Institution: University of Exeter

Unit of Assessment: UoA 17 Business and Management Studies

Title of case study: Improving the Stability of the UK Financial System Through Improvements to the Bank of England's Stress Testing Procedures

Period when the underpinning research was undertaken: 2009-2011 and 2016-2018

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Richard Harris	Professor of Finance	October 1994 - 2019

Period when the claimed impact occurred: 2016 onwards

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

In response to the 2007-08 financial crisis, the Bank of England (BoE) - the Central Bank and financial regulator in the UK - initiated a programme of annual 'stress testing' for the UK's major banks in 2014, in order to better gauge the vulnerability of the UK banking system to a future crash. The key issue that emerged from the early tests was the need for the BoE to better understand the linkages between financial market volatility, market sentiment and the 'real' economy. Professor Harris' expertise in modelling financial market volatility and its relationship with the wider economy has achieved the following impacts:

- **Improved the formulation and calibration of the annual stress test exercise;**
- **Improved macro-economic forecasting for the Monetary Policy Committee; and**
- **Influenced broader aspects of BoE financial stability policy making.**

Within this broader policy landscape, improved stress tests enable the BoE to refine its response to market volatility and **thereby have played a critical role in safeguarding the stability of the UK financial system and the wider economy.**

2. Underpinning research

Professor Harris's research has developed a new model of the dynamics of the volatility of financial asset returns. This model was used to analyse the relationship between financial market volatility and the real economy. Together with Dr Evarist Stoja at the University of Bristol, Dr Ching-Wai (Jeremy) Chiu of the Bank's Stress Testing Strategy Division and Dr Michael Chin of the Bank's Macro-Financial Analysis Division, Professor Harris developed an analytical framework for measuring and forecasting the relationship between volatility in equity and bond markets and different aspects of the macroeconomic environment, including output, employment, interest rates and prices. The framework is based on Harris' earlier published research that provides a method of decomposing volatility into a long run persistent and a short run cyclical component **[3.1]**. Using the developed framework, Professor Harris and his co-authors showed that the long run component of volatility is more closely related to macroeconomic fundamentals while the short run component is more closely related to investor sentiment, a finding that has important implications for understanding the channels through which shocks are transmitted between financial markets and the real economy.

Specifically, publication **[3.1]** develops a new multi-factor 'cyclical' volatility model in which the volatility of financial asset returns is decomposed into two components: the first is a long run trend (i.e. a low frequency, highly persistent component), while the second is a high frequency transitory component that oscillates around the trend. It uses a non-parametric filter to extract the long run trend and models the transitory deviation of volatility around the

long run trend as a stationary autoregressive process using standard econometric techniques. Such 'component' models of volatility have become increasingly important in the analysis of financial markets, since they have important implications for modelling and forecasting volatility over both short and long horizons. The model developed by Harris not only provides very substantial computational advantages over existing component models of volatility, but also offers a significant improvement in forecasting performance. As an illustration, the model is used to forecast the volatility of the GBP/USD, JPY/USD and CHF/USD exchange rates, using the intraday high-low price range as a measure of realized volatility. It is shown that the cyclical volatility model generates out-of-sample forecasts that are able to explain a substantial fraction of the variation in actual volatility at horizons of up to one year, and which outperform the forecasts from the well-established but computationally burdensome range-based EGARCH and FIEGARCH models, in terms of both forecast accuracy and informational content. Moreover, owing to its simplicity, the cyclical volatility model also offers a substantial computational advantage over these models, with an estimation time that is many orders of magnitude lower.

In publication **[3.2],** undertaken with colleagues from the University of Bristol and the Bank of England, Professor Harris uses the cyclical volatility model described above to investigate the dynamic relationship between financial market volatility, macroeconomic fundamentals and investor sentiment. In particular, the model is used to decompose both equity and bond market volatility into a persistent long run component and a transitory short run component. Using a structural VAR model with Bayesian sign restrictions, it is shown that adverse shocks to aggregate demand and supply cause an increase in the persistent component of both stock and bond market volatility, and that adverse shocks to the persistent component of either stock or bond market volatility cause a deterioration in macroeconomic fundamentals. The transitory component of volatility is shown to be related to changes in investor sentiment rather than to macroeconomic fundamentals.

Professor Harris also worked on a number of other projects relating to financial stability, in collaboration with research staff at the Bank of England. In publication **[3.3],** he investigated the impact that the publication of the Financial Stability Report (FSR) has on the equity returns and credit default swap spreads of UK financial institutions. Using an event study methodology and a sample of 73 UK-listed banks and other financial institutions, it is found that publication of the FSR is, on average, associated with no abnormal returns. The research shows that this is because the content of the FSR is largely anticipated by the market, owing to effective signalling undertaken by the Financial Policy Committee ahead of any action to be taken.

3. References to the research

[3.1] Harris, R. D. F., E. Stoja and F. Yilmaz (2011) "A Cyclical Model of Exchange Rate Volatility", Journal of Banking and Finance, 35, 3055-3064. doi.org/10.1016/j.jbankfin.2011.04.007

[3.2] Chiu, C-W, R. **Harris**, E. Stoja and M. Chin (2018) "Financial market volatility, macroeconomic fundamentals and investor sentiment", Journal of Banking and Finance, 92, 130-145. doi.org/10.1016/j.jbankfin.2018.05.003

[3.3] R. **Harris**, V. Karadotchev, R. Sowerbutts and E. Stoja (2019), "Have FSRs got news for you? Evidence from the Impact of Financial Stability Reports on Market Activity", Bank of England Working Paper No. 792. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3376524

4. Details of the impact

Professor Harris' research has directly informed Bank of England approaches to understanding future risks of shocks within the UK banking sector. Results obtained from Harris' analytical framework, described above, have been used to improve the formulation and calibration of the annual stress testing exercise undertaken by the Bank of England. In addition, they have improved macro-economic forecasting for the Monetary Policy Committee, allowing the Bank to better gauge the vulnerability of the UK banking system to possible future shocks, and the channels through which these shocks are transmitted. The analysis has also allowed policy makers at the Bank to evaluate feedback mechanisms, which are believed to play an important role during periods of economic turbulence, thus helping to fine-tune the Bank's policy decisions.

Improved formulation and calibration of the annual stress-test exercise:
Following a recommendation by the Financial Policy Committee (FPC), the Bank of England initiated a programme of annual stress testing in 2014 in order to assess the capital adequacy of the UK banking sector, and its resilience to a range of possible future shocks. The stress testing exercise involves the formulation of a hypothetical scenario, representing a deterioration in global economic conditions that would adversely affect UK banks and building societies. The results of this scenario are compared with those from a baseline scenario that is based on the Bank of England's forecasts of future macroeconomic conditions. A key issue that emerged from the early stress tests was the need for a better understanding of the linkages between financial market volatility, market sentiment and the 'real' economy. This is cited as *"a key area for the Bank in terms of ensuring financial stability and a resilient financial system"* by the Head of the Bank of England's Stress Testing Strategy Division, which is mandated with monitoring systemic risk in the UK financial system **[5.1]**.

This issue was addressed by Professor Harris whilst working on secondment at the Bank of England. Based on his underpinning research **[3.1]** and working together with Dr Evarist Stoja from the University of Bristol, Dr Jeremy Chiu of the Bank's Stress Testing Strategy Division and Dr Michael Chin of the Bank's Macro-Financial Analysis Division, Professor **Harris developed an analytical framework, distinguishing between the different effects of core and transient financial volatility on the macroeconomic environment, that has influenced policymaking at senior levels within the Bank.**

Professor Harris published his findings in Bank of England Working Papers no. 608 and no. 792 **[5.2; 5.3]** and produced an associated confidential policy note (drawing out and emphasising policy implications and recommendations) that was circulated to senior management within the Bank, including members of the Monetary Policy Committee and Financial Policy Committee. While the outcomes of these discussions and meetings remain confidential, the Head of the Stress Testing Strategy Division has provided a testimonial that confirms that Professor Harris's work had "*important policy implications, especially for the Bank's annual stress testing exercise and, more generally, for macro-financial analysis. In particular, since the core volatility is related to macroeconomic fundamentals while transitory volatility is associated with investor sentiment,* ***policy makers are better served*** *by using core volatility rather than total volatility in calibrating the adverse scenarios*" **[5.1]**.

The Senior Economist at the Bank's Stress Testing Strategy Division, and Professor Harris's co-author, confirms the policy impact of the BoE Working paper **[5.2]**, stating that their findings have been *"discussed in important policy-making meetings, with the attendance of the Head of the Research Hub, the Head of Stress Testing Strategy Division, and the Head of the Macro-Finance Analysis Division during the summer of 2016. The responses were immensely positive, and our results were recognized as making a material impact regarding macro-prudential policies and annual stress-testing exercise"* **[5.4]**.

Improved macro-economic forecasting for the Monetary Policy Committee and broader aspects of financial stability policy-making:

Professor Harris' analysis is also directly supporting improved macro-economic forecasting at the Bank. The Senior Economist **[5.4]**, now working in the Forecasting Division at the BoE, and in charge of improving in-house modelling, confirms that the Working Paper findings on financial volatility **[5.2] have been used to develop a new macro-economic forecasting model that is being used every quarter by the Monetary Policy Committee to inform its decision-making [5.4]**.

Professor Harris' work has clearly made an important contribution to the development of effective stress-testing approaches at the Bank of England, enabling the Bank to refine its response to market volatility and thereby playing a critical role in safeguarding the stability of the UK financial system and the wider economy. The significance of Professor Harris' impact can be viewed in terms of the importance of stress-testing to the UK economy. On its website **[5.5]**, the Bank of England explains the need to ensure that banks and insurance companies are strong enough to withstand another financial crisis: "Banking stress tests assess how banks can cope with severe economic scenarios. We look at banks' resilience, making sure they have enough capital to withstand extreme shocks and are able to support the economy." In its latest Financial Stability Report (FSR), **the Bank notes a substantial increase in banks' resilience since the 2007/8 financial crisis**: "The FPC judges that the UK banking system remains resilient to a wide range of possible economic outcomes. It has the capacity to continue to support households and businesses even if outcomes are considerably worse than expected. This reflects the build-up of substantial buffers of capital since the global financial crisis" **[5.6]**.

Within changes to the broader policy landscape, stress tests enable the BoE to refine its response to market volatility and thereby play a critical role in safeguarding the stability of the UK financial system and the wider economy.
In addition, the Senior Economist in the Macroprudential Strategy and Support Division of the BoE, and co-author, said in August 2019, of the Working Paper 792 **[5.3]**, that the study *"is important and timely and fills a glaring gap in the literature of particular importance to the bank of England"* **[5.7]**. She describes the impact of the work as **providing BoE with an improved understanding** of the challenges it faces with its communications such as the FSR, delivering *"the **concrete steps necessary to address those challenges which the bank has accepted and has started to implement and will continue to do so** in the medium to long term as it pursues its core objective of financial stability and ultimately a healthy British economy"* **[5.7].**

Finally, Professor Harris' research has also supported the Bank of England's efforts to engage with the wider public on its policy decisions. The non-confidential aspects of the analysis work formed the basis of an article for 'Bank Underground', the Bank of England's blog **[5.8].** The blog serves to demystify the work of the Bank for journalists and the wider public. The analysis was also summarised in the Wall Street Journal **[5.9]**.

5. Sources to corroborate the impact

[5.1] *Letter from the Bank of England's Head of Stress Testing Strategy Division – 07/02/17*

[5.2] *Bank of England working paper No. 608 that is based on the underpinning academic research and which develops the research in a policy-related context – 16/08/16*
https://web.archive.org/web/20210219094412/https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2016/financial-market-volatility-macroeconomic-fundamentals-and-investor-sentiment.pdf

[5.3] *Corresponding Bank of England working paper No. 792, 18/04/2019*
https://web.archive.org/web/20210219094618/https://www.bankofengland.co.uk/working-paper/2019/have-fsrs-got-news-for-you

[5.4] Letter from Senior Economist – Forecasting Division, Bank of England, 06/08/2019

[5.5] Bank of England website – Stress Testing
https://web.archive.org/web/20210219095224/https://www.bankofengland.co.uk/stress-testing

[5.6] Financial Stability Report, December 2020
https://web.archive.org/web/20210219095349/https://www.bankofengland.co.uk/financial-stability-report/2020/december-2020

[5.7] Letter from Senior Economist – Macroprudential Strategy and Support Division, Bank of England 01/08/2019.

[5.8] Blog entry on Bank Underground (the Bank of England's blog for disseminating policy related research into the public domain) that describes the non-confidential aspects of the work and policy implications – 19/05/17
https://web.archive.org/web/20200408163217/https://bankunderground.co.uk/2017/05/19/do-core-and-transitory-volatilities-matter-for-the-economy/

[5.9] Write up of the research undertaken at the Bank of England in the Wall Street Journal – 22/5/17
https://web.archive.org/web/20200408163313/https://www.wsj.com/articles/core-volatility-and-the-economy-1495 446232