

How Safe are Safe Withdrawal Rates in Retirement? An Australian Perspective



RESEARCH REPORT

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FOREWORD

Finsia began a research program in 2012 to identify the scope of the retirement adequacy challenge and investigate policy responses to improve the sustainability of retirement savings for all Australians.

The first stage of the research culminated in a landmark research report — *Sequencing Risk: A key challenge to creating sustainable retirement income*.

In *Sequencing Risk*, Professor Michael Drew SF Fin, Dr Anup Basu F Fin and Brett Doran examined the profound influence that the ordering or sequence of investment returns exerts on the sustainability of retirement income. Their findings, based on simulations from a century of historical investment returns, challenged the orthodoxy that it is the average return of investments that determines the quality of retirement outcomes.

Importantly, this first phase of research identified that sequencing risk is acute particularly during the period in which retirement savings are at their peak.

In this second phase of research, Finsia furthers our understanding of what is now known as the 'Retirement Risk Zone' — the critical years that incorporate the final 20 years of the retirement saving journey and the first 15 years retirement. The retirement risk zone marks the shift from accumulation to withdrawal or decumulation of retirement savings.

In this report, *How Safe Are Safe Withdrawal Rates in Retirement? An Australian Perspective*, Professor Michael Drew SF Fin and Dr Adam Walk SF Fin tackle the logical next step by examining the post-retirement or decumulation phase in one's retirement journey.

The authors surveyed the annualised performance of different investments in a number of countries over a period of 112 years. From this, they calculated the portfolio success rates of different asset allocations considering different withdrawal rates. This research ultimately identifies the maximum withdrawal rate that ensures portfolio survivability based on long-term, historical averages.

It shows that the long-held convention that adequacy and sustainability of savings is assured by a 4 per cent withdrawal rate — the 4% Rule — is not a silver bullet.

In fact, even with the exceptional performance of the Australian stock market over the last century, a 4 per cent withdrawal rate over 30 years on a 50:50 growth/defensive asset allocation is associated with a 20 per cent chance of financial ruin.

The implications of this research paper are two-fold. First, the financial services industry has an obligation to confront retirement sustainability and develop financial products that assist in mitigating longevity risk. This also includes industry practitioners carefully educating clients about retirement adequacy and sustainable withdrawal rates.

While the 4% Rule is a baseline, we need to move from a silver bullet approach to one that takes greater care in coordinating asset allocation, planning horizon, scenario testing and risk management to alleviate the asset-liability mismatch in retirement.

Second, it is clear that many Australian retirees will fall back on the pension faster than anticipated. That is, their lifetime of savings will not give them a lifetime of income. This creates a significant public policy dilemma and places a sizeable impost on the next generation to fund the future pension liabilities of their forebears.

Australia's system of compulsory superannuation is world-leading. With 20 years having passed since the introduction of the superannuation guarantee, now is the time to ensure that the industry is equipped to manage the adequacy challenge. The findings in this research paper form the foundation for this discussion.



Russell Thomas F Fin
CEO and Managing Director
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HOW SAFE ARE SAFE WITHDRAWAL RATES IN RETIREMENT?

This study considers one of the cornerstone questions in the retirement income debate; namely, what's a safe withdrawal rate for retirement?

This question is of particular importance to Australia's superannuation system, which is characterised by having compulsory contributions during the retirement saving (or accumulation) phase, but no requirement to annuitise lump sums at the commencement of the retirement income (or distribution/decumulation) phase. As a result, many retirees face a classic asset-liability mismatch — the need to fund relatively short- and medium-term retirement spending needs with a longer term investment strategy. The Global Financial Crisis (GFC) provided a living case study of the perils of retirees ignoring the mismatch between the durations of retirement assets and liabilities.

Given the centrality of this question to the development of a sustainable retirement income strategy (both here and abroad), we wanted to commence our search using a tool that many individual (or mum and dad) investors may use when considering this question; that is, Google.

A simple Google search of the terms [safe withdrawal rate retirement] returned in excess of 5.2 million hits.¹

Reviewing the first dozen pages of results, two key (yet contradictory) themes emerged:

1. The 4% or Golden Rule of Retirement Withdrawals;² and
2. The 4% Rule for Retirement Withdrawals Is Golden No More.³

The issue of what a safe withdrawal rate is remains one of the most hotly contested ideas in retirement planning today. The current debate challenges the decades-held view that there is a simple, robust solution to the asset-liability mismatch faced by many retirees.

The much celebrated 4% Rule has become a popular heuristic that has provided a quick shortcut to 'solving' this most difficult of retirement planning problems.⁴ Using a 30-year holding period, William Bengen (1994) calculated that a 4.1 per cent withdrawal rate would allow the retiree to survive the worst market declines, hence the rise of the 4% Rule.

Assuming a minimum requirement of 30 years of portfolio longevity, a first-year withdrawal of 4 per cent, followed by inflation-adjusted withdrawals in subsequent years, should be safe.

Bengen (1994) p. 172

The results of our Google search mirror the current state of published research in the field, with recent studies suggesting that a safe withdrawal rate could range between less than two and as much as seven per cent of assets.⁵ By any measure, this is an extraordinary range of results — imagine on a starting balance of \$800,000, the lower bound (2 per cent) would not replace the current public pension for a couple, with the upper (7 per cent) bound equivalent to the current Association of Superannuation Funds of Australia (ASFA) comfortable standard of retirement income for a couple for a horizon of three decades.⁶

This study tests some of the most popular heuristics that have arisen from the safe withdrawal debate.

1 A Google search of [safe withdrawal rate retirement] returned 'about 5,280,000 results (0.18 seconds)' <<http://www.google.com.au>> (accessed 1 October 2013).

2 The rule that if retirees withdraw 4 per cent of their retirement assets every year, adjusted for inflation, their nest egg should last 30 years, is popularly termed the Golden or 4% Rule, see: Nasdaq Investor's Business Daily, 'How to use the 4% Rule for Retirement Withdrawals', (9 August 2013) <<http://www.nasdaq.com/article/how-to-use-the-4-rule-for-retirement-withdrawals-cm266340>>.

3 For further discussion, see: Eilene Zimmerman, '4% Rule for Retirement Withdrawals Is Golden No More', *New York Times*, (14 May 2013) <http://www.nytimes.com/2013/05/15/business/retirementspecial/the-4-rule-for-retirement-withdrawals-may-be-outdated.html?_r=0>.

4 The seminal study of Bengen (1994) considered safe withdrawal rate for a US investor using year-on-year returns from 1925 for a 50/50 stock/bond portfolio. Bengen (1994) assumed half the portfolio was allocated to the S&P 500 and half in intermediate term government bonds.

5 For an excellent summary of the current debate, see 'Is the 4% Rule Still Viable?' by Glenn Ruffenach (7 February 2013) in the Smart Money magazine of the *Wall Street Journal*. Ruffenach notes, 'Last year, a research paper in the Journal of Financial Planning predicted that a safe nest egg withdrawal rate for retirements begun in 2010 is 1.8%. Within weeks of that report's appearance, a study in Retirement Management Journal made the case that a safe withdrawal rate for some individuals could be as much as 7%.'

6 As at the June quarter 2013, the ASFA Retirement Standard suggests, in general, a couple looking to achieve a comfortable retirement needs to spend \$56,406 a year, see: <<http://www.superannuation.asn.au/resources/retirement-standard>>.

The study finds there is one key 'known unknown' in the debate — the ordering, sequencing or path dependency of returns (Basu, Doran and Drew, 2012, 2013; Doran, Drew and Walk, 2012; Bianchi, Drew and Walk, 2013). The Australian experience of returns has been among the best in the world over the last century. However, despite this stellar performance, serious questions are raised about the efficacy of the 4% Rule. To provide further support to this claim we explore the 4% Rule in a number of markets around the world to highlight how different returns paths can impact on the sustainability of a retirement income plan that is funded by drawing on capital and income returns in retirement.

The remainder of the report proceeds as follows. In the following section, we lay the ground work of the Retirement Risk Zone, and illustrate the key elements of the retirement income challenge.⁷ From this foundational discussion, a formal survey of the key studies in the safe withdrawal rate literature is conducted. This assessment of previous studies highlights the US-centric nature of previous work, and provides a rationale for the methodological approach taken in this study.

The empirical section of the research, somewhat cheekily entitled, 'Why Australia may be the worst case study for safe withdrawal rates', places the Australian experience in an international context to provide further rigour to our testing of the 4% Rule. The rationale for our boldness in selecting this title (and subsequent broader international testing of the rule) is that Australia has had the best performing stock market in the world (in a sample covering 19 countries over a period of 112 years, ended 2011). The use of international comparators raises some serious issues for the robustness (or otherwise) of the 4% Rule. However, while acknowledging the shortcomings of the Rule, we argue that its best application may be to assist in informing baseline expectations of retirement income using paths of returns that in the future may not be as stellar as those from the land Down Under.

With a set of baseline results developed, we explore a range of starting balances (or retirement nest eggs) to test the sustainability of retirement income streams against some well-regarded comparators. We conclude the paper by considering next steps in the field of retirement income planning and possible avenues for future research.

⁷ For further discussion, see Finsia's Retirement Risk Zone website: <<http://www.retirementriskzone.com.au>>.

A PRIMER ON THE RETIREMENT RISK ZONE

The superannuation journey extends over much of the life course, from a person's working life through to retirement. The retirement risk zone (hereafter referred to as 'RRZ') represents the critical years that incorporate the last two decades of our retirement saving journey (commonly referred to as the accumulation phase) and the first fifteen years of our retirement years (termed the withdrawal, distribution, income or decumulation phase). It is this conversion period when many of the key risks that determine the sustainability (or otherwise) of our retirement income are at their most threatening. In short, what happens when the largest amount of our retirement savings is at risk, matters.

The following primer on the RRZ provides the foundation for the rest of this study. One of the central messages from this section is that, prior to assessing the efficacy of safe withdrawal rates in retirement, our ability to manage (and possibly mitigate) longevity risk in retirement can be eroded dramatically by the sequence of returns we experience when our retirement savings are at their zenith (Basu and Drew, 2009).

Since the decline of defined benefit (DB) plans, and the associated rise in defined contribution (DC) plans, retirement products have tended to focus mostly on the accumulation phase of the investment lifecycle, which begins on entry to the workforce and continues until retirement. In this phase, contributions and investment returns combine to generate the final plan balance, which is available for lump sum payout (largely the Australian experience) or the purchase of a pension or annuity product.

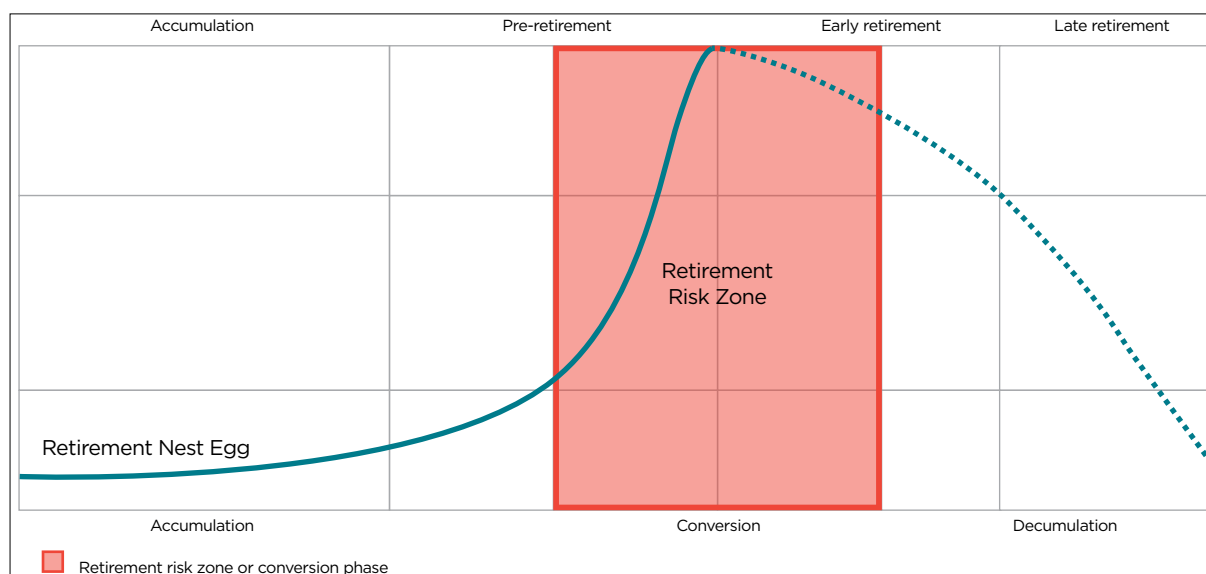
As more and more people from the baby boomer generation move into retirement, a raft of new

changes are taking place in the global retirement planning industry. The turbulence experienced during the GFC has motivated regulatory action to examine flaws in DC plan design, and led trustees to seek better tools to assist their members in meeting long-term saving and income goals. As large numbers of investors have now met (or are soon to reach) their retirement date, stakeholders are considering whether existing asset accumulation products, tools and processes are likely to be adequate for providing income generation and protection into the future.

Consider an investor with a traditional 40-year accumulation period. Assume that the member is following the hopeful accumulation strategy of a 70 per cent stocks/25 per cent bonds/5 per cent cash asset allocation. Assuming a fixed rate of compounding, the member would experience around half of the dollar accumulation in the last decade of that 40-year period. Therefore, as the investor comes close enough to retirement, they have half of their dollar wealth at stake. At that point, trying to maximise total returns with naked exposure to the full volatility of the stock market, which may be defensible during the accumulation phase, may no longer make as much sense. At that point in the RRZ (or conversion phase) the issue of sequencing risk becomes vital for investors.⁸

Prudent management during the RRZ — shown pictorially in Figure 1 — also requires consideration of the early periods of retirement to secure retirement income across the decumulation phase. As with the final decade prior to retirement, the impact of the portfolio size effect immediately post retirement is critical in determining the sustainability of retirement income.

Figure 1: The retirement risk zone



⁸ The impact of this effect, popularly termed the 'portfolio size effect', was investigated by Basu and Drew (2009a), and subsequently considered for default designs (Basu and Drew, 2010) and retirement outcomes by gender (Basu and Drew, 2009b).

As Milevsky (2006), Milevsky and Abaimova (2006), Basu, Doran and Drew (2012, 2013) and Bianchi, Drew and Walk (2013) have illustrated, the odds of portfolio ruin in retirement are highly sensitive to the returns the investor earns decade by decade. Path dependency matters greatly. As a conditional probability statement, the experience of zero returns (let alone negative returns) in the first decade in retirement may be associated with a 70 to 80 per cent chance of portfolio ruin (that is, running out of money before the retiree dies).

Therefore, there is a transition phase before and immediately after retirement when return maximisation and risk taking may be considerably less desirable than downside protection for many investors. After that conversion phase, in late retirement, some retirees may need to focus on income distribution and, potentially, mortality credits.⁹

The RRZ — which includes the retirement date — is thus a critically important part of the investment lifecycle. It is during this phase that the best opportunity for improving retirement outcomes exists because, paradoxically, so much is at stake.

Unfortunately, it is at this time when the risks to retirement objectives are at their most threatening.

One of the greatest challenges for retirees in Australia relates to the management of their retirement income (liability). While there are numerous approaches to the way in which members can convert retirement savings into retirement income, the majority can be categorised into three basic approaches. An excellent summary of these major approaches is provided by Schaus (2010), illustrated in Table 1.

The approaches to the conversion phase identified by Schaus (2010, Table 1) provide the perfect framework in which to place the research agenda undertaken in this study. This study considers the efficacy of safe withdrawal rates or, using Schaus's (2010) terminology, systematic withdrawal plans. It is interesting to note that Schaus (2010) confirms the industry norms of around 4 to 5 per cent per annum as a systematic withdrawal level (as well as highlighting the longevity risks associated with these norms).

⁹ In an annuity pool, the surviving annuitants receive some of the funds of the pool members who die earlier; this excess return is the 'mortality credit', and assists in the hedging of longevity risk.

Table 1 Major approaches to the conversion phase

Approach	Synopsis	Discussion
Income-only plan	Those members with sufficient wealth may manage their assets so that they can live off the income from those assets without spending the principal.	<ul style="list-style-type: none"> — This plan may include income from bonds, such as treasury inflation protected securities (TIPS) or nominal bonds in pre-tax accounts. — It may also include term deposits and savings accounts. — In addition, participants might consider laddering certificates of deposit or look to stock holdings for dividend income. — Purchasing real estate can also provide rental or other income.
Systemic (or partial) withdrawal plans (SWPs)	<p>Most retirees lack sufficient assets to live solely off the income generated by those assets.</p> <p>Rather, they will need to begin drawing down principal in addition to investment income.</p>	<ul style="list-style-type: none"> — There are several ways to set up a SWP, such as withdrawing a fixed-dollar amount adjusted for inflation, taking a required minimum distribution amount that increases the percentage of assets withdrawn as the participant ages, or setting up a retirement bucket approach that earmarks certain assets to meet specific expenses. — Many industry participants who advocate a SWP approach suggest that retirees draw down no more than 4 to 5 per cent of their retirement assets each year. Yet, even at this withdrawal rate, many members run the risk of running out of money too quickly.
Guaranteed income/annuitisation	Those with a lower risk tolerance or a greater expectation of longevity may want to convert a portion of their DC assets into an immediate or other type of income-producing annuity.	<ul style="list-style-type: none"> — By annuitising, retirees create an income stream that provides a monthly payout for the remainder of their lives. — Many types of annuities are being introduced within DC plans, including immediate, deferred fixed income, living benefit, and longevity insurance.

Source: Schaus (2010)

As retirees have no (or minimal) future income from their labour, income replacement (from retirement savings and/or the public pension) may have to last as long as 25 years, possibly more, particularly in the case of a couple. According to the Australian Life Tables (Commonwealth of Australia, 2009) an Australian male who lives until age 65 has approximately a 82 per cent chance of living beyond 85 and a 71 per cent chance of living past 90. Females are even longer-lived. And for couples who live to 65, there's a 90 per cent chance that one or both will live until beyond 92 and an 81 per cent chance that one or both will live beyond 97.

Faced with this longevity profile, retirees require solutions that sufficiently manage market risk, longevity risk, and inflation risk. However, as is a recurrent theme throughout the paper, it is important to note that the most important types of retirement

risk (market, longevity and inflation risks) will change over the investor's life span. One of the potential advantages of robust retirement income planning is that these dynamic risks (and their respective emphasis) can be better managed through time, informed by the retiree's preferred outcome.

With the foundational aspects of the RRZ established, and the major approaches to the conversion phase outlined, we move the discussion in the following section to a critical review of the literature on safe withdrawal rates in retirement. In our opening remarks of this study, we noted the controversy online on the issue of safe withdrawal rates in retirement. As will be seen in the following section, the same debate rages throughout the scholarly literature on the topic.

SAFE WITHDRAWAL RATES: A SURVEY AND ASSESSMENT OF KEY STUDIES

In countries such as Australia where there is no single mandated approach to the retirement income conversion phase (that is, a range of income-only plans, systemic (or partial) withdrawal plans and/or guaranteed income/annuitisation plans), the risk of asset-liability mismatch abounds. Many retirees are faced with the challenge of funding relatively short- and medium-term (typically stable) retirement spending needs with a longer term (typically volatile) investment strategy. The complexities of liability-driven investing, even for seasoned investment professionals, can be challenging. The behavioural finance literature confirms the importance of rules-of-thumb (or heuristics) in financial decision making. And so it is with retirement income, with the 4% Rule being the 'rule-of-thumb' answer to the perennial question: 'How much money can I withdraw annually from my retirement nest egg without running out?'

The pioneering work in the field was contributed by Bengen (1994). Using historical simulation, the study shows that the retirement portfolios of people who retired during the period 1926 through 1976 and withdrew 4 per cent of the initial balanced portfolio value every year (adjusted for inflation) could be sustained for at least three decades. In a series of subsequent studies, Bengen (1996 (phase-down approach); 1997 (small capitalisation stocks in the asset allocation); 2001 (modified prosperous retirement, fixed-percentage withdrawals and floor-and-ceiling withdrawals); and 2006 (bespoke to client needs)) reports results that largely support the 4% Rule.

The second group of studies that provide support to the 4% Rule are known as the Trinity studies.¹⁰ These studies use a simple, but highly informative, approach to investigate withdrawal rates with respect to different asset allocations, and several time horizons. Cooley, Hubbard, and Walz (1998) measure the portfolio success rate of various portfolios over 15, 20, 25, and 30 years from 1926 through 1995. The portfolio success rate is the percentage of times a retiree could sustain a given withdrawal rate without exhausting the retirement assets. The findings demonstrate that the optimal portfolio should consist of around

75 per cent in stocks and 25 per cent in bonds (75:25). Furthermore, a typical retiree that has an asset allocation of 50:50 (with a 30-year retirement horizon) could sustain a 3 per cent withdrawal rate with complete success, and a 4 per cent withdrawal rate with a probability of portfolio success of 95 per cent. Cooley, Hubbard, and Walz (1999) update their previous work by assuming monthly withdrawals of retirement income and monthly accruals of portfolio returns. The results using monthly data largely corroborate (if not slightly improve) their substantive findings on safe withdrawal rates.¹¹ Finally, in their most recent paper, Cooley, Hubbard, and Walz (2011) extend their observation period from January 1926 through December 2009. This study suggests that retirees who plan to make annual inflation adjusted withdrawals should stay within the 4 to 5 per cent range.¹²

The sequence of major events in the first decade of the 21st century — 9/11; the dot.com bubble; the sub-prime crisis and the GFC — have resulted in a level of wealth compression in investment portfolios not seen for many years.

The sequence of major events in the first decade of the 21st century — 9/11; the dot.com bubble; the sub-prime crisis and the GFC — have resulted in a level of wealth compression in investment portfolios not seen for many years.

This period of heightened volatility underscored the importance of path dependency to the sustainability of retirement income. It has given rise to a far more critical assessment of the 4% Rule (and its variants). However, as will be canvassed in the following discussion, much of the work still remains US-centric and lacks international perspective.

10 All three authors are professors of finance at Trinity University in San Antonio, Texas.

11 Cooley, Hubbard, and Walz (2003) also investigate portfolio success rates for various withdrawal rates with and without international stocks in the portfolio. Using Monte Carlo analysis, Pye (2000) also concludes that the 4 per cent, inflation-adjusted withdrawal rate is highly sustainable. Guyton (2004) and Guyton and Klinger (2006) provide further support to the 4% Rule by expanding the range of asset classes held by the retiree.

12 Cooley, Hubbard, and Walz (2011) note that for retirees who are willing to accept greater risk of portfolio ruin, portfolios with at least 50 per cent allocated to stocks can provide a withdrawals rates upwards of 7 per cent.

The work of Spitzer, Strieter, and Singh (2007) and Spitzer (2008) has been important in developing a line of argument that suggests the 4% Rule may be an oversimplification of a complex process that involves the analysis of risk tolerance, asset allocation, withdrawal size and expected returns. Using a bootstrap approach, these studies examine a myriad of withdrawal rates finding that the fixed 4% Rule is not always safe and that dynamic approaches to the withdrawal rate may assist the retiree. Harris (2009) finds that sequencing risk is a key determinant of the sustainability (or otherwise) of safe withdrawal rates, with rates varying in the range of 2 to 4 per cent.¹³

The work of Pfau (2011) highlights the importance of market valuations on the sustainability of safe withdrawal rates. Taking a novel multi-factor regression approach, Pfau (2011) shows that for a typical retiree in the US (with a 30-year retirement horizon) the maximum sustainable withdrawal rates (MWRs) peaked at 8.8 per cent for those retired in 1982, falling to around 1.5 per cent during the GFC in 2008. Finke, Pfau, and Williams (2012) explore optimal withdrawal rates and asset allocations for retirees with different attitudes toward shortfall risk. The study uses a bootstrap method to investigate withdrawal rates from 3 per cent through 9 per cent, and stock allocations between zero and 100 per cent. The findings suggest that the traditional 4% Rule and modest (30 per cent) stock allocation may only be appropriate for risk-averse retirees who must revert to living on social security income if the portfolio is exhausted.

Continuing the market valuation theme, Finke, Pfau, and Blanchett (2013) investigate the robustness of the 4% Rule when today's low interest rates reflect future expectation of bond returns within a retirement portfolio. Using a Monte Carlo simulation (6 per cent historical equity premium and -1.4 per cent average real bond returns on five-year tips), the findings demonstrate that failure rates are surprisingly sensitive to bond returns. With a zero

per cent bond yield, the hypothetical retiree has a 33 per cent chance of running out of money, and with a real US bond yield of -1.4 per cent the odds that the retiree will run out of money are 57 per cent. Importantly, the researchers conclude that there is nothing inherently safe about the 4% Rule in the low interest rate environment that the US is currently experiencing.

Extensive research of 'safe' withdrawal rates in the US market has prompted critics to argue that the result may be distorted by survivorship bias or data snooping. Dimson, Marsh, and Staunton (2004) argue that only looking at past US data for future predictions will lead to 'success bias'. One way to dismiss data snooping bias is to conduct out-of-sample tests to confirm the findings from the original studies.

Pfau (2010) conducted the first major study to examine the issue of safe withdrawal rates from a larger selection of countries. This study replicates the methodology of Bengen (2006) by using the Dimson, Marsh, and Staunton data from 1900 through 2008 for 17 developed countries. The analysis provides some interesting results that the 4 per cent withdrawal rate is not safe when using the original Bengen (2006) maximum safe withdrawal rate criterion. Pfau (2010) implements a 'perfect foresight assumption' to test safe withdrawal rates around the world (that is, it is assumed that in each year for each country the new retiree has perfect foresight to choose the fixed asset allocation for the subsequent 30 years that provides the best MWR). The findings show that, even with the assumption of perfect foresight, the maximum safe withdrawal rate exceeds 4 per cent in only four of the 17 countries, ranges between 2 and 4 per cent in a further eight countries, and is less than 2 per cent in five countries. The most unfortunate retirees in Pfau's (2010) analysis were those investors retiring in 1940 in Japan, with a maximum withdrawal rate of only 0.47 per cent per annum.¹⁴

Even with the assumption of perfect foresight, maximum safe withdrawal rate exceeds 4 per cent in only four of the 17 countries.

13 Athavale and Goebel (2011) examine withdrawal rates over a 35-year retirement horizon (with varying assumptions for the underlying distribution of portfolio returns) and find that a 2.5 per cent withdrawal rate could be sustained over a 35-year period. Zolt (2013) again illustrates the importance of a dynamic approach to withdrawal rates, looking at the impact of foregoing annual inflation increases on withdrawal rates when cumulative portfolio performance is less than expected.

14 A further interesting study on the international experience, particularly the experience in emerging markets, was conducted by Meng and Pfau (2011) who investigated the robustness of the 4% Rule in 25 emerging markets through to the end of 2009. Due to the limited historical data for emerging markets, this study uses a simulation approach and again invokes the perfect foresight assumption. The findings demonstrate that the 4% Rule is perhaps not as safe as previously thought. Only six out of 25 countries could sustain 30 years of withdrawals with a 4 per cent withdrawal rate, 11 countries experienced withdrawal rates between 2 and 4 per cent, and eight countries experienced withdrawal rates of less than 2 per cent. The worst-case scenario was experienced in Russia.

We are motivated in this study to build on the findings commencing with Bengen (1994) through to the current agenda investigated by Pfau (2010). Much of the work to date, with the exception of Pfau (2010) and Meng and Pfau (2011), has centred on the US experience (with the vast majority of studies using Ibbotson Associates' Stocks, Bonds, Bills, and Inflation (SBBI) data from 1926). Moreover, many studies, even when using various simulation techniques (such as Monte Carlo and/or bootstrap simulation) are sampling from portfolios largely exposed to US capital markets. The recent findings of Pfau (2010) are instructive in that, even when invoking the assumption of perfect foresight, the defensibility of blindly following the 4% Rule is limited.

While acknowledging Pfau's (2010) motivation to use the perfect foresight assumption in testing the 4% Rule (that is, 'this assumption avoids the accusations that a poor-performing asset allocation was chosen to discredit the 4 per cent rule [p.54]'), this study will use a range of popular asset allocation choices in the retirement income phase to test the 4% Rule. This methodological decision is supported by Pfau (2010) who states, 'consider a specific asset allocation of 50:50 for stocks and bonds ... [and] a 4 per cent withdrawal rate when using the SAFEMAX (that is, safe maximum withdrawal rate) criterion for any country in the DMS data [p.60].' Our study begins where Pfau's (2010) important international contribution concludes. Using a range of asset allocations, and widely different return experiences and investment horizons, we ask: What's a safe withdrawal rate for retirement?

In order to provide positive insights into what is, at its core, a normative question, our review of the literature suggests that it is prudent for researchers to investigate capital markets that have very, very long historical data series and, if possible, markets with different return distributions. For this reason, we have non-randomly selected five countries to stress test the 4% Rule. As will be discussed in the following section, all 19 countries in the Dimson, Marsh and Staunton (2012) database are ranked in ascending order based on their respective annualised performance (real accumulated returns) of stock returns for the period 1900 through 2011 (a total of 112 years). Those countries representing the key percentile levels (minimum; first quartile; median; third quartile and maximum) are selected to test safe withdrawal rates under different asset allocations and investment horizons.

'Consider a specific asset allocation of 50:50 for stocks and bonds ... [and] a 4 per cent withdrawal rate when using the SAFEMAX (that is, safe maximum withdrawal rate) criterion for any country in the DMS data.'

Pfau (2010) p. 60

Given the centrality of inflation (and its relationship to stocks, bonds and bills through time), we use real returns throughout the study. Specifically, instead of using nominal rates of return and then adjusting withdrawals each year for inflation, we elect to use real returns to avoid the annual inflation adjustment. Annual withdrawal rates ranging from 1 per cent through 10 per cent (in increments of 100 basis points) are considered across investment horizons of 10, 20, 30, and 40 years. Given that Australians are living longer lives (and many Australians retire before 65 years of age), we argue it is important to include the 30- and 40-year horizons to provide positive insights into the robustness of safe withdrawal rates across longer horizons. We consider the 4% Rule for stock allocations ranging from zero to 100 per cent (in increments of 25 per cent) for each of our representative countries (rebalanced annually), and report maximum safe withdrawal rates (or SAFEMAX as in Bengen (2005)).¹⁵ Finally, we assume that retirees make an initial withdrawal at the commencement of each year. That is, the initial withdrawal amount is equal to the specified withdrawal rate times the starting balance of the portfolio (Pfau, 2012).

With our research agenda informed and motivated by the body of work that has considered the controversial topic of safe withdrawal rates in retirement, let's recall the late Professor Julius Sumner Miller's (1909–1987) oft-quoted epithet, 'Why is it so?'

¹⁵ We examine safe withdrawal rates for five countries for the period 1900 through 2011. The long horizon nature of the DMS (2012) database allows for a range of overlapping retirement periods to be examined (specifically, 102 x 10 years; 92 x 20 years; 82 x 30 years; and 72 x 40 years) across varying asset allocations to stocks, bonds and bills for each country.

WHY AUSTRALIA MAY BE THE WORST CASE STUDY FOR SAFE WITHDRAWAL RATES

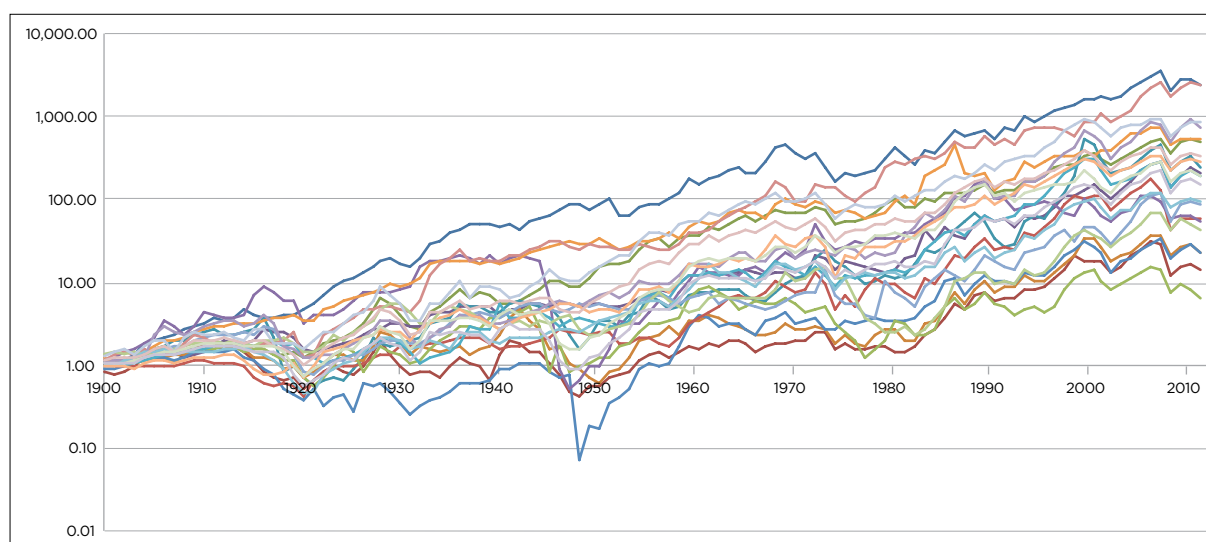
The empirical section of the study is titled, 'Why Australia may be the worst case study for safe withdrawal rates.' It is important to provide a clear rationale for this decision. As we have seen from the survey of the literature, previous studies have highlighted the importance of scenario testing in safe withdrawal rate studies. Moreover, the literature has stressed the potential dangers of the US-centric nature of the testing, particularly given the strong performance of the US stocks over many decades.

To directly address this concern, we use the Dimson, Marsh and Staunton (DMS) (2002, 2012) database, covering 19 countries (and three regions: world,

world ex-US, and Europe), all with index series that start in 1900 through 2011.¹⁶ Figure 2 provides the annualised performance of \$1 invested in stocks in all 19 countries and three regions using real accumulated returns.

It is important to note that these results are plotted using a logarithmic scale on the y-axis, with a maximum dollar value of \$2,459 (Australia) through to a minimum of \$6 in Italy. To provide a sense of the annualised (or geometric) reward and risk of these different markets, Table 2 provides an historical, returns-based ranking in ascending order.

Figure 2 Evolution of \$1 invested in 1900 (n=22, logarithmic scale base=10)



¹⁶ As noted by Dimson, Marsh and Staunton (2012), the database contains annual returns on stocks, bonds, bills, inflation, and currencies for 19 countries from 1900 to 2011. The countries comprise two North American nations (Canada and the USA), eight euro-currency area states (Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, and Spain), five European markets that are outside the euro area (Denmark, Norway, Sweden, Switzerland, and the UK), three Asia-Pacific countries (Australia, Japan, and New Zealand), and one African market (South Africa). These countries covered 89 per cent of the global stock market in 1900, and 85 per cent of its market capitalisation by the start of 2012.

Table 2 Ranking of annualised performance (stocks, real accumulated returns)				
Ranking	Country	Annualised performance (%)	Standard deviation	Reward/risk ratio
1	Australia	7.22	18.23	0.40
2	South Africa	7.21	22.49	0.32
3	United States	6.19	20.20	0.31
4	Sweden	6.11	22.87	0.27
5	New Zealand	5.76	19.66	0.29
6	Canada	5.69	17.22	0.33
7	United Kingdom	5.20	19.94	0.26
8	Finland	5.01	30.41	0.16
9	Denmark	4.85	20.90	0.23
10	Netherlands	4.81	21.76	0.22
11	Switzerland	4.13	19.73	0.21
12	Norway	4.08	27.33	0.15
13	Ireland	3.72	23.06	0.16
14	Japan	3.62	29.78	0.12
15	Spain	3.42	22.21	0.15
16	France	2.87	23.45	0.12
17	Germany	2.86	32.18	0.09
18	Belgium	2.39	23.57	0.10
19	Italy	1.68	28.99	0.06

Source: DMS (2012)

We have highlighted five countries — Australia (AUS); New Zealand (NZL); Netherlands (NLD); Japan (JPN); and Italy (ITA) — in the table as they represent annualised performance levels that most closely correspond to key percentiles in the distribution of the annualised performance of stock markets over the long run.¹⁷

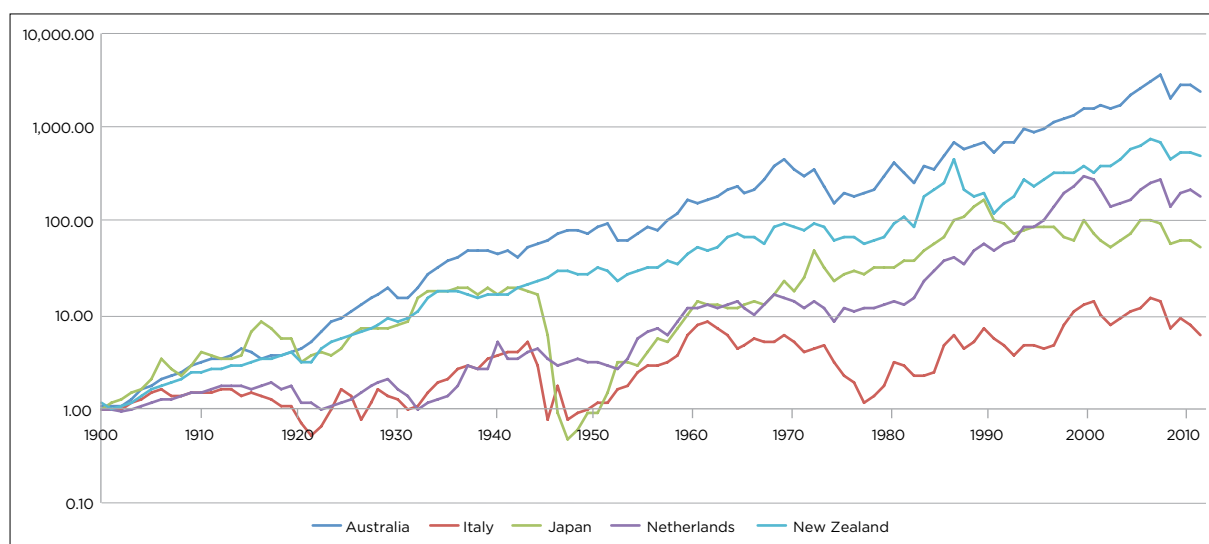
Table 3 Distribution of annualised performance (stocks, real accumulated returns)		
Percentile	Annualised performance (%)	Representative country
Minimum value	1.68	Italy
First quartile (25th percentile)	3.52	Japan
Median (50th percentile)	4.81	Netherlands
Third quartile (75th percentile)	5.73	New Zealand
Maximum value	7.22	Australia

¹⁷ We use the standard three-letter country codes defined in ISO 3166-1 interchangeably throughout this study, part of the ISO 3166 standard published by the International Organization for Standardisation (ISO).

These results underscore the concerns of previous studies in the field regarding the need to select different scenarios, countries, return distributions, and sequences of returns when testing the 4% Rule. If we were to focus solely on Australia, we would run the risk of undertaking another safe withdrawal rate study, though this time outside the US, using a stock market that has been a very strong performer over the observation period. The accumulated performance of stocks in Australia over the last 112 years has been superior to the vast majority of other markets (given that the sample covers around 85 per cent of global market capitalisation

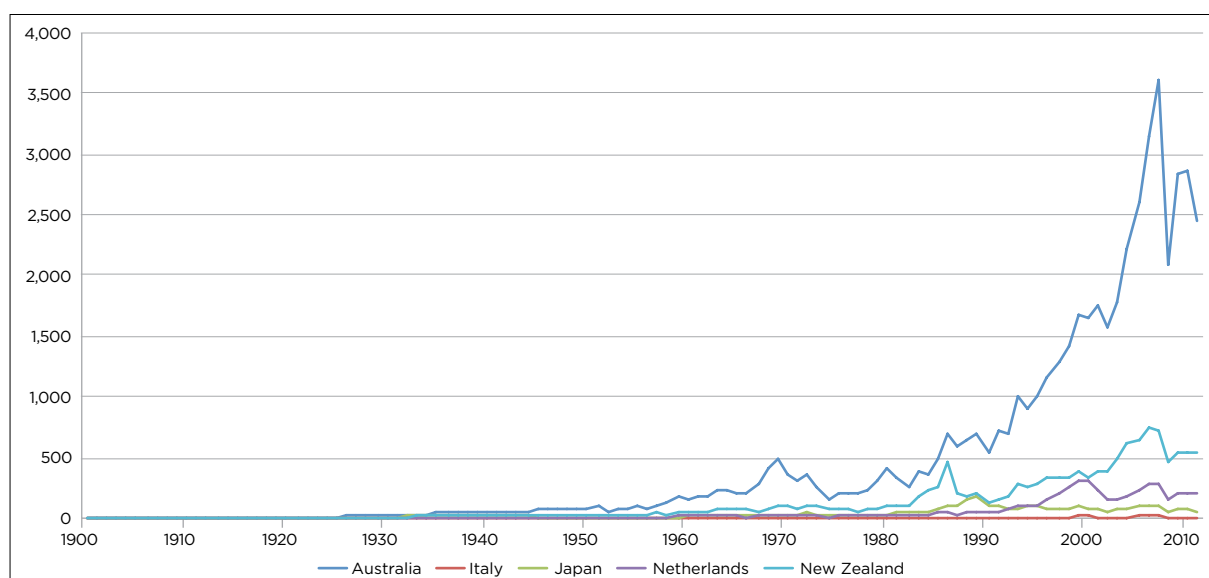
in 2012), but, more importantly, has done so with the lowest level of recorded risk (where risk is defined as the standard deviation of returns). Hence, it is not surprising that the reward/risk ratio (shown in Table 2, column 5) is also superior to the rest of the world, nearly double that of the median market, and seven times that of the worst performing market. In fact, compared to Italy, Australia has recorded over four times the annualised performance with less than two-thirds the volatility. To ensure consistency, we now plot the five countries that approximate the key percentiles to highlight the distribution of investment outcomes.

Figure 3 Evolution of \$1 invested in 1900 (n=5, logarithmic scale base=10)



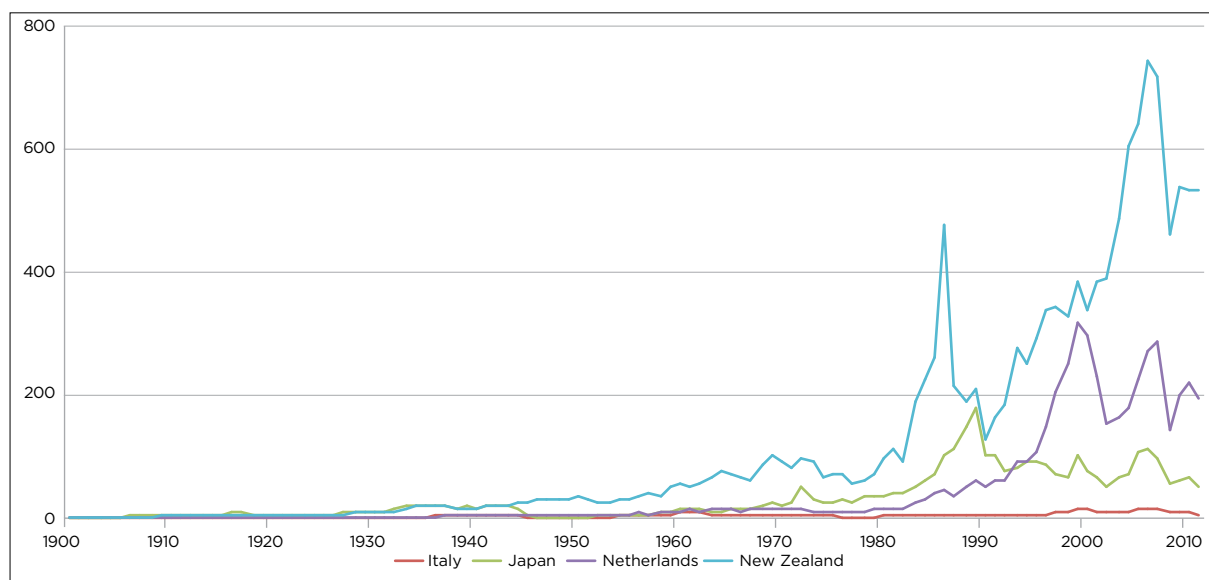
It is also instructive to now replace the logarithmic scale on the y-axis with a simple final value scale, to appreciate the differences in dollar outcomes for investors.

Figure 4 Evolution of \$1 invested in 1900 (n=5, final value scale)



Finally, given the stellar performance of Australian stocks, we exclude the Australian series from the chart to better illustrate the lower four percentiles of interest.

Figure 5 Evolution of \$1 invested in 1900 (n=4, ex-Australia, final value scale)



In summary, over the last 112 years (1900 through 2011), the real value of stocks, with income reinvested, grew to around \$2,459 in Australia (max); \$531 in New Zealand (Q3); \$193 in the Netherlands (median); \$53 in Japan (Q1); and \$6 in Italy (min). Moreover, as a general (but controversial) observation, the standard deviation was typically higher for the countries in the lowest quartile of annualised performance, when compared to those in the top quartile (see Appendix).

We also report the annualised performance of accumulated bond returns in the DMS (2012) database. It is interesting to note that while many of the countries selected for analysis remain largely stable in the bond ranking, the changes in ranking historically for Australia is stark (from the best annualised performance in stocks to slightly above median in bonds).

Table 4 Ranking of annualised performance (bonds, real accumulated returns)				
Ranking	Country	Annualised performance (%)	Standard deviation	Reward/risk ratio
1	Denmark	3.18	11.69	0.27
2	Sweden	2.56	12.42	0.21
3	Canada	2.22	10.42	0.21
4	Switzerland	2.19	9.34	0.23
5	New Zealand (#5 stocks)	2.12	9.11	0.23
6	United States	2.01	10.34	0.19
7	Norway	1.82	12.17	0.15
8	South Africa	1.77	10.35	0.17
9	Australia (#1 stocks)	1.57	13.20	0.12
10	United Kingdom	1.52	13.75	0.11
11	Netherlands (#10 stocks)	1.51	9.41	0.16
12	Spain	1.31	11.71	0.11
13	Ireland	0.94	14.80	0.06
14	Belgium	-0.08	11.93	-0.01
15	France	-0.10	12.96	-0.01
16	Finland	-0.17	13.65	-0.01
17	Japan (#14 stocks)	-1.06	20.02	-0.05
18	Italy (#19 stocks)	-1.74	14.02	-0.12
19	Germany	-1.77	15.51	-0.11

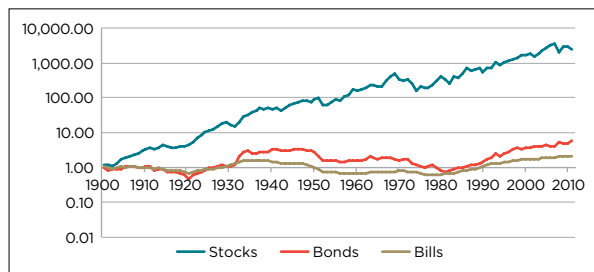
Source: DMS (2012)

We posit that the divergence of results globally provides a very wide range of scenarios under which to test the safe withdrawal rule (in addition to the potential risk of retirees' forming future expectations reliant on Australia's historical performance). We now present a visual comparison of the differing return histories of our non-random sample.¹⁸ Following this comparison, we conduct tests of the 4% Rule across our five selected countries.

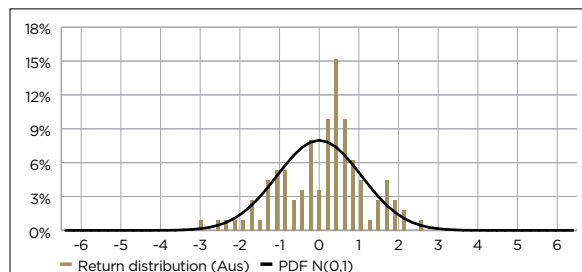
¹⁸ For list of summary statistics for all countries (inflation, stocks, bonds and bills) see Appendix.

Figure 6 Annualised performance of stocks, bonds and bills

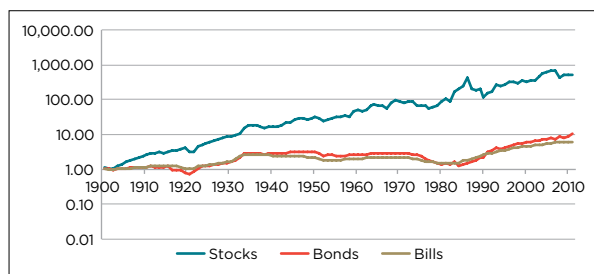
Australia (stocks 2,459; bonds 5.7; bills 2.2)



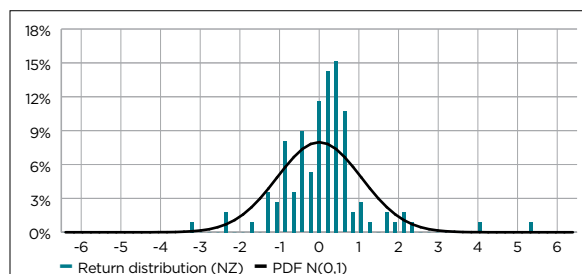
Australia histogram stocks N (7.22, 18.2)



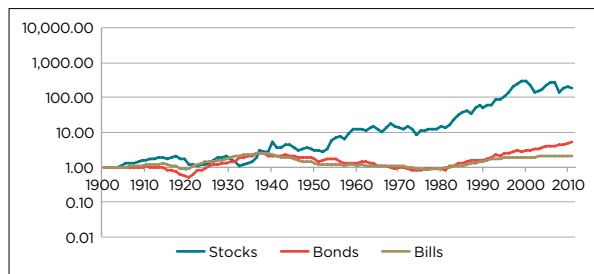
New Zealand (stocks 531; bonds 10.5; bills 6.4)



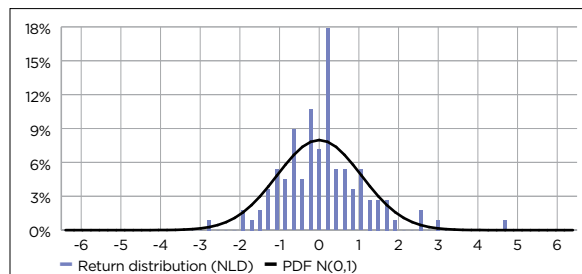
New Zealand histogram stocks N (5.76, 19.7)



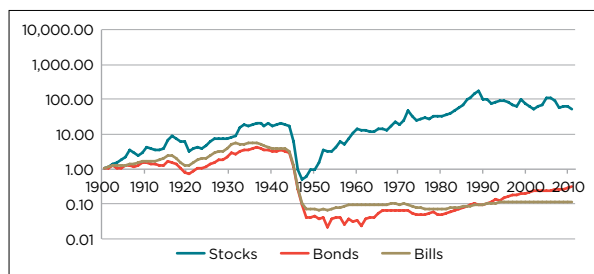
Netherlands (stocks 193; bonds 5.4; bills 2.1)



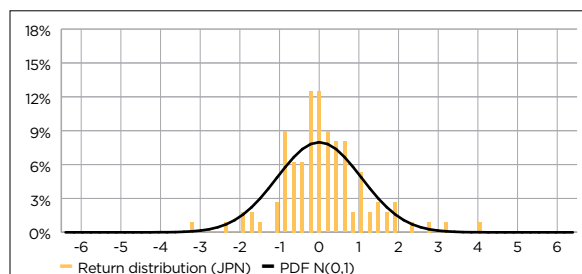
Netherlands histogram stocks N (4.81, 21.8)



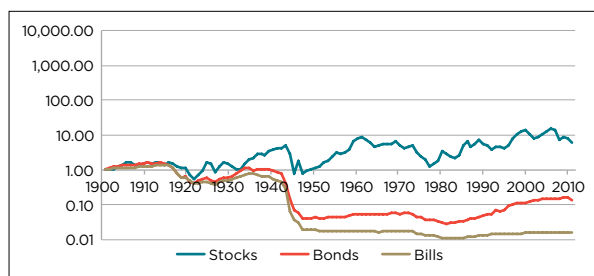
Japan (stocks 53; bonds 0.3; bills 0.1)



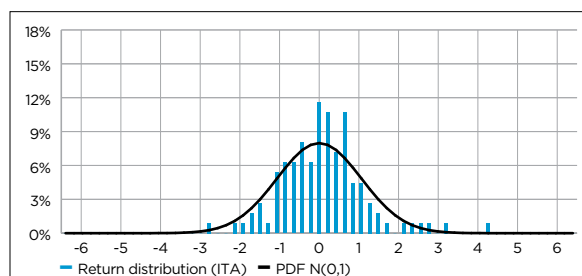
Japan histogram stocks N (3.62, 29.8)



Italy (stocks 6; bonds 0.14; bills 0.02)



Italy histogram stocks N (1.68, 29.0)



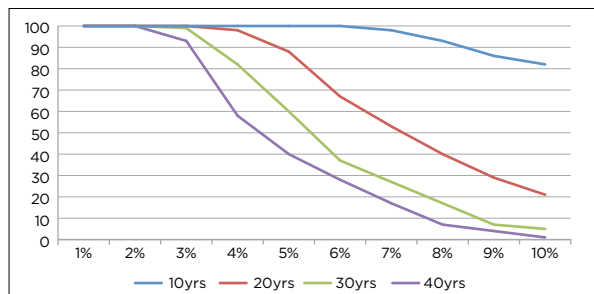
AUSTRALIA

Given the strong performance of Australian stocks over the last century (in concert with the average performance of bonds), those portfolios with greater allocations to growth assets have typically exhibited greater longevity. However, even with this stellar performance, we find success for the 4% Rule in the shortest of timeframes, with horizons greater than a decade exposing the hypothetical investor to some chance of ruin.

Table 5 Portfolio success rates

	Withdrawal rate as a percentage of initial portfolio value									
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
100% stocks										
10 yrs	100%	100%	100%	100%	100%	99%	96%	96%	95%	90%
20 yrs	100%	100%	100%	98%	96%	91%	76%	64%	51%	33%
30 yrs	100%	100%	99%	96%	90%	72%	61%	45%	27%	16%
40 yrs	100%	100%	97%	94%	79%	63%	50%	32%	21%	11%
75% stocks/20% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	99%	98%	95%	93%	87%
20 yrs	100%	100%	100%	98%	93%	85%	65%	52%	41%	24%
30 yrs	100%	100%	99%	95%	77%	61%	41%	27%	17%	9%
40 yrs	100%	100%	97%	88%	60%	50%	26%	18%	8%	4%
50% stocks/45% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	98%	93%	86%	82%
20 yrs	100%	100%	100%	98%	88%	67%	53%	40%	29%	21%
30 yrs	100%	100%	99%	82%	60%	37%	27%	17%	7%	5%
40 yrs	100%	100%	93%	58%	40%	28%	17%	7%	4%	1%
25% stocks/70% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	97%	89%	82%	76%
20 yrs	100%	100%	100%	88%	67%	51%	36%	30%	27%	18%
30 yrs	100%	100%	85%	56%	33%	28%	17%	10%	6%	2%
40 yrs	100%	94%	63%	33%	24%	11%	6%	3%	1%	0%
95% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	95%	92%	81%	71%	58%
20 yrs	100%	100%	93%	67%	48%	35%	29%	28%	26%	16%
30 yrs	100%	90%	49%	33%	26%	18%	10%	6%	2%	2%
40 yrs	100%	72%	32%	24%	8%	4%	1%	1%	0%	0%

Figure 7 Portfolio success rates comparison

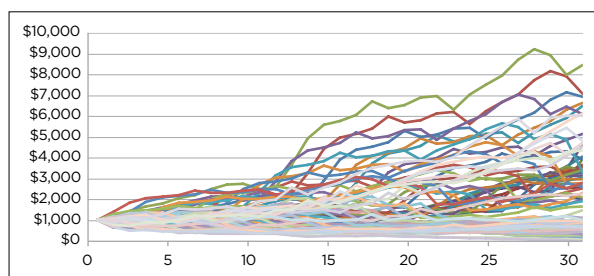


Turning specifically to the 30-year planning horizon, we report SAFEMAX results (that is, the maximum withdrawal rate that ensured portfolio survivability) for a range of risk preferences. Given its popularity in practice and supported by the literature, we focus on the 50:50 growth/defensive asset allocation. We find that, even with a 10 per cent chance of portfolio ruin, the SAFEMAX 90 stands at 3.62 per cent, some 40 basis points less than that suggested by the 4% Rule. In fact, in this scenario, a 4 per cent withdrawal rate was associated with a one-in-five chance of ruin.

Table 6 30-year SAFEMAX rates

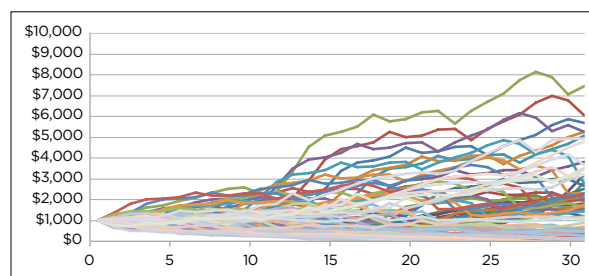
Asset allocation (rebalanced annually, 30 years)	Withdrawal rate as a percentage of initial portfolio value			
	SAFEMAX100	SAFEMAX95	SAFEMAX90	SAFEMAX50
100% stocks	2.74	4.20	5.13	7.63
75% stocks/20% bonds/5% bills	2.94	4.01	4.31	6.71
50% stocks/45% bonds/5% bills	2.96	3.54	3.62	5.37
25% stocks/70% bonds/5% bills	2.45	2.69	2.85	4.11
95% bonds/5% bills	1.66	1.83	2.04	5.37

Figure 8 SAFEMAX



SAFEMAX100 = 2.96%

Figure 9 4% Rule



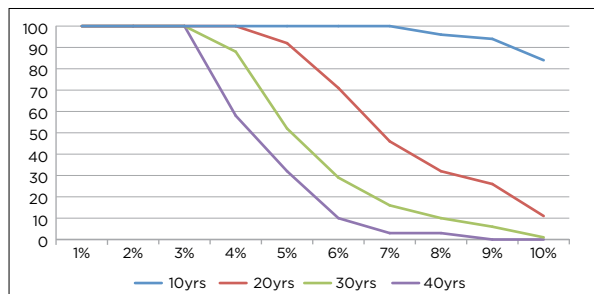
NEW ZEALAND

The combination of New Zealand's third quartile performance in both stocks and bonds over the last 112 years has provided the strongest support for the Golden Rule in this study. This is particularly the case with the 75:25 portfolio, recording a SAFEMAX100 of approximately 4 per cent in the 10- through 30-year horizons and around a one-in-ten chance of ruin over 40 years.

Table 7 Portfolio success rates

	Withdrawal rate as a percentage of initial portfolio value									
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
100% stocks										
10 yrs	100%	100%	100%	100%	99%	99%	99%	96%	94%	86%
20 yrs	100%	100%	99%	99%	98%	89%	71%	52%	32%	17%
30 yrs	100%	100%	100%	100%	87%	66%	48%	17%	9%	7%
40 yrs	100%	100%	100%	99%	71%	53%	19%	7%	3%	1%
75% stocks/20% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	99%	97%	93%	89%
20 yrs	100%	100%	100%	100%	98%	82%	62%	41%	23%	12%
30 yrs	100%	100%	100%	99%	74%	49%	26%	11%	9%	5%
40 yrs	100%	100%	100%	88%	57%	28%	6%	3%	1%	0%
50% stocks/45% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	96%	94%	84%
20 yrs	100%	100%	100%	100%	92%	71%	46%	32%	26%	11%
30 yrs	100%	100%	100%	88%	52%	29%	16%	10%	6%	1%
40 yrs	100%	100%	100%	58%	32%	10%	3%	3%	0%	0%
25% stocks/70% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	94%	90%	78%
20 yrs	100%	100%	100%	97%	82%	47%	36%	30%	17%	11%
30 yrs	100%	100%	100%	52%	28%	23%	11%	7%	1%	1%
40 yrs	100%	100%	72%	40%	17%	4%	3%	0%	0%	0%
95% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	96%	92%	79%	70%
20 yrs	100%	100%	100%	87%	53%	34%	32%	26%	12%	11%
30 yrs	100%	100%	68%	33%	24%	16%	5%	4%	1%	1%
40 yrs	100%	89%	46%	21%	7%	3%	0%	0%	0%	0%

Figure 10 Portfolio success rates comparison

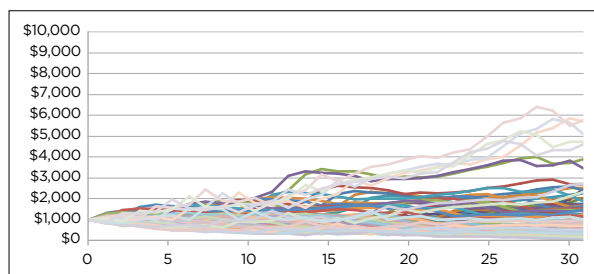


Turning to the 30-year horizon, New Zealand again recorded the highest SAFEMAX 100 level at 3.64 per cent, approaching the 4% Rule level of 4 per cent with a 10 per cent probability of portfolio ruin. The results again suggest that the real returns in more defensive assets (bonds and bills) need to be complemented with stocks to assist in asset-liability matching for retirees.

Table 8 30-year SAFEMAX rates

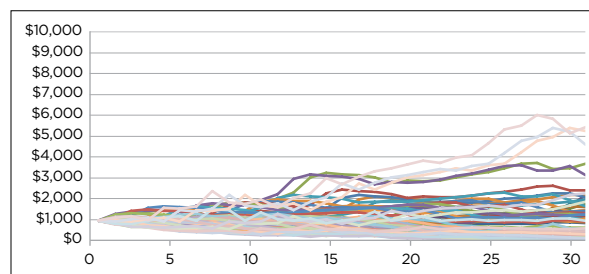
Asset allocation (rebalanced annually, 30 years)	Withdrawal rate as a percentage of initial portfolio value			
	SAFEMAX100	SAFEMAX95	SAFEMAX90	SAFEMAX50
100% stocks	4.05	4.68	4.95	6.82
75% stocks/20% bonds/5% bills	3.97	4.37	4.51	5.96
50% stocks/45% bonds/5% bills	3.64	3.90	3.97	5.18
25% stocks/70% bonds/5% bills	3.12	3.22	3.36	4.30
95% bonds/5% bills	2.39	2.44	2.51	3.36

Figure 11 SAFEMAX



SAFEMAX100 = 3.64%

Figure 12 4% Rule



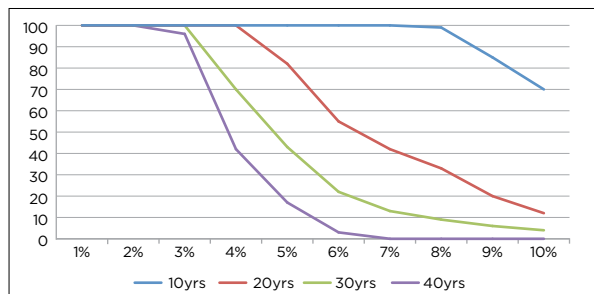
NETHERLANDS

We have selected the Netherlands as a proxy for testing the 4% Rule in a market that achieved about median annualised stock returns over the last 112 years. The results provide some support to the 4% Rule for horizons of around 20 years (particularly for those portfolios with a minimum of half the portfolio allocated to stocks). However, the sustainability of this practice is challenged over longer time periods.

Table 9 Portfolio success rates

	Withdrawal rate as a percentage of initial portfolio value									
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
100% stocks										
10 yrs	100%	100%	100%	100%	100%	100%	96%	88%	79%	69%
20 yrs	100%	100%	100%	97%	84%	63%	49%	37%	33%	26%
30 yrs	100%	100%	99%	79%	56%	35%	24%	20%	18%	11%
40 yrs	100%	100%	86%	61%	39%	22%	13%	10%	4%	1%
75% stocks/20% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	95%	85%	69%
20 yrs	100%	100%	100%	100%	83%	65%	47%	34%	28%	20%
30 yrs	100%	100%	100%	78%	49%	33%	20%	12%	9%	6%
40 yrs	100%	100%	99%	56%	31%	13%	3%	0%	0%	0%
50% stocks/45% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	99%	85%	70%
20 yrs	100%	100%	100%	100%	82%	55%	42%	33%	20%	12%
30 yrs	100%	100%	100%	70%	43%	22%	13%	9%	6%	4%
40 yrs	100%	100%	96%	42%	17%	3%	0%	0%	0%	0%
25% stocks/70% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	98%	82%	65%
20 yrs	100%	100%	100%	99%	63%	45%	36%	26%	14%	5%
30 yrs	100%	100%	94%	46%	29%	20%	11%	6%	2%	2%
40 yrs	100%	100%	65%	24%	10%	3%	1%	0%	0%	0%
95% bonds/5% bills										
10 yrs	100%	100%	100%	100%	100%	100%	100%	94%	66%	54%
20 yrs	100%	100%	100%	75%	46%	37%	33%	20%	5%	4%
30 yrs	100%	100%	62%	35%	23%	15%	7%	2%	2%	1%
40 yrs	100%	68%	35%	11%	6%	3%	1%	0%	0%	0%

Figure 13 Portfolio success rates comparison

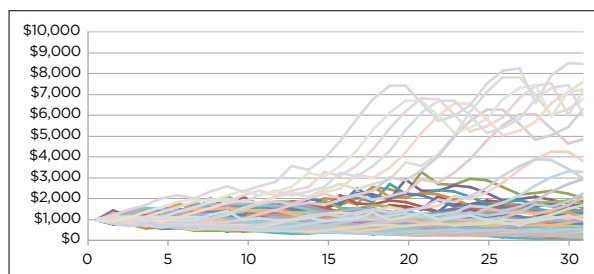


The Netherlands case study suggests more a 3% Rule, or 3.5% Rule if retirees are willing to take on some risk of ruin. The 4% Rule particularly is challenged with a 25% stocks/70% bonds/5% bills allocation (25:75), with the chance of the portfolio sustaining more than 30 years of income less than the probability of tossing a head on a fair coin.

Table 10 30-year SAFEMAX rates

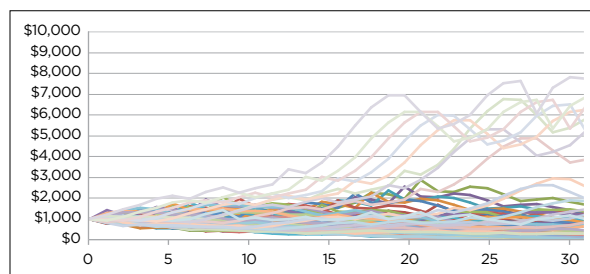
Asset allocation (rebalanced annually, 30 years)	Withdrawal rate as a percentage of initial portfolio value			
	SAFEMAX100	SAFEMAX95	SAFEMAX90	SAFEMAX50
100% stocks	2.93	3.14	3.40	5.25
75% stocks/20% bonds/5% bills	3.31	3.51	3.77	4.98
50% stocks/45% bonds/5% bills	3.19	3.53	3.67	4.65
25% stocks/70% bonds/5% bills	2.83	2.99	3.10	3.85
95% bonds/5% bills	2.04	2.12	2.16	3.35

Figure 14 SAFEMAX



SAFEMAX100 = 3.19%

Figure 15 4% Rule



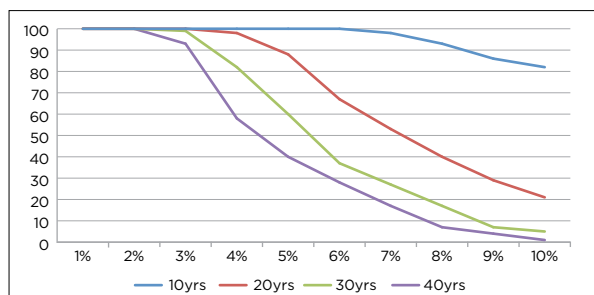
JAPAN

Over the last century, Japanese stocks (and bonds) have been a bottom quartile performer on a global comparison. Moreover, the correlation between Japanese stocks and bonds has average 0.38 over the same period. Japan provides the lowest SAFEMAX levels across the sample. In fact, less than 1 per cent (SAFEMAX equals 0.47 for the 100 per cent stock portfolio).

Table 11 Portfolio success rates

	Withdrawal rate as a percentage of initial portfolio value									
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
100% stocks										
10 yrs	94%	92%	91%	91%	90%	89%	86%	82%	75%	70%
20 yrs	86%	83%	78%	74%	70%	65%	60%	51%	45%	30%
30 yrs	84%	74%	66%	61%	59%	55%	40%	32%	22%	15%
40 yrs	81%	63%	50%	49%	44%	39%	32%	24%	19%	14%
75% stocks/20% bonds/5% bills										
10 yrs	94%	92%	92%	91%	91%	91%	88%	84%	83%	74%
20 yrs	86%	82%	80%	78%	72%	66%	62%	49%	38%	25%
30 yrs	80%	73%	67%	62%	59%	54%	41%	21%	13%	11%
40 yrs	72%	54%	49%	49%	44%	40%	28%	14%	13%	11%
50% stocks/45% bonds/5% bills										
10 yrs	94%	92%	92%	91%	91%	91%	89%	85%	84%	78%
20 yrs	84%	82%	80%	80%	75%	68%	55%	43%	28%	18%
30 yrs	76%	71%	68%	62%	57%	44%	26%	11%	10%	7%
40 yrs	67%	50%	49%	47%	42%	28%	14%	11%	8%	6%
25% stocks/70% bonds/5% bills										
10 yrs	93%	92%	92%	90%	90%	90%	88%	85%	84%	75%
20 yrs	83%	82%	79%	79%	75%	62%	47%	28%	18%	10%
30 yrs	73%	68%	66%	60%	45%	24%	13%	4%	1%	1%
40 yrs	54%	47%	46%	43%	22%	10%	4%	1%	0%	0%
95% bonds/5% bills										
10 yrs	93%	91%	91%	90%	89%	89%	86%	83%	68%	62%
20 yrs	80%	80%	78%	78%	55%	39%	34%	24%	15%	10%
30 yrs	70%	66%	65%	39%	20%	12%	6%	1%	1%	1%
40 yrs	49%	46%	40%	13%	6%	1%	0%	0%	0%	0%

Figure 16 Portfolio success rates comparison

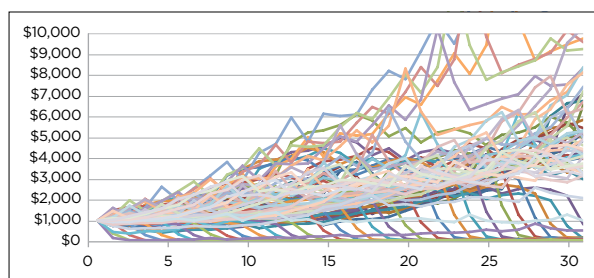


The Japanese experience in their stock, bond and bill markets provides some of the most interesting insights for safe withdrawal rates. Japan recorded the highest standard deviation of bonds over the last century (and third largest for stocks, see Appendix). This incredible dispersion of results has seen some sequences of returns (particularly those in the left tail of the distribution) lead to almost immediate portfolio ruin under any rule. Moreover, the incredible returns in the right tail have led to stellar gains for some paths (in fact, far better than the best paths experienced in Australia).

Table 12 30-year SAFEMAX rates

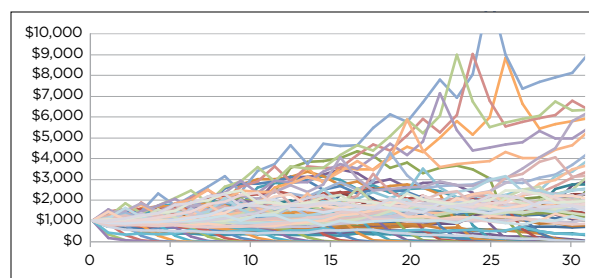
Asset allocation (rebalanced annually, 30 years)	Withdrawal rate as a percentage of initial portfolio value			
	SAFEMAX100	SAFEMAX95	SAFEMAX90	SAFEMAX50
100% stocks	0.47	0.49	0.54	6.52
75% stocks/20% bonds/5% bills	0.37	0.40	0.43	6.30
50% stocks/45% bonds/5% bills	0.24	0.27	0.29	5.71
25% stocks/70% bonds/5% bills	0.12	0.14	0.15	4.87
95% bonds/5% bills	0.04	0.05	0.06	3.71

Figure 17 SAFEMAX



SAFEMAX100 = 0.24%

Figure 18 4% Rule



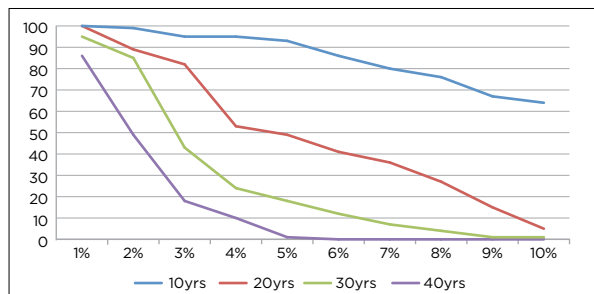
ITALY

Over many, many decades, stocks in Italy have barely kept pace with inflation (DMS, 2012). And while the Italian case study seems extreme, we are reminded of the wit and wisdom of Mark Twain when he said, 'Truth is stranger than fiction, but it is because Fiction is obliged to stick to possibilities; Truth isn't.' We find some SAFEMAX levels for the very shortest time periods and lowest payout levels; however, these results are troubling for the 4% Rule.

Table 13 Portfolio success rates

	Withdrawal rate as a percentage of initial portfolio value									
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
100% stocks										
10 yrs	100%	100%	99%	97%	90%	88%	82%	71%	62%	53%
20 yrs	100%	98%	82%	64%	54%	45%	32%	23%	21%	20%
30 yrs	100%	88%	61%	37%	27%	21%	13%	13%	9%	6%
40 yrs	100%	76%	42%	24%	17%	10%	4%	0%	0%	0%
75% stocks/20% bonds/5% bills										
10 yrs	100%	100%	97%	95%	94%	87%	81%	75%	65%	57%
20 yrs	100%	95%	85%	58%	53%	41%	34%	26%	20%	17%
30 yrs	100%	87%	50%	28%	23%	15%	12%	7%	4%	1%
40 yrs	99%	65%	31%	17%	10%	1%	0%	0%	0%	0%
50% stocks/45% bonds/5% bills										
10 yrs	100%	99%	95%	95%	93%	86%	80%	76%	67%	64%
20 yrs	100%	89%	82%	53%	49%	41%	36%	27%	15%	5%
30 yrs	95%	85%	43%	24%	18%	12%	7%	4%	1%	1%
40 yrs	86%	49%	18%	10%	1%	0%	0%	0%	0%	0%
25% stocks/70% bonds/5% bills										
10 yrs	100%	95%	94%	92%	88%	86%	82%	75%	69%	63%
20 yrs	89%	86%	74%	53%	45%	37%	30%	15%	9%	3%
30 yrs	84%	65%	29%	20%	11%	7%	2%	1%	1%	1%
40 yrs	64%	43%	11%	0%	0%	0%	0%	0%	0%	0%
95% bonds/5% bills										
10 yrs	96%	94%	92%	52%	88%	84%	79%	73%	68%	60%
20 yrs	86%	82%	70%	9%	41%	21%	17%	14%	10%	1%
30 yrs	74%	50%	23%	0%	5%	4%	2%	1%	1%	1%
40 yrs	47%	35%	0%	13%	0%	0%	0%	0%	0%	0%

Figure 19 Portfolio success rates comparison

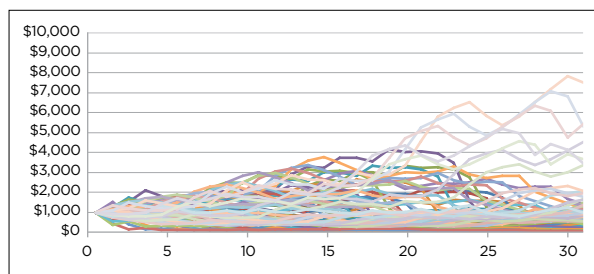


While Italian stocks recorded a similar level of standard deviation as Japan, bonds in Italy recorded a third less volatility when compared to Japanese bonds over the sample period. This has provided only marginally better overall safe withdrawal results than those recorded in Japan. Interestingly, investors were faced with around a one-in-four chance of the portfolio surviving a 4 per cent withdrawal level of 30 years. In addition to Japan, Italy provides a further interesting set of results when thinking about rule-based retirement income strategies.

Table 14 30-year SAFEMAX rates

Asset allocation (rebalanced annually, 30 years)	Withdrawal rate as a percentage of initial portfolio value			
	SAFEMAX100	SAFEMAX95	SAFEMAX90	SAFEMAX50
100% stocks	1.34	1.76	1.94	3.50
75% stocks/20% bonds/5% bills	1.31	1.50	1.84	3.00
50% stocks/45% bonds/5% bills	0.89	1.01	1.23	2.66
25% stocks/70% bonds/5% bills	0.45	0.50	0.55	2.49
95% bonds/5% bills	0.18	0.21	0.22	2.09

Figure 20 SAFEMAX



SAFEMAX100 = 0.89%

Figure 21 4% Rule

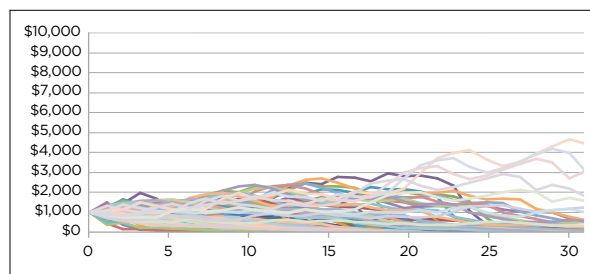
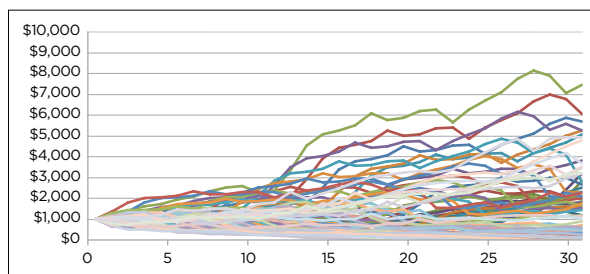
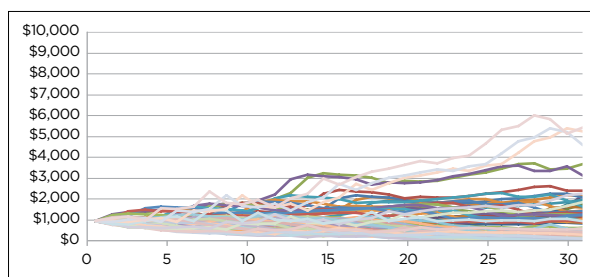


Figure 22 Heat maps of SAFEMAX results (50:50, 30 years)

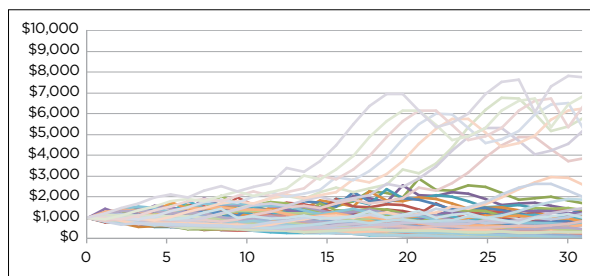
Australia 4% (SAFEMAX100 2.96)



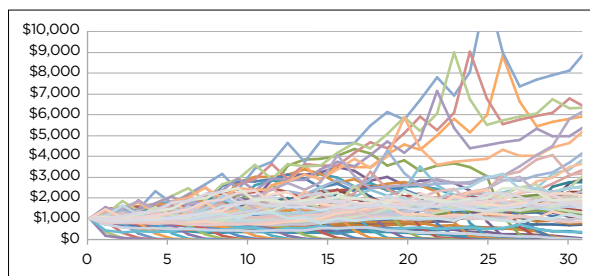
New Zealand 4% (SAFEMAX100 3.64)



Netherlands 4% (SAFEMAX100 3.19)



Japan 4% (SAFEMAX100 0.24)



Italy 4% (SAFEMAX100 0.89)

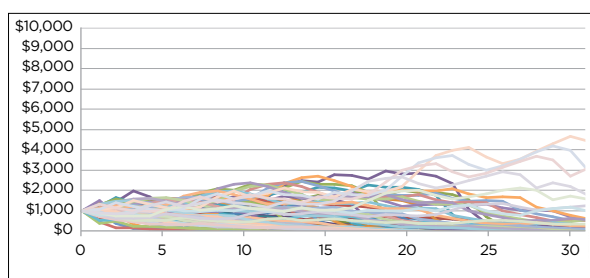


Figure 22 Heat maps of SAFEMAX results (50:50, 30 years) *continued*

Australia heat map

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	98%	93%	86%	82%
20 yrs	100%	100%	100%	98%	88%	67%	53%	40%	29%	21%
30 yrs	100%	100%	99%	82%	60%	37%	27%	17%	7%	5%
40 yrs	100%	100%	93%	58%	40%	28%	17%	7%	4%	1%

New Zealand heat map

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	100%	96%	94%	84%
20 yrs	100%	100%	100%	100%	92%	71%	46%	32%	26%	11%
30 yrs	100%	100%	100%	88%	52%	29%	16%	10%	6%	1%
40 yrs	100%	100%	100%	58%	32%	10%	3%	3%	0%	0%

Netherlands heat map

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	100%	99%	85%	70%
20 yrs	100%	100%	100%	100%	82%	55%	42%	33%	20%	12%
30 yrs	100%	100%	100%	70%	43%	22%	13%	9%	6%	4%
40 yrs	100%	100%	96%	42%	17%	3%	0%	0%	0%	0%

Japan heat map

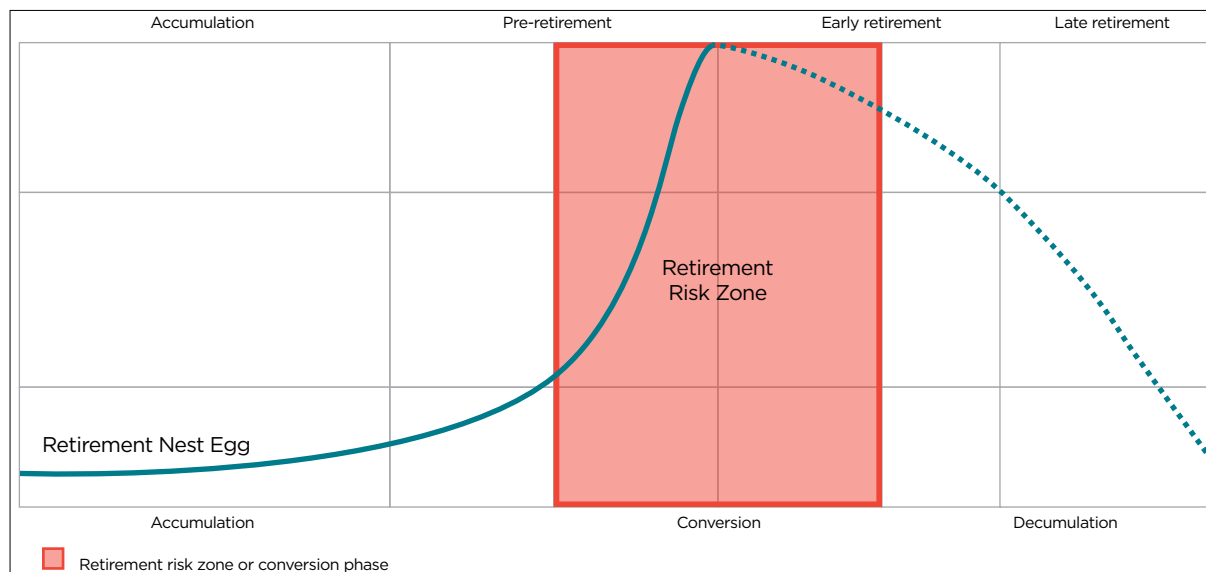
Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	94%	92%	92%	91%	91%	91%	89%	85%	84%	78%
20 yrs	84%	82%	80%	80%	75%	68%	55%	43%	28%	18%
30 yrs	76%	71%	68%	62%	57%	44%	26%	11%	10%	7%
40 yrs	67%	50%	49%	47%	42%	28%	14%	11%	8%	6%

Italy heat map

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	99%	95%	95%	93%	86%	80%	76%	67%	64%
20 yrs	100%	89%	82%	53%	49%	41%	36%	27%	15%	5%
30 yrs	95%	85%	43%	24%	18%	12%	7%	4%	1%	1%
40 yrs	86%	49%	18%	10%	1%	0%	0%	0%	0%	0%

THE 4% RULE IS DEAD, LONG LIVE THE 4% RULE

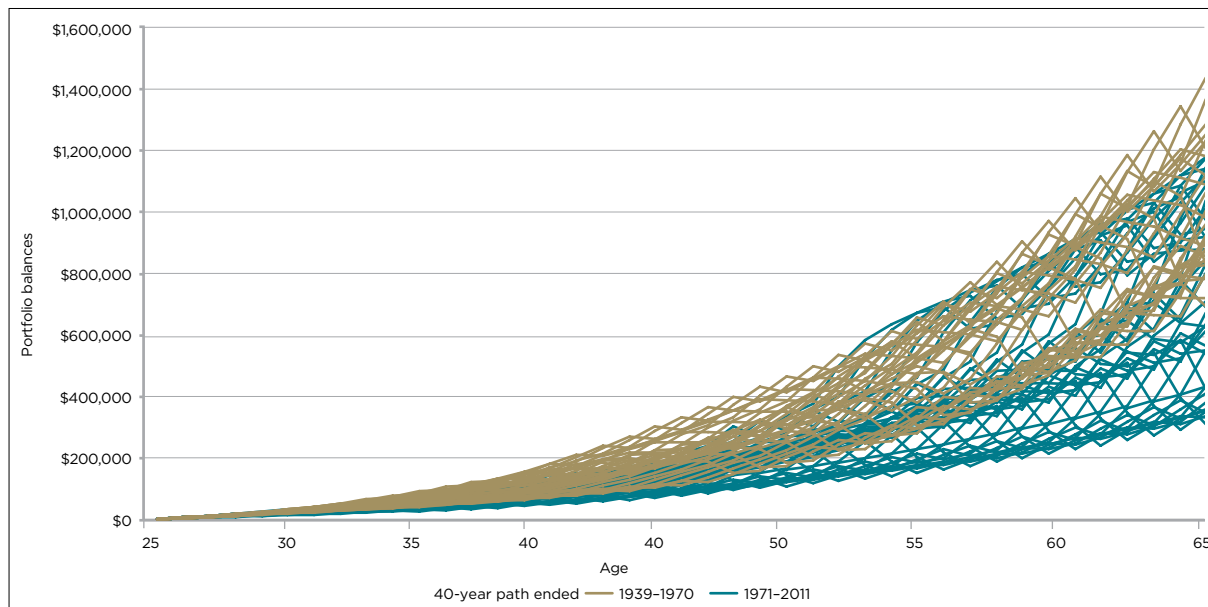
We opened the study with a discussion of the importance of the conversion phase, where retirees are in the final stages of their accumulation journey and are converting these savings into retirement income. The concept of the retirement risk zone explains complex investment principles for ordinary investors.



While acknowledging the illustrative power of the above figure, the findings of this paper (as well as those from the first paper in the Finsia RRZ research series on the topic of sequencing risk (Basu, Doran and Drew, 2012)) suggest that the myriad of risks facing investors are far, far greater than such stylised versions of the RRZ suggest. At the heart of this debate is the fact that success in retirement investing is heavily dependent on the cash flow profile of the investor — cash inflows during the accumulation phase and cash outflows during the income phase. The complexity of the task facing investors is exacerbated further by the multi-sequence, path-dependent nature of retirement outcomes.

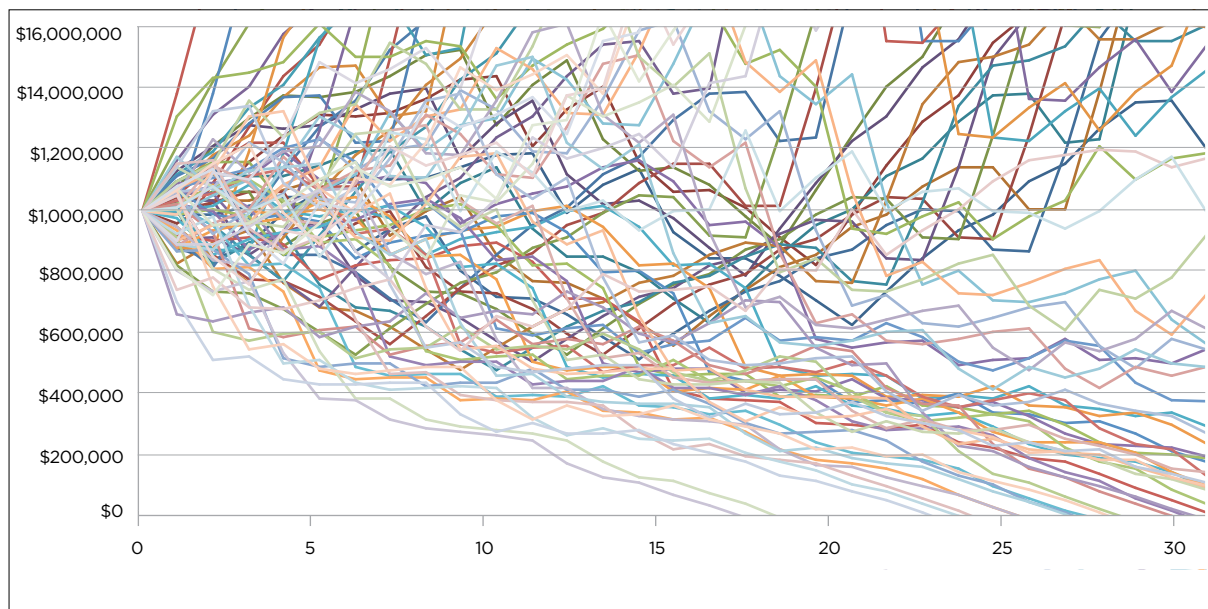
Going back to the first study in this series, Basu, Doran and Drew (2012, 2013) use the same data as employed in this study to illustrate the range of outcomes for a 25-year-old Australian contributing 9 per cent of salary over their lifetime. Using a 40-year investment horizon, with a 66:34 asset allocation of real returns, the research shows the fan of retirement outcome uncertainty during the accumulation phase.

Figure 23 Accumulation paths from 1900 to 2011



Source: Basu, Doran and Drew (2012)

Figure 24 Views from a multi-cash flow, multi-sequencing world



The results presented in Figure 23 highlight the range of results for our hypothetical investor, ranging from around \$300,000 through to \$1.5 million. Importantly, this analysis keeps the same cash contributions throughout, and the same asset allocation, and simply applies different 40-year paths of returns (from between 1900 and 2011) to determine the outcome. Moving from the accumulation phase through to the decumulation phase we must acknowledge just how heroic this and other safe withdrawal studies are by assuming the starting point for analysis — that is, the investor's final accumulation balance. Even with the uncertainties surrounding the final balance, our results demonstrate a similar fan of uncertainty facing retirees (Figure 24, Australia 4% Rule, starting balance of \$1 million) as they enter the income phase.

We must do better in assisting retirees with formulating realistic expectations of the sustainability of their retirement savings.

In a world currently providing retirees (and investors more generally) with significant headwinds (low-risk investments offering low nominal returns and negative real returns for all but the very longest horizons; the constant tinkering of superannuation policy; and our seemingly ever increasing longevity), there is a very real temptation to look for a 'silver bullet' to solve the asset-liability mismatch facing retirees. As the dark shadow of complexity looms, surely there must be a 'fix-all' to the retirement income challenge? In many respects, the financial services industry (both in Australia and abroad), and governments have continued their search for the solution, retirement's holy grail.¹⁹

The framing of our approach to the income conversion phase is critical. It is important that we are cognisant of the holy grail dilemma; that we aren't spending too much time searching for a silver bullet to solve all ills. As we have seen in the analytical sections of this study, sequencing risk, record low interest rates, the dynamism of correlations between asset classes and constant

shadow of inflation create an environment where, many times, the quest for a sustainable retirement income leads to decisions that simply exchange one risk for another.

Depressingly, fiscal death seems to be developing into a risk to rival that of physical death.

To start, we have to acknowledge the 'known unknown', that is, the path dependency of outcomes (resulting from the unknown sequence of returns). Our selection of five countries illustrates that, even with the best annualised performance of any stock market in the world over the past century, the 4% Rule could not be followed deterministically through time without some risk of portfolio ruin. Moreover, our friends in New Zealand and the Netherlands, third quartile and median performers in long-term real stock returns, respectively, sustained high safe withdrawal rates. In short, what happens when the largest amount of retirement savings is at risk, matters. While acknowledging that we have limited skills in forecasting whether or not the retiree gets the 'bad' draw out of the cosmic investing world, we can and we must do better in assisting retirees with formulating realistic expectations of the sustainability (or otherwise) of their retirement savings (assets) in meeting their income needs (liability).

We have entitled this section, 'The 4% Rule is dead, long live the 4% Rule'. We do this to underline the dangers of following this rule in a deterministic way. However, we can also see the merit in using the safe withdrawal rate approach to inform (and, perhaps lower) the income expectations of retirees. While we reject the 4% Rule as a retirement income strategy, we will argue that the underlying philosophy of the 4% Rule can be a very useful tool to frame the liability aspect of retirement planning, and assist retirees with forming expectations.

Our results confirm that whatever you think you need as a superannuation nest egg, it is almost certainly going to be less than you actually need.²⁰ The conversation is a difficult one in that, for many investors, their focus is on the asset side (particularly, the return portion) of the equation, not the liability. We posit that the first challenge in tipping the scales in the retiree's favour is to get the framing right, moving from a 'pot of gold' (asset) mindset to an 'income replacement' focus (liability).

19 As students, the authors (particularly the first named author) followed a little Australian pub band, known as the Hunters and Collectors. Perhaps Hunters and Collectors lead singer, Mark Seymour, frames it best when he penned: 'Woke up this morning from the strangest dream. I was in the biggest army the world has ever seen. We were marching as one. On the road to the holy grail.' We take this opportunity to pay homage to the first named author's favourite band, H&C, the anthems of our generation and their insights into the retirement product debate, see: <<http://www.markseymour.com.au/>>.

20 For an excellent discussion, and accompanying analytics, regarding this issue see Deloitte (2013) report on the 'Dynamics of the Australian Superannuation System: The next 20 years', <http://www.deloitte.com/view/en_AU/au/industries/financialservices/dynamics-superannuation/index.htm>.

It's time for a difficult conversation. Let's assume (somewhat heroically) that a couple has a retirement nest egg of \$1 million today.²¹ How can we begin to assist retirees with framing reasonable expectations given different starting balances?

The first challenge in tipping the scales in the retiree's favour is to get the framing right, moving from a 'pot of gold' mindset to an 'income replacement' focus.

The Association of Superannuation Funds of Australia (ASFA) has developed the ASFA Retirement Standard benchmarks that estimate the annual budget needed by Australians to fund either a comfortable or modest standard of living in retirement. It is updated quarterly to reflect inflation, and provides detailed budgets of what singles and couples would need to spend to support their chosen lifestyle. We argue that these benchmarks are a critical component to improving the framing of retirement income decisions. The ASFA Retirement Standard (June quarter 2013) shows that, in

general, a couple looking to achieve a 'comfortable' retirement needs to spend \$56,406 a year, while those seeking a 'modest' retirement lifestyle need to spend \$32,656 a year (ASFA, 2013).²²

For the purposes of providing a practical perspective to the safe withdrawal debate, we can consider (on a \$1 million starting balance), a real income requirement of 3.27 per cent (that is, 3.27 per cent of \$1 million = \$32,700 per annum for 30 years) for a modest income level; and a 5.64 per cent for a comfortable income (5.64 per cent of \$1m = \$56,400 p.a. for 30 years). To provide a further yardstick for comparison, the age pension rate for a combined couple (using the maximum basic rate, and excluding the maximum pension supplement and the clean energy supplement) stands at around \$29,463 (2.94 per cent).²³ These three income levels provide an indicative income liability for a couple in retirement of between \$30,000 and \$60,000 per annum (we acknowledge that, for many Australian couples, even the upper end of this range would not represent a life of 'endless summers, candlelit dinners and long walks along the beach'). We plot these ranges against our safe withdrawal rate findings (note that the dotted lines represent the ASFA modest and comfortable income levels on a starting balance of \$1 million).

21 We note that the majority of studies use this accumulated level as the starting point for testing safe withdrawal rates, by way of example, see Bengen (1994); through to more recent studies by Athavale and Goebel (2011) and Finke, Pfau, and Williams (2012).

22 For a more detailed view of the expenditure components in the ASFA Retirement Standard (and the methodological approach, see: <<http://www.superannuation.asn.au/resources/retirement-standard>>.

23 Perhaps the age pension could be considered a form of back-stop annuity. We find the approximately 3 per cent withdrawal level (2.94 per cent) on a starting balance of \$1 million particularly useful as a lower bound. It also highlights just how modest the ASFA modest standard is. Using back-of-the-envelope numbers, ASFA's 'modest' standard equates to an extra \$115 per fortnight over and above the maximum basic rate for a couple.

Figure 25 ASFA retirement income standards as withdrawal rates*

Australia

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	98%	93%	86%	82%
20 yrs	100%	100%	100%	98%	88%	67%	53%	40%	29%	21%
30 yrs	100%	100%	99%	82%	60%	37%	27%	17%	7%	5%
40 yrs	100%	100%	93%	58%	40%	28%	17%	7%	4%	1%

New Zealand

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	100%	96%	94%	84%
20 yrs	100%	100%	100%	100%	92%	71%	46%	32%	26%	11%
30 yrs	100%	100%	100%	88%	52%	29%	16%	10%	6%	1%
40 yrs	100%	100%	100%	58%	32%	10%	3%	3%	0%	0%

Netherlands

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	100%	100%	100%	100%	100%	100%	99%	85%	70%
20 yrs	100%	100%	100%	100%	82%	55%	42%	33%	20%	12%
30 yrs	100%	100%	100%	70%	43%	22%	13%	9%	6%	4%
40 yrs	100%	100%	96%	42%	17%	3%	0%	0%	0%	0%

Japan

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	94%	92%	92%	91%	91%	91%	89%	85%	84%	78%
20 yrs	84%	82%	80%	80%	75%	68%	55%	43%	28%	18%
30 yrs	76%	71%	68%	62%	57%	44%	26%	11%	10%	7%
40 yrs	67%	50%	49%	47%	42%	28%	14%	11%	8%	6%

Italy

Payout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10 yrs	100%	99%	95%	95%	93%	86%	80%	76%	67%	64%
20 yrs	100%	89%	82%	53%	49%	41%	36%	27%	15%	5%
30 yrs	95%	85%	43%	24%	18%	12%	7%	4%	1%	1%
40 yrs	86%	49%	18%	10%	1%	0%	0%	0%	0%	0%

*The white dotted lines in the country charts above represent ASFA modest income standard (left) and ASFA comfortable income standard (right).

We can consider the ASFA benchmarks as forming a retirement income channel through which retirees are attempting safe passage (in this case, safe passage is avoiding portfolio ruin). Even if we exclude the countries with the lowest safe withdrawal rate results (Japan and Italy), the results on a starting balance of \$1m for a couple suggest that the ASFA modest range is vastly more sustainable than the comfortable equivalent. Even at this withdrawal rate, history suggests that a couple would still face somewhere between a 10 to 30 per cent chance of portfolio ruin for a 30-year horizon.

As a form of 'ready reckoner', we include in the table below different starting points, and their safe withdrawal equivalent percentage.

Table 15 Withdrawal rates equivalents for varying starting values

Starting balance	ASFA modest \$32,656	ASFA comfortable \$56,406
\$250,000	13.06%	22.56%
\$500,000	6.53%	11.28%
\$750,000	4.35%	7.52%
\$1,000,000	3.27%	5.64%
\$1,250,000	2.61%	4.51%
\$1,500,000	2.18%	3.76%

In short, holding a 50:50 portfolio over 30 years, the highest SAFEMAX100 rate we report in this study is from New Zealand at 3.64 per cent. This suggests that even using the best result from our sample, a couple with a starting balance of \$1.5m would, using history as a guide, still face some probability of portfolio ruin. We again acknowledge the limitations of the 4% Rule, particularly the deterministic nature of the rule. In the real world, retirees face an array of expenses, the frequency of which range from well-known (such as utility bills, insurance costs, general living expenses) to some which are stochastic or random in nature (for instance, major unanticipated health events). However, as previously mentioned, the 4% Rule used as a 'line in the sand' can be very helpful as a heuristic for retirees (a quick shortcut to assist in our understanding the challenge of income planning). Like many shortcuts, it provides an imperfect answer to help us better understand the problem (and formulate more robust responses). As neatly summarised by Scott, Sharp, and Watson (2009), the 4% Rule imposes an opportunity cost on retirees and is therefore inefficient. We would certainly echo their view. The 4% Rule helps us initially engage cognitively in the retirement income problem which, as we have seen from this study, is simultaneously complex and dynamic in nature.

The 4% Rule is dead, long live the 4% Rule.

RETIREMENT INCOME PLANNING: THE NEXT STEPS

‘There are known knowns; there are things we know that we know. There are known unknowns; that is to say, there are things that we now know we don’t know. But there are also unknown unknowns — there are things we do not know we don’t know.’

Former United States Secretary of Defense, Donald Rumsfeld

As mentioned in the previous section, we have limited skills in forecasting whether or not the retiree gets the ‘bad’ draw out of the cosmic investing world. In the words of Mr Rumsfeld, we consider this a ‘known unknown’. We know that if the sequence of returns is against us (particularly when the largest amount of our nest egg is at risk) and the timing is wrong, the reality is that some investor is going to get the 5 per cent worst outcome.

However, there are many levers that can be coordinated to tip the scale in the favour of the retiree, including more dynamic approaches to the:

> Withdrawal rate

Through mortality updating, regular mid-point reviews and updating of the cash flow profile of retirees.

> Asset allocation

Our results suggest that going defensive doesn’t necessarily work and can potentially lock in a bad outcome; being judicious about selling expensive assets through time and not being a forced seller due to liquidity needs; liability-driven investment.

> Planning horizon

Working longer and phased retirement results in saving more and shortening the income period. Consider also: aged care costs; medical expenses; bequest motive.

> Fees and after-tax management

We need to start to think of the fee debate as something more than an expense, but rather a budget to assist retirees in managing their asset-liability mismatch. After all, retirees live on after fee, after-tax outcomes.

> Scenario testing

We need to regularly update our retirement expectations; that is, the liability we need to meet and the asset base with which we must achieve this. Identifying this can be informed by a range of simulation techniques.

> Risk management

Our findings highlight that a tail event in the early stages of the income phase almost ensures portfolio ruin. We insure for a range of events in our life — home and contents, life and disability — why would we not insure against tail events late in our accumulation phase and early in the income phase?

> Investment governance

We need to ensure that we have trustees that can understand the asset-liability mismatch faced by retirees. As we have seen, the mismatch is a multi-dimensional problem: a complex interplay between market risk, longevity risk, and inflation risk. This requires more than, ‘did we beat peers’ or ‘can we pick stocks?’ We need to break our current obsession with the return characteristics of the asset side of the equation and move the fiduciary focus to liability management.

We acknowledge that this is not an exhaustive list. However, these are some of the key levers that our research findings suggest can fall within the gambit of 'known knowns'.

A recurrent theme throughout this study has been the role of cash flows. The biggest difference between the accumulation phase and the retirement income phase is that the cash flow profile moves from inflows (hence increasing liquidity) to outflows (hence decreasing liquidity). Importantly, as we move into retirement, time frames also shrink. Moreover, the amount of money available for long-term investments (and therefore strategies that might take a decade or more to work) also shrinks. The practical takeaways from this research are the dynamic nature of the problem, and strategies that are built on a philosophy of dynamism are key to putting the balance of probabilities in the retiree's favour.

The combination of cash outflows and shorter time horizons changes our perspective on the risk of investing in stocks. Equity risk becomes even more risky, with retirees exposed to the very real chance of a permanent loss of capital (particularly detrimental if this occurs within, say, the first seven years of the income phase). However, as our results have shown, retirees would require astronomical retirement nest eggs to immunise their retirement income liability. Our results suggest that nothing is risk-free in retirement investing, even government bonds and bills.

The days of searching for the retirement income silver bullet are over. In this study, the 4% Rule works for favourable sequences of returns (let's be honest, everything works in such markets), ignores asset values of the day and is decoupled from the dynamic nature of the asset-liability mismatch faced by many Australians. However, the 4% Rule does present us with an opportunity to form a baseline which can dramatically improve our expectations of what's possible in retirement.

For the future, we need to move from a silver bullet approach (such as the 4% Rule) to a veritable arsenal of weapons (based on dynamism: withdrawal rates; asset allocation; planning horizon; fees and after-tax management; scenario testing; risk management; investment governance) to assist retirees in managing and mitigating the asset-liability mismatch in retirement.

Strategies that are built on a philosophy of dynamism are key to putting the balance of probabilities in the retiree's favour.

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APPENDIX SUMMARY STATISTICS

Country	Annualised performance (inflation)	Arithmetic mean (inflation)	Standard deviation (inflation)	Annualised performance (real bills)	Arithmetic mean (real bills)	Standard deviation (real bills)	Correlation (bills, bonds)	Correlation (bills, equities)	Annualised performance (real bonds)	Average performance (real bonds)	Standard deviation (real bonds)	Correlation (bonds, equities)	Annualised performance (real equity)	Average performance (real equity)	Standard deviation (real equity)
Australia	3.9	4.0	5.2	0.7	0.8	5.4	0.6	0.2	1.6	2.4	13.2	0.25	7.2	8.9	18.2
Belgium	5.3	5.7	8.9	-0.4	0.0	8.0	0.7	0.2	-0.1	0.6	11.9	0.40	2.4	5.0	23.6
Canada	3.0	3.1	4.6	1.6	1.7	4.9	0.6	0.1	2.2	2.7	10.4	0.16	5.7	7.1	17.2
Denmark	3.9	4.1	6.1	2.2	2.4	6.0	0.6	0.1	3.2	3.8	11.7	0.45	4.9	6.7	20.9
Finland	7.3	9.0	26.7	-0.5	0.5	11.8	0.9	0.3	-0.2	1.1	13.6	0.30	5.0	9.0	30.4
France	7.2	7.8	12.3	-2.8	-2.3	9.5	0.8	0.2	-0.1	0.8	13.0	0.37	2.9	5.5	23.5
Germany	4.7	5.6	15.0	-2.4	-0.4	13.2	0.8	0.3	-1.8	0.9	15.5	0.43	2.9	7.9	32.2
Ireland	4.2	4.5	6.9	0.7	0.9	6.6	0.7	0.4	0.9	2.0	14.8	0.50	3.7	6.3	23.1
Italy	8.4	10.8	34.8	-3.6	-2.6	11.5	0.9	0.3	-1.7	-0.5	14.0	0.40	1.7	5.7	29.0
Japan	6.9	10.3	41.6	-1.9	-0.3	13.9	0.7	0.4	-1.1	1.6	20.0	0.38	3.6	8.3	29.8
Netherlands	2.9	3.0	4.7	0.7	0.8	4.9	0.6	0.0	1.5	1.9	9.4	0.07	4.8	6.9	21.8
NZ	3.7	3.8	4.6	1.7	1.8	4.7	0.7	0.2	2.1	2.5	9.1	0.30	5.8	7.5	19.7
Norway	3.7	4.0	7.3	1.2	1.4	7.1	0.8	0.2	1.8	2.5	12.2	0.17	4.1	7.1	27.3
Sth Africa	4.9	5.2	7.5	1.0	1.2	6.2	0.7	0.2	1.8	2.3	10.3	0.43	7.2	9.4	22.5
Spain	5.8	6.0	6.9	0.3	0.5	5.8	0.6	0.2	1.3	2.0	11.7	0.35	3.4	5.7	22.2
Sweden	3.6	3.8	7.2	1.8	2.1	6.8	0.7	0.2	2.6	3.3	12.4	0.20	6.1	8.5	22.9
Switzerland	2.3	2.4	5.2	0.8	0.9	5.0	0.8	0.3	2.2	2.6	9.3	0.38	4.1	6.0	19.7
UK	4.0	4.2	6.6	1.0	1.2	6.4	0.6	0.3	1.5	2.4	13.8	0.51	5.2	7.1	19.9
US	3.0	3.1	4.8	0.9	1.0	4.7	0.5	0.2	2.0	2.5	10.3	0.18	6.2	8.2	20.2
World	3.0	3.1	4.8	0.9	1.0	4.7	0.6	0.2	1.7	2.3	10.4	0.42	5.4	6.9	17.7
World Ex-US	3.0	3.1	4.8	0.9	1.0	4.7	0.5	0.2	1.3	2.3	14.2	0.62	4.8	6.8	20.4
Europe	3.0	3.1	4.8	0.9	1.0	4.7	0.4	0.2	0.9	2.0	15.3	0.62	4.6	6.7	21.5

Source: DMS (2012). (For Germany, summary statistics for inflation are calculated excluding the period of hyperinflation of 1921 and 1922.)

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