



Sue Li
+1 212 526 1745
changxiu.li@barclays.com

Risk Attribution in POINT

October 2014

Agenda

- Motivation for Risk Attribution (RA)
 - Alternative (flexible) partitions of the total risk of the portfolio
 - Towards a holistic view of the risk / return trade-off
- Model and Implementation
 - Decision hierarchy
 - Factor and sector partition
 - Asset allocation and security selection
- Extension: Beta Attribution
- Future developments

Motivation

- Objective: Evaluate investment decisions – return and risk analysis
 - Portfolio: 50 credit bonds + overlay strategy with five long/short IR swaps
 - Benchmark: Barclays US Credit Corp index.
- Currently POINT produces:

	Performance Attribution	Isolated TEV	Correlated TEV
Total	47.09	15.15	15.15
Rates factors	45.17	12.6	10.54
Spread factors	2.00	10.3	4.61
Asset Allocation	-1.20	N/A	N/A
Security Selection	3.20	N/A	N/A

Source: POINT

- Research questions:
 - How to allocate the correlated risk to the factors? Isolated? Correlated contribution?
 - How to reflect the decision hierarchy of the overlay strategy?
 - How to evaluate the risk on asset allocation and security selection decisions?

Our Proposal I

A. POINT allows for a decision hierarchy (proprietary algorithm)

- Example: Rates manager can be responsible for:

- Isolated risk from Rates (Isolated TEV)

Rates	Correlation
Correlation	Credit

- Isolated risk from Rates + half correlated risk (Correlated TEV)

Rates	Correlation
Correlation	Credit

- Isolated risk from Rates + all correlated risk (our example)

Rates	Correlation
Correlation	Credit

- Hierarchy is defined by POINT partitions
 - Use factor partition (e.g., to isolate YC risk)
 - Use security partition (e.g., to isolate EMG portfolio or an FX overlay)

Our Proposal II

B. Risk on asset allocation and security selection

- Use security partition to define asset classes
- Traditional Brinson style AA+SS

C. POINT provides a clear link with HPA

- Algorithm allows a link between risk attribution and existing HPA models
- Factors are aligned between the two models
- Partitions and data are completely shared between the applications

Result

- Performance Attribution in POINT
 - Portfolio: 50 credit bonds + overlay strategy with five long/short IR swaps
 - Benchmark: Barclays US Credit Corp index.

- Risk Attribution in POINT

	Performance Attribution	Risk Attribution (no hierarchy)	Risk Attribution (overlay hierarchy)
Total	47.09	15.15	15.15
Rates factors	45.17	10.54	8.18
Spread factors	2.00	4.61	6.97
Asset Allocation	-1.20	1.28	1.83
Security Selection	3.20	3.33	5.14

Source: POINT

- Risk attributions are all in TEV contribution terms
- Flexibility to define the hierarchy to let overlay responsible for the correlated risk
- Attributed risk are split into asset allocations and security selection
- Able to drill down to factor and sector level asset allocation and security selection

Implementation in POINT

Basic | Model Input | Hedging/Leveraging | Risk and Beta Attribution | Report Options | **REPORT**

Attribution Partitions

Factor level Partition GRM Implicit Hedging (System)

		Hierarchy	Attribution
Currency	Flat Hierarchy + All factors attributed (No common factor)	1	<input checked="" type="checkbox"/>
Yield Curve		1	<input checked="" type="checkbox"/>
Volatility		1	<input checked="" type="checkbox"/>
Swap Spreads		1	<input checked="" type="checkbox"/>
Others		1	<input checked="" type="checkbox"/>

Security level Partition class 3

	Hierarchy	Attribution
INDUSTRIAL-CA	1	<input checked="" type="checkbox"/>
UTILITY-CB	1	<input checked="" type="checkbox"/>
FINANCIAL_INSTITUTIONS-CC	1	<input checked="" type="checkbox"/>
TREASURIES-A	1	<input checked="" type="checkbox"/>
Others	1	<input checked="" type="checkbox"/>

Attribution Asset Classes

Security Partition HPA Default Partition (System)

Attribution of cross terms By Hierarchy ▼ → redundant without a hierarchy

Source: POINT

Example

Basic | Model Input | Hedging/Leveraging | **Risk and Beta Attribution (Beta)** | Report Options

Attribution Partitions

Factor level Partition GRM Implicit Hedging (System)

Factor level Partition	Hierarchy	Attribution
Currency	2	<input checked="" type="checkbox"/>
Yield Curve	1	<input type="checkbox"/>
Volatility	1	<input type="checkbox"/>
Swap Spreads	1	<input type="checkbox"/>
Others	2	<input checked="" type="checkbox"/>

Custom Factor Partition

Security level Partition

Attribution Asset Classes

Security Partition HPA Default Partition (System) → Partition defines AA + SS

Attribution of cross terms By Hierarchy

YC + Vol + SS
Higher hierarchy

YC + Vol + SS:
not attributed
as common factors

All non-rates factors have the same hierarchy:
correlations will be equally distributed

Source: POINT

Attribution of Portfolio Beta

- GRM delivers portfolio beta with TEV
- The Risk Attribution framework extends easily to the attribution of beta
 - Understand co-movement of returns, under an excess systematic beta

$$Risk(TEV) = Var(r^P - r^B) = W \times L \times \Omega \times L' \times W'$$

$$Excess\beta = \frac{Cov(r^P, r^B)}{Var(r^B)} - 1 = \frac{W \times L \times \Omega \times L' \times W^{B'}}{Var(r^B)}$$

- Beta attribution: split the excess return co-movement into
 - Common factors
 - Asset allocation + Security selection
- Example (same example and settings)

Excess Beta Attribution	
Total	0.07
Rates Factors	0.06
Asset Allocation	0
Security Selection	0.01

Source: POINT

Future Projects

- Idiosyncratic and default TEV attribution
- Extend the asset allocation and security selection methodology to use other contributions as bucket weights
- Risk-adjusted performance attribution models to implement
 - Potentially including a proprietary model

Adjusted Performance Attribution Model	Risk Adjusted Return
Sharpe/Information Ratio	R^P / σ_P or R^{P-B} / σ_{P-B}
MM2	$R^P \times \frac{\sigma_B}{\sigma_P}$
MM3	$R^{P*} = wR^P + \omega R^B$

Source: POINT

Analyst Certification and Important Disclosures

Analyst Certification

I, Changxiu Li, hereby certify (1) that the views expressed in this research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this research report and (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this research report.

To the extent that any of the conclusions are based on a quantitative model, Barclays hereby certifies (1) that the views expressed in this research report accurately reflect the firm's quantitative research model and (2) no part of the firm's compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this research report.

Important Disclosures:

The Index Portfolio and Risk Solutions Group ("IPRS") is a part of the Research Department within the Investment Bank of Barclays Bank PLC and its affiliates (collectively and each individually, "Barclays"). IPRS is a leading provider of benchmark and strategy indices, portfolio analytics, risk and attribution models, and portfolio construction tools. IPRS operates independently from other businesses within the Investment Bank, including Sales, Trading, Structuring and Investment Banking. Notwithstanding the foregoing, potential conflicts of interest may exist where: (i) IPRS acts in multiple capacities with respect to a particular Barclays index, including but not limited to functioning as index sponsor, calculation agent, licensing agent, and/or publisher; (ii) IPRS uses price contributions from Barclays' trading desks as a primary pricing source for a Barclays index; and (iii) Barclays' Sales, Trading or Structuring desks launch tradable products linked to the performance of a Barclays index. Barclays has in place policies, information barriers and governance procedures that are designed to avoid or otherwise appropriately manage such conflicts of interest and ensure the independence and integrity of its indices. Where permitted and subject to appropriate information barrier restrictions, Barclays IPRS personnel regularly interact with internal trading desk personnel regarding current market conditions and prices. Additional information about Barclays indices is available at: <https://indices.barcap.com/index.dxml>.

Any systematic investment strategies described herein may involve a high degree of risk, including without limitation market risk and other risks inherent in investing in securities, commodities, currencies, derivatives and other financial instruments. The value of and income from investments linked to such strategies may decline in value and loss of the original amount invested can occur.

Barclays regularly trades, generally deals as principal and generally provides liquidity (as market maker or otherwise) in the securities, commodities, currencies, derivatives and other financial instruments included in Barclays indices, as well as other financial products linked to such indices. Barclays trading desks may have either a long and/or short position in such securities, commodities, currencies, derivatives and index-linked products, which may pose a conflict with the interests of investing customers and/or index users. All levels, prices and spreads are historical and do not represent current market levels, prices or spreads, some or all of which may have changed since the publication of this document. To the extent that any historical pricing information was obtained from Barclays trading desks, the firm makes no representation that it is accurate or complete.

Barclays does and seeks to do business with issuers covered in its research reports. As a result, investors should be aware that Barclays may have a conflict of interest that could affect the objectivity of this report. Barclays has investment banking and other business relationships with many of the issuers of securities included in Barclays indices, which may result in potential conflicts of interest. Barclays may from time to time perform commercial, investment banking or other advisory services for the issuers of securities included in Barclays indices, including acting as manager, co-manager or underwriter of such securities.

Barclays produces various types of research including, but not limited to, fundamental analysis, equity-linked analysis, quantitative analysis, index strategies research, and trade ideas. Recommendations contained in one type of research may differ from recommendations contained in other types of research, whether as a result of differing time horizons, methodologies, or otherwise.

In order to access Barclays Statement regarding Research Dissemination Policies and Procedures, please refer to <https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-research-dissemination.html>. In order to access Barclays Research Conflict Management Policy Statement, please refer to: <https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-conflict-management.html>.

For current important disclosures regarding companies that are the subject of this research report, please send a written request to: Barclays Research Compliance, 745 Seventh Avenue, 14th Floor, New York, NY 10019 or refer to <http://publicresearch.barclays.com> or call 212-526-1072.

Disclaimer

This publication has been prepared by the Investment Bank of Barclays Bank PLC and/or one or more of its affiliates (collectively and each individually, "Barclays"). It has been issued by one or more Barclays legal entities that are a part of the Investment Bank as provided below.

Indices are unmanaged and cannot be invested in directly. The development or creation of any product that uses, is based on, or is developed in connection with any Barclays index (each a "Product") is prohibited without the prior written consent of Barclays. IPRS does not sponsor, endorse, sell or promote such Products and makes no representation regarding the advisability of investing in any such Product.

Barclays is not acting as an investment adviser or fiduciary. This publication does not constitute personal investment advice or take into account the individual financial circumstances or objectives of any investor. The indices, securities, commodities, currencies, derivatives and other financial products discussed herein may not be suitable for all purposes or for all investors. Accordingly, recipients must independently determine, in consultation with their own advisors, whether any index or investment discussed herein is appropriate for their purposes.

The index data, quantitative models, analytic tools and other information ("Content") referenced in this publication are considered reliable, but Barclays does not represent that the Content (including information obtained from third party sources) is accurate, complete or error free, and it should not be relied upon as such. The Content is provided for informational purposes only and is made available "as is". Barclays does not guarantee the accuracy, timeliness, reliability, performance, continued availability, completeness or currency of any Content and Barclays shall have no liability for any errors, omissions or interruptions therein. Any data on past performance, modelling or back-testing contained in the Content is no indication as to future performance. No representation is made as to the reasonableness of the assumptions made within or the accuracy or completeness of any modelling or back-testing. Because of the possibility of human and mechanical errors as well as other factors, Barclays accepts no responsibility for any errors or omissions in the Content (including but not limited to the calculation or performance of any index and/or the output of any quantitative model or analytic tool). Barclays accepts no liability whatsoever for the accuracy, timeliness, reliability, performance, continued availability, completeness or currency of the Content, or for delays or omissions therein, or for interruptions in the delivery of any Content, or for any special, punitive, indirect, incidental or consequential losses arising from the use of or reliance on any content, even if advised of the possibility of such losses.

Index returns represent past performance and are not indicative of any specific investment. The Content (including any of the output derived from any analytic tools or models) is not intended to predict actual results, which may differ substantially from those reflected. Past performance is not necessarily indicative of future results.

Not all products or services mentioned are available in all jurisdictions. No offers, sales, resales, or delivery of any products or services described herein or any offering materials relating to any such products or services may be made in or from any jurisdiction except in circumstances which will result with compliance with any applicable laws and regulations and which will not impose any obligations on Barclays.

This material has been issued and approved for distribution in the UK and European Economic Area by Barclays Bank PLC. It is being made available primarily to persons who are investment professionals as that term is defined in Article 19 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005. It is directed at, and therefore should only be relied upon by, persons who have professional experience in matters relating to investments. The investments to which it relates are available only to such persons and will be entered into only with such persons. Barclays Bank PLC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority and is a member of the London Stock Exchange.

The Investment Bank of Barclays Bank PLC undertakes U.S. securities business in the name of its wholly owned subsidiary Barclays Capital Inc., a FINRA and SIPC member. Barclays Capital Inc., a U.S. registered broker/dealer, is distributing this material in the United States and, in connection therewith accepts responsibility for its contents. Any U.S. person wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of Barclays Capital Inc. in the U.S. at 745 Seventh Avenue, New York, New York 10019.

Non-U.S. persons should contact and execute transactions through a Barclays Bank PLC branch or affiliate in their home jurisdiction unless local regulations permit otherwise.

Barclays Bank PLC, Paris Branch (registered in France under Paris RCS number 381 066 281) is regulated by the Autorité des marchés financiers and the Autorité de contrôle prudentiel. Registered office 34/36 Avenue de Friedland 75008 Paris.

This material is distributed in Canada by Barclays Capital Canada Inc., a registered investment dealer, a Dealer Member of IIROC (www.iiroc.ca), and a Member of the Canadian Investor Protection Fund (CIPF).

Subject to the conditions of this publication as set out above, the Corporate & Investment Banking Division of Absa Bank Limited, an authorised financial services provider (Registration No.: 1986/004794/06. Registered Credit Provider Reg No NCRCP7), is distributing this material in South Africa. Absa Bank Limited is regulated by the South African Reserve Bank. This publication is not, nor is it intended to be, advice as defined and/or contemplated in the (South African) Financial Advisory and Intermediary Services Act, 37 of 2002, or any other financial, investment, trading, tax, legal, accounting, retirement, actuarial or other professional advice or service whatsoever. Any South African person or entity wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of the Corporate & Investment Banking Division of Absa Bank Limited in South Africa, 15 Alice Lane, Sandton, Johannesburg, Gauteng 2196. Absa Bank Limited is a member of the Barclays group.

Disclaimer Continued

In Japan, foreign exchange research reports are prepared and distributed by Barclays Bank PLC Tokyo Branch. Other research reports are distributed to institutional investors in Japan by Barclays Securities Japan Limited. Barclays Securities Japan Limited is a joint-stock company incorporated in Japan with registered office of 6-10-1 Roppongi, Minato-ku, Tokyo 106-6131, Japan. It is a subsidiary of Barclays Bank PLC and a registered financial instruments firm regulated by the Financial Services Agency of Japan. Registered Number: Kanto Zaimukyokuchō (kinsho) No. 143.

Barclays Bank PLC, Hong Kong Branch is distributing this material in Hong Kong as an authorised institution regulated by the Hong Kong Monetary Authority. Registered Office: 41/F, Cheung Kong Center, 2 Queen's Road Central, Hong Kong.

Information on securities/instruments that trade in Taiwan or written by a Taiwan-based research analyst is distributed by Barclays Capital Securities Taiwan Limited to its clients. The material on securities/instruments not traded in Taiwan is not to be construed as 'recommendation' in Taiwan. Barclays Capital Securities Taiwan Limited does not accept orders from clients to trade in such securities. This material may not be distributed to the public media or used by the public media without prior written consent of Barclays.

This material is distributed in South Korea by Barclays Capital Securities Limited, Seoul Branch.

All equity research material is distributed in India by Barclays Securities (India) Private Limited (SEBI Registration No: INB/INF 231292732 (NSE), INB/INF 011292738 (BSE) | Corporate Identification Number: U67120MH2006PTC161063 | Registered Office: 208 | Ceejay House | Dr. Annie Besant Road | Shivsagar Estate | Worli | Mumbai - 400 018 | India, Phone: + 91 22 67196363). Other research reports are distributed in India by Barclays Bank PLC, India Branch.

Barclays Bank PLC Frankfurt Branch distributes this material in Germany under the supervision of Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin).

This material is distributed in Malaysia by Barclays Capital Markets Malaysia Sdn Bhd.

This material is distributed in Brazil by Banco Barclays S.A.

This material is distributed in Mexico by Barclays Bank Mexico, S.A.

Barclays Bank PLC in the Dubai International Financial Centre (Registered No. 0060) is regulated by the Dubai Financial Services Authority (DFSA). Principal place of business in the Dubai International Financial Centre: The Gate Village, Building 4, Level 4, PO Box 506504, Dubai, United Arab Emirates. Barclays Bank PLC-DIFC Branch, may only undertake the financial services activities that fall within the scope of its existing DFSA licence. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

Barclays Bank PLC in the UAE is regulated by the Central Bank of the UAE and is licensed to conduct business activities as a branch of a commercial bank incorporated outside the UAE in Dubai (Licence No.: 13/1844/2008, Registered Office: Building No. 6, Burj Dubai Business Hub, Sheikh Zayed Road, Dubai City) and Abu Dhabi (Licence No.: 13/952/2008, Registered Office: Al Jazira Towers, Hamdan Street, PO Box 2734, Abu Dhabi).

Barclays Bank PLC in the Qatar Financial Centre (Registered No. 00018) is authorised by the Qatar Financial Centre Regulatory Authority (QFCRA). Barclays Bank PLC-QFC Branch may only undertake the regulated activities that fall within the scope of its existing QFCRA licence. Principal place of business in Qatar: Qatar Financial Centre, Office 1002, 10th Floor, QFC Tower, Diplomatic Area, West Bay, PO Box 15891, Doha, Qatar. Related financial products or services are only available to Business Customers as defined by the Qatar Financial Centre Regulatory Authority.

This material is distributed in the UAE (including the Dubai International Financial Centre) and Qatar by Barclays Bank PLC.

This material is distributed in Russia by OOO Barclays Capital, affiliated company of Barclays Bank PLC, registered and regulated in Russia by the FSFM. Broker License #177-11850-100000; Dealer License #177-11855-010000. Registered address in Russia: 125047 Moscow, 1st Tverskaya-Yamskaya str. 21.

This material is distributed in Singapore by the Singapore branch of Barclays Bank PLC, a bank licensed in Singapore by the Monetary Authority of Singapore. For matters in connection with this report, recipients in Singapore may contact the Singapore branch of Barclays Bank PLC, whose registered address is One Raffles Quay Level 28, South Tower, Singapore 048583.

Barclays Bank PLC, Australia Branch (ARBN 062 449 585, AFSL 246617) is distributing this material in Australia. It is directed at 'wholesale clients' as defined by Australian Corporations Act 2001.

IRS Circular 230 Prepared Materials Disclaimer: Barclays does not provide tax advice and nothing contained herein should be construed to be tax advice. Please be advised that any discussion of U.S. tax matters contained herein (including any attachments) (i) is not intended or written to be used, and cannot be used, by you for the purpose of avoiding U.S. tax-related penalties; and (ii) was written to support the promotion or marketing of the transactions or other matters addressed herein. Accordingly, you should seek advice based on your particular circumstances from an independent tax advisor.

© Copyright Barclays Bank PLC (2015). All rights reserved. No part of this publication may be reproduced or redistributed in any manner without the prior written permission of Barclays. Barclays Bank PLC is registered in England No. 1026167. Registered office 1 Churchill Place, London, E14 5HP. Additional information regarding this publication will be furnished upon request. US28591