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Discussion Papers | Finance

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No. 2014-02

Series Editor: Dr. Alexandr Akimov

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Equity risk versus retirement adequacy: Asset allocation solutions for KiwiSaver

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Version: 31st March 2014

ABSTRACT

New Zealand's default fund and retirement system known as 'KiwiSaver' operates with a conservatively low asset allocation towards equity investments. This paper employs stochastic simulation to examine both target risk and target date funds to determine what asset allocations improve the balance of probabilities for retirement adequacy. The findings show that the legislated range for KiwiSaver default fund asset allocation (growth assets 15-25%) is excessively conservative and imposes a strategy which is unable to ensure that investors are successful compared to popular benchmarks in the pension literature and in practice. Overwhelmingly, the results from hypothetical funds modelled on asset allocation weights from the literature and from Australian funds show that increasing the asset allocation of KiwiSaver towards equities is the only solution to significantly improve retirement adequacy given the low contribution rates observed in New Zealand.

Keywords: KiwiSaver; retirement outcomes; asset allocation.

JEL classification: D14; G11; G18; J32

INTRODUCTION

The debate over appropriate asset allocation has again come to the fore in the aftermath of the 2008 Global Financial Crisis (OECD, 2011; Roxburgh, Lund, Dobbs, Manyika, & Wu, 2011).¹ In the post-GFC world, investors question whether the old adage of “buy shares and hold for the long term” is appropriate, however, a reduction in the portfolio allocation to equities may have significant implications for retirement outcomes. The problem is not simply one of considering portfolio losses and the impact on the adequacy of retirement savings. Nowhere does the issue of growth versus defensive assets become more complex than in the design of default pension/superannuation funds.²

The design principles underpinning KiwiSaver default funds are based on the concepts of capital preservation and a low fee model (Ministry of Business Innovation and Employment, 2012).³ Given that almost half of the default investors are aged between 18 and 35, the focus on capital preservation seems to be at odds with the long term focus of section 3.1 of the KiwiSaver Act (2006) and the objective of asset accumulation.⁴ Moreover, MacDonald, Bianchi and Drew (2012) show that a typical default fund is unable to achieve acceptable measures of retirement success with a 6% minimum contribution rate over a 40 year investment horizon.⁵ In this study, we examine how New Zealanders can increase their probability of retirement adequacy by investing the 6% contribution rate across various permutations of asset allocation.

¹ Over the decade 2001-2011, some countries' equity allocations increased, including top performing superannuation countries such as Australia, but the weighted average equity holdings in OECD countries declined from 49.7% of assets to 40.9% of assets (OECD, 2012). In 2011, most countries decreased their asset allocation to equities in favour of cash and alternative assets. Interestingly, in the NZ context, cash has remained a prominent asset class in both KiwiSaver and non-KiwiSaver funds (Ministry of Business Innovation and Employment, 2012).

² There is a general consensus in the literature and practice that funds cannot be designed so that ‘one size fits all’. Given that investors' early experiences in the market affect their long run asset allocation to risky assets, a major market event early in an investor's retirement savings, could lead to excessively conservative investments (Malmendier & Nagel, 2011). This is important in the NZ context since NZ was hardest hit by the October 1987 share market crash. By late 1988, some countries were recovering, while over 25 years later NZ has not recovered to pre-crash level (Gaynor, 2012; Hunt, 2009).

³ KiwiSaver is a voluntary system involving defined contribution (DC) investment schemes, was introduced on 1 July 2007 in NZ to encourage long-term savings and to provide an opportunity for investors who would not otherwise be able to provide for themselves in retirement.

⁴ Younger investors are more likely to use KiwiSaver's first home withdrawal facility and most withdrawals currently come from default funds (Ministry of Business Innovation and Employment, 2012). Any withdrawal of funds prior to retirement motivates change to ensure that investors have the best possible chance to accumulate assets to recover from the reduction in their KiwiSaver account balance. Nevertheless, this paper ignores the issue of first home withdrawal to focus solely on asset allocation and its impact on the adequacy of retirement outcomes.

⁵ The 6% minimum and default contribution rate in Kiwisaver represents a minimum employee contribution rate of 3% and a minimum employer contribution rate of 3%.

Previous NZ government initiated reviews support the need for changes to the current default fund design. Both the Capital Market Development Taskforce (2009) and the Savings Working Group (2011) proposed moves to a more balanced asset allocation or the adoption of ‘lifecycle’ funds.⁶ Although some of their recommendations were enacted, no action was taken in terms of asset allocation. On November 2012, ahead of the expiry of the initial default provider arrangements on 30 June 2013, the NZ government released a discussion document and called for submissions on default provider arrangements. The discussion document outlined concerns about the trade-off that may be required between minimising losses and improving average retirement outcomes for default fund investors (Ministry of Business Innovation and Employment, 2012).⁷ On the whole, the 29 submissions made to the government had a different outlook on equity risk and marginally favoured a move to lifecycle default funds over balanced funds or the status quo. While some submissions favoured the increased equity that would result from lifecycle funds and the flow on effects to the availability of capital for NZ businesses, the continued development of NZ capital markets, growth in the economy and improved job prospects, others quantitatively demonstrated the possibility of improvements even with a more subtle shift in equity from the current ‘conservative’ default asset allocation to a balanced fund.⁸ Yet, despite a volume of empirical evidence establishing the dominant influence of asset allocation on returns for long term investors (Basu & Drew, 2010; Blake, Cairns, & Dowd, 2001; Brinson, Hood, &

⁶ A lifecycle allocation applies time varying investment weights to form a glide path towards a retirement date. The approach is based on the premise that the balance of human capital in relation to the investor’s portfolio is changing and that as a young investor one should invest heavily in risky equities with the proportion of equities declining as the investor ages and becomes less risk tolerant (Bodie, 2003).

⁷ Arguments in favour of the status quo included the suitability of the current low risk default design for risk-averse investors and investors nearing retirement and the need to reduce short to medium capital loss which may discourage savings. The basis for this argument is UK evidence that persistency of contributions has more influence than investment performance in ensuring that members’ savings are maximised (Ministry of Business Innovation and Employment, 2012). Favouring the status quo to ensure persistence in contributions is arguably a redundant point, with FMA (2012) data showing that 43% of KiwiSaver default funds savers are either on contributions holidays or are non-contributing members for other reasons despite the relatively good performance in default funds through the recent market turbulence. More importantly, this argument ignores the distinctly different default fund asset allocation between NZ and the UK or other OECD nations. Arguments considered in favour of lifecycle funds included the increasing number of countries who have adopted lifecycle default, reduced likelihood of crystallising losses as an investor enters retirement compared to higher equity fixed allocation strategies, and improving the potential for asset growth from the status quo while also better matching age-based risk profile. Counterarguments were also considered, with the benefits from equity premiums in the long run and reducing shortfall risk and the erosion of portfolio value due to inflation favouring a move away from the status quo but the mixed evidence on the efficacy of lifecycle funds raising questions about their potential as an alternate default design (Ministry of Business Innovation and Employment, 2012).

⁸ See, for example, submissions from Institute of Financial Professionals NZ Inc. and Financial Services Council at:

<http://www.med.govt.nz/business/business-law/current-business-law-work/changes-to-kiwisaver/default-provider-arrangements/list-of-submissions>

Beebower, 1986; Brinson, Singer, & Beebower, 1991; Ibbotson & Kaplan, 2000) and no empirical research to date examining how strategies other than the current default fund impact on investor outcomes, on 17 October, 2013, a decision was made to continue with a ‘conservative’ default fund design mandating no more than 15-25% growth assets.⁹

The purpose of this paper is to model the alternate investment strategies available and compare them to the current default fund design to determine what changes can be made to improve the balance of probabilities for adequacy. A stochastic simulation methodology is applied to evaluate KiwiSaver retirement outcomes for four typical existing target risk funds and five hypothetical funds modelled on asset allocations from the literature and in Australia, including target date funds. We find the legislated range for default fund asset allocation is excessively conservative and imposes a strategy which is unable to ensure that investors are successful compared to popular benchmarks in the pensions literature and practice. Other existing target risk funds provide improved retirement outcomes over default funds, some with little additional risk. However, the results from the hypothetical target risk and target date funds highlight the need for further consideration of the design of KiwiSaver funds to improve not only the prospects for passive investors, but also for investors making an active investment choice. Furthermore, the analysis augments our previous findings on the NZ equity risk premium by considering four different periods of data and the potential for higher equity strategies to assist in avoiding an ‘equity gap’ in NZ where there is a known lack of equity home bias.¹⁰

The remainder of this paper is organised as follows. The next sections discuss the institutional setting and literature, including definitions of the measures of adequacy and risk used to evaluate KiwiSaver retirement outcomes. This is followed by an explanation of the simulation methodology, discussion of the data sources and characteristics, and finally, the results and conclusions of the study.

⁹ Asset allocation explains around 90% of the variability of pension fund returns over time and approximately 40% of variability between funds (Brinson et al., 1986; Ibbotson & Kaplan, 2000). In NZ, the results are similar with asset allocation accounting for approximately 80% of the variation in returns over time and 60% of variation in returns between funds (Fowler, Grieves, & Singleton, 2010). In portfolios where bonds dominate equities, contribution rates must be significantly higher to achieve similar retirement outcomes (Blake et al., 2001), which is not the case in NZ, and such portfolios are likely to have lower upside potential than high equity portfolios yet similar downside potential (Basu & Drew, 2010).

¹⁰ MacDonald et al. (2012) considered data for the period 1970-2010 only.

RELATED LITERATURE

KiwiSaver is a voluntary DC system and currently has quantitative restrictions by asset class on default funds with low asset allocation weightings to equities.¹¹ Beshears et al. (2009) explore the role of public policy in saving and find the impact of default fund design is not neutral but instead hinders or facilitates improved retirement outcomes. This warrants investigation in the NZ context because there is evidence that ‘conservative’ portfolios may in fact be riskier than investing more heavily in growth assets if risk is considered in terms of longer life expectancies and the risk of outliving one’s retirement nest egg (Basu & Drew, 2010; Milevsky, Ho, & Robinson, 1997).¹²

Table 1. Comparison of international default fund allocations

	Equities	Bonds	Cash	Source
New Zealand	19%	41%	40%	MacDonald et al. (2012)
Australia	67%	26%	7%	Basu and Drew (2010)
United Kingdom	81%	16%	3%	Byrne, Blake, Cairns & Dowd (2007)
	60%	40%	0%	Byrne et al. (2007)
	100%	0%	0%	Byrne et al. (2007)
Chile	3 lifecycle defaults depending on age:			Beshears et al. (2009)
	1) Workers aged < 35			
	2) Men 36-55 & Women 36-50			
	3) Men 56+ and Women 51+			
Sweden	Lifecycle with 100% equity until age 55			Pichardo-Allison (2009)
	50% equities 50% bonds by age 75			

This table presents typical ‘default’ fund asset allocations for the countries listed. The comparison countries generally rank amongst the most successful pension systems globally. In 2013, the Melbourne Mercer Global Pension index ranks Australia 3rd, Sweden 5th, Chile 7th and UK 8th. NZ is not currently included. NZ and Australian figures represent average ‘default’ fund allocations. UK ‘default’ funds generally fall into an equity-

¹¹ Many mandatory DC plans are governed by regulations stipulating quantitative risk limits and some by minimum investment returns (absolute) and quantitative investment restrictions by asset class. Most voluntary DC systems exhibit less regulation, although a few regulate default funds (Antolin et al., 2009), including NZ.

¹² In the Australian market, Basu and Drew (2010) find the average ‘default’ fund is outperformed by all other investment strategies. They conclude the best retirement outcomes can be achieved by investing 100% in equity, a result supported by other outcomes-oriented research, including Booth and Yakoubov (2000), Blake et al. (2001), Hibbert and Mowbray (2002) and Byrne et al. (2007). Although the higher equity portfolios result in greater dispersion of outcomes and acknowledgement is given that not all investors will be willing to take on so much equity, Australian and NZ evidence shows that there is greater variability on the upside of the distribution of retirement outcomes, with poorer outcomes concentrated around similar values for all investment profiles (Basu & Drew, 2010; MacDonald et al., 2012). Similarly, UK results indicate lower variability of outcomes in lower risk portfolios, a lower median outcome and a 5% VaR below the equity strategy with Byrne et al. (2007, p. 47) claiming investment in such low risk funds could be considered “reckless conservatism”. These results all raise alarm bells for KiwiSaver with far more conservative default allocations.

bond-cash mix, global equity (60-40 UK to US equity) and 100% UK equity. In contrast to NZ and Australia, nearly all UK ‘default’ funds are based on a lifecycle strategy or provide the option to turn on the de-risking of assets over time. Chile and Sweden both use a lifecycle strategy for their ‘default’ funds.

Although NZ is not alone in its high cash, low equity mix for its default funds, Table 1 shows that it is at odds with the default funds of some of the most successful pension systems around the world. Furthermore, even though diversity exists in the literature around the lower bound, there is a consensus that the upper bound for optimal allocation to equity is relatively high.¹³ Nonetheless, 59% of KiwiSaver members or just over half of all KiwiSaver assets are invested in ‘default’ and ‘conservative’ portfolios or ‘cash only’ and ‘fixed interest’ portfolios which have less than 25% equity or no equity in the portfolio, respectively (FMA, 2013).

Of the most successful pension systems, Australia stands out for having the highest allocation to equities in the OECD (OECD, 2012).¹⁴ While NZ and Australia subscribe to the Closer Economic Relations Agreement and free movement between countries, and therefore a common labour market, these neighbouring economies exhibit divergent experiences with their retirement systems over the last two decades with Australia enacting their compulsory savings regime via the Superannuation Guarantee versus the voluntary unsubsidised savings and universal pension in NZ. Even though the universal government pension remains alongside KiwiSaver, Table 2 shows that asset allocations differ markedly between NZ and Australia and the differences are not isolated to default funds.¹⁵

¹³ For example, Milevsky et al. (1997) provide evidence that almost all retirees should invest in some equity, with the optimal allocation between 70 to 100% for many investors. In contrast, Antolin et al. (2009) emphasise a much larger potential range for equity (between 20 and 80%) given that portfolios with very low or high levels of equity which are mean-variance efficient in the short-run, become inefficient over a long horizon from the perspective of replacement rate expectations versus risk.

¹⁴ Australia is currently ranked third in the Melbourne Mercer Global Pension index (Australian Centre for Financial Studies, 2012) and third in terms of performance in the OECD (OECD, 2012).

¹⁵ As shown in Table 2, the average allocation in an Australian ‘defensive’ fund approaches a 70-30 growth to defensive rule with more equity allocated in ‘moderate’ and ‘aggressive’ funds. NZ follows more of a 20-80 growth to defensive rule for the average ‘default’ fund while at the opposite end of the spectrum ‘growth’ funds average a 75-25 growth to defensive mix.

Table 2. Comparison of trans-Tasman asset allocation across four typical investment profiles

New Zealand				Australia			
Investment profile	Equities	Bonds	Cash	Investment profile	Equities	Bonds	Cash
Default	19%	41%	40%	Default	67%	26%	7%
Conservative	19%	58%	23%	Defensive	66%	29%	5%
Balanced	49%	39%	12%	Moderate	76%	22%	2%
Growth	75%	13%	12%	Aggressive	85%	13%	2%

This table contrasts the asset allocations of Australia and NZ across four typical investment profiles. Australian allocations are as reported by Basu and Drew (2010) which include default fund allocations from APRA (2008) and the average asset allocation of default investment options rated ‘platinum’ (top 15% of funds) by SuperRatings, an independent research house. Basu and Drew (2010) group funds into ‘defensive’, ‘moderate’ and ‘aggressive’ by the funds’ varying allocations to equity (less than 70%, 70-80% and above 80%). NZ allocations are the average benchmark asset allocations for the largest ten KiwiSaver schemes by funds under management for the period 2008 to 2010 (Government Actuary, 2008, 2009, 2010).

Investors’ returns are associated with the risk of an asset portfolio, dependent on the mix of investments chosen in the asset allocation decision. The significance of the asset allocation decision on returns is highlighted in the works of Brinson et al. (1986), Brinson et al. (1991), Bogle (1994) and Blake, Lehmann and Timmerman (1999) and the consequent impact on retirement wealth in Blake et al. (2001), Byrne et al. (2007), Basu and Drew (2010) and Basu, Byrne and Drew (2011). Traditional explanations of how investors optimally allocate funds and build portfolios to create wealth are founded on the seminal work of Markowitz (1952, 1959) and the principles of Modern Portfolio Theory (MPT). However, the Markowitz (1952, 1959) one-period equilibrium model is problematic in its application to real world settings and is too narrow in addressing issues relating to pension system design.¹⁶ The pensions literature broadens optimal portfolio choice by examining other empirical variables such as contribution rates, time-varying investment and dollar weighted returns along with the characteristics of empirical financial market returns.

An applied or outcomes-oriented focus in the vein of Blake et al. (2001) is most important in providing real-world insights into both the design and modelling of KiwiSaver. Three fundamental differences exist between the outcomes-oriented approach and others in the pension literature. First, it is not an attempt to build a theoretical model in order to select

¹⁶ See MacDonald et al. (2012) for a discussion of MPT versus alternate models in a pensions context.

the optimal portfolio. The intention is to provide positive insights (as opposed to normative) into the design of KiwiSaver to inform investors, advisors, fund managers and policymakers. Second, although there is always a need to simplify models to capture the essence of a problem, not all variables are equal in this respect. For example, some pension models use very conservative growth rates on assets, say 2%, but they can never capture the impact of a market crash on an investor's retirement savings.¹⁷ Such an assumption may not be critical in the short-term due to the smaller size of the investor's portfolio in the early years. But, considering say a 40 year horizon for a 25 year old individual, the use of simulation methods to incorporate the stochastic nature of asset returns is essential to form a proper understanding of the risk and return trade-off associated with a portfolio. Due to the portfolio size effect, a market crash in the retirement risk zone could be catastrophic (Basu & Drew, 2009; Doran, Drew, & Walk, 2012) and far worse than only earning an average 2% on assets in the long run. Finally, while MPT informs us about the fundamentals of risk and return, applied models move away from restrictive assumptions about utility towards quantile-based risk measures and revise the definition of risk to reflect real world asset return distributions and investors' concern for losses or downside risk.

Survey evidence shows that many New Zealanders believe they will, and are likely to, fall short of their retirement savings goals (ASB, 2012; Law, Meehan, & Scobie, 2011).¹⁸ Downside risk measures can be used to quantify the chance and size of shortfall for KiwiSaver investors.¹⁹ A popular measure of downside risk in pensions, value at risk (VaR), focuses on expected loss and the chance of a negative outcome within a specified time interval. Despite its theoretical and practical weaknesses, VaR has proven to be a viable alternative to variance in the risk-return trade-off guiding portfolio selection, but VaR does not distinguish between losses that are just a little or much worse (Acerbi & Tasche, 2002;

¹⁷ See for example, Mitchell and Moore (1998) who apply static rates of growth equal to the geometric average return on each financial asset class or, in a NZ context, Le et al. (2009) who apply a static real after tax rate of 2% on financial assets.

¹⁸ 22% of savers surveyed expect to fall short of a basic standard of living (self-defined by participants as a median retirement income to meet needs of \$33,000) by \$12,600 on average. 50% of savers surveyed expect to fall short of a comfortable standard of living (self-defined by participants as a median retirement income to feel comfortable of \$45,000) by \$15,100 on average (Law et al., 2011). However, the ASB survey highlights the large discrepancy between aspirational savings targets and actual savings with over half of respondents aiming to retire on about \$40,000 per year and accumulating a fund of \$600,000, but when compared with the actual average savings behaviour of KiwiSaver members, it is estimated that some savers will fall significantly short, coming in with as little as \$70,000 at retirement. The survey concluded there is a knowledge gap between goal setting and what is required to achieve retirement goals (ASB, 2012).

¹⁹ Downside risk approaches can be applied in different pension contexts, for example, Antolin et al. (2009) set a risk benchmark at the 5th percentile in consideration of a regulator's perspective in wanting to ensure the majority of investors accumulate adequate retirement wealth 95% of the time.

Rockafellar & Uryasev, 2002).²⁰ The introduction of conditional value at risk (CVaR), or expected tail loss, and its improved statistical characteristics compared to VaR make CVaR an important tool for assessing the risk of very poor portfolio outcomes.²¹ Whereas VaR looks at the worst outcomes in the 95% of best cases assuming a 5% confidence level, for the same confidence level, CVaR quantifies the expected loss in the 5% of worst outcomes (Acerbi et al., 2001). But, in order to apply such measures, a benchmark or retirement target must also be defined.

Determining whether a retirement outcome is ‘adequate’ is problematic. Multiple measures of both adequacy and pre-retirement earnings present challenges in determining the appropriate benchmarks against which to define and evaluate successful retirement outcomes.²² Furthermore, judgement must be applied to determine what constitutes success in relation to the chosen measure of adequacy. Importantly, this paper does not seek to prescribe an appropriate benchmark but instead evaluates retirement outcomes against the KiwiSaver legislation and a popular benchmark from the pensions literature. According to section 3.1 of the KiwiSaver Act, the objective of KiwiSaver is to enable a retirement nest egg to be saved by those who would otherwise not be able to provide for themselves to achieve standards of living in retirement similar to those in pre-retirement. This is consistent with the generally accepted goal of retirement planning which is to provide enough income in retirement to prevent one’s standard of living from falling much below the pre-retirement level (Schulz, 1992).

Turning to the outcomes-oriented literature for guidance, the common measure of retirement success is a multiple of final earnings, generally in the range of between five to eight times final earnings.²³ With little opportunity for annuitisation of retirement wealth and a low wage

²⁰ For example, Artzner, Delbaen, Eber and Heath (1997, 1999) criticise VaR for failing to meet their definition of a coherent risk measure since it is possible for the VaR of individual securities to sum to a greater total than VaR for the portfolio. This lack of subadditivity potentially discourages diversification and, said to be biased towards optimism, may lead to excessive risk taking (Dowd & Blake, 2006; Szegö, 2002).

²¹ CVaR is also known as mean excess loss, mean shortfall or tail VaR (Rockafellar & Uryasev, 2000) and, for the case of continuous distributions, expected shortfall (Acerbi, Nordio, & Sirtori, 2001). CVaR is a coherent risk measure that considers extreme risk or how bad things will go when they go really bad (Acerbi et al., 2001).

²² The adequacy of retirement wealth has been defined in many different ways, for example, in terms of income replacement rates (Burns & Widdows, 1988; Le et al., 2009; Mitchell & Moore, 1998), prescribed savings rates (Bernheim, 1996; Le et al., 2009; Mitchell & Moore, 1998), net worth (Scholz, Seshadri, & Khitatrakun, 2006), confidence whether an adequate income will be achieved (Drew & Tharenou, 2008) and multiples of pre-retirement salary (Basu & Drew, 2010; Booth & Yakubov, 2000; Park, 2011).

²³ Wysocki (1995) reports Merrill Lynch survey results of the time recommending a multiple of 6.5 times final earnings to retire in comfort. Booth and Yakubov (2000) refer to a benchmark of five times final earnings, while Basu and Drew (2010) argue that, despite a lack of agreement on a definition of adequacy, a multiple of

economy, many New Zealanders potentially require higher than usual earnings multiples, but due to differences in health systems, the earnings multiple target will not be as extreme as the worst case outcomes reported for US investors. Following the Australian model of Basu and Drew (2010), the final earnings target employed to evaluate the adequacy of pre-retirement savings is defined as eight (8) times final earnings.

The collective issues raised in the literature and the review of KiwiSaver default provider arrangements provide the motivation to evaluate the asset allocation in KiwiSaver. If investors in other countries such as Australia are investing higher percentages of, in many cases, higher incomes, into funds with a stronger focus on growth assets yet still many face a retirement shortfall:²⁴

- 1) How do existing typical asset allocations impact on retirement adequacy for KiwiSaver members?

If the government and KiwiSaver providers are to encourage investors to move away from default funds, there must be evidence that the alternative funds available are able to support the achievement of pension goals. With evidence that asset allocation is the primary driver of higher returns, and therefore positively related to retirement adequacy, and the continuing ultra-conservative nature of KiwiSaver default funds, the critical issue becomes:

- 2) What asset allocations can improve the balance of probabilities for adequacy?

METHODOLOGY

A simulation model is developed for a hypothetical investor, a 25 year old male with no accumulated savings who earns the 2010 average NZ male salary of \$43,153 over his working lifetime from age 25 to 65.²⁵ The hypothetical investor joins KiwiSaver at age 25 and both he and his employer contribute the minimum rate of 3%, equating to a joint contribution of 6%. For illustrative purposes, contributions are assumed to be credited to the investor's account at the end of every year at which time the portfolio is rebalanced to

eight times final earnings is more appropriate. Park (2011) demonstrates that US investors in different income categories, with differing allocations to equity and differing degrees of annuitisation of retirement wealth face varying requirements for final earnings multiples to achieve adequacy. For example, a final earnings target of 5 for a high income earner could be as high as 33 for a low income earner due to the characteristics associated with living conditions.

²⁴ Working life incomes in NZ are currently up to 35% below those in Australia with the income gap forecast to increase to 42% by the year 2025 (2025 Taskforce, 2010).

²⁵ Salary data was sourced from Statistics NZ. Age 65 is the age of entitlement to NZS and the working life assumption of 25-65 is consistent with previous studies by Blake et al. (2001) and Basu and Drew (2010).

maintain the target asset allocation.²⁶ Furthermore, investment fees and taxes vary according to the chosen plan and individual's income, thus taxes and fees on KiwiSaver earnings and transactions are ignored.²⁷

The stochastic simulation is based on Efron's (1979) bootstrap resampling approach applied to empirical annual return vectors for five asset classes, being NZ equities, NZ bonds, NZ bills, international equities and international bonds, over four different time periods, being the full sample 1901-2010, the first forty years 1901-1940, the last forty years 1970-2010 and the post war period 1947-2010. By redrawing randomly to create 10,000 samples from the data set, it is possible to generate potential retirement wealth outcomes based on asset returns that reflect many different plausible capital market environments for each of the four time periods while retaining the cross correlation between each class of asset returns and assuming independence in individual asset class distributions over time (Blake et al., 2001; Hibbert & Mowbray, 2002).

Figure 1. 'Lifecyle' glide path

Motivated by the review of KiwiSaver default provider arrangements which considered a move from a 'conservative' to a 'balanced' or 'lifecycle' default strategy, this study compares existing typical KiwiSaver funds and five hypothetical funds. To form the hypothetical

²⁶ This study extends the previous study by employing a longer set of empirical returns, but can be further extended to include different profiles including, but not limited to, females, different types of employment, periods of unemployment and variation in salaries over the investor's lifetime. It is important to acknowledge the varying productivity and income over an investor's lifetime and to more closely match the real world situation where some individuals work part-time over long periods or move between part and full time employment modes, where one or both parents experience breaks in paid employment to start a family or for other reasons become unemployed.

²⁷ Like all savings products, contributions are paid from after-tax income, fund earnings are taxed and withdrawals are exempt. Marginal income tax rates and employer superannuation contribution tax rates range from 10.5 to 33%. Taxes payable on income, employer contributions and investment earnings are dependent on a combination of the particular circumstances of an individual investor and the tax status of the superannuation vehicle (Inland Revenue, 2012). While there are issues with disclosure and inconsistencies in the way fees are reported (Ministry of Economic Development, 2010), it is estimated that the average KiwiSaver scheme charges a management and expense ratio equivalent to 1.46% consisting of 0.83% of assets plus an average charge of \$2.55 per member per month (Savings Working Group, 2011).

funds, we employ the asset allocations considered in pension literature and those of Australian funds, given their established track record of success. As shown in Table 2, Australian and NZ asset allocations are closest in their ‘aggressive’ and ‘growth’ funds, respectively. To address concerns about the risk of shortfall associated with low equity portfolios and evaluate the impact of additional equity risk, 10% investment is taken from cash in a typical NZ ‘growth’ fund and split equally into international and NZ equities to mirror an Australian ‘aggressive’ fund. The high equity portfolio dominance in outcomes-oriented pension studies prompts the inclusion of ‘global equities’, a 100% allocation to equity where funds are split 60% international equity and 40% NZ equity.²⁸ To address the mixed international evidence and the lack of NZ evidence in regard to lifecycle models, both ‘lifecycle’ and ‘dynamic lifecycle’ models are considered. Figure 1 depicts the glide path for reductions in equity and increasing bond allocations over the investment horizon, although equity and bond switches in the ‘dynamic lifecycle’ are not automatic and are made with reference to portfolio performance. Finally, ‘100% bonds’, is a comparison portfolio only, weighted 60% international bonds and 40% NZ bonds and used in the same way as Antolin, Payet and Yermo (2010) or Byrne et al. (2007) as the low risk benchmark. The asset allocation weights employed in this study are summarised in Table 3. We construct hypothetical Kiwisaver investment profiles to these asset allocations and we apply 10,000 bootstrap iterations to estimate 10,000 independent final KiwiSaver account balances for each strategy in each of the four investment periods.

²⁸ A 100% equity allocation to domestic or international equities and ‘global equities’ have been used in prior studies (Basu & Drew, 2010; Byrne et al., 2007). The justification for the selection of ‘global equities’ over domestic or international equities is demonstrated in the results section. Where ‘global equities’ have been used, for example, in Byrne et al. (2007), domestic equities (UK equities) make up the larger proportion of the portfolio and international equities the smaller proportion. The weightings have been reversed here given the small nature of and idiosyncrasies associated with the NZ market as well as the lack of home equity bias shown in NZ investment allocations.

Table 3. Average existing benchmark asset allocations and hypothetical asset allocations

KiwiSaver investment profile	NZ cash	NZ bonds	NZ equities	International bonds	International equities
100% bonds	0%	40%	0%	60%	0%
Default	40%	15%	6%	27%	12%
Conservative	23%	28%	6%	30%	13%
Balanced	12%	18%	16%	21%	33%
Growth	12%	6%	27%	8%	48%
Aggressive	2%	6%	32%	8%	53%
Global Equities	0%	0%	40%	0%	60%
Lifecycle	80% equity until age 45, reducing to 55% equity 45% bonds by age 65				
Dynamic lifecycle	Planned switches from equity to bonds occur as for lifecycle when performance is above target. If below target, funds move to 100% equity.				

Table 3 presents the 4 typical existing asset allocations and 5 hypothetical asset allocations. Using the average existing benchmark allocations reported by the Government Actuary (2008, 2009, 2010) for the period 2008-2010 for the largest ten KiwiSaver schemes by funds under management, property and other assets are removed and their weightings allocated pro rata across the remaining asset classes for ‘default’, ‘conservative’, ‘balanced’ and ‘growth’ funds. ‘100% bonds’ is a low risk benchmark portfolio while the 4 other hypothetical funds, ‘aggressive’, ‘global equities’, ‘lifecycle’ and ‘dynamic lifecycle’, are chosen to represent the styles of investment, being increased investment in equity or lifecycle funds, proposed by the Ministry of Business, Innovation and Employment (2012) in the discussion document on KiwiSaver default provider arrangements.

The terminal value of KiwiSaver assets is given by:

$$W = k \sum_{t=0}^{R-1} S_t (1 + r_t) \prod_{u=t+1}^{R-1} (1 + r_u) \quad (1)$$

where:

W is the value of KiwiSaver assets accumulated at the point of retirement;

k is the sum of employee and employer contribution rates;

S_t is the annual salary in year t ;

r_t is the nominal rate of investment return earned in year t ; and,

R is the number of years in the plan before retirement.

The cash flow contributions to a KiwiSaver plan are affected by both k , the contribution rate, and S_t , the annual salary in year t , where annual salary is defined by the equation:

$$S_t = S_0(1 + g)^{t-1} \quad (2)$$

where:

S_0 is the initial salary of a KiwiSaver member;

g is the nominal wage growth; and,

t is the years elapsed since commencement of employment.

As Hibbert and Mowbray (2002) explain, salary inflation is an important consideration due to its relationship with superannuation contributions and the replacement ratio, but with uncertainty increasing with the investment horizon, its importance is reduced and a fixed salary inflation rate can be assumed. Although assumed rates of salary growth vary across studies and countries (for example, 2.5% in excess of inflation in the UK (Hibbert & Mowbray, 2002) or 4% linear growth applied to US data (Basu et al., 2011)), the literature indicates a preference for a simple nominal analysis over more complex assumptions about inflation and real salary growth. The nominal wage growth rate, g , is therefore fixed at 4%, a rate equivalent to the average nominal NZ labour cost index for the period 1996-2010 (Statistics NZ, 2011).

DATA

Return data for five asset classes, NZ bills, bonds and equities and international bonds and equities, all including reinvested income and capital gains, is obtained from Dimson, Marsh and Staunton (2012) in NZ dollars.²⁹ Due to the lack of disclosure surrounding asset classes, little is known about the mix of assets known as ‘other’ reported by the top ten KiwiSaver schemes. Additionally, there is limited availability of long reliable data sets for NZ industrial and commercial property.³⁰ Similarly to Brinson et al. (1986) and Annaert, De Ceuster and

²⁹ In the previous study, the six asset classes included NZ property and NZ cash and 3 sources of data were used to access the NZ asset class data, international equity data and international bond data. With the recent availability of NZ data from Dimson et al. (2012), we are now able to access all data from a single source and with a consistent timeframe. The advantage of a greatly increased sample timeframe out to 110 years overrides the removal of NZ property from the analysis and the substitution of data on NZ bills in place of NZ cash.

³⁰ Although the NZ residential property index was used as a proxy in the previous study, this study employs data from 1901-2010 for which the NZ residential property index is unavailable.

Hyfte (2005), the minute proportions of ‘other’ assets and the low allocation to property in each of the typical NZ asset allocation profiles have been allocated pro-rata to bills, bonds and equities. US data is used as a proxy for international assets. This is common practice in pension modelling, see, for example, Blake et al. (2001) and Basu and Drew (2010) and can be justified on the basis of empirical evidence, for example, Jorion and Goetzmann’s (1999) demonstration that a globally diversified portfolio performs similarly to US equities.

Table 4 presents the descriptive statistics of the nominal asset class returns for the period 1901 to 2010. Across a 110 year horizon, NZ asset classes follow risk-return expectations, with higher risk equities earning more than bonds and bonds earning more than lower risk bills. NZ equities rank just behind US equities in terms of return matched with a slightly lower risk. The long run NZ asset class statistics mask volatility and periods in time where NZ bills outperform bonds and NZ bonds outperform equities. For example, despite reporting a large negative annual loss of -19.2% in 1984 (the year of the infamous snap election and removal of interest rate controls), NZ bonds outperformed NZ equities in many years from 1971 to 2010. NZ’s strong bond market resulting in low to negative equity risk premiums in the recent 40 year period is relatively common in the late 20th century.³¹ On the other hand, international bonds exhibit a lower return and higher coefficient of variation than international equities over the last 40 year period and the gap between the two asset classes widens over the full sample period. Dimson, Marsh and Staunton (2000) attribute the disappointing performance of international bonds over the last 100 years to the impact of high and unexpected levels of inflation.

³¹ Jorion and Goetzmann (1999) report that 16 countries have a very low or negative equity risk premia, including NZ, for the period 1931-1996, while Dimson, Marsh and Staunton (2004) show that most countries in their study fail to maintain consistent positive real equity returns for 20 year holding periods from 1900-2002.

Table 4. Descriptive statistics of nominal annual asset class returns 1901-2010

	NZ bills	NZ bonds	NZ equities	International bonds	International equities
Mean	5.57%	6.10%	11.41%	7.19%	12.89%
Median	4.61%	4.94%	10.77%	3.58%	11.10%
Maximum	25.96%	37.43%	119.42%	65.75%	81.30%
Minimum	1.51%	-19.20%	-48.55%	-42.63%	-37.01%
Standard deviation	4.25%	8.24%	20.73%	17.42%	24.02%
Coefficient of variation	0.76	1.35	1.82	2.42	1.86
Skew	2.44	0.57	1.81	1.03	0.35
Kurtosis	10.36	5.57	11.94	5.52	2.97

Table 4 presents the summary statistics of annual nominal returns for NZ bills, bonds, and equities and international bonds and equities for the sample period 1901-2010. Calculations are based on asset class data sourced from Dimson et al. (2012).

Cross asset correlations for NZ asset classes and inflation are presented in Table 5. As expected, bills exhibit the strongest relationship with the CPI and bonds and bills are most strongly associated assets in each sub-sample and across the whole period ($\rho = 0.52$). Weak positive relationships exist between NZ equities and bills ($\rho = 0.16$) and NZ equities and bonds ($\rho = 0.23$). Furthermore, there is almost no relationship between NZ bonds and the CPI ($\rho = 0.05$) and NZ equities and the CPI ($\rho = 0.04$), therefore there will be improved diversification, in particular, more insulation from the impact of inflation, if bonds and equities are combined with bills in a portfolio. Relationships between asset classes become relatively stable from the post-World War II period onwards, resulting in the relationships for the whole period being similar to that of the latter years.

Table 5. Relationship between asset classes

Correlation matrix				
Panel A: 1901-2010				
	NZ bills	NZ bonds	NZ equities	CPI
NZ bills	1.00	0.52	0.16	0.43
NZ bonds	0.52	1.00	0.23	0.05
NZ equities	0.16	0.23	1.00	0.04
CPI	0.43	0.05	0.04	1.00
Panel B: 1901-1940				
	NZ bills	NZ bonds	NZ equities	CPI
NZ bills	1.00	0.08	0.05	-0.14
NZ bonds	0.08	1.00	0.33	-0.26
NZ equities	0.05	0.33	1.00	-0.17
CPI	-0.14	-0.26	-0.17	1.00
Panel C: 1947-2010				
	NZ bills	NZ bonds	NZ equities	CPI
NZ bills	1.00	0.56	0.15	0.47
NZ bonds	0.56	1.00	0.21	0.08
NZ equities	0.15	0.21	1.00	0.05
CPI	0.47	0.08	0.05	1.00
Panel D: 1971-2010				
	NZ bills	NZ bonds	NZ equities	CPI
NZ bills	1.00	0.50	0.12	0.47
NZ bonds	0.50	1.00	0.18	0.02
NZ equities	0.12	0.18	1.00	0.08
CPI	0.47	0.02	0.08	1.00

Table 5 reports the correlation coefficients for 3 NZ asset classes and the CPI across 4 different time periods. Calculations are based on asset class data sourced from Dimson et al. (2012).

There has, however, been significant variation in estimates of the historical equity risk premium in NZ.³² Furthermore, the sensitivity of returns to the sampling period has been shown to be high, for example, Dimson et al. (2004) show that for a rolling 100 year period, a shift of just 3 years forward from 1900-1999 to 1903-2002 results in a decrease of 1% in the return to US equities. In the NZ context, Table 6 shows that investors with a 10 year holding period face very different opportunities for investment in NZ bonds and equities over time.

³² Among the published evidence, estimates of the NZ historical equity market risk premium include 5.1% (PriceWaterhouseCoopers, 2002) for the period 1925-2002, 6.5% (Chay, Marsden, & Stubbs, 1995) for the period 1931-1994, 5.5-6.2% (Lally & Marsden, 2004a), 5.5-7.2% (Lally & Marsden, 2004b) for the period 1931-2002, 6-6.8% (Marsden, 2005) for the period 1931-2004 and 0.9-33.6% (Boyle, 2005) for the period 1970-2003. While Lally and Marsden (2004a, 2004b) and Marsden (2005) use the Brennan-Lally specification of the capital asset pricing model which considers personal taxes and results in higher MRP estimates, all other authors apply the standard CAPM. However, PWC (2002) argue that there has been less divergence in estimates of the equity MRP in NZ than in the US even when applying different methodologies.

Even though NZ bonds earn more than NZ equities 35% of the time, there was an equity risk premium to be earned in most decades of the last century.³³ Table 6 is consistent with Siegel's (2012) US findings that equities beat bonds in 80% of 10 year periods. However, KiwiSaver investors are locked into their investment for their whole working life, so a 40 year holding period is more relevant. Since more than half of the years in which NZ bonds outperformed NZ equities occurred in the period 1971 to 2010, a 40 year holding period return shows the NZ market in a very different light.

Table 6. NZ equity risk premium and 10 year holding period returns

Period	NZ Bonds	NZ Equities	Equity risk premium over bonds	Average Annual CPI
1901-1910	31%	155%	95%	1.4%
1911-1920	6%	116%	103%	5.7%
1921-1930	104%	137%	16%	-1.0%
1931-1940	81%	99%	10%	0.5%
1941-1950	40%	163%	88%	2.9%
1951-1960	32%	145%	85%	4.3%
1961-1970	59%	134%	47%	3.6%
1971-1980	36%	200%	120%	11%
1981-1990	294%	235%	-15%	9.6%
1991-2000	220%	214%	-2%	1.9%
2001-2010	86%	107%	11%	2.7%

Table 6 presents the 10 year holding period returns for NZ bonds, equities and the equity risk premium on equities over bonds with the average annual CPI for each of the 10 year periods from 1901-2010. Calculations are based on asset class data sourced from Dimson et al. (2012).

Table 7 shows that investors in 1911-1950, 1921-1960, and 1931-1970 would receive similar returns on NZ bills, NZ bonds and NZ equities to previous 40 year holding periods. While an investor saving for retirement in 1940 might expect returns to continue in the same way, inflation increased in the period 1931-1970 then doubled in the period 1941-1980. At the same time, returns to NZ bills exceeded the returns on NZ bonds, a pattern that holds right through until the final 40 year holding period when NZ bills and NZ bonds perform equally well and only 2% below NZ equities. The period 1951-1990 sees a large increase in returns to all NZ asset classes, but NZ bills and NZ bonds continue to grow, although at a reduced

³³ Based on an arithmetic difference between the return on NZ bonds and NZ equities in a year, NZ bonds earned more than NZ equities in 35 years out of 110 between 1901 and 2010.

rate, while the return to NZ equities slowly declines again resulting in a low nominal equity risk premium. This potentially explains the high asset allocation to defensive assets currently offered by KiwiSaver providers.

Table 7. NZ equity risk premium and annual average compound returns for 40 year holding periods

Period	NZ Bills	NZ Bonds	NZ Equities	Equity risk premium over CPI	Equity risk premium over bills	Equity risk premium over bonds	CPI
1901-1940	3.8%	4.2%	8.5%	6.9%	4.5%	4.1%	1.5%
1911-1950	3.4%	4.4%	8.6%	6.6%	5.0%	4.3%	1.9%
1921-1960	3.3%	4.9%	8.9%	7.2%	5.5%	3.8%	1.6%
1931-1970	3.4%	4.3%	8.9%	6.0%	5.3%	4.4%	2.7%
1941-1980	4.1%	3.5%	10.0%	4.4%	5.6%	6.2%	5.4%
1951-1990	7.6%	6.3%	10.7%	3.4%	2.9%	4.1%	7.0%
1961-2000	8.7%	8.6%	11.4%	4.6%	2.5%	2.5%	6.4%
1971-2010	8.9%	9.1%	11.0%	4.5%	1.9%	1.8%	6.2%

Table 7 presents the annual average compound returns for 40 year holding periods for each decade of the dataset from 1901-2010. In the same way as the source data of Dimson et al. (2012), equity risk premia are calculated as the geometric difference between the total return on equity and the total return on bonds, bills or CPI.

The analysis in Table 7 is consistent with the finding of numerous researchers (Claus & Thomas, 2001; Fama & French, 2002; Siegel, 1999) that the equity risk premium is declining over time. The school of thought is that this pattern will continue in the future with future equity market returns predicted to be lower than many investors' expectations (Dimson et al., 2000; Siegel, 2012). This is an important consideration in the interpretation of the simulation results.

RESULTS

Before embarking on a comparison of the typical and hypothetical KiwiSaver portfolios, results for three definitions of the '100% equities' portfolio must first be considered. Table 8 shows that US equity has similar coefficients of variation (CVs) and interquartile range ratios

(IQRRs) for the overall period as for the post war and last 40 year periods. Both US and NZ equity experience lower variability in the first 40 year period and rise, particularly NZ equity, in the post war and final 40 year periods. This pattern is also reflected in Table 9 with declining levels of VaR between panels B and C and C and D for a ‘100% NZ equities’ portfolio. Despite the significant rises in variability for later periods, NZ exhibits lower variability over the whole period compared to international equity. This is largely explained by the difference between the CV and IQRR. Both measures of dispersion are relatively close for each set of outcomes except for ‘100% NZ equities’ in the post war period and final 40 year period in which NZ has extremely large maximum values. In the periods in which NZ equities produce a very large maximum value, the large gap between IQRR and CV indicates that it is likely the variability has increased due to a small number of outliers in the data set.

Table 8. Distribution parameters of final year earnings multiples: Alternate 100% equities asset allocations

Investment profile	Mean	Median	Max	Min	Q1	Q3	CV	IQRR
Panel A: Simulation results based on 6% contributions and 1901-2010 data								
100% Int'l equities	19.36	10.75	1202.60	0.64	5.60	21.49	1.60	1.48
100% NZ equities	13.03	8.77	495.01	0.43	5.26	15.46	1.14	1.16
Global equities	16.46	11.74	331.59	0.89	6.98	19.84	1.01	1.10
Panel B: Simulation results based on 6% contributions and 1901-1940 data								
100% Int'l equities	6.44	4.12	169.34	0.38	2.40	7.42	1.21	1.22
100% NZ equities	6.85	6.34	31.38	1.57	4.99	8.13	0.39	0.49
Global equities	6.60	5.48	51.26	0.87	3.72	8.11	0.66	0.80
Panel C: Simulation results based on 6% contributions and 1947-2010 data								
100% Int'l equities	28.43	16.11	1284.10	0.40	8.32	32.49	1.50	1.50
100% NZ equities	19.40	10.57	1163.90	0.33	5.44	20.94	1.83	1.47
Global equities	24.21	16.38	773.51	0.81	9.32	29.49	1.11	1.23
Panel D: Simulation results based on 6% contributions and 1971- 2010 data								
100% Int'l equities	24.74	13.98	902.15	0.62	7.09	28.22	1.41	1.51
100% NZ equities	31.48	13.18	3240.90	0.39	5.87	31.22	2.58	1.92
Global equities	27.29	16.51	1399.10	0.73	8.84	32.27	1.34	1.42

Table 8 reports the distribution parameters of the final year earnings multiples derived from simulated terminal account balances and simulated final year gross salary. Potential return paths are created via 10,000 iterations of the simulation model for three alternate 100% equities investment profiles over 40 years. ‘Global equities’ is defined as 60% international (US) equities and 40% NZ equities. Calculations are based on asset class data sourced from Dimson et al. (2012). Max, Min, Q1, and Q3 represent the maximum, minimum, first and third quartile outcomes respectively. The dispersion of final earnings outcomes is measured by the coefficient of variation (CV) and interquartile range ratio (IQRR).

In general, Table 8 shows an increasing pattern of mean and maximum outcomes over time with increasing variability. International equity outperforms NZ over the whole and post war periods. NZ equity performs better in the first 40 and the last 40 year periods. Furthermore, Table 9 indicates that ‘global equities’ (i.e. 60% international equity and 40% NZ equity) reports a better VaR and CVaR for three out of the four periods. ‘Global equities’ has therefore been selected as the ‘100% equities’ portfolio to be compared to the typical and hypothetical KiwiSaver portfolios because it diversifies risk, exhibits less extreme downside outcomes and in numerous cases improves the lower quartile outcome and either the mean or median outcome or both.

Table 9. Tail risk estimates for distribution of final year earnings multiples: Alternate 100% equities asset allocations

Investment profile	VaR	CVaR
Panel A: Simulation results based on 1901-2010 data		
100% Int'l equities	2.50	1.85
100% NZ equities	2.64	2.06
Global equities	3.62	2.81
Panel B: Simulation results based on 1901-1940 data		
100% Int'l equities	1.16	0.92
100% NZ equities	3.56	3.12
Global equities	2.20	1.80
Panel C: Simulation results based on 1947-2010 data		
100% Int'l equities	3.54	2.57
100% NZ equities	2.39	1.75
Global equities	4.45	3.32
Panel D: Simulation results based on 1971- 2010 data		
100% Int'l equities	2.95	2.13
100% NZ equities	2.06	1.48
Global equities	3.64	2.66

Table 9 reports the tail risk estimates for the distribution of final year earnings multiples using a bootstrap simulation approach and a 6% contribution rate. VaR and CVaR are estimated at a 95% confidence level, therefore there is a 5% chance of falling below the VaR and the expected value of CVaR indicates the size of the expected retirement outcome in the worst 5% of outcomes. Calculations are based on asset class data sourced from Dimson et al. (2012).

Like the comparison of alternate ‘100% equities’ portfolios in Tables 8 and 9, the comparison of typical and hypothetical investment profiles in Table 10 shows an increasing pattern of mean, median and maxima over time. Panels B and D in Table 10 illustrate the sensitivity of the results to the period from which the asset class returns data is sampled. Although higher

allocations to equity lead to improved outcomes in all periods, as shown in Figure 2, only higher equity weighted portfolios have a chance of reaching the retirement target of eight times final earnings using the 1901-1940 sub-sample whereas in the last 40 year period, Table 10 indicates that all investment profiles exhibit medians exceeding the eight times final earnings target.

Figure 2. Comparative cumulative distribution function of final earnings multiples based on 1901-1940 data

The results are also sensitive to their data source. As shown in MacDonald et al. (2012), using asset class data from cash rather than bills provides much more conservative results.³⁴ Since NZ portfolios are heavily weighted towards cash, the use of data that is purely cash or bills either under or overstates returns and retirement outcomes. Although the previous study only considered the last 40 year period, simulated retirement outcomes employing cash produce results comparable to the analysis of the full period in Panel A of Table 10. The results in Panel A are also more likely to be robust given the evidence of declining equity risk premia and forecasts of lower future equity returns (Dimson et al., 2000; Fama & French, 2002; Siegel, 1999, 2012) since investment returns for a 25 year old investor are sampled with replacement from the full 110 year period for his or her 40 year retirement savings time horizon.

³⁴ In comparison to NZ cash, NZ bills have higher risk, a stronger skew and fatter tails. Although the minimum returns for NZ cash and NZ bills are similar, NZ bills have a higher mean and median and a maximum return level almost twice that of NZ cash.

The increasing mean and median outcomes in Table 10 can be further explained by increasing equity investment which is accompanied by increasing variability. There is a bunching of results around low, medium and high equity weighted portfolios which can be seen by comparing Figures 2 to 4. Most notable are the large gaps between the mean and median results for 'conservative' and 'balanced' profiles. For example, mean final earnings

Table 10. Distribution parameters of final year earnings multiples: ‘Typical’ versus ‘hypothetical’ asset allocations

Investment profile	Mean	Median	Max	Min	Q1	Q3	CV	IQRR
Panel A: Simulation results based on 6% contributions and 1901-2010 data								
Global bonds	4.23	3.81	22.56	1.04	2.93	5.04	0.45	0.55
Default	4.84	4.58	15.67	1.72	3.80	5.61	0.31	0.40
Conservative	5.00	4.68	17.30	1.57	3.81	5.83	0.34	0.43
Balanced	7.73	6.78	56.89	1.27	5.02	9.33	0.52	0.64
Growth	8.31	7.03	62.28	1.57	5.09	10.03	0.60	0.70
Aggressive	13.13	10.12	196.36	0.97	6.44	15.96	0.84	0.94
Global equities	16.46	11.74	331.59	0.89	6.98	19.84	1.01	1.10
Lifecycle	10.23	8.55	124.70	1.24	5.99	12.38	0.65	0.75
Dynamic lifecycle	13.60	10.68	248.16	0.90	7.31	16.07	0.81	0.82
Panel B: Simulation results based on 6% contributions and 1901-1940 data								
Global bonds	2.56	2.50	5.89	1.12	2.16	2.89	0.22	0.29
Default	2.90	2.86	5.41	1.71	2.57	3.18	0.16	0.21
Conservative	2.95	2.91	5.81	1.66	2.59	3.26	0.18	0.23
Balanced	3.93	3.71	13.38	1.40	3.01	4.58	0.33	0.42
Growth	4.09	3.79	18.65	1.24	3.04	4.82	0.37	0.47
Aggressive	5.61	4.86	34.77	0.99	3.49	6.83	0.56	0.69
Global equities	6.60	5.48	51.26	0.87	3.72	8.11	0.66	0.80
Lifecycle	4.98	4.67	17.11	1.68	3.78	5.86	0.34	0.45
Dynamic lifecycle	6.40	5.97	26.69	1.26	4.36	8.06	0.43	0.62
Panel C: Simulation results based on 6% contributions and 1947-2010 data								
Global bonds	5.67	4.85	64.02	1.18	3.49	6.84	0.58	0.69
Default	6.70	6.27	31.07	2.04	4.97	7.90	0.37	0.47
Conservative	6.87	6.32	40.14	2.01	4.91	8.20	0.41	0.52
Balanced	10.96	9.52	78.06	1.42	6.72	13.46	0.58	0.71
Growth	11.96	9.89	114.13	1.90	6.78	14.54	0.68	0.79
Aggressive	19.12	14.19	399.51	0.94	8.70	23.67	0.91	1.06
Global equities	24.21	16.38	773.51	0.81	9.32	29.49	1.11	1.23
Lifecycle	14.79	11.79	171.21	1.49	7.68	18.09	0.77	0.88
Dynamic lifecycle	19.84	14.16	381.66	0.81	9.06	23.62	1.01	1.03
Panel D: Simulation results based on 6% contributions and 1971- 2010 data								
Global bonds	11.24	9.13	249.60	1.45	6.11	13.97	0.72	0.86
Default	11.09	10.20	59.73	2.55	7.80	13.34	0.42	0.54
Conservative	11.58	10.43	80.12	2.24	7.76	14.06	0.47	0.60
Balanced	15.93	13.16	124.31	1.84	8.93	19.74	0.65	0.82
Growth	17.04	13.41	153.54	1.83	8.82	20.93	0.76	0.90
Aggressive	23.29	16.02	690.17	0.99	9.27	28.38	1.06	1.19
Global equities	27.29	16.51	1399.10	0.73	8.84	32.27	1.34	1.42
Lifecycle	21.08	15.29	439.56	1.55	9.37	25.47	0.96	1.05
Dynamic lifecycle	25.72	16.12	1060.90	0.77	9.45	29.99	1.30	1.27

Table 10 reports the distribution parameters of the final year earnings multiples derived from simulated terminal account balances and simulated final year gross salary. Potential return paths are created via 10,000 iterations of the simulation model for four ‘typical’ KiwiSaver and five alternate investment profiles over 40 years. ‘Aggressive’ matches the asset allocation of an average aggressive Australian superannuation fund and is equivalent to a typical KiwiSaver growth profile with a transfer of 5% from cash to each of international and NZ equities. ‘Global bonds’ is defined as 60% international (US) bonds and 40% NZ bonds. ‘Global equities’ is defined as 60% international (US) equities and 40% NZ equities. Calculations are based on asset class data sourced from Dimson et al. (2012). Max, Min, Q1, and Q3 represent the maximum, minimum, first and third quartile outcomes respectively. The dispersion of final earnings outcomes is measured by the coefficient of variation (CV) and interquartile range ratio (IQRR).

Multiples for these investment profiles differ by 2.73 and 4.82, respectively for the whole sample period, but the difference is much greater when considering the post war and final 40 year periods. Even if there was no change to the current asset allocations on offer in KiwiSaver, investors have opportunities to improve their upside investment potential by moving to more equity concentrated investment strategies. More importantly, Table 11 shows that a shift from a ‘default’ or ‘conservative’ to a ‘balanced’ or ‘growth’ strategy also comes with a reduction in downside risk (reduced chance and smaller size of shortfall).

Comparing the typical versus hypothetical allocations highlights the same findings as Basu and Drew (2010) that increasing the portfolio weighting towards equities may not be as risky as holding less equity if shortfall risk is considered. Apart from the ‘global bonds’ low risk benchmark, the hypothetical investment profiles all exhibit higher mean and median outcomes than the typical KiwiSaver profiles due to their higher allocation to both NZ and international equity. The mean and median outcomes increase greatly between ‘growth’ and ‘aggressive’ and ‘aggressive’ and ‘global equities’ profiles. For example, for just an extra 10% equity added to ‘growth’, the ‘aggressive’ asset allocation is equivalent to an Australian ‘growth’ investment and results in an additional 4.82 units of final earnings for the mean and 3.09 units for the median for the whole sample period. Additionally, a shift from ‘growth’ to ‘aggressive’, ‘global equities’, ‘lifecycle’ or ‘dynamic lifecycle’ will reduce downside risk. While some KiwiSaver ‘growth’ investments may already offer higher levels of equity than is typical, this finding highlights the need for investors seeking higher retirement outcomes to look specifically at the target asset allocations offered by a particular fund rather than merely choosing a fund labelled ‘growth’.

Of the hypothetical funds, ‘global equities’ performs the strongest in terms of mean, median and Q3 outcomes followed by ‘dynamic lifecycle’, ‘aggressive’ then ‘lifecycle’, a pattern which holds for all 4 time periods. This result is consistent with Blake et al. (2001) who find a static high equity allocation outperforms a dynamic lifecycle fund over 40 years. Thus, for default fund KiwiSavers who are, for the most part, automatically enrolled when they turn 18 or on commencement of their first job and are locked in until age 65, the benefit of lifecycle funds may be reduced, unless the investor is particularly concerned about the worst case outcomes since ‘dynamic lifecycle’ consistently outperforms all other strategies in terms of Q1 results.³⁵ In line with the results of Blake et al. (2001) and Basu et al. (2011), investors are also likely to prefer ‘dynamic lifecycle’ or a fixed high equity allocation, such as the ‘aggressive’ fund examined here, over a deterministic lifecycle fund.

³⁵ The length of the contribution period changes fund rankings. ‘Lifecycle’ funds have been shown to outperform a static asset allocation for a 20 year time horizon (Basu et al., 2011). This suggests that investors who opt out and rejoin KiwiSaver at a later date may benefit more from ‘lifecycle’ funds than a fixed high equity allocation, but only if the switch from equities to bonds is delayed until just before retirement.

Table 11. Tail risk estimates for distribution of final year earnings multiples: ‘Typical’ vs ‘hypothetical’ asset allocations

Investment profile	VaR	CVaR
Panel A: Simulation results based on 1901-2010 data		
Global bonds	2.09	1.82
Default	2.98	2.70
Conservative	2.94	2.64
Balanced	3.40	2.94
Growth	3.35	2.86
Aggressive	3.65	2.92
Global equities	3.62	2.81
Lifecycle	3.85	3.24
Dynamic lifecycle	3.74	2.92
Panel B: Simulation results based on 1901-1940 data		
Global bonds	1.73	1.59
Default	2.21	2.09
Conservative	2.20	2.07
Balanced	2.24	2.00
Growth	2.25	2.03
Aggressive	2.20	1.85
Global equities	2.20	1.80
Lifecycle	2.79	2.47
Dynamic lifecycle	2.82	2.36
Panel C: Simulation results based on 1947-2010 data		
Global bonds	2.31	1.99
Default	3.65	3.24
Conservative	3.49	3.09
Balanced	4.21	3.54
Growth	4.13	3.45
Aggressive	4.45	3.32
Global equities	4.52	3.37
Lifecycle	4.41	3.61
Dynamic lifecycle	4.22	3.13
Panel D: Simulation results based on 1971- 2010 data		
Global bonds	3.53	2.96
Default	5.42	4.72
Conservative	5.18	4.46
Balanced	5.23	4.29
Growth	4.90	3.98
Aggressive	4.20	3.23
Global equities	3.64	2.66
Lifecycle	4.82	3.78
Dynamic Lifecycle	3.49	2.52

Table 11 reports the tail risk estimates for the distribution of final year earnings multiples using a bootstrap simulation approach and a 6% contribution rate. VaR and CVaR are estimated at a 95% confidence level, therefore there is a 5% chance of falling below the VaR and the expected value of CVaR indicates the size of the

expected retirement outcome in the worst 5% of outcomes. Calculations are based on asset class data sourced from Dimson et al. (2012).

Unlike Q1 results, but similar to Basu and Drew (2010), Table 11 indicates that there is no clear pattern for VaR and CVaR in the most recent 40 year period and across all time periods. In the first 40 year period and post war period, VaR generally improves and CVaR remains stable as the asset allocations increase their portfolio weightings to equities. When considering the past 110 years of data, excluding the low risk benchmark, the VaR statistics across investment strategies in Table 11 differ by less than one multiple of final earnings. 5% of the time an investor's portfolio may fall below 2.98 or 3.85 times final earnings for a 'default' or 'lifecycle' portfolio, respectively. Further concentrated are the CVaR results, with the expected outcome in the worst 5% of cases varying between a 'conservative' portfolio at 2.64 times final earnings to a 'lifecycle' portfolio at 3.24 times final earnings. The exception is the 'global bonds' low risk benchmark with not only the lowest mean and median retirement outcomes of all, but also the highest risk of shortfall. Thus, the presence of even a very small amount of equity contributes to the comparatively better performance of a typical 'default' fund.

Figure 3. Comparative cumulative distribution function of final earnings multiples based on 1901-2010 data

In the period 1901-2010, Figure 3 shows that while higher equity weighted portfolios report a 10% chance of failing to reach a 5 times earnings multiple, very low equity portfolios of 'global bonds', 'default' and 'conservative' portfolios report an approximately 5% chance of meeting the retirement target of eight times final earnings. Balanced and growth portfolios

exhibit a 40% chance of attaining the retirement target of 8 times final earnings. In this full time period, portfolio performance is still bunched into three groups of investment strategies, but far less so than for shorter sample periods. In the long run, the dynamic lifecycle portfolio has the least risk in terms of reaching the retirement target of eight times final earnings and is only outperformed by a ‘global equities’ portfolio if the benchmark is raised to 9 times final earnings or greater.

In the period 1971-2010, Figure 4 highlights the similarity in performance of all portfolios with the exception of the very low risk portfolios of ‘global bonds’, ‘default’ and ‘conservative’, with about a 20% chance of shortfall below the retirement target of eight times final earnings. For investors seeking an increased chance of much larger nest eggs (say a 50% chance of reaching double the retirement target), ‘lifecycle’, ‘aggressive’ and ‘global equities’ portfolios perform more strongly than ‘balanced’ and ‘growth’ and these in turn outperform the lower equity weighted portfolios (approximately 40% chance of reaching double the retirement target versus 10%).

Figure 4. Comparative cumulative distribution function of final earnings multiples based on 1971-2010 data

In the post war period depicted in Figure 5, performance becomes more diverse with medium to high equity weighted portfolios outperforming low equity portfolios in terms of achieving retirement goals. Medium to high equity weighted portfolios are bunched around a 60 to 80% chance of achieving the 8 times final earnings target, but again the high equity weighted

‘aggressive’, ‘dynamic lifecycle’ and ‘global equities’ portfolios are more likely to produce a larger accumulation of assets from which to derive retirement income.

Figure 5. Comparative cumulative distribution function of final earnings multiples based on 1947-2010 data

The results signal good news for advocates of NZ equity investment. As the savings in KiwiSaver grow, there is a real opportunity to deepen NZ markets and reduce the likelihood of any future shortage of equity funding. The hypothetical ‘global equities’ investment profile exhibits a 40% asset allocation to NZ equities and outperforms all other styles of investment in terms of superior terminal wealth outcomes. Comparing the data in Tables 10 and 11, it is also evident that ‘aggressive’, with an additional 5% of NZ equity and 5% of international equity over and above a typical ‘growth’ allocation, and ‘100% NZ equities’ outperform all the existing typical KiwiSaver profiles in terms of the mean and median outcome. Although a ‘100% NZ equities’ investment has higher variability than all the others, for investors with a higher risk appetite, they may be willing to face the risks to gain greater upside potential since the Q1 result is better than the median outcome for ‘balanced’ and 95% of the time the final earnings multiple achieved would be just below four, while a ‘conservative’ fund has a VaR of 2.94. The expected size of the final earnings multiple in the worst 5% of cases would be 2.81 compared to 2.70 in the case of ‘conservative’ investment, emphasising the very small differences between strategies on the downside of the distribution of outcomes.

CONCLUSION

The majority of KiwiSaver members are investing ‘conservatively’, but in NZ the definition of ‘conservative’ lies at the very low equity end of the asset allocation spectrum. Furthermore, asset allocations across other investment profiles are also much lower in equity than comparative funds from the best performing superannuation systems worldwide. KiwiSaver members are inadvertently exposing themselves to the hidden risk of failing to reach a retirement target that will enable them to enjoy standards of living in retirement similar to those in pre-retirement. Because investors are unable to evaluate the effectiveness of their investment until it is too late, the purpose of this study is to investigate how asset allocation impacts on retirement adequacy for KiwiSaver members and what asset allocations improve the balance of probabilities for adequacy of KiwiSaver retirement outcomes. This study goes beyond consideration of the average investor to consider the skewed nature of the distribution of retirement outcomes and measures of downside risk.

Asset allocation impacts on both equity risk and retirement adequacy, but, importantly, the change in the probability of retirement shortfall is far from proportional to the increase in equity risk. Existing typical KiwiSaver funds do not expose investors to a sufficient asset allocation to growth assets to maximise the probabilities of investors attaining their retirement goals. By increasing their asset allocation to equities, KiwiSaver investors can substantially improve the upside potential of their investment, while maintaining a relatively stable level of downside risk. The results conclusively show that increasing equity investment improves the adequacy of KiwiSaver retirement outcomes in the long run. Increasing equity to the level of a typical ‘balanced’ or ‘growth’ fund improves the size of the retirement nest egg as well as reducing the risk of shortfall compared to investing in a ‘default’ fund, but, considering the whole sample period, it takes 6% contributions into a typical ‘growth’ fund before the average outcome reaches the retirement target and only a ‘dynamic lifecycle’ comes close to ensuring that 95% of investors reach the target. All hypothetical target risk strategies outperform existing typical target risk funds due to their higher allocations to equity, but target date funds are dominated by the higher equity weighted target risk portfolios, ranking in the order of ‘global equities’, dynamic lifecycle’, ‘aggressive’ then ‘lifecycle’ in terms of superior terminal wealth outcomes for all time periods.

This Kiwisaver study provides the first set of comprehensive outcome oriented results on its asset allocation to support investors, advisors, fund managers and policy makers in making informed decisions. These results have important implications. First, since there will be no change to the default fund design on June 2014 when the current default provider arrangements cease, there must be an increased effort to educate investors about asset allocation and fund choice. With a small percentage of NZ investors seeking professional advice, thought must be given to how to utilise other popular education forums such as the Commission for Financial Literacy and Retirement Income's 'Sorted' website to convey the importance of considering equity risk and retirement adequacy simultaneously.³⁶

Second, the results from hypothetical profiles demonstrate the potential to improve retirement outcomes for active choice, growth seeking investors. There is evidence to support not only increased investment in equity above the levels of a typical 'growth' fund, but also increased investment in NZ equity, with a '100% NZ equities' portfolio outperforming many current typical investment funds. If acted on, along with improvements across all aspects of the economy, the flow on effects for NZ financial markets and improved access to equity funding for businesses will ensure NZ does not face a growing 'equity gap' in the future.

Finally, the results highlight the extreme change in risk attitude required to ensure most investors reach their retirement goals. But, in a low contribution rate environment such as NZ, it is important not to shy away from the potential gains available from changing asset allocation because if investors instead make additional contributions from income, and are therefore worse off during their working life, they may find the retirement target is still unattainable. We would encourage continued investigation of asset allocation solutions for KiwiSaver considering further target risk strategies and alternate glide paths for target date funds.

³⁶ Under 20% of KiwiSaver members have sought advice from a financial advisor, with most relying on advice from family and friends, then the internet, books and magazines (Matthews, 2013). Although the 'Sorted' website provides material which discusses the gap between retirement income expectations and the universal pension, this is not connected to a discussion of asset allocation and risk. Currently investors are only informed that "the risk level of a fund is determined by the percentage invested in growth assets" (Commission for Financial Literacy and Retirement Income, 2014).

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