Institution: University of Oxford

Unit of Assessment: 10 – Mathematical Sciences

Title of case study: Risk On / Risk Off: from academic research to financial market staple

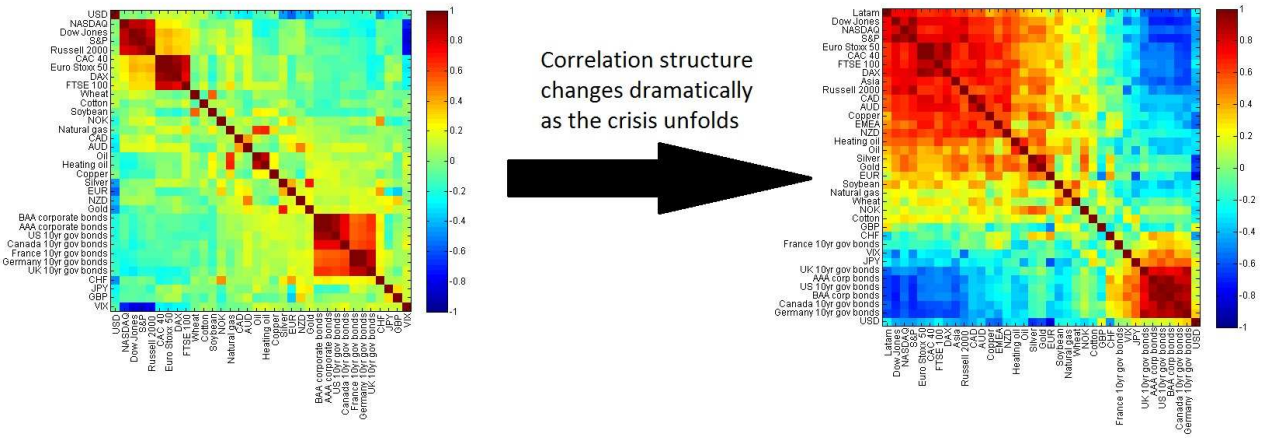
1. Summary of the impact

This case study charts the influence of the Risk On / Risk Off (RORO) paradigm, developed in research at the University of Oxford in collaboration with investment bank HSBC. Since 2008, RORO has had a significant economic impact on HSBC as well as wider impact on the thinking and actions of investors and other global market participants. Having begun as a specialised research tool within HSBC's foreign exchange team, the RORO methodology was publicised in the advice that HSBC supply to a wide range of major fund managers, corporate institutions and central banks. The research has led directly to a change in the way that asset managers think about investment decisions, with consequent impact on the investment and risk management strategies they undertake. RORO is regularly featured in the financial press and is becoming increasingly mainstream, with coverage in national and international media aimed at retail investors.

2. Underpinning research

The collapse of Lehman Brothers in 2008 precipitated a dramatic and enduring change in the correlation structure of global financial markets. This has become widely known by investment professionals as the Risk On/Risk Off (RORO) phenomenon – a term coined by the authors of the research considered below, and now common market parlance.

Researchers in the University of Oxford started thinking about the temporal evolution of multi-asset correlations and their relationship to macro-economic and geo-political events in 2008. In [1] these were characterised and measured using evolving correlation matrices, which were constructed from a large dataset covering 98 major asset prices over 12 years from January 1999. The research compares the realised correlations with those that would result from a random-matrix equivalent, revealing that there is structure in the data that is not present in the Gaussian model used in standard financial theory. This structure is investigated in more detail via a Principal Component Analysis. A key result is that before the collapse of Lehman Brothers in September 2008, the first component is generally unremarkable and many assets are close to uncorrelated (see the left-hand panel of the figure below, in which the colour indicates the strength of correlation). Post-Lehman, a dominant component emerges, the strength of which is tightly coupled to market events, as illustrated in the right-hand panel of the figure below, in which all bonds are closely correlated, as are all equities.



The research [1] provided a view of the markets which came to be known as RORO. This is the direct manifestation of the Principal Component Analysis in [1], and is backed up by the parallel studies [2,3] which use techniques from network analysis to develop algorithms to detect large clusters which may indicate the presence of changes of risk states. RORO uses two states to characterise market conditions, and individual assets are characterised as being either risky

assets, or safe-havens. “Risk On” periods see investors buy risky assets and employ traditional correlation-based strategies, although even in these periods, correlation levels are much higher than was typical before the financial crisis. Thus, risky assets rise in value and safe-haven instruments fall. In “Risk Off” periods these moves swing into reverse as investors all move into safe havens, which all become highly correlated. RORO has profound consequences for asset managers as well as for other market participants such as hedge funds, corporate institutions and central banks.

A second significant outcome of the research, also described in [1], was the development of PCA-based graphical and quantitative methods to analyse the evolution of correlation structure, track the RORO phenomenon and monitor its influence on particular assets.

The underpinning research was carried out at the University of Oxford between 2008 and 2011 together with colleagues from HSBC. The key researchers were Mason Porter (University Lecturer, 2007 to date) and Dr Nick Jones (Research Fellow, 2008-2012).

3. References to the research

* [1] Fenn DJ, Porter MA, Williams S, McDonald M, Johnson NF & Jones NS. *Temporal evolution of financial-market correlations*. Phys. Rev. E **84**, 026109, 2011. DOI 10.1103/PhysRevE.84.026109.

* [2] Fenn DJ, Porter MA, McDonald M, Williams S, Johnson NF, & Jones NS. *Dynamic Communities in Multichannel Data: An Application to the Foreign Exchange Market During the 2007-2008 Credit Crisis*, Chaos, **19**, 033119, 2009. DOI 10.1063/1.3184538.

* [3] Fenn DJ, Porter MA, Mucha PJ, McDonald M, Williams S, Johnson, NF, & Jones NS, *Dynamical Clustering of Exchange Rates*, Quantitative Finance, **12**, 1493-1520. 2012. DOI 10.1080/14697688.2012.668288.

The three asterisked outputs best indicate the quality of the underpinning research. All these papers are in high quality internationally refereed journals.

4. Details of the impact

The primary impact of the research described in Section 2 is economic, and the beneficiaries are HSBC and other financial institutions. There is secondary societal impact in the adoption of RORO as a standard term in media coverage of financial markets. All impacts have occurred since 2008.

From research to impact

The HSBC Foreign Exchange Group were key partners in the development of the underpinning research, three HSBC employees were coauthors, and HSBC coined the phrase RORO. The underpinning research was taken up by the Foreign Exchange Research Group at HSBC, the world’s third largest bank by market capitalisation. The bank has a major presence in global markets with large trading operations in all significant asset classes. Trading is undertaken on behalf of clients, including institutional and sovereign fund managers, central banks, charities, and supra-national organisations. HSBC Research actively engages with its client base, both enhancing the clients’ background understanding of markets and providing advice on specific investment and trading strategies.

The Head of FX Quantitative Strategy at HSBC states [A] “*The RORO research was translated from the original PRE paper into two major HSBC Global Research publications* [Risk On-Risk Off: a paradigm is born (2010) and Risk On-Risk Off: Fixing a broken investment process (2012)]*, aimed at Market Practitioners*”. These publications explore the far-reaching consequences of RORO for market participants, and describe techniques explicitly devised to combat the phenomenon, with strategies to aid market participants in incorporating this new view of the market into their planning. HSBC also devised the HSBC RORO Index (illustrated below) to quantify the RORO effect.

Nature and extent of the impact

Investors have traditionally relied on certain guiding principles, some of which are consistent with standard finance theory such as the Capital Asset Pricing Model (assets respond to their own economic fundamentals as well as overall market conditions, risk reduction through diversification is achievable across asset classes) and others which may not be (enhanced returns can be generated though "active" strategies such as relative value trades and stock picking). The RORO phenomenon means these principles are much less useful than they once were. Furthermore, and crucially for investors, it provides a replacement framework within which they can construct new and effective asset allocation strategies.

Immediate impact for HSBC can be measured in terms of client take-up. Research is distributed via a web-site, and by an emailed web-link, enabling active downloads to be tracked. The Head of FX Quantitative Strategy at HSBC writes [A]: "*In 2012, HSBC published over* **[text removed for publication]** *research reports. Scored by distinct hits, the report "RORO: Fixing a Broken Investment Process" was ranked 3rd globally.* […] *It is a testament to the importance of RORO to traditional practitioners as well as 'quants' and points to RORO becoming 'mainstream and widely relevant.* […] *HSBC also distributes research in online video format and two videos were produced … Of over* **[text removed for publication]** *video releases in 2012, these two videos were ranked 2nd and 3rd most watched."*

As a consequence of client demand, the PCA-based graphical and quantitative tools, as developed by the University of Oxford and HSBC, are now updated weekly by HSBC and provided to clients on a subscription basis. The immediate commercial impact for HSBC is exemplified in the letter from the Head of FX Quantitative Strategy at HSBC [A], which states **[text removed for publication]**. Trading businesses are high volume, low margin operations. A higher ongoing volume of client business is thus extremely valuable. Numbers are too commercially sensitive to state, but are significant enough that HSBC has now launched a dedicated Emerging Market version of the PCA-based tools to further its Asian, Latin American and Middle Eastern franchises.

Deeper impact is seen in requests for in-depth project work by HSBC from top-tier clients. "*We also conducted bespoke research for individual clients, including central banks, corporates and investment managers looking to adapt their businesses to the RORO phenomenon. The combined AUM* [assets under management] *of these clients totalled hundreds of billions of dollars*" states the Head of FX Quantitative Strategy at HSBC [A].

The research has directly benefited the wider investment management community, with many substantial investors using the HSBC RORO index as a key quantitative tool for making investment decisions. As an example of typical usage, the website of Institutional Asset Manager, reporting a presentation [B] by Peter Rigg, Global Head of HSBC Alternative Investment Group and an early adopter of the use of RORO, states: "*Quite simply, until the RORO Index shows signs of falling, Rigg does not envisage a transition from Scenario 1* [relatively pessimistic] *to Scenario 2* [cautiously optimistic]"; it goes on to explain that his investment strategy will be determined by this signal: *"'We're currently positioned for Scenario 1 but we can move quickly into Scenario 2 when required', said Rigg*". HSBC AIM is the largest Alternative manager in the UK with $30 Bn AUM.

The Global Chief Investment Officer of **[text removed for publication]** writes (to the University of Oxford) [C]: "*Your published research in this area has been instrumental for practitioners endeavouring to measure and adapt to this once-in-a-generation shift in market structure. I consider your work to be groundbreaking and it has had significant impact within the asset management community and beyond*". A Director at **[text removed for publication]** writes [D]: *"*[RORO] *helped my team better understand our positioning during a difficult time in the markets*",

listing areas where **[text removed for publication]**uses it, including stress testing positioning (analysis of portfolio behaviour under extreme scenarios) and assisting clients in total portfolio construction. A Senior Portfolio Manager at **[text removed for publication]**, states [E]: "*The hallmark of the RORO phenomenon was a dramatic increase in cross-asset correlations: this had profound consequences for the asset management community.* […] *the insight we derived from your research has had a direct impact on the construction methodologies we adopted for our funds*."

Use of the RORO framework has now extended well beyond HSBC and other professional investment managers. After featuring in specialist publications such as Risk Magazine ("*Everyone is perplexed by these risk-on or risk-off days, where it feels like you can actually see the correlation increase*" [F], para 2) and FX Week (headline: Risk-on, risk-off markets boost demand for active currency management [G], RORO began to feature regularly in the generalist financial press, often with explicit reference to the HSBC research team. There have been many appearances in the Financial Times and Wall Street Journal, for example "*In the scale of Risk On/Risk Off trading days, this looked usual*" [H] from the FT and the WSJ headline "Bernanke's 'Risk-On, Risk-Off' Monetary Policy" [I]; they include columns, blogs, feature articles and inclusion in a Private Wealth Management supplement. The Financial Times has recently added RORO to the official list of tags it uses to index its website FT.com, where a search for RORO gives more than 50 results [J].

The RORO paradigm has now moved on to become a staple of mainstream journalism. For example, articles in the Times (headline: "Risk on, risk off as stock market's RoRo goes into sharp reverse" [K]) and the New York Times Business Day 'Your Money' section ("Why are markets so highly correlated? The answer may be found in "risk on, risk off," a bit of jargon favored by financial traders and strategists." [L]) are aimed at mainstream retail audiences, while [M] looks at the repercussions of RORO for retirement planning and saving for children's education. Likewise, mainstream retail investor websites use the terminology routinely; for example, in an article entitle *Rising star fund managers,* Investor's Chronicle simply quoted Jason Hollands from Bestinvest:. "*A false call on the risk on/risk off trade could turn a manager from hero to zero overnight*" [N].

5. Sources to corroborate the impact

[A] Letter from Head of FX Quantitative Strategy at HSBC, describing the development, use and impact of RORO in HSBC. Copy held by University of Oxford.

[B] http://www.institutionalassetmanager.co.uk/2012/02/07/161783/hsbc-alternative-investments-limited-hail-remains-defensive-2012-while-risk-%E2%80%93-risk, 2012.

[C] Letter from CIO, **[text removed for publication]**. Copy held by University of Oxford.

[D] Letter from Director at **[text removed for publication]** Copy held by University of Oxford.

[E] Letter from Senior Portfolio Manager, **[text removed for publication]**. Copy held by University of Oxford.

[F] http://search.proquest.com/docview/753944406/13D07A448C83210A5E5/6?accountid=13042

[G] http://www.fxweek.com/fx-week/news/2188455/amundi-signs-mim-currency-account

[H] James Mackintosh, 'The Short View', *The Financial Times*, 5 January 2012, http://www.ft.com/cms/s/0/40c5f0ea-37bd-11e1-a5e0-00144feabdc0.html#axzz2OIbGgj00

[I] http://online.wsj.com/article/SB10000872396390443524904577649793013124710.html?KEYWORDS=%22risk+on%22+%22risk+off%22 – note the attached tags. 2012.

[J] http://search.ft.com/search?ftsearchType=type_news&queryText=Roro

[K] http://www.thetimes.co.uk/tto/business/markets/article3424248.ece, 2013.

[L] http://www.nytimes.com/2012/01/29/your-money/how-long-can-the-stock-market-forget-about-the-pain.html?, 2012.

[M] http://www.nytimes.com/2011/04/03/your-money/03stra.html., 2011.

[N] http://www.investorschronicle.co.uk/2013/01/14/funds-and-etfs/the-big-theme/rising-star-fund-managers-262S1OKsmlBjoCcTo1CVcJ/article.html, 2013.

[C]-[E] confirm the reach and significance of the economic impact of RORO among major fund managers. [F]-[N] corroborate the reach and significance of the societal impact of RORO. The University of Oxford holds copies of all webpages.