



**When US rates rise,
it may be time to
consider adding
emerging market
bonds**

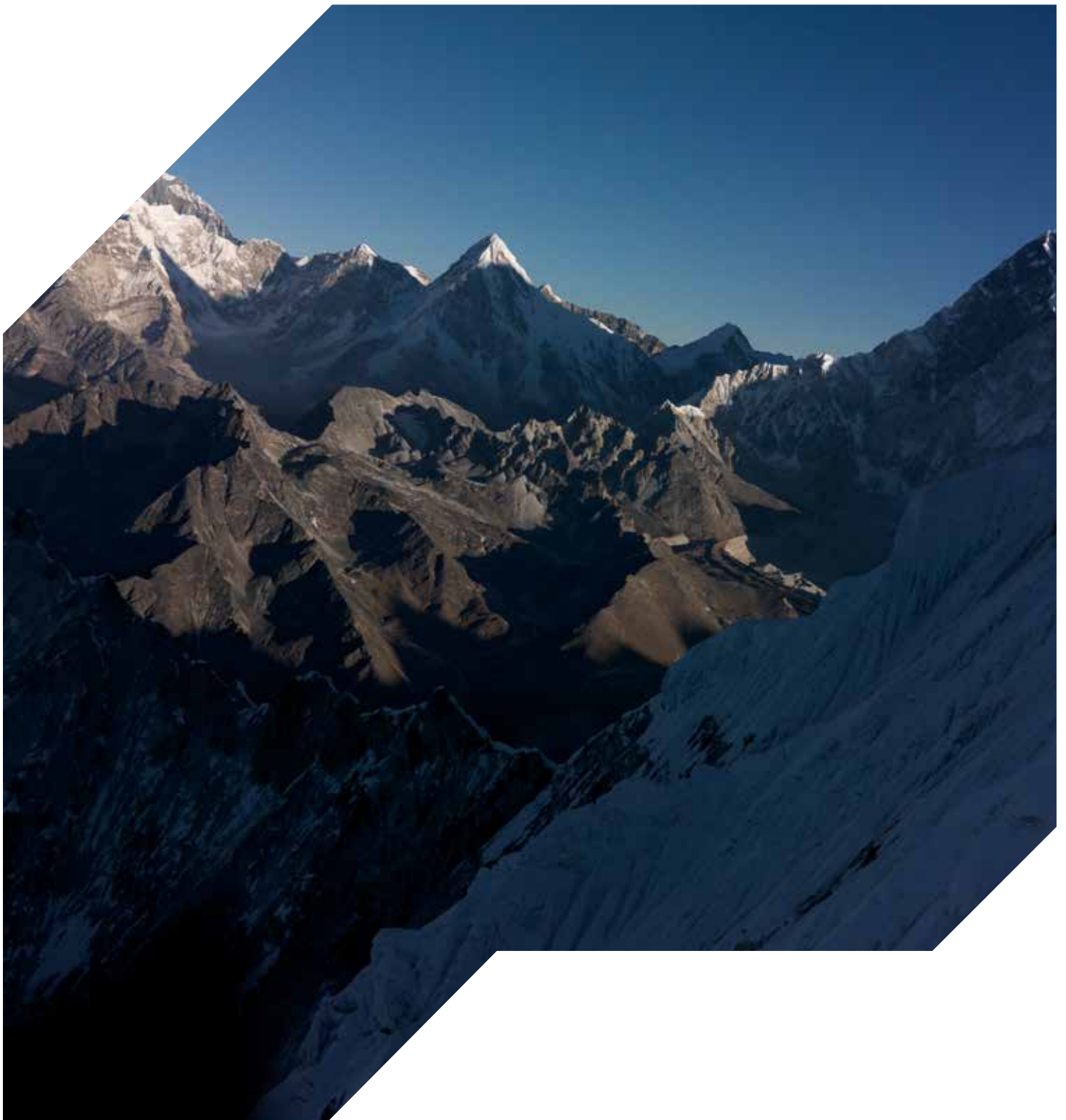
Factor investing: building
balanced factor portfolios

Risk-based currency
management

What makes a successful
forecaster?

Risk & Reward

Research and investment strategies



What makes a successful forecaster?

by Scott E. Wolle

In brief

Without successful forecasting there is no chance of ever beating the market. But forecasting isn't easy - though investors have an advantage over some other groups whose views of the future are an important part of their work: investors can succeed with even a small majority of correct views, and can hold multiple, unrelated views at once. We consider three levels of decision making relevant to investors. These are: the quality of inputs, the combination of inputs to form a decision and the combination of decisions to create a portfolio. In this way, good judgement is absolutely possible - but it does not come naturally. It is the product of processes and team structures that explicitly pursue it.

Economic forecasting has a reputation for always getting it wrong. Yet it can't be denied that everybody eagerly awaits the most recent estimates of future growth, interest rates and stock market returns. We give an overview of common forecasting pitfalls, and show what can be done methodologically and conceptually to improve forecast quality.

“The only function of economic forecasting is to make astrology look respectable.” John Kenneth Galbraith

2016 may be remembered for many things - but excellence in forecasting will most assuredly not be one of them. Voters' choices in favour of “Brexit” in the UK and of Donald Trump for President in the US stand as remarkably egregious misses by the experts. Yet, our surprise at these failures must itself be viewed as surprising, given the well-documented inaccuracy of expert forecasters¹. Philip Tetlock, perhaps the most prominent researcher of expert judgement, famously stated that, “the average expert was roughly as accurate as a dart-throwing chimpanzee.”² Ironically, it seems that the uncertainty associated with last year's forecast errors has actually served to increase demand for forecasts.

Fortunately, the research on forecasting and judgement does contain some hopeful news. First, the fact that the average forecaster performs poorly allows for some forecasters to do well. Second, the forecasters who do perform well tend to exhibit behaviours that overcome the weaknesses that make forecasting so difficult. Investors have an advantage over some other groups whose views of the future are an important part of their work. We can succeed with even a small majority of correct views, and can hold multiple, unrelated views at once. This article considers three levels of decision making relevant to investors: the quality of inputs, the combination of inputs to form a decision and the combination of decisions to create a portfolio.

Inputs

Quantopian, a website and self-described crowd-sourced quantitative investment firm, provides a wealth of tools to aspiring quantitative investors, including tutorials, fourteen years of data on stocks and the opportunity to license successful strategies



to the firm. Membership has doubled in each of the past few years, and has now reached over 100,000. These members have developed over 300,000 investing algorithms.

“Where is all the knowledge we have lost in information?”

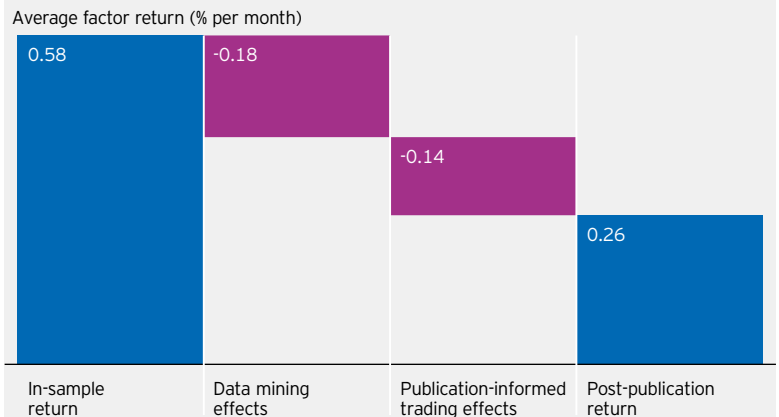
Thomas Stearns Eliot

Quantopian reflects both the opportunity and vulnerability of vast increases in data availability. Expanded information can help fundamental investors narrow their investment universe through the use of screens, as well as reduce the likelihood of certain cognitive errors [see Jones³ for a good summary]. The benefit for quantitative investors, of course, is more direct.

Yet, information has a cost in terms of false positives. Consider the 300,000 algorithms mentioned above: even if none of them had any information whatsoever, approximately 15,000 would pass standard statistical tests of significance, simply by random chance⁴.

For example, McLean and Pontiff⁵ review nearly 100 variables from peer-reviewed journals that purportedly explain the cross-section of stock returns. According to their findings, the variables lost on average more than half of their effectiveness from the period studied to post-publication (figure 1). The authors further dissect the information loss into potential data mining and publication-informed

Figure 1
The disappearance of forecast returns

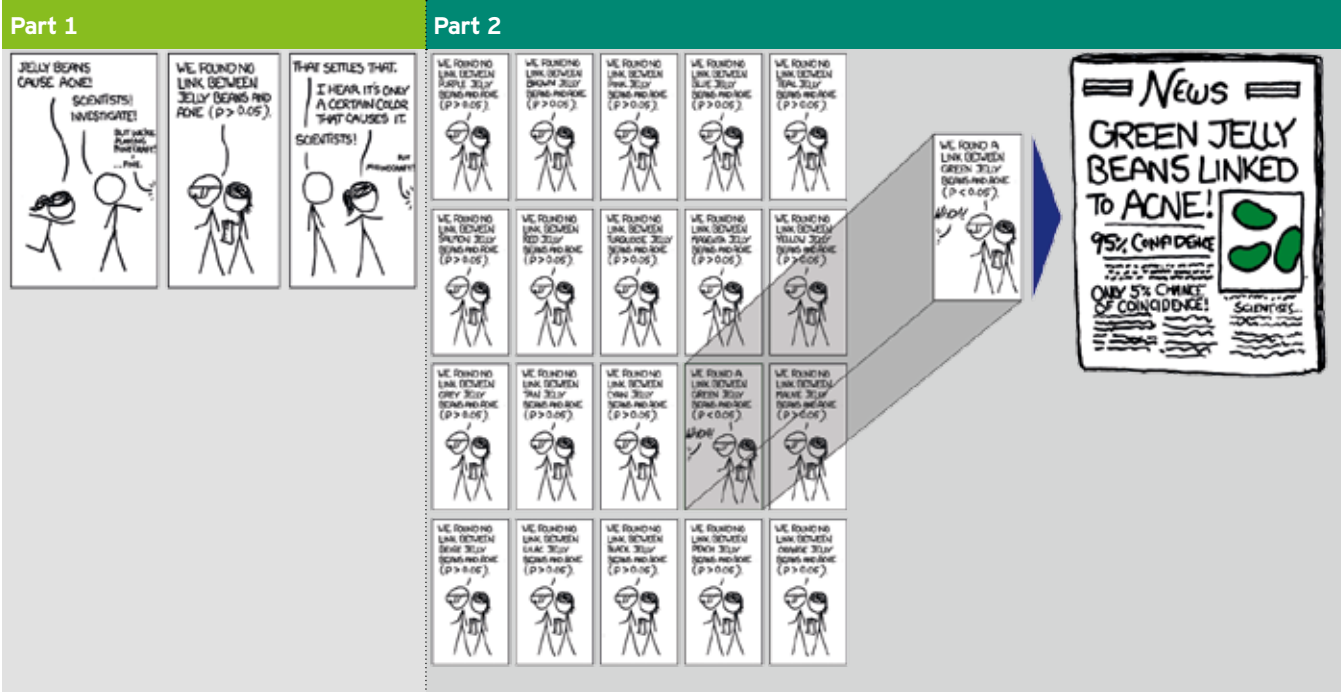


Data was collected for 97 variables from peer-reviewed journals dating from 1973 to 2013. Source: McLean, R. D. and J. Pontiff. 2015. Does academic research destroy return predictability? Journal of Finance, 2016.

trading effects (i.e., practitioners using a variable and thereby degrading its effectiveness). None of these include trading costs or fees, which make the effective returns even smaller.

The one-third loss of information from data mining is particularly worrying given the source of the information. Harvey, Liu, and Zhu⁶ reviewed an even larger sample of factors: a nearly unimaginable 316 from peer-reviewed journals. They find that the majority are likely to fail significance tests once account is taken of multiple testing. Professor Harvey used a cartoon to explain the problem (figure 2).

Figure 2
The jelly bean problem



Source: XKCD.com, as at 31 December 2016. Available at <https://xkcd.com/882>.

In the first frame, scientists are conducting tests to find out whether jelly beans cause acne, and conclude that they do not, based on the p value (convention considers only scores below 0.05 to be significant). The follow-on hypothesis posits that only certain colours of jelly beans cause acne - so the scientists test twenty different colours, concluding with 95% confidence that it is green jelly beans that cause acne. The same holds true with investment factors - testing many variations on a theme will almost certainly reveal a winning strategy, even if only by chance, unless we adjust the results appropriately.

Failure to account for multiple testing represents only one of many potential statistical and behavioural challenges facing investors, who must incorporate practices into their investment processes to help alleviate the risks. For example, the views of individuals within a team can, when aggregated, surpass the quality of the most knowledgeable member. But, a team squanders this virtue without a structure that prevents a minority of members from dominating the discussion.

Combining inputs

The years following the financial crisis witnessed a variety of financial commentators portending an imminent relapse into crisis. Michael Johnston counts twenty-five bearish predictions made from July 2010 through June 2015 from reputable outlets like The New York Times and CNBC.⁷ The predictions certainly made for interesting news and conversation - but all have proved incorrect (figure 3). The language used by these commentators seems to identify them, in Tetlock's taxonomy, as "hedgehogs".

"The whole problem with the world is that fools and fanatics are always so certain of themselves, but wiser people so full of doubts." Bertrand Russell

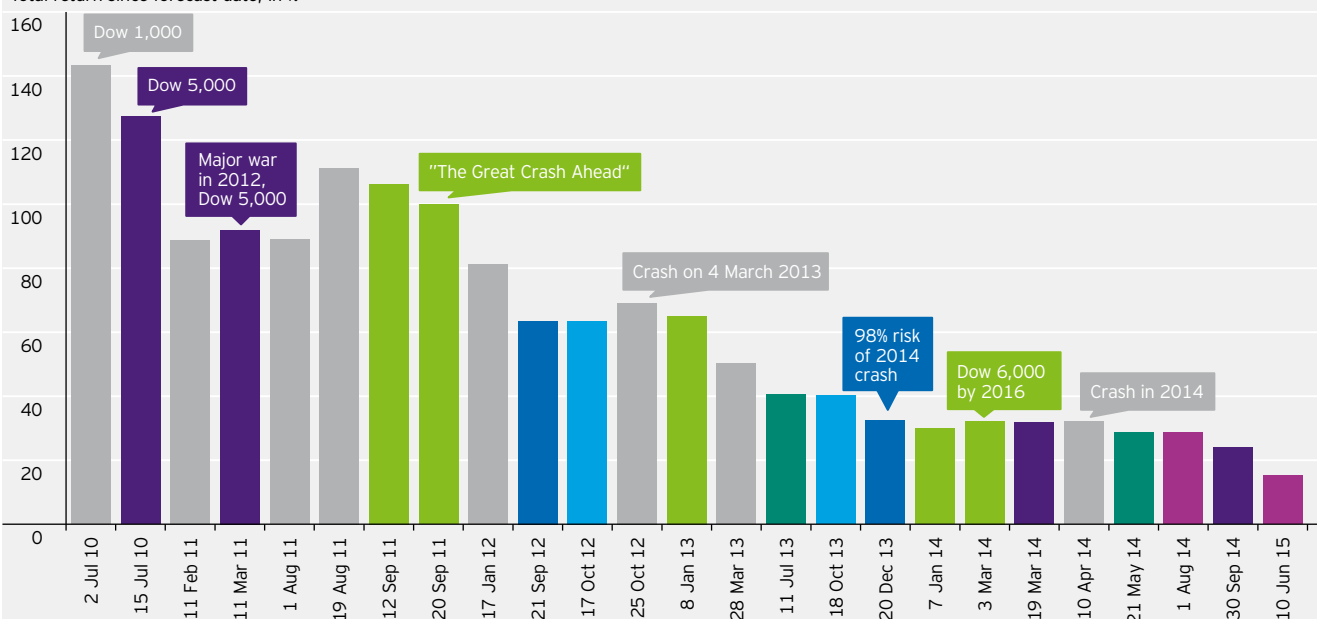
In his book 'Expert Political Judgment' (2006), Tetlock documents the results of his work, gathering and analyzing thousands of opinions from over two hundred experts over the course of two decades. His work finds no substantial difference in results between liberals and conservatives, optimists and pessimists, or any other obvious category. Rather, he classifies forecasters by how they think. Hedgehogs view the world through a single lens - a single big idea. The other group, "foxes," takes a broader perspective, continually looking for additional information to test their views. Foxes are shown to generate vastly superior performance, and this result prompted Tetlock to explore how good forecasting could become through applying best practices. The promising solutions are documented in his book, "Superforecasters".

In investment terms, the outperformance of foxes is simple to explain, even assuming equally informative inputs⁸: foxes effectively have a diversified portfolio of inputs, while the hedgehogs have the equivalent of a one stock portfolio. Grinold and Kahn have developed a framework, the "Fundamental Law of

Figure 3
Hedgehogs get it wrong

Legend:
 ■ Forecaster with only 1 forecast recorded
 ■ ■ ■ ■ ■ Forecaster with multiple forecasts recorded (e.g., all purple bars represent forecasts made by a single person)

Total return since forecast date, in %



Source: "A Visual History of Market Crash Predictions," Michael Johnston. 16 July 2015. Available at <http://financialgroup.com/wp-content/uploads/2016/02/A-Visual-History-of-Market-Crash-Predictions.pdf>.

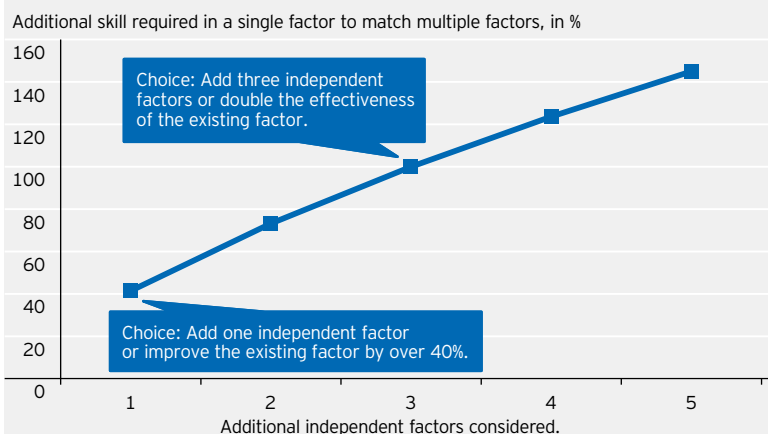
Active Management" (figure 4), that explains how the quality of inputs and the number of independent inputs impact the quality of a decision⁹. Applying this to hedgehogs and foxes helps us see the massive advantage of the latter. By seeing the world through two independent lenses, rather than one, the fox has a 40% advantage over the hedgehog. In other words, the hedgehog's lens has to be 40% better than the average of the fox's lenses to have the same expected accuracy! The advantage, of course, builds with the number of additional independent factors (assuming a similar quality of input).

Investors have many alternative means of combining inputs to form a decision. Perhaps surprisingly, research by Timmerman¹⁰ finds that a simple average outperforms most more-complicated alternatives, at least when it matters - out of sample¹¹. He explains that part of the appeal of simple averages lies in the possibility of structural breaks, which are difficult to discern in real time, and certainly plague financial variables, but not all of them at the same time. The key lesson is clear: investors should require exceptionally compelling evidence before veering from the simplest approach to combining inputs.

A portfolio of decisions

The work of combining decisions to create a portfolio resembles what was outlined in the prior section. In this case, however, one aspect requires some additional thought: how to handle differences in volatility among decisions. When combining inputs into a decision, all of the inputs likely possess similar volatility, since they all relate to a single phenomenon - such as the attractiveness of stocks relative to bonds. But, the volatility of the various decisions

Figure 4
The fundamental law of active management



Sources: Grinold and Kahn, Invesco analysis.

arrived at can vary considerably (figure 5). In this example, global stocks relative to bonds exhibit more than twice the historical volatility as the duration decision (18% vs. 8%). Accordingly, the global stocks vs. bonds decision contributes more than half of the volatility.

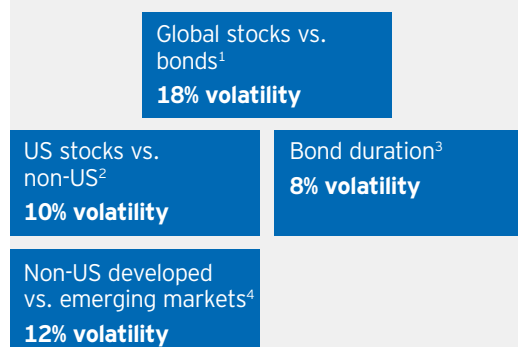
The concentration of risk means that these four decisions - even if completely independent - have less effective breadth than four with a similar level of volatility, because expected return per unit of risk also falls. Investors can address this by adjusting the allocation ranges for each decision, such that the product of the allocation range and the volatility are equal for each decision. In this example, the following allocation ranges would result in an equal risk contribution for each decision:

- Global stocks vs. bonds: +/- 7%
- US stocks vs. non-US: +/- 12%
- Duration: +/- 16%
- Non-US developed vs. emerging markets: +/- 11%

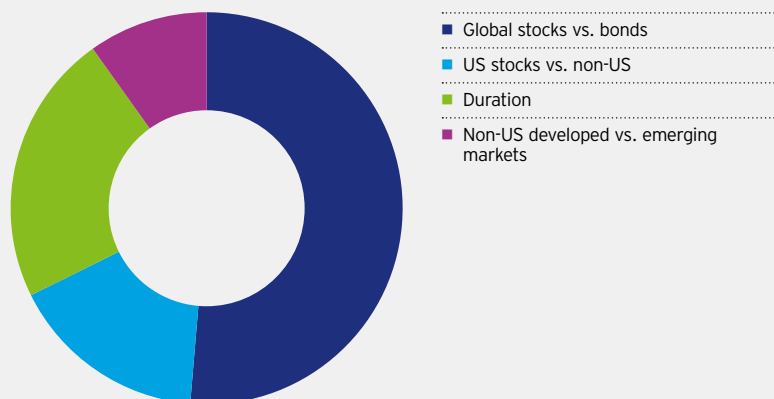
"All models are wrong, but some are useful." George Box

Figure 5
Contributions to portfolio volatility

Sample decision set and associated volatility



Risk contribution with equal allocation ranges



Decisions represented by 1: MSCI All Country World Index (ACWI) relative to Barclays Global Aggregate; 2: MSCI USA relative to MSCI ACWI ex-US; 3: Barclays US 10 Year Treasury Bellwether Index; 4: MSCI ACWI ex-US relative to MSCI Emerging. Source: Datastream. Period considered: 31 December 2006 - 31 December 2016.

The same principle can apply when allocating assets to managers: all things equal, higher tracking error managers should receive smaller allocations than lower tracking error managers, to avoid an over-concentration of risk in one manager.

Summary

More than forty years have passed since Tversky and Kahneman¹² alerted us to the frailties of human judgement. Since that time, forecasters across many disciplines have continued to fall for the same errors. The proliferation of financial data and analytical tools has helped solve some problems – but created new ones as well.

“Whenever there is a simple error that most laymen fall for, there is always a slightly more sophisticated version of the same problem that experts fall for.” Amos Tversky

The good news is that good judgement is absolutely possible. But it does not come naturally. It is the product of processes and team structures that explicitly pursue it. Of the traits that Tetlock identifies in successful forecasters, two stand out: a drive to improve and the discipline to keep score. One could do far worse than to start with those.

About the author



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Scott Wolle serves as the Chief Investment Officer for Invesco's Global Asset Allocation team which focuses on alternative investment strategies including risk parity, risk-balanced commodities and global macro solutions.

Notes

- 1 Grove, W. M., Zald, D. H., Lebow, B. S., Snitz, B. E., & Nelson, C. (2000). Clinical versus mechanical prediction: a meta-analysis. *Psychological assessment*, 12(1), 19.
- 2 Tetlock, Philip E., and Dan Gardner. 2015. *Superforecasting: the art and science of prediction*.
- 3 Making Better (Investment) Decisions *The Journal of Portfolio Management*, vol. 40, no. 2. (January 2014), pp. 128-143, doi:10.3905/jpm.2014.40.2.128 by Robert C. Jones
- 4 A common test of significance is for a p value below 0.05 (Z score 1.645). In a normal distribution, 5% of observations will meet this criterion. 5% x 300,000 = 15,000. This assumes that the 300,000 were the total number of algorithms tested which may be a low estimate given that unsuccessful algorithms may not have been saved.
- 5 McLean, R. David and Pontiff, Jeffrey, Does Academic Research Destroy Stock Return Predictability? (January 7, 2015). *Journal of Finance*, Forthcoming. Available at SSRN: <https://ssrn.com/abstract=2156623> or <http://dx.doi.org/10.2139/ssrn.2156623>
- 6 Harvey, Campbell R. and Liu, Yan and Zhu, Heqing, ...and the Cross-Section of Expected Returns (February 3, 2015). Available at SSRN: <https://ssrn.com/abstract=2249314> or <http://dx.doi.org/10.2139/ssrn.2249314>
- 7 Johnston, M. (2014 July 17). A Visual History of Market Crash Predictions. Retrieved from URL.
- 8 Given the extreme nature of many of the forecasts, one could assume that at least some of the forecasters suffered from confirmation bias or overconfidence. These would serve to reduce the quality of their forecasts relative to an unbiased observer.
- 9 Grinold, Richard C., and Ronald N. Kahn. 2000. *Active portfolio management: a quantitative approach for providing superior returns and controlling risk*. New York: McGraw-Hill.
- 10 Timmermann, Allan G., *Forecast Combinations* (November 2005). CEPR Discussion Paper No. 5361. Available at SSRN: <https://ssrn.com/abstract=878546>
- 11 The formula is Information Ratio = Information Coefficient x $\sqrt{\text{Breadth}}$
- 12 Kahneman, Daniel and Amos Tversky. *Judgment under Uncertainty: Heuristics and Biases* (September 27, 1974). *Science*.

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