.38	0.00	-0.01	2.39	-0.18	0.00	0.00	-0.18	0.00
Financials	54.84	10.78	10.44	0.00	-0.05	10.49	0.33	0.00	0.00	0.33	0.00
Health Care	0.51	0.18	0.16	0.00	-0.00	0.16	0.01	0.00	0.00	0.01	0.00
Industrials	4.98	0.22	0.56	0.00	-0.00	0.57	-0.34	0.00	0.00	-0.34	0.00
Information Technology	0.54	0.06	0.11	0.00	-0.00	0.11	-0.05	0.00	0.00	-0.05	0.00
Materials	9.48	1.31	1.89	0.00	-0.01	1.89	-0.58	0.00	0.00	-0.58	0.00
Telecommunication Services	1.75	0.18	0.42	0.00	-0.00	0.42	-0.23	0.00	0.00	-0.23	0.00
Utilities	1.65	0.40	0.40	0.00	-0.00	0.40	0.01	0.00	0.00	0.01	0.00

6 Sample Results

To help crystallize the FIRA attribution concepts, we've prepared a sample multi-asset portfolio that was run against the Barclays Capital US Treasury Bill Index as the Benchmark. The FIRA statistic was configured to run as Incremental Standard Deviation with the options to compute Credit Risk, and Currency Risk both selected. We've set Duration Type equal to Enhanced Effective Duration since the portfolio contains many derivatives.

We've set-up two separate row groups to demonstrate how the FIRA results should be interpreted; **positionType by SecurityName** and **gicsSector by Moody Rtg by SecurityName**. We will focus our attention on the Interest Rate Tracking Error attribution results since they have the largest impact on this particular portfolio. The Credit Risk and FX Risk results can be interpreted in exactly same way with the only difference being that spread and exchange rate risk factors are the ones simulated instead of interest rates

Duration Attribution Risk

The below screenshot was taken using the row group **positionType by SecurityName**. We can see that approximately **4.14 bps** (23%) of the total Tracking Error comes from Duration Attribution Risk which reflects duration adjustment decisions. As expected, this result is all contained within the generic bond position type category since the Benchmark only contains bonds. The other position types display zero Duration Attribution Risk because they don't exist in the Benchmark

positionType by SecurityName | Run What-If

xpand One Level / Collapse One Level

Results 1 to 14 of 14

	Weight (% Portfolio PV)			FIRA: IncStdDev									
Name	Total	portfolio	benchmark	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Total	**-0.00**	**100.00**	**-100.00**	**18.11**	**17.21**	**4.14**	**-2.06**	**15.13**	**-1.91**	**0.00**	**0.00**	**-1.91**	**2.80**
Bond Future	0.63	0.63		9.28	9.28	0.00	-0.97	10.25	0.00	0.00	0.00	0.00	-0.00
Cash	2.73	2.73		-2.39	-3.07	0.00	-0.00	-3.07	-0.03	0.00	0.00	-0.03	0.72
Credit Default Swap	-0.26	-0.26		0.02	-0.01	0.00	0.00	-0.02	0.03	0.00	0.00	0.03	0.00
Credit Default Swap Option	-0.15	-0.15		0.03	-0.01	0.00	0.00	-0.01	0.04	0.00	0.00	0.04	0.00
Equity	0.03	0.03		-0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foreign Exchange Option	0.06	0.06											
Generic Bond	-16.71	83.29	-100.00	13.19	13.11	4.14	0.00	8.97	-1.97	0.00	0.00	-1.97	2.05
Interest Rate Future	-0.10	-0.10		-0.15	-0.15	0.00	0.34	-0.48	0.00	0.00	0.00	0.00	0.00
Option on Bond Future	0.03	0.03		-0.65	-0.65	0.00	0.11	-0.76	0.00	0.00	0.00	0.00	0.00
Option on Interest Rate Future	-0.11	-0.11		-0.08	-0.08	0.00	0.09	-0.17	0.00	0.00	0.00	0.00	0.00
Securitized Product	14.29	14.29		-1.16	-1.20	0.00	-1.64	0.44	0.00	0.00	0.00	0.00	0.04

Negative values for Duration Attribution Risk would indicate that increasing the weight of a specific set of securities by a small amount would tilt the Active Portfolio's duration closer to the Benchmark's duration and result in less duration mismatch.

Sector Allocation Risk

The below screenshot was taken using the row group **gicSector by MoodysRating by SecurityName**. We can see the Ba2 subsector within the parent sector Materials has Sector Allocation Risk of **0.09bps**. This means that an increase in the allocation to Ba2 rated Utilities of 1 basis point will increase the total Sector Allocation Risk (i.e. the risk of RP_2-RP_1) by 0.09 bps.

	Weight (% Portfolio PV)	FIRA: IncStdDev									
Name	Total	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
Utilities	**0.04**	**0.29**	**-0.21**	**-0.21**	**0.18**	**-0.18**	**0.50**	**-0.14**	**0.02**	**0.63**	**0.00**
Ba2	1.09	0.38	-0.01	0.00	0.09	-0.10	0.39	0.00	-0.01	0.40	0.00
Ba1	0.48	0.10	-0.00	0.00	0.06	-0.06	0.10	0.00	-0.01	0.11	0.00
Baa1	0.07	0.05	-0.03	-0.03	0.00	-0.01	0.08	-0.02	0.01	0.09	0.00
B1	0.07	0.02	-0.00	0.00	0.01	-0.01	0.02	0.00	-0.00	0.02	0.00
NR	-0.01	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00
Baa3	-0.06	-0.00	-0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00
Aaa	-0.12	-0.03	-0.02	-0.01	-0.00	0.00	-0.02	-0.03	0.01	0.00	0.00
Aa3	-0.17	-0.03	-0.02	-0.02	0.00	0.00	-0.01	-0.02	0.00	0.00	0.00
Aa2	-0.21	-0.03	-0.02	-0.03	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00
A1	-0.21	-0.04	-0.02	-0.02	0.00	0.00	-0.02	-0.02	0.01	0.00	0.00
Baa2	-0.24	-0.02	-0.02	-0.02	0.00	0.00	-0.01	-0.00	-0.00	0.00	0.00
A3	-0.31	-0.05	-0.03	-0.03	0.01	0.00	-0.02	-0.03	0.01	0.00	0.00
A2	-0.35	-0.06	-0.04	-0.04	0.00	0.00	-0.02	-0.02	0.00	0.00	0.00

Security Selection Risk

Drilling down to the security level, we can see that the ALLSTATE CORP 5.75 08/15/2023 corporate bond contributes **0.11bps** of interest rate tracking error which is entirely classified as Security Selection Risk. This is because the security is outside the Benchmark investment universe, and therefore reflects a pure selection decision.

	Weight (% Portfolio PV)	FIRA: IncStdDev									
Name	Total	Total Tracking Error	Interest Rate Tracking Error	Duration Attribution Risk	Sector Allocation Risk	Security Selection Risk	Credit Risk	Spread Duration Attribution Risk	Spread Market Allocation Attribution Risk	Spread Security Selection Risk	FX Risk
12/01/2023											
ALLSTATE CORP 5.75 08/15/2053	0.80	0.18	0.13	0.00	0.00	0.11	0.05	0.00	0.00	0.05	0.00
ALLY FINANCIAL INC 6.25 12/01/2017	0.28	-0.00	0.01	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00
ALTICE LUXEMBOURG SA 7.75 05/15/2022	0.11	0.00	0.01	0.00	0.00	0.01	-0.01	0.00	0.00	-0.01	0.00
ALTRIA GROUP INC 9.95 11/10/2038	0.15	0.05	0.04	0.00	0.00	0.04	0.01	0.00	0.00	0.01	0.00
ARCELORMITTAL SA 6.25 03/01/2021	0.49	0.08	0.05	0.00	0.00	0.04	0.03	0.00	0.00	0.03	0.00

7 Summary and Conclusions

The FIRA framework outlined in this paper and in the accompanying technical note is still being refined to support attribution on absolute return portfolios and to display additional decomposition buckets. That said, users can still find value in FIRA report output when the portfolios selected have an accompanying benchmark with a similar risk profile, and if the proper row groups are used.

Users should pay close attention to tagging, and ensure that the dimensions chosen in their row groups reflect tags that exist on both the Active Portfolio and Benchmark. Users should also be mindful to always include *SecurityName* as the bottom level in their row group so the reference portfolio construction can be properly performed.

When interpreting FIRA results users should do so with the understanding that the dimensions chosen in the row group directly impact the validity of those results. For best results, it is recommended that at least two dimensions are applied in a row group. The first dimension should reflect a common tag (*gicsSector, Moody's Rating, Duration Bucket*) that will be used to define the sector allocation decisions, and the second dimension should be set to *SecurityName*.

CONTACT US

AMERICAS

Americas	1 888 588 4567 *
Atlanta	+ 1 404 551 3212
Boston	+ 1 617 532 0920
Chicago	+ 1 312 675 0545
Monterrey	+ 52 81 1253 4020
New York	+ 1 212 804 3901
San Francisco	+ 1 415 836 8800
Sao Paulo	+ 55 11 3706 1360
Toronto	+ 1 416 628 1007

EUROPE, MIDDLE EAST & AFRICA

Cape Town	+ 27 21 673 0100
Frankfurt	+ 49 69 133 859 00
Geneva	+ 41 22 817 9777
London	+ 44 20 7618 2222
Milan	+ 39 02 5849 0415
Paris	0800 91 59 17 *

ASIA PACIFIC

China North	10800 852 1032 *
China South	10800 152 1032 *
Hong Kong	+ 852 2844 9333
Mumbai	+ 91 22 6784 9160
Seoul	00798 8521 3392 *
Singapore	800 852 3749 *
Sydney	+ 61 2 9033 9333
Taipei	008 0112 7513 *
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