

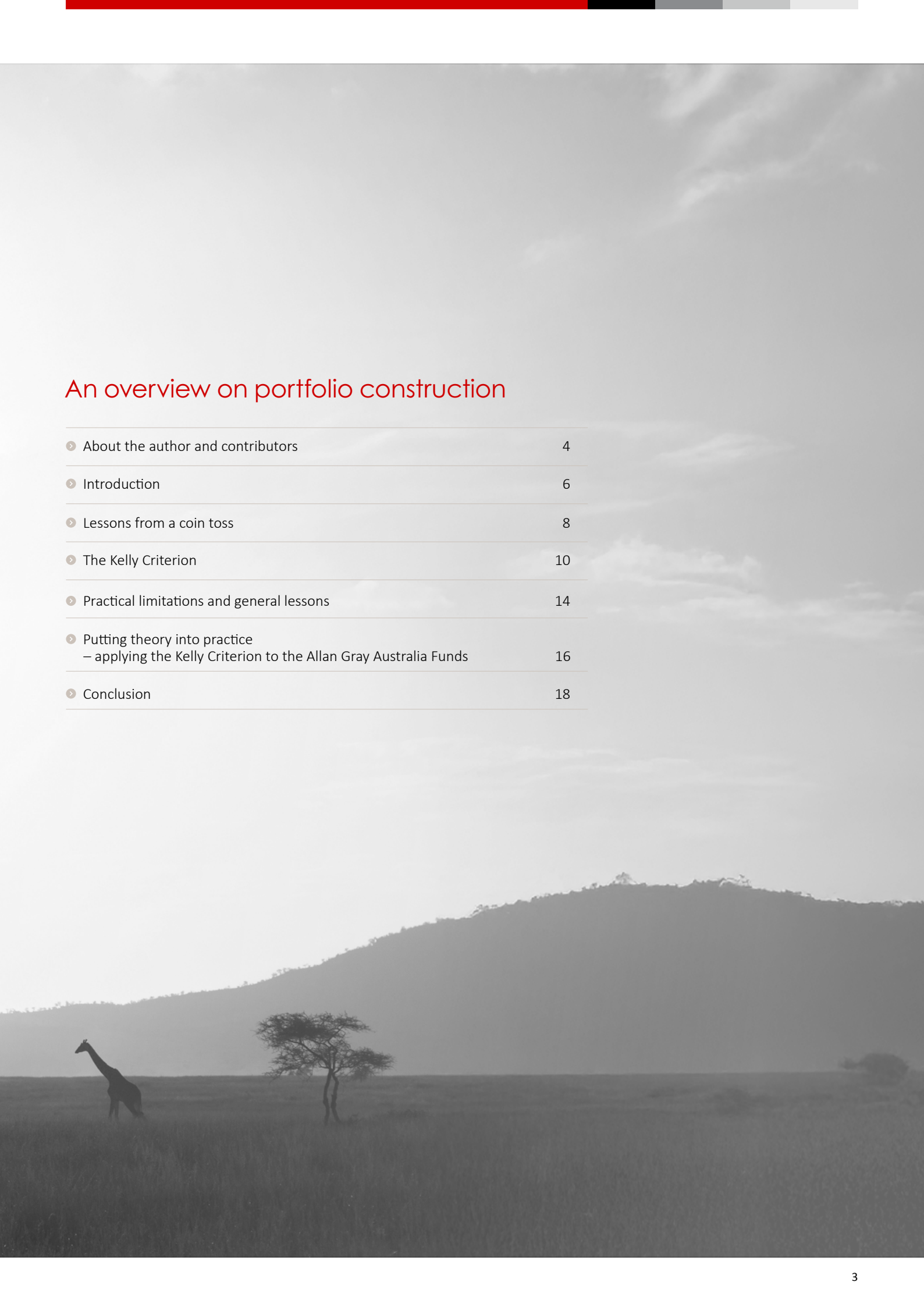
Weighty Decisions

An overview on
portfolio construction



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An overview on portfolio construction

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About the contributors

Author



Dr Justin Koonin

Analyst

Justin joined Allan Gray from PwC in 2015, where he consulted in data analytics to government, healthcare and industry clients. He previously worked as a researcher in pure mathematics at the University of Sydney. In addition, he is a board director, philanthropic advisory, community advocate on health and human rights, and he holds several expert roles with the World Health Organization in global health.

Justin has a Bachelor of Science with Honours and a Doctor of Philosophy in Mathematics. He is Adjunct Professor at the Kirby Institute, Faculty of Medicine and Health at the University of New South Wales, and Distinguished Fellow and Honorary Professorial Fellow at The George Institute for Global Health. Justin is also a Fellow of the Australian Institute of Company Directors.

Contributors



Simon Mawhinney

Managing Director and Chief Investment Officer

Simon joined Allan Gray in 2006 as an analyst and became the Managing Director and Chief Investment Officer in 2015. Before this, he was at Alliance Bernstein, Macquarie Bank and Deloitte and Touche. Simon has a Bachelor of Business Science with First Class Honours (majoring in Finance and Business Strategy) and a Postgraduate Diploma in Accounting from the University of Cape Town. Simon was a Chartered Accountant and is a CFA Charterholder.



Dr Suhas Nayak

Analyst and Portfolio Manager

Suhas joined Allan Gray as an analyst in 2011 and has been a portfolio manager since 2016. Prior to this, Suhas spent five years at McKinsey & Co, leaving as an engagement manager. He has a Bachelor of Science with Honours from the California Institute of Technology and holds a Doctor of Philosophy in Mathematics from Stanford University.



Chris Hestelow

Senior Investment Specialist

Chris is a seasoned investment specialist with over ten years of experience in financial services including previous roles at BT. Known for a strategic and analytical approach, he is responsible for managing our relationships with ratings houses and asset consultants, as well as keeping the market abreast of our portfolios. Chris holds a Bachelor of Commerce from Sydney University, majoring in Economics and Finance, and is a CFA Charterholder.

Introduction



Outperformance requires more than good stock picking

As a fund manager, we like to talk about the stocks we hold: what the companies do, why they look attractive and how they fit with our investment philosophy.

As such, stock picking is key to our investment philosophy. Outperforming over the long term, however, does not solely depend on the stocks you pick. It also depends on how you weight those stocks in your portfolio.

We know this ourselves too well. There have been times where our portfolios had many small outperformers but took large losses on some bigger positions. This meant that there have been periods where we have underperformed on aggregate due to the weights of positions in the portfolios.

While there are many ways to construct a portfolio, our preferred method is to weight stocks so that those we think have lower downside risk have a higher weight. This paper explains why we choose to do this: exploring some theoretical underpinnings in the Kelly Criterion; explaining how it might apply to portfolios; some practical limitations in the real world and how we use this approach in the Allan Gray Australia Funds.



Lessons from a coin toss



Suppose we play a game in which we toss a fair coin (50% chance of heads or tails) once a month for twenty years; a total of 240 coin tosses.

We start with \$100 in the bank and, for each coin toss, we are allowed to bet as much of our current pool of funds as we would like.

For every \$1 we bet, if the coin toss comes up heads, we win exactly the amount we staked as profit, so we end up with \$2 in total. If the coin toss comes up tails, we lose half of our stake and would end up with 50 cents.

Sounds like a pretty good game to play, doesn't it? Even odds of winning and losing, but the amount you win is double the amount you lose. So why not bet everything you've got? After all, on average, for each dollar you bet, you will end up with \$1.25 (there is a 50% chance of winning \$1, and a 50% chance of losing 50c). So the more you bet, the better, right?

If things go your way and a lot of heads come up you could end up as rich as Warren Buffett. Indeed, there is around a 3% chance that your initial \$100 will be worth more than \$100 billion after twenty years!

Unfortunately, if there are a lot of tails in the series of coin tosses, this strategy fares badly. In fact, there is about a one-in-three chance that you will have less than \$1 left after twenty years, and a greater than 50% chance you will end up with no more than the \$100 you started with. Suddenly, betting the farm on every coin toss seems pretty risky. It turns out that the average return is distorted by a small minority of outliers.

What about the other extreme? If you bet zero on each coin toss, you will definitely end up with \$100 at the end of twenty years. That's a good way to limit the downside, but \$100 might only buy a couple of decent hamburgers in twenty years – probably not a sensible retirement strategy.

There must be a middle ground – a way to give yourself the best chance of making significant returns on your capital while minimising the chance of financial ruin.

The Kelly Criterion

It was American physicist John Kelly who figured out the optimal strategy for the coin toss scenario, as well as far more complicated examples, in the 1950s.

His work established the so-called 'Kelly Criterion', which describes the size of the stake that maximises the expected geometric growth rate of your wealth over time or, equivalently, the amount of money you will have at the end of a given period.

In the case of the coin toss game, the optimal stake at each toss of the coin is exactly half of what is in your wallet. Following this strategy, the chance that you will end up with less than the \$100 you started with is only 0.4%, compared to the one-in-two chance with the all-in strategy. There is a greater than 50% chance of amassing more than \$100m at the end of twenty years, and an 11% chance of amassing more than \$100b! Position sizing changes the payoff profile dramatically.

What you sacrifice is the tail-end chance of earning astronomic returns (trillions and higher) with a run of extreme luck in the all-in strategy, but most people would regard the range of possible outcomes as very attractive. We simulated playing this game a million times, with stakes of 20%, 50% and 100% of our wallet at each stage. You can see the results in the table.

While it will not always be true that allocating a 50% stake gives the best outcome, in our simulation this allocation gave a better outcome than placing a 20% stake roughly 95% of the time, and a better outcome than placing a 100% stake over 99% of the time.¹

One striking aspect about following the Kelly criterion is that it leads to concentrated bets. In the above case, a 50/50 bet where you lose half your stake if you are wrong, but win the entire amount you stake if you are right, dictates betting 50% of your wallet on each bet. To take another example, for an even money bet (which will return exactly the amount you staked as profit if you win, but will cause you to lose the full amount staked if you lose), and where the odds of success are 60%, the Kelly criterion suggests betting 20% of your wallet.

For those who appreciate the detail, you can see how we come to that conclusion using the formula on the following page², which relates the fraction (F) of your wallet you should invest in any one iteration of the game.

Range of outcomes			
Final wealth	20% stake	50% stake	100% stake
<= \$1	0.00%	0.02%	32.55%
\$1 to \$10	0.00%	0.10%	9.76%
\$10 to \$100	0.00%	0.29%	10.27%
\$100 to \$1k	0.07%	0.79%	5.11%
\$1k to \$10k	1.58%	2.86%	9.79%
\$10k to \$100k	11.95%	4.69%	4.49%
\$100k to \$1m	33.84%	7.86%	7.99%
\$1m to \$10m	35.96%	15.95%	6.48%
\$10m to \$100m	14.33%	14.89%	2.60%
\$100m to \$1b	2.15%	15.24%	4.11%
\$1b to \$10b	0.11%	17.26%	2.80%
\$10b to \$100b	0.00%	9.08%	1.00%
> \$100b	0.00%	10.97%	3.06%

¹ For some of the details behind this simulation, see 'The Kelly Criterion: You Don't Know the Half of It' from the CFA Institute.

² Kelly, Jr J. L. A New Interpretation of Information Rate in the Bell System Technical Journal, July 1956 at page 917.

If you would like further detail on this formula, please contact us and we would be happy to discuss it in greater detail.

$$F = \frac{p}{a} + \frac{q}{b}, \text{ where:}$$

p is the probability that the investment increases in value

$q (= 1-p)$ is the probability that the investment decreases in value

a is the fraction of the investment that is lost in a negative outcome

b is the fraction that is gained in a positive outcome

In the case of the coin-tossing game:

$$p = q = 0.5, a = 0.5, b = 1.$$

$$\text{So } F = \frac{0.5}{0.5} - \frac{0.5}{1}$$

$$F = 0.5.$$

In the case of an even money bet where the odds of success are 60%:

$$p = 0.6$$

$$q = 1 - 0.6 = 0.4$$

$$a = b = 1$$

$$\text{So } F = \frac{0.6}{1} - \frac{0.4}{1}$$

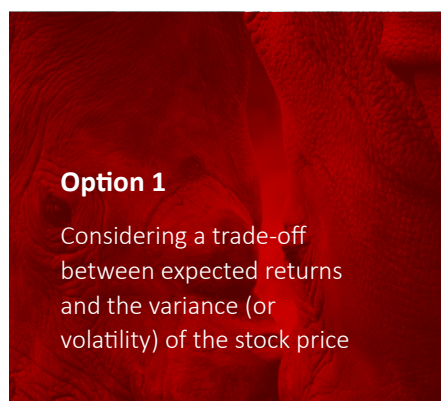
$$F = 0.2.$$



Applying the Kelly Criterion to an investment portfolio

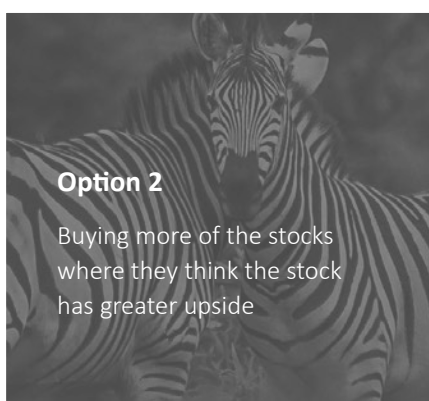
If we think through the lens of the Kelly Criterion, the process of a fund manager selecting stocks to invest in is very similar to playing a succession of games like those in the example.

When fund managers think about how to construct a portfolio, they can choose a number of different ways to size their positions. Some of these include:



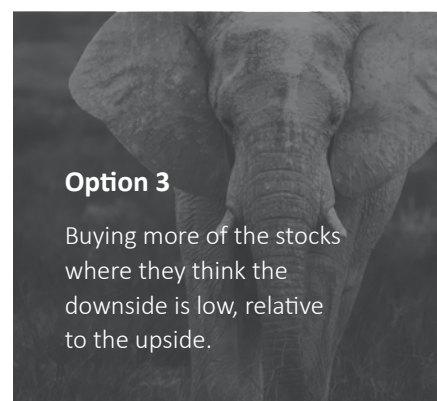
Option 1

Considering a trade-off between expected returns and the variance (or volatility) of the stock price



Option 2

Buying more of the stocks where they think the stock has greater upside



Option 3

Buying more of the stocks where they think the downside is low, relative to the upside.

Option 1 is standard Markowitz modern portfolio theory. This theory has been popular in academic literature for the past several decades, but is arguably less useful (and less used) in practice. Option 2 seems logical – investing more in the ideas you think will win big.

But at Allan Gray, we tend to construct our portfolios using option 3. This may seem counterintuitive. Why not use option 2 and weight more to the stocks that have greater upside potential?

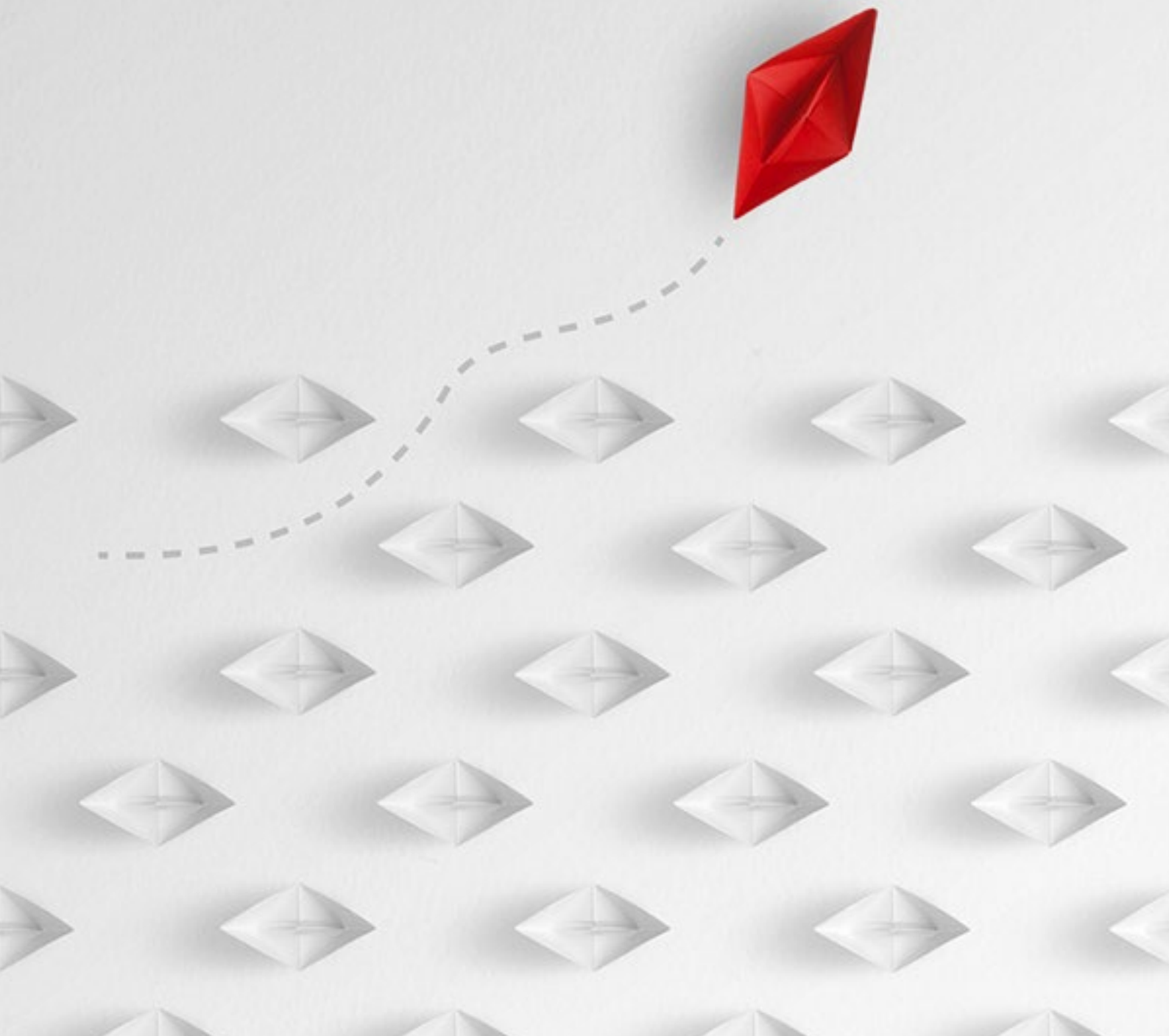
The Kelly Criterion shows us why that may not be optimal. If the downside is large (i.e. the 'a' in the formula is large), or the probability of that downside is large (i.e. the 'q' in

the formula is large), then Kelly would suggest investing a small fraction of your capital (F), because repeating this across many stocks over many years would result in a suboptimal outcome.

By using option 3, we essentially focus on the 'a' relative to the 'b' (or how much we could lose relative to how much we could gain). If 'a' is small in relative terms, we will consider allocating a larger weight. And knowing that even the best investors probably get 45% of their calls wrong, the 'p' and the 'q' (or the probability that the investment increases or decrease in value) may be near equal.

At Allan Gray we invest in more of the stocks where we think the downside is low, both in absolute terms and relative to the upside.

Practical limitations and general lessons



While this is all nice in theory, the real world is messier than the idealised example we use to illustrate the Kelly Criterion, for example:

- You cannot place the identical trade successive times.
- There are friction costs, such as trading fees and tax, that will eat into returns.
- The stocks we invest in can be correlated, which changes the portfolio's risk profile.
- News flow can change the upside and downside potential continuously.
- The opportunity to buy a stock at your ideal price may not last long enough to build your position.
- There may be self-imposed constraints that try to reduce some measure of risk, e.g. not having any individual stock be greater than a certain weight in the portfolio.

But the theory does provide a few useful lessons:

Consider having a more concentrated portfolio.

Application of the Kelly Criterion lends itself to larger weights than you might expect. This is not the way most fund managers behave; most are overly diversified, perhaps in part because incentive structures are not aligned to reward the potential volatility of such a strategy.

Sense-check position sizes.

When viewing our portfolio, we always ask ourselves: have we got a greater weight in stocks that have a lower downside risk and, if not, what can we do about it? Restraint can be better than regret.

Hit rate isn't everything.

A hit rate describes the number of stocks in a portfolio that outperform. You can outperform with a low hit rate (providing the upside of each outperforming investment is large) and you can underperform with a high hit rate (if, for example, your position sizing does not work out).

In summary, maximising the chances of long-term outperformance depends on the position size, as well as the stocks that we pick. Our contrarian investment strategy helps us with stock selection, but the somewhat 'hidden art' of portfolio weighting contributes no less to how we perform in the long term.



Putting the theory into practice – applying the Kelly Criterion to the Allan Gray Australia Funds

As contrarian, long-term investors, we thrive by not following the crowd

We search for value in stocks that we consider have been overlooked or undervalued by the broader market. Then we determine what could drive the company's performance and hence its value over the next five or even ten years.

The relationship between prospective return, risk, and the popularity of an investment can be counterintuitive to investor psychology. Ironically, it is the unpopular and uncomfortable that can make contrarian investing a rewarding strategy. Stocks that are unpopular, that make you feel uncomfortable, are usually priced accordingly; low prices offer greater potential upside as well as lower downside risk.

Contrarian investing fits naturally with the Kelly Criterion principles. When we invest in stocks that we perceive to have been overlooked or undervalued, the price ought to be naturally lower. If we are right, this increases the probability of success (the 'p') and reduces the downside risk (i.e. decreases the 'a').

One of the potential benefits of the Allan Gray investment philosophy is our willingness to take a long-term view. We're prepared to wait for the right opportunity to buy, and ready to wait (sometimes years) for our thesis to play out for our portfolios. While this may sound easy in theory, in reality it can be hard. Many investors either don't have the patience, or have time constraints, and are unwilling or unable to wait.

While an investment strategy following Kelly Criterion principles can give the best chance of having the most wealth in the long term, it can also be volatile at times. Fund managers and their clients may have to endure periods of underperformance while waiting for the strategy to deliver. There is no such thing as a free lunch, however, and this is the price we, and our investors, may pay for the opportunity of long-term outperformance.

Low prices offer
greater potential
upside as well as
lower downside risk

Conclusion

For an investment approach to add value, it must involve strategy or behaviour that is difficult to replicate, for example because it's too complicated, or because it's uncomfortable and investors are unwilling to stomach the accompanying volatility.

To be successful, it's vital to effectively increase the probability of success (the 'p') and reduce the downside (i.e. decrease the 'a'). Buying stocks at lower prices relative to what they are worth is a solid starting point.

For investors in Allan Gray portfolios who are willing and able to exercise discipline and patience, the Kelly Criterion strategy could be rewarding over time.



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