

Product Guide

CreditManager: Risk Attribution Module

Mark Schmude

Mark.Schmude@msci.com

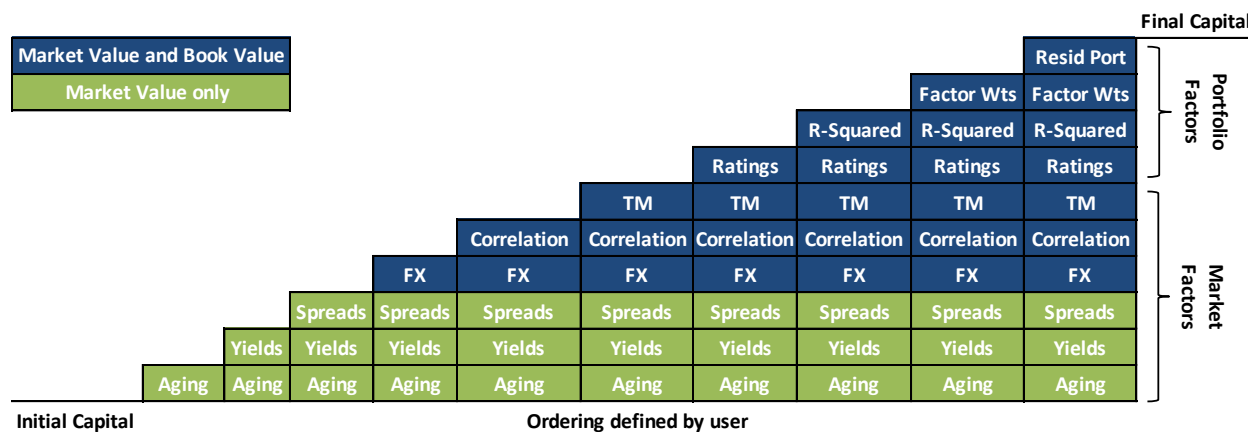
February 2014

Introduction

Credit risk statistics in CreditManager are produced by a simulation-based model. Changes in these statistics between two dates are driven by various factors such as portfolio composition changes, the passage of time and changes in market data such as yields, credit spreads, correlation market factors and transition matrices (TM). Understanding and attributing these changes across time is an important part of the capital allocation process.

This paper highlights CreditManager’s Attribution Module that is designed to systematically address changes in simulated statistics such as VaR and Expected Shortfall (hereafter called capital), as well as non-simulated statistics such as current value and mean horizon value, across two points in time. The top level change in the statistics is broken down via a cumulative, sequential changing of the individual factors (Figure 1). This can be further attributed across portfolio drilldowns defined via tags. In the following sections, we present a practical overview of the methodology before moving to a case study showing the module in use. We conclude with examples of the CreditManager work flow.

Figure 1: Schematic of attribution analysis methodology



Notes: A) Graphic above for illustration only; individual factors such as correlation may not always increase capital. B) If position is set to mature before risk horizon (typically 1yr), after moving to final attribution analysis date, 'Aging' can factor in Book Value also.

Methodology – Step by step

Within CreditManager, Credit Value at Risk (CVaR) can be defined as a percentile of a profit and loss (PnL) distribution, produced from many simulation trials. Each PnL is defined as the difference between a value for the exposure, due to a simulated rating at the risk horizon (horizon value), and the current value. In book value mode, this PnL is driven primarily by default. In market value mode, PnL is further driven by rating migrations, since valuation comes into play. Both modes are referenced in Figure 1.

CreditManager's Attribution Module runs sequential simulations to isolate changes in Capital across time (initial and final) to factors. Apart from Capital, this module can also be used for a variety of other statistics, such as current value or mean horizon value. The general steps are explained below:

Step 1 – 'Starting': Credit risk simulation using all 'initial' market data and correlation settings.

Step 2 – 'Aging': Step 1 parameters remain unchanged except for instrument pricing date (from Report Settings), which is moved to 'final' date; the simulation is then re-run. 'Aging' is attributed to the difference in Step 2 and Step 1 capital figures.

Step 3 – 'Yields': Step 2 parameters remain unchanged except for government and swap curve levels, which are moved to values corresponding to the 'final' date; the simulation is then re-run. 'Yields' is attributed to the difference in Step 3 and Step 2 capital figures.

Step 4 – 'Spreads': Step 3 parameters remain unchanged except for spread levels, which are moved to values corresponding to the 'final' date; the simulation is then re-run. 'Spreads' is attributed to the difference in Step 4 and Step 3 capital figures.

Step 5 – 'FX': Step 4 parameters remain unchanged except for FX levels, which are moved to values corresponding to the 'final' date; the simulation is re-run. 'FX' is attributed to the difference in Step 5 and Step 4 capital figures.

Step 6 – 'Correlation': Step 5 parameters remain unchanged except for the 'Market Factor Indices' date (from Report Settings), which is moved for 'final' date; the simulation is then re-run. 'Correlation' is attributed to the difference in Step 6 and Step 5 capital figures.

Step 7 – 'Transition Matrices': Step 6 parameters remain unchanged except for 'Transition Matrices'. Here, the transition matrices associated with obligors from the 'final' date snapshot are used; the simulation is then re-run. 'Transition Matrices' are attributed to the difference in Step 7 and Step 6 capital figures.

Step 8 – 'Portfolio Factors': Step 7 parameters remain unchanged, and the portfolio (obligors and exposures) corresponding to the 'initial' date is exchanged for the portfolio corresponding to the 'final' date; the simulation is then re-run. As suggested by Figure 1, these changes can be further decomposed into changes in assigned credit ratings, obligor R-squared, relative factor weights as well as the portfolio positions themselves, which are included in the 'residual portfolio changes' category.

The steps presented above can be generated when row groups are presented. This is the case in the example that follows.

Case Study

To help highlight the functionality, we present a case study. For our portfolio, we use a single government bond portfolio, with our time endpoints being 1 January 2013 and 15 April 2013. The

composition is entirely investment grade, with roughly a third of notional in each of EUR, GBP and JPY currencies.

During this period, we exchange roughly EUR1bn of United States government bonds for Italian government bonds (Table 1). This exchange can be seen in ratings and currency composition. For example, at 15 April 2013, the BBB allocation has increased to 15% from 9%, while the AAA allocation has been reduced accordingly. A similar change is seen in the currency composition; EUR allocation has increased and USD has decreased. We will conduct this study in CreditManager's 'market value mode' and therefore market data changes will also be meaningful in the attribution analysis.

Table 1: Portfolio notional at beginning and end of measurement period

	1 January 2013	15 April 2013
Rating Composition (%)		
AAA	26	20
AA	60	60
A	5	5
BBB	9	15
Currency Composition (%)		
EUR	30	36
GBP	5	5
JPY	29	29
USD	26	20
Other	10	10

Attribution Analysis Report

We begin our case study with an example from the CreditManager VaR Attribution report itself, which shows an attribution analysis report on VaR contribution (defined hereafter as capital), by Country (Figure 2). For each of the columns in this report, only one factor is changed, and a 'new' simulation is run. This report output will be referred to throughout this document.

Top level capital during this time period rose from approximately EUR212mm to EUR300mm. In what follows, we show the results of the attribution report and specifically look at the factor behavior over a time period, to help understand the drivers for change during the period.

Figure 2: Example output of attribution analysis report

Δ VaR Contribution (99%) *

	VaR Contribution (99%) *													
	Levels		Differences										Levels	
	Starting	Aging	Yields	Spreads	FX	Correlations	Transition Matrices	Credit Ratings	R-Squared	Relative Factor Weights	Residual Portfolio Effects	Ending		
Total	212,792,849	-7,360,938	2,593,427	-9,105,416	-4,085,628	304,470	0	0	0	0	104,780,603	299,919,367		
AT	665,882	-26,488	-583	-96,974	67,692	-134,176	0	0	0	0	110,928	586,282		
AU	734,111	-33,275	-31,721	95,085	-105,343	30,505	0	0	0	0	-263,876	425,485		
BE	2,426,757	-76,195	29,209	-581,181	249,452	1,195,726	0	0	0	0	-2,223,998	1,019,772		
CA	4,377,872	-175,347	-71,761	211,856	-97,116	-1,248,569	0	0	0	0	-1,035,858	1,961,077		
CH	594,700	-24,919	-2,097	25,616	-22,579	-80,025	0	0	0	0	-157,471	333,225		
DE	13,175,428	-471,833	-325,343	2,133,132	-45,222	347,221	0	0	0	0	-3,945,025	10,868,357		
DK	665,119	-5,161	-10,856	95,854	-39,017	374,221	0	0	0	0	-456,784	623,376		
ES	12,512,436	-474,266	-107,165	-1,585,907	174,893	896,194	0	0	0	0	-3,027,774	8,388,412		
FI	747,964	-28,362	-43,389	1,625	7,887	-249,041	0	0	0	0	-149,538	287,147		
FR	7,364,548	-242,659	333,407	-1,984,623	52,651	-1,399,965	0	0	0	0	-659,309	3,464,049		
GB	15,086,515	-219,290	150,583	2,074,430	-1,377,350	-830,655	0	0	0	0	1,456,873	16,341,106		
IT	86,478,919	-2,135,955	-1,296,492	5,155,039	3,687,516	3,759,953	0	0	0	0	133,185,494	228,834,474		
JP	42,075,480	-1,304,521	4,023,176	-10,800,651	-7,145,605	-2,086,951	0	0	0	0	-6,831,895	17,929,033		
MX	235,655	-8,293	-38,324	-45,862	130,059	30,124	0	0	0	0	-318,436	-15,077		
MY	145,661	-12,386	992	-5,192	4,299	-121,964	0	0	0	0	-7,054	4,357		
NL	4,649,855	-177,547	-297,803	836,741	-52,977	-260,568	0	0	0	0	-981,575	3,716,127		
NO	124,754	-6,789	1,290	5,791	-4,188	15,794	0	0	0	0	-48,114	88,537		
PL	568,171	-25,924	-24,757	26,769	86,381	-333,237	0	0	0	0	-113,655	183,748		
SE	612,171	-26,905	-25,500	12,767	25,194	-65,857	0	0	0	0	-308,048	223,822		
SG	124,613	-5,936	-249	5,053	-5,566	-54,549	0	0	0	0	-18,559	44,807		
US	19,426,237	-1,878,886	330,809	-4,684,784	323,310	520,289	0	0	0	0	-9,425,724	4,611,250		

* denotes baseline for loss distribution is Mean Horizon Value

Aging

As noted previously, we have enabled CreditManager’s market value mode in this study. This option allows for Hull White valuation to take place, and hence duration is accounted for. The report shows that aging reduces capital by about EUR7.4mm, and suggests that aging has made the portfolio marginally less sensitive to other market factor changes, as the age and duration have been reduced. In other words, when the simulation that corresponds to the incremental aging change is run, the portfolio PnL is less sensitive to rating migrations due to its lower duration.

Yields

This risk factor group includes government curves across currencies. The output in Figure 2 shows an attribution of about EUR2.6mm during our measurement period, with a significant portion of that coming from Japan and the US, which account for about two thirds of notional.

Figure 3: Yield curve levels at beginning and end of measurement period

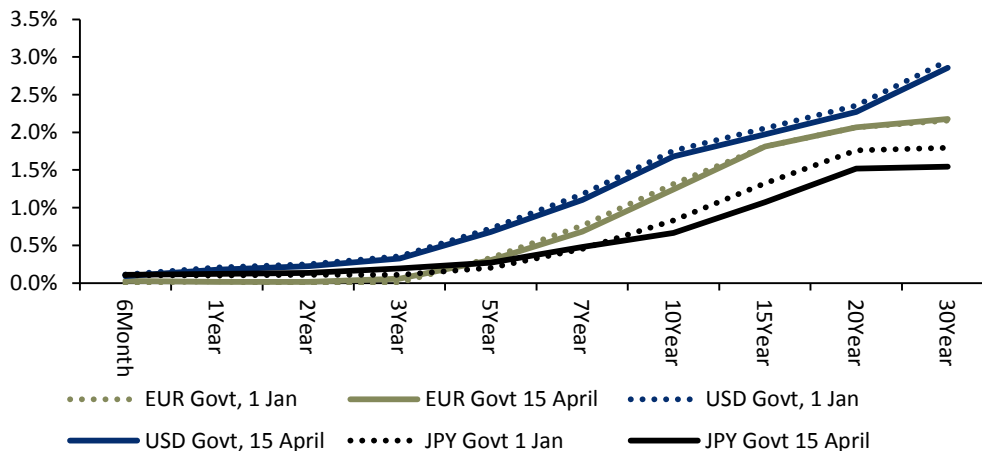
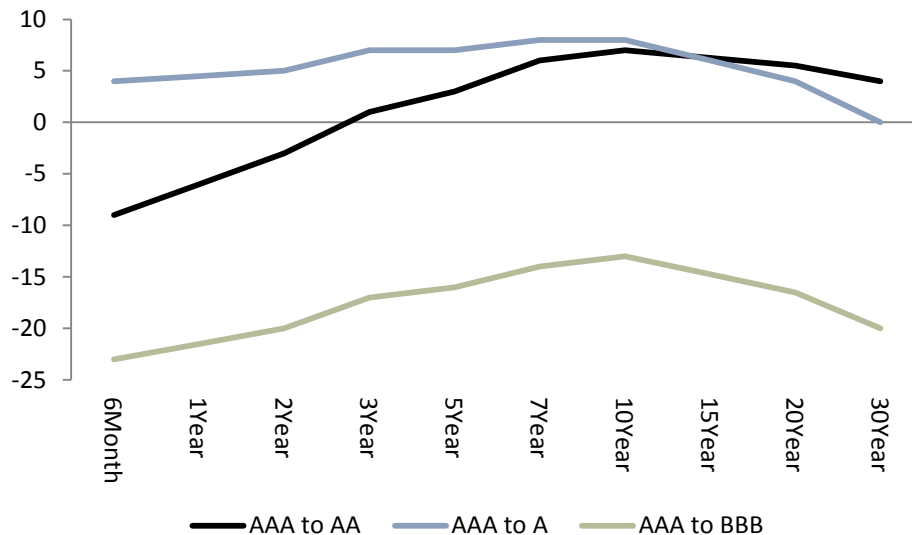


Figure 3 shows the movement of USD and JPY curves, as well as the EUR government yield curves which are used for EUR denominated bonds. For each currency, the dotted line denotes the 1 January level, while the solid line shows the 15 April level. The movements here are intuitive, for example, the EUR curve shows essentially no change while we see both USD and especially JPY tightening during the period. The tightening works to increase the value of the USD and JPY portions of the portfolio, which acts as a larger base from which capital is accounted for. Accordingly, within the 'Yield' factor of attribution, JPY and USD bonds contribute the majority of the capital change allocation while the EUR denominated bond contributions are more mixed.

Spreads

Top level capital attributable to spreads decreased by about EUR9mn. While general spread levels tightened during our measurement period, the spread differences between ratings varied. For example, Figure 4 shows that during our measurement period, the spread change due to a migration from AAA to AA at the 6mo tenor decreased nearly 10bps, and the spread change due to migration from AAA to single-A at the 6mo tenor increased nearly 5bps. PnL due to rating migration in CreditManager is driven by the differences between spread levels, while attribution is driven by the relative changes of these differences during the measurement period.

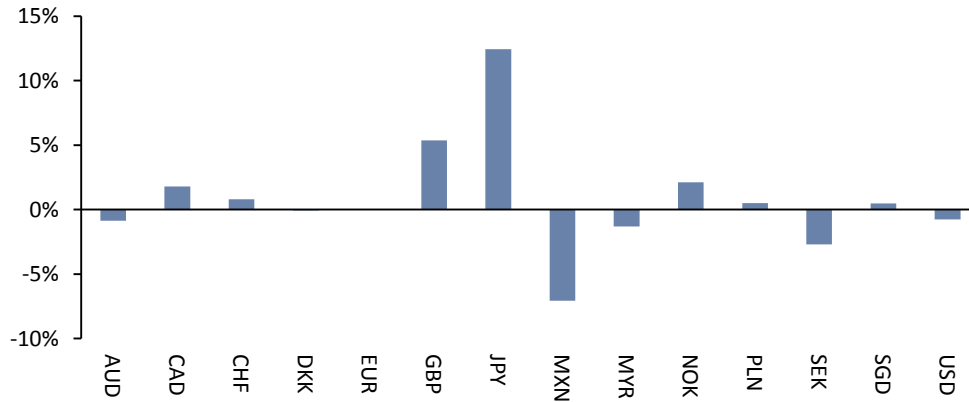
Figure 4: Change in spread between ratings during period (15 Apr minus 1 Jan, bps)



FX

Foreign exchange movements of EUR-4.1mm were driven largely by JPY exposures, which account for about a third of the holdings. The significant weakening of the Yen relative to the EUR reporting currency was the primary driver, with a -EUR7.1mm contribution over the period. A smaller relative weight to the JPY positions following the FX move is the reason for this reduction. We observe a similar story for GBP as well.

Figure 5: Euro currency returns (reporting currency) during measurement period



Correlation

Our government bond portfolio references various equity index factors, which were chosen to be the respective country financials index. A one year lookback period for these indices was used for correlation. For example, the first period looks back a year from 1 January, while the end period looks back a year from 15 April. The respective charts for factor returns used to derive asset return correlation are shown in Figure 6 and Figure 7. Going a step further and running the Obligor Correlation Diagnostics report in CreditManager, we find that the average pairwise correlation among obligors remained relatively stable, having moved from about 29% to 31% over our measurement period. This Attribution Report confirms this stability with only a change of EURO.3mm over the measurement period.

Figure 6: One year historical cumulative factor returns, at 1 January 2013

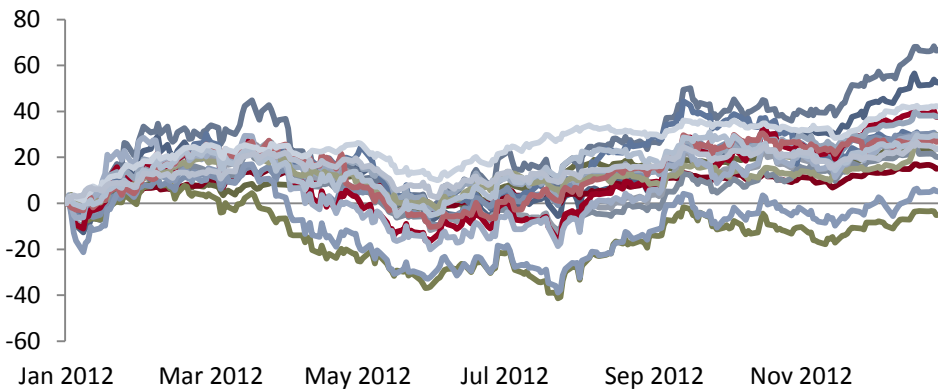
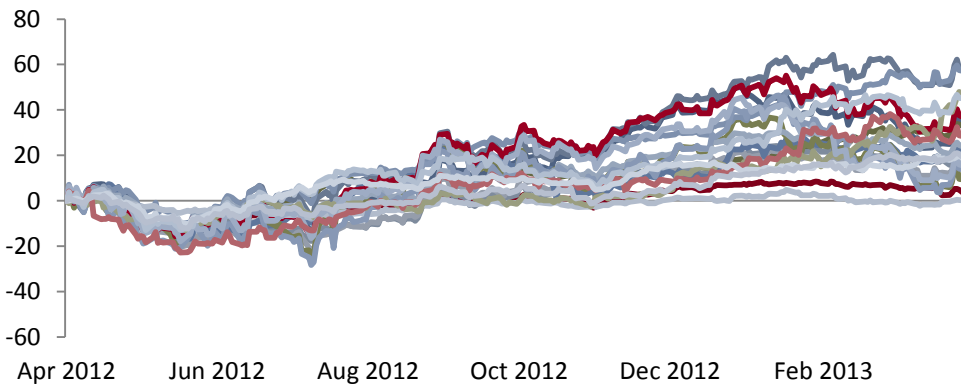


Figure 7: One year historical cumulative factor returns, at 15 April 2013



Transition Matrices

In some cases, factors may not change during the measurement period. For example, the same rating transition matrix might be used at both measurement endpoints. This is the case in our study; the 2012 cohort was used on both periods. Should the analysis period start and end points fall in different years, where different cohorts of matrices are used, this would be accounted for in the attribution analysis.

Portfolio Changes

Finally, we consider the portfolio changes during our measurement period. In this case, attribution is driven by changes in assigned credit ratings, obligor R-squared, relative factor weights and the portfolio positions themselves (residual portfolio changes).

Within our case study, recall that the rating composition changed due to the United States and Italian government bond exchange, which was the only portfolio change during our measurement period (Table 1). This can clearly be seen as the single largest driver of VaR contribution during this period at EUR 104mm; all other components are zero. From a ratings perspective, riskier bonds replaced less risky bonds. Put another way, we see that the one-for-one exchange of bonds was not reflective by a one-for-one exchange in capital. For example, removing the United States component reduced its VaR contribution by about EUR9mm while the Italian component increased by about EUR 133mm.

Application in CreditManager

The Attribution Module is optional in CreditManager and is available via an additional tab in the application. The sub components within this tab are 'Market Data', 'Portfolio' and 'Automation'.

Market Data Snapshots

To mark the start and end points of the attribution analysis, corresponding market data snapshots are defined. The components governed by the market data snapshot are:

Market Data Date: As the name suggests, the date at which market data is snapped for the analysis.

Market Factor Indices Date: The end date for the correlation market factor indices.

Sampling Interval: The return sampling frequency for correlation market factor indices.

Years of History: The number of years of history to use for correlation market factor indices.

Figure 8: Market data snapshot tab in CreditManager attribution analysis module

The screenshot shows the 'Attribution Analysis Data' tab in the CreditManager interface. It features a navigation menu with 'Reports' selected, and sub-menus for 'Obligors', 'Exposures', 'Market Data', 'Credit Server', 'Data Library', and 'Scenario Analysis'. Below this, there are buttons for 'Automation', 'Market Data', and 'Portfolio'. The main content area is titled 'MARKET DATA SNAPSHOT FOR ATTRIBUTION ANALYSIS' and contains a table with the following data:

Name	Description	Market Data Date	Market Factor Indices Date	Sampling Interval	Years of History	Created Date
15 April 2013 5/24/2013 11:53:14 AM		4/15/2013	4/15/2013	5 days	1	5/24/2013 11:53:14 AM
1 January 2013 5/24/2013 11:47:20 AM		1/1/2013	1/1/2013	5 days	1	5/24/2013 11:47:20 AM

Below the table is a 'Create' button.

Scenarios

When creating market data snapshots, the user may also incorporate scenarios (Figure 9). In addition to allowing for custom data to be used, Scenarios can integrate stress tests in the overall attribution analysis.

Figure 9: Portfolio snapshot tab in CreditManager attribution analysis

The screenshot shows the 'Scenario Events' configuration screen. It has a table with columns for 'Type', 'Event', and 'Description'. The 'Type' column lists 'Transitions', 'Spreads', 'FXs', 'Yields', and 'Correlations'. Each type has a dropdown menu currently set to '- None Selected -'.

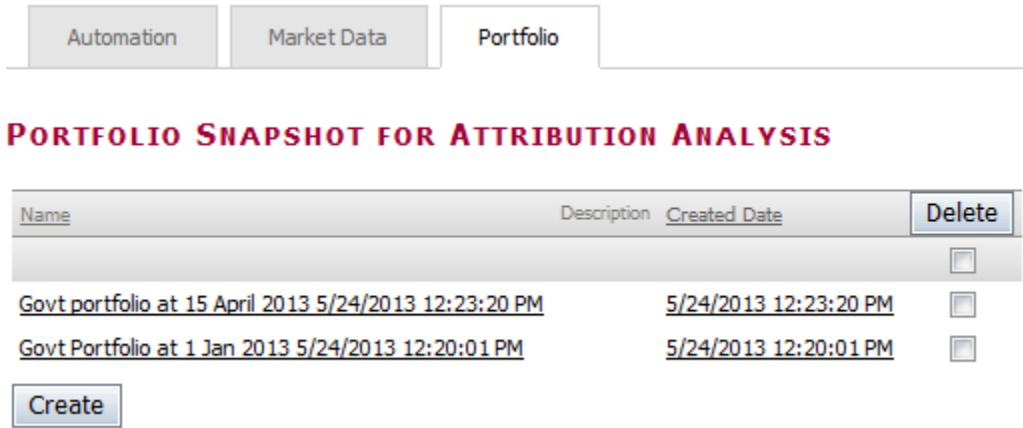
Type	Event	Description
Transitions	- None Selected -	
Spreads	- None Selected -	
FXs	- None Selected -	
Yields	- None Selected -	
Correlations	- None Selected -	

Portfolio Snapshots

Within CreditManager, creating a portfolio snapshot is quite simple; the user need only specify a date for the snapshot. However, behind the scenes, a larger process takes place. That is, a copy of all obligors and exposures, and therefore all portfolios, in the user's realm is created and stored with the name of the snapshot. This copy is time stamped, and can be accessed later in the attribution report by

specifying the portfolio snapshot, and corresponding portfolio. Importantly, this snapshot can be accessed even if all the obligors and exposures have since been deleted by the user.

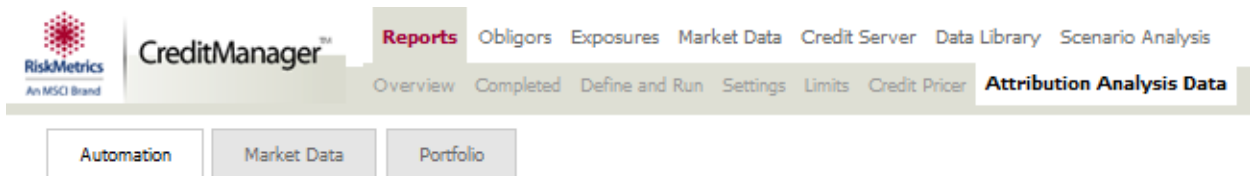
Figure 10: Portfolio snapshot tab in CreditManager attribution analysis module



Automation

To help integrate attribution analysis as part of a larger workflow, the Automation tab can be used to schedule automatic market data and portfolio snapshots to take place. Such functionality is intended to increase efficiency and also help in historical analysis, where the user may wish to call up various historical instances of a particular portfolio.

Figure 11: Snapshot automation tab in CreditManager attribution analysis module



ATTRIBUTION ANALYSIS DATA SNAPSHOT

Market Data Snapshot

Schedule: Monthly on day 1 at 6 : 00 Enabled

Historical Date Range: Go back 1 year from the Market Factor Indices Date.

Index Data Sampling Interval: 1 week

Portfolio Snapshot

Schedule: Monthly on day 1 at 6 : 00 Enabled

Report Creation

Once the above components have been defined, the remaining step is a report definition. This is similar to creating most other reports in CreditManager, with the addition of referencing the portfolio and market data snapshot to use.

Figure 12: Report definition template for CreditManager attribution analysis module

DEFINE ATTRIBUTION ANALYSIS

Name

Report settings

Use scenario

Market data selection	Market data date	Market factor indices date	Sampling interval	Years of history	Created date	
Start of period:	<input type="text" value="1 January 2013 24/5/2013 11:47:20"/>	<input type="text" value="1/1/2013"/>	<input type="text" value="1/1/2013"/>	<input type="text" value="5 days"/>	<input type="text" value="1"/>	<input type="text" value="24/5/2013 11:47:20"/>
End of period:	<input type="text" value="15 April 2013 24/5/2013 11:53:14"/>	<input type="text" value="15/4/2013"/>	<input type="text" value="15/4/2013"/>	<input type="text" value="5 days"/>	<input type="text" value="1"/>	<input type="text" value="24/5/2013 11:53:14"/>

Portfolio Selection

Portfolio 1: **Include these** All Portfolios

2nd portfolio

Sequence of factors *Drag and Drop to Select and Reorder Factors:*

Unselected:

Market Factors:

Portfolios Factors:

Selected:

Aging

Yields

Spreads

FX

Correlations

Transition Matrices

Credit Ratings

R-Squared

Relative Factor Weights

Residual Portfolio Effects

Reset

Conclusion

Storage of multiple portfolio instances coupled with the attribution functionality can be valuable for CreditManager users. The intuitive and rigorous methodology paired with the easy to use interface provides CreditManager users with a platform to quickly and accurately understand changes in capital, as part of the credit risk management process.

Client Service Information is Available 24 Hours a Day

clientservice@msci.com

Americas

Americas	1.888.588.4567 (toll free)
Atlanta	+ 1.404.551.3212
Boston	+ 1.617.532.0920
Chicago	+ 1.312.675.0545
Montreal	+ 1.514.847.7506
Monterrey	+ 52.81.1253.4020
New York	+ 1.212.804.3901
San Francisco	+ 1.415.836.8800
Sao Paulo	+ 55.11.3706.1360
Stamford	+1.203.325.5630
Toronto	+ 1.416.628.1007

Europe, Middle East & Africa

Amsterdam	+ 31.20.462.1382
Cape Town	+ 27.21.673.0100
Frankfurt	+ 49.69.133.859.00
Geneva	+ 41.22.817.9777
London	+ 44.20.7618.2222
Madrid	+ 34.91.700.7275
Milan	+ 39.02.5849.0415
Paris	0800.91.59.17 (toll free)
Zurich	+ 41.44.220.9300

Asia Pacific

China North	10800.852.1032 (toll free)
China South	10800.152.1032 (toll free)
Hong Kong	+ 852.2844.9333
Seoul	+827.0768.88984
Singapore	800.852.3749 (toll free)
Sydney	+ 61.2.9033.9333
Tokyo	+ 81.3.5226.8222

Notice and Disclaimer

- This document and all of the information contained in it, including without limitation all text, data, graphs, charts (collectively, the “Information”) is the property of MSCI Inc., its subsidiaries (including without limitation Barra, Inc. and the RiskMetrics Group, Inc.) and/or their subsidiaries (including without limitation the FEA, ISS, and CFRA companies) (alone or with one or more of them, “MSCI”), or their direct or indirect suppliers or any third party involved in the making or compiling of the Information (collectively (including MSCI), the “MSCI Parties” or individually, an “MSCI Party”), as applicable, and is provided for informational purposes only. The Information may not be reproduced or disseminated in whole or in part without prior written permission from the applicable MSCI Party.
- The Information may not be used to verify or correct other data, to create indices, risk models or analytics, or in connection with issuing, offering, sponsoring, managing or marketing any securities, portfolios, financial products or other investment vehicles based on, linked to, tracking or otherwise derived from any MSCI products or data.
- Historical data and analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction.
- None of the Information constitutes an offer to sell (or a solicitation of an offer to buy), or a promotion or recommendation of, any security, financial product or other investment vehicle or any trading strategy, and none of the MSCI Parties endorses, approves or otherwise expresses any opinion regarding any issuer, securities, financial products or instruments or trading strategies. None of the Information, MSCI indices, models or other products or services is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such.
- The user of the Information assumes the entire risk of any use it may make or permit to be made of the Information.
- NONE OF THE MSCI PARTIES MAKES ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATIONS WITH RESPECT TO THE INFORMATION (OR THE RESULTS TO BE OBTAINED BY THE USE THEREOF), AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, MSCI, ON ITS BEHALF AND ON THE BEHALF OF EACH MSCI PARTY, HEREBY EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES (INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ORIGINALITY, ACCURACY, TIMELINESS, NON-INFRINGEMENT, COMPLETENESS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY OF THE INFORMATION.
- Without limiting any of the foregoing and to the maximum extent permitted by law, in no event shall any of the MSCI Parties have any liability regarding any of the Information for any direct, indirect, special, punitive, consequential (including lost profits) or any other damages even if notified of the possibility of such damages. The foregoing shall not exclude or limit any liability that may not by applicable law be excluded or limited, including without limitation (as applicable), any liability for death or personal injury to the extent that such injury results from the negligence or willful default of itself, its servants, agents or sub-contractors.
- Any use of or access to products, services or information of MSCI requires a license from MSCI. MSCI, Barra, RiskMetrics, ISS, CFRA, FEA, EAFE, Aegis, Cosmos, BarraOne, and all other MSCI product names are the trademarks, registered trademarks, or service marks of MSCI in the United States and other jurisdictions. The Global Industry Classification Standard (GICS) was developed by and is the exclusive property of MSCI and Standard & Poor’s. “Global Industry Classification Standard (GICS)” is a service mark of MSCI and Standard & Poor’s.

About MSCI

MSCI Inc. is a leading provider of investment decision support tools to investors globally, including asset managers, banks, hedge funds and pension funds. MSCI products and services include indices, portfolio risk and performance analytics, and governance tools.

The company’s flagship product offerings are: the MSCI indices with approximately USD 7 trillion estimated to be benchmarked to them on a worldwide basis¹; Barra multi-asset class factor models, portfolio risk and performance analytics; RiskMetrics multi-asset class market and credit risk analytics; MSCI ESG (environmental, social and governance) Research screening, analysis and ratings; ISS governance research and outsourced proxy voting and reporting services; FEA valuation models and risk management software for the energy and commodities markets; and CFRA forensic accounting risk research, legal/regulatory risk assessment, and due-diligence. MSCI is headquartered in New York, with research and commercial offices around the world.

¹As of June 30, 2011, based on eVestment, Lipper and Bloomberg data.