Downside protection: how to stress-test portfolio diversification

By Dr Quintin Rayer | March 14, 2019

This article takes a closer look at stress-testing portfolio diversification. It is the latest in our series, which has so far focussed on general overviews [1], [2], [3], [4], [5]; classification [6], [7]; detail on specific approaches [6], [8], [9], [10]; setting up a stress-testing programme [11] and application to P1's models [12].

Extreme market moves can negatively impact portfolios in ways which may not be captured by conventional risk measures, and diversification breakdown may mean that portfolio values are not protected. Stress-testing may be used to estimate portfolio impacts, and if necessary, appropriate restructuring can limit the downside. Typically, stress-testing may look at significant historical market events, or scenarios that reflect specific concerns.

Artificial stress-tests

A significant distinction is between historical scenarios (re-enactments of past events) [10] and artificial scenarios (invented to capture particular concerns and often involving assumptions) [6], [9]. Apart from the fact that history may not repeat, market developments (perhaps regulation changes) can mean that past financial crises could no longer occur in the

same way. Also, historical events can be messy with knock-on effects making it hard to isolate individual aspects of concern.

Artificial stress-tests can attempt to include the impact of changes (or anticipated changes) on markets; perhaps regulatory developments, new currencies or new geopolitical developments like Brexit. One approach is hypothetical testing which can examine the robustness of portfolio diversification [6], [8].

Stress-testing diversification

Portfolio managers use de-correlated assets to achieve diversification. However, correlations often increase during market crises, reducing diversification benefits. One approach to stress-testing diversification involves increasing selected correlations using 'covariance matrix' tests. Generally, some correlations are increased while leaving others unchanged. The sizes of correlation changes can be guided by analysing correlation variability or reflect specific concerns. The impact on diversification can be quantified by portfolio risk measures such as volatility or Value-at-Risk [13].

However, correlations cannot be changed arbitrarily. For example, suppose that Chinese, UK and US equities have low correlations between them. If a test were to isolate US-UK and UK-China correlations and increase these significantly, this also should imply higher US-China correlations. Consequently, these tests require the use of various mathematical techniques to ensure correlations are adjusted appropriately.

How this works

Selected correlations are changed to reflect diversification concerns. Ideally, correlations not selected should be left unchanged, or else only adjusted minimally. How to achieve this and the sizes of changes is an area where techniques differ [8].

One approach requires full return histories for portfolio assets. Selected returns are modified to adjust correlations, and if necessary rescaled to preserve asset class volatilities. However, if increases are desired to multiple correlation pairs, this method only targets an 'average' increase across the correlations selected; targeting to different values is not possible. In the example above suppose UK-US equity and UK-China equity correlations were historically at values of +0.16 and -0.29 respectively, and the stress-test aimed to increase them to target values of +0.89 and +0.68. With only the average values being raised, the resulting stress-test correlations would be +0.82 and +0.75, different from the target values. Another difficulty may be that for a large portfolio with a long history, the extended calculations required may become cumbersome and a complete asset history may be unavailable.

An alternative method allows correlations to be targeted directly. Asset return histories are not required, as they do not have to be modified. It also means that individual correlation pairs can be targeted to different values. In the case above, with UK-US and UK-China equities targeted at +0.89 and +0.68 respectively for the stress-test, these exact values can be obtained. However, this approach requires a higher level of mathematical sophistication

which some practitioners may be uncomfortable with, as well as access to suitable software to generate the necessary solutions.

In summary, data availability can be a significant factor, as well as access to the necessary skills and software. For exploring 'what if' stress-tests the ability to target individual correlation values through the second of the above approaches undoubtedly yields advantages, although the first method may seem more institutive. In practice, the ability to explore outcomes from both is likely to provide more robust results.

How advisers can add value

Advisers can play an important role by working with clients and investment managers to help identify suitable portfolio concerns and interpreting test results against their client's portfolio objectives. When stressed scenarios have little impact on a portfolio, it reassures both advisers and clients that the event may be of lesser concern than feared. Conversely, if a portfolio looks to be severely impacted, it can be restructured to make it more resilient. This helps demonstrate that advisers are working hard to protect portfolios and clients can be reassured that robust investment processes are in place.

References

[1] Q. G. Rayer, "Testing times," *STEP Journal,* vol. 24, no. 8, pp. 62-63, October 2016.
[2] Q. G. Rayer, "The increasing value of stress-testing portfolios," *Citywire Wealth Manager®,* no. 384, p. 12, 2 February 2017.
[3] Q. G. Rayer, "Testing times," *Accounting and Business, UK Edition,* pp. 24-25, April 2017.
[4] Q. G. Rayer, "A flaw in the ointment?," *The Actuary, ©The Institute and Faculty of Actuaries,* pp. 20-21, May 2017.
[5] Q. G. Rayer, "Testing ground," *Personal Finance Professional,* pp. 38-39, 9 June 2017.
[6] Q. G. Rayer, "Dissecting portfolio stress-testing," *The Review of Financial Markets,* vol. 7, pp. 2-7, 2015.
[7] Q. G. Rayer, "The different types of portfolio stress testing," DISCUS, 9 March 2017. http://discus.org.uk/different-types-portfolio-stress-tests/.
[8] Q. G. Rayer, "An investigation of hypothetical variance-covariance matrix stress testing," *Risk Management in Financial Institutions,* vol. 9, no. 3, pp. 264-288, Summer 2016.
[9] Q. G. Rayer, "Artificial portfolio stress-testing and how advisers add value to this process," DISCUS, 24 May 2017. http://discus.org.uk/artificial-portfolio-stress-testing/.
[10] Q. G. Rayer, "Managing risk: historical portfolio stress testing," DISCUS, 4 May 2017. http://discus.org.uk/historical-portfolio-stress-testing/.
[11] Q. G. Rayer, "Implementing a Portfolio Stress-testing Programme," DISCUS, 21 June 2017. http://discus.org.uk/implementing-portfolio-stress-testing-programme/.
[12] Q. G. Rayer, "Stress-testing P1's models and helping clients appreciate risk," DISCUS, 18 October 2018. http://discus.org.uk/stress-testing-p1s-models-and-helping-clients-appreciate-risk/.
[13] Q. G. Rayer, "Exploring Value-at-Risk," DISCUS, 28 February 2019. http://discus.org.uk/exploring-value-at-risk/.

This article was written by Dr Quintin Rayer, Head of Research and Ethical Investing at P1 Investment Management. It has also been published on the DISCUS website

discus
Discretionary Investment Services Coming Under Scrutiny