



Optimal Behaviour

Issue 1: The Behavioural Science of Risk

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Abstract

Traditional approaches to investment risk, whilst mathematically convenient, do not correspond with what people mean by 'risk'. 'Risk', in everyday language, refers to the chance of something bad happening, but the conventional measure used in the finance industry, volatility, also treats better-than-expected performance as risky. Financial institutions' failure to reflect risk as it is psychologically experienced by investors is reflected in misconceived portfolio optimisation techniques. The result is that investment managers provide portfolios that do not reflect their clients' true risk/return trade-off. After all, it is clear that each investor has his or her own view of what constitutes 'risk'.

A more appropriate approach first assumes that better-than-expected possible investment outcomes detract from perceived risk rather than adding to it. It would also assume that the potential for catastrophic outcomes results in higher perceived risk than a volatility-based risk measure would suggest.

To develop this approach, we designed a risk tolerance scale that employs advanced psychometric and decision theoretic principles. As part of our ongoing experimental research work to test and validate our approach, we recently ran an experiment in collaboration with leading academics on a pool of 3,000 experimental subjects worldwide. The subjects were asked to choose between five different portfolios, each offering higher potential returns but also with the possibility of a worse outcome than the certainty provided by the least risky portfolio. Our findings show that risk tolerant people do indeed choose riskier investments, and that our psychometric scale can be linked to the actual amount of risk investors would choose for themselves. But it also shows that even the least risk tolerant individuals are prepared to take on some risk.

Our approach enables us to link risk tolerance to an appropriate downside risk curve. This in turn offers the prospect of minimising only those risks that actually matter to each individual – that is, it represents a more efficient use of the available risk budget.

What is financial risk?

It is a truism of investing that achieving higher returns requires taking more risk. On average those who take risk are rewarded for doing so – but 'on average' provides no guarantees and there remains the possibility that the outcome will be worse than expected. Determining whether the average expected reward is sufficient to compensate for the risks taken requires an understanding of precisely what is meant by risk.

Problems with volatility

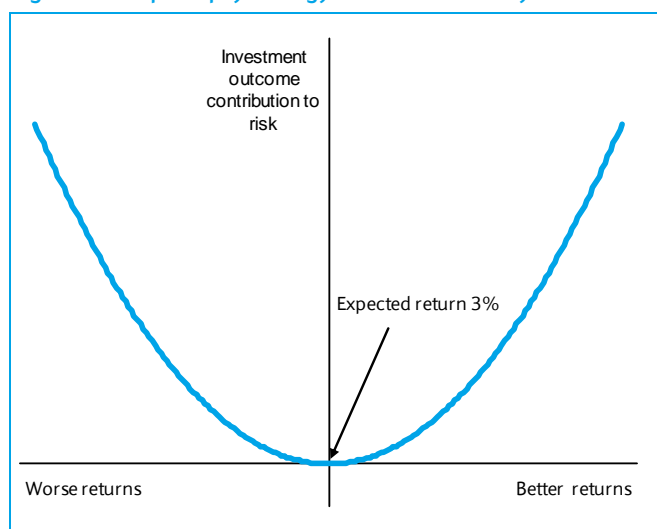
The standard definition used in finance is that risk is *volatility*, or to give it its full technical definition, the *square root of the average of squared deviations from the expected return*. However mathematically pleasing this definition may be, it bears little relation to risk as a psychologically intuitive concept. If investors are to decide how much extra risk to take on in exchange for increased expected returns, they need a measure that reflects risk in a way that is meaningful and important to them as investors, not just a technical definition that financial modellers find mathematically convenient.

Everyday usages of risk commonly refer to the *chance of something bad happening*. This is a much more natural concept than volatility which treats outcomes that are better than expected as being just as risky as worse-than-expected outcomes. This is not how the vast majority of the world responds to financial risk – the chance that your portfolio may return 4% more than you expect next year simply does not strike normal people as a 'risk'...and to accept lower expected returns in order to reduce such a risk is nonsensical, and yet this is precisely what is advocated by most traditional portfolio optimisation techniques. Risk is a downside notion and by failing to recognise this in their portfolio optimisation techniques, banks have been giving customers portfolios which cannot reflect their true personal risk/return trade-off.

By using volatility as a risk measure, the finance industry is making implicit assumptions about how individuals psychologically react to risk.¹ To see just what these assumptions are, consider Figure 1. This shows how people

would evaluate the risk associated with possible future returns if they really did interpret risk as volatility. As shown, the expected outcome is a real return of 3%, and there is no psychological risk associated with getting 3%. Any possible amounts less than this, however, are considered negative outcomes and add to the psychological risk of the investment. The worse the possible outcome, the more it adds to the perceived risk of the investment – for example, the possibility of getting 0% instead of 3% increases the risk of the investment by a small amount; of -3% by somewhat more; and the thought of a return of -6% causes the investor considerable stress.

Figure 1 – Implied psychology of risk as volatility



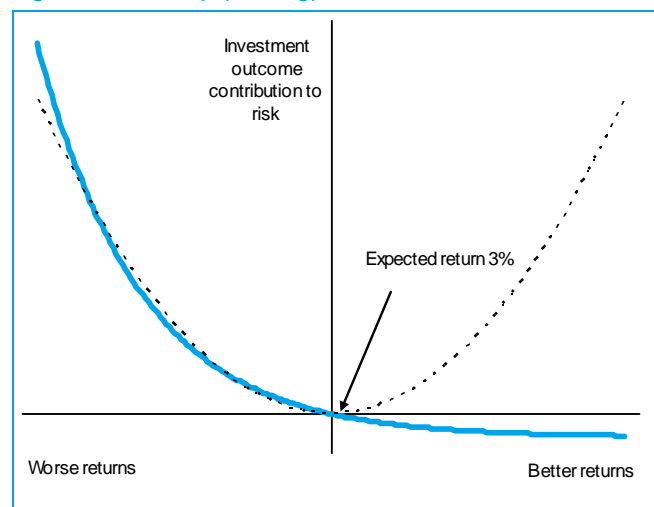
Source: Barclays Wealth

However, note that this curve is symmetrical around the expected return point of 3%. This means that the possibility of getting 6% instead of 3% actually *adds* to the risk of the investment – in fact it adds the same amount of perceived risk as getting 0% returns. And as returns get better and better they add more and more to the measured risk of the investment! Clearly, assuming that good outcomes are identified with risk to investors is unrealistic ... and yet this assumption still underpins the majority of optimisation techniques used in the industry today. This definition of risk means that any technique used to minimise risk will penalise potential good outcomes as much as it will potential negative outcomes. Investors' risk budgets will be filled up with potential outcomes that they just do not see as risky.

Reflecting risks that matter

A much more psychologically accurate and intuitive response to risk is shown in Figure 2. It is based on the same theoretical foundation as the traditional model,² but using much more psychologically plausible assumptions from research in the last few decades into the psychology of risk and financial decision making. As before, potential outcomes that are worse than expected add to risk, and at an increasing rate. However, now outcomes that are better than expected actually *detract* from the perceived risk of the investment. Investments with potential upside thus increase the risk budget so real risks can be taken elsewhere in the portfolio.

Figure 2 – Actual psychology of risk



Source: Barclays Wealth

Another difference between the psychological approach to risk and the traditional volatility measure is more subtle but just as important: for most of the downside the two curves are fairly close to each other. However, the psychological measure gets steeper at a faster rate as outcomes get worse and worse. This means that extra emphasis is placed on those possible outcomes that people most fear, the potential for catastrophic losses in the left tail of the returns distribution. Using this measure means that portfolios are optimised to reflect the risks that are most important to investors, but also to take on the upside variation that they would rather embrace than avoid.

Individual differences

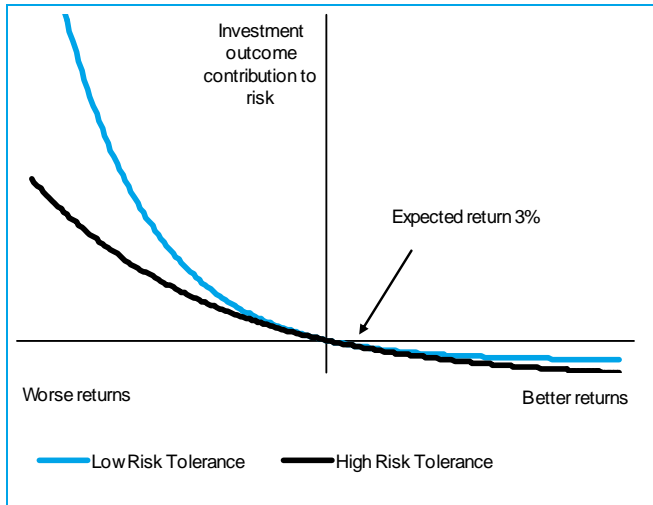
A further difficulty with the traditional measure of risk is that it assumes that the risk of an investment is exactly the same for everyone, and that it should be measured in the same way. In reality we all perceive risks differently: what seems a risky investment to one person may seem quite acceptable to another.

Using a psychological approach to measuring risk means we can reflect these differences between people clearly. The lines in the Figure 3 show the same psychological approach to risk as described above, but for two quite different individuals. The blue line reflects the risk attitudes of someone with low risk tolerance: this person will get much more worried at the thought of bad outcomes, so increasingly worse potential outcomes will contribute much more to the perceived risk of an investment. The black line, by contrast, reflects the risk attitude of an investor with high risk tolerance. This investor does not get nearly as worried by negative outcomes, and places greater emphasis on positive outcomes.

¹Actually these comments apply equally to institutions as to individuals – though “true risk” may differ for institutions, it is still very different to volatility for many of the same reasons.

²That is, Expected Utility Theory.

Figure 3 – Differences in risk tolerance



Source: Barclays Wealth

Both of these investors see risk as a downside notion and are most worried about the possibility of extremely bad outcomes. However, the more risk tolerant investors are much more prepared to accept downside risks in their portfolio in exchange for good expected returns. The optimal portfolio for each should naturally reflect the degree to which avoiding bad outcomes is important to them individually.

Determining risk tolerance

So, even with a more intuitive model of what risk means to individuals, how do we determine how to attribute a particular level of risk tolerance to each investor? The industry tends to use fairly ad hoc risk tolerance questionnaires to determine how much risk an individual can tolerate. However, these questionnaires commonly confound psychological risk tolerance (the importance placed on downside outcomes captured in the curves shown above) with other aspects which should be considered separately. For example, traditional questionnaires tend to ask about investment objectives, such as time horizon and income requirements, as well as questions about psychological risk tolerance. Whilst these aspects are important, they are completely distinct from risk tolerance, and including them in risk tolerance questionnaires simply masks the investors' true ability to cope with risk. In addition, traditional questionnaires tend to require knowledge of financial markets, or investments, or involve numerical calculations – these mean that the resulting 'risk tolerance' tends to be more a measure of knowledge, numeracy and investment experience than actual risk tolerance.

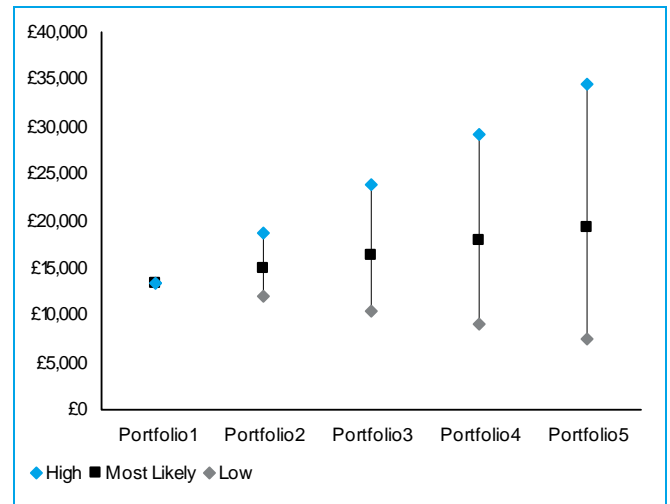
To avoid these weaknesses, we have developed and implemented a pure risk tolerance scale designed using advanced psychometric and decision theory principles. This scale isolates the fundamental ability of the individual investor to cope with risk, and has now been tested on over 5,000 experimental subjects, clients, and investment professionals.

Linking psychometric scales to risk attitudes

The following experiment, which we conducted on over 3,000 subjects worldwide in collaboration with leading academic experts on risk attitude³, helps to show how the psychometric scale links to the actual amount of risk that investors would choose for their portfolios. In this experiment each respondent was given the following choice between the potential returns of the five portfolios shown in Figure 4 below. The question was phrased as follows:

This chart shows the high, low and most likely final values of £12,500 invested in five different portfolios for five years. For example, in Portfolio 1 you will get £13,500 and in Portfolio 5 you end up getting anything between £7,500 and £34,000, but the most likely amount is £19,000. Which portfolio would you prefer?

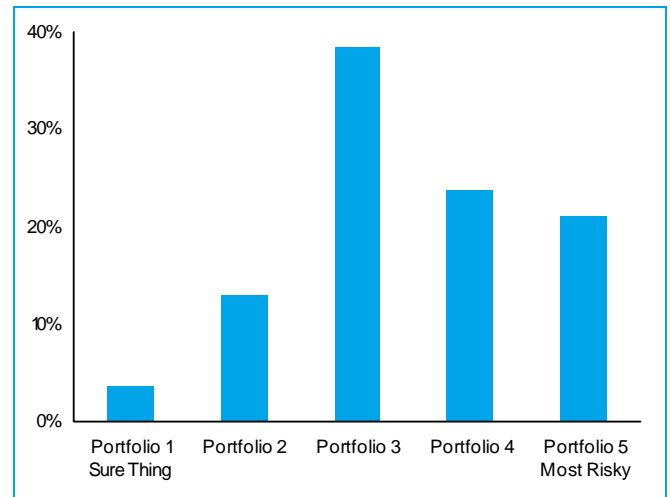
Figure 4 – Which portfolio would you prefer?



Source: Barclays Wealth

Those subjects who are highly risk tolerant should be more likely to pick Portfolio 5, whereas those with very low risk tolerance would choose the zero-risk Portfolio 1. Subjects' choices from the UK study⁴ are shown in Figure 5. Respondents showed a wide spread of risk tolerance, but very few went for the completely sure outcome, and as many as 21% chose the riskiest portfolio, which had a possibility of a 40% loss over five years.

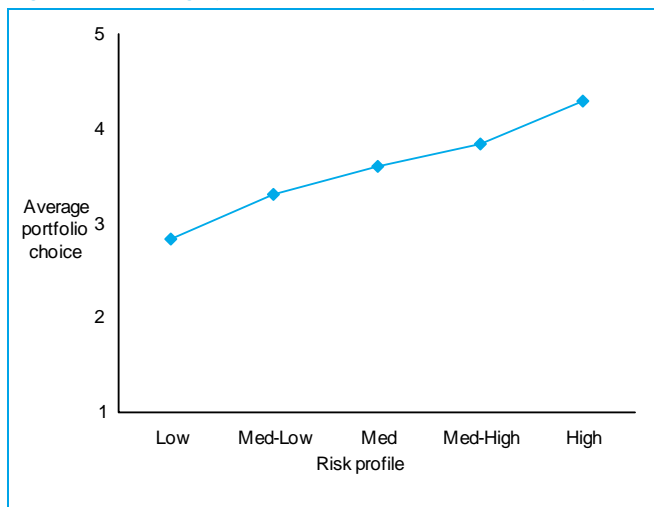
Figure 5 – Proportion of subjects choosing each portfolio



Source: Barclays Wealth

In addition to this, all respondents were given the Barclays Wealth psychometric risk tolerance questionnaire, which puts each individual in one of five risk profiles, from low risk to high risk. Examining the average portfolio chosen by individuals in each of these risk profiles shows that the amount of objective risk chosen does indeed increase with each risk tolerance profile – that is, the average portfolio chosen by those in risk profile 5 is 4.3 (Figure 6). However, note that on average even the least risk tolerant individuals are prepared to take on a fair amount of risk over a five-year time horizon, choosing on average a portfolio just safer than the medium-risk portfolio on offer, Portfolio 3.

Figure 6 – Average portfolio chosen by risk tolerance profile



Source: Barclays Wealth

Conclusion

So risk tolerance **can** be measured in a meaningful way that relates the actual risk that individuals are prepared to take in their portfolios. Armed with this, we can now go further and connect each risk tolerance profile directly to the appropriate psychologically intuitive downside risk curve introduced earlier. Using this concept of risk and linking it directly to individuals' risk tolerance offers the prospect of minimising only those risks that actually matter to each individual ... and not using the portfolio risk budget to reduce upside 'risks' that the investor would happily accept.

³Prof. Martin Weber and his team at Mannheim University

⁴Results for other countries were very similar.

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