Time Varying Prospective Utility and Optimal Asset Allocation for Stocks and Bonds:
The Case of Australia and Japan, 1926-1995

Ian McManus
School of Management, University of Southampton, UK.

Owain ap Gwilym *
Bangor Business School, Bangor University, UK.
* Corresponding author: owain.apgwilym@bangor.ac.uk

Stephen Thomas
Cass Business School, City University, London, UK.

This version: 22\textsuperscript{nd} January 2012.
Abstract
Many of the empirical investigations in behavioural finance are focused on US markets; with their focus on investor psychology, biases and heuristics these explanations may well not be robust when exposed to different countries, races and cultures. This paper investigates a popular explanation for the equity risk premium, namely Myopic Loss Aversion, in the two very different market environments of Australia and Japan. We also extend previous studies by explicitly allowing for time-varying distributions of asset returns. We present evidence that the concept of the frequency of portfolio evaluation required to produce indifference (in Prospective Utility terms) between Stocks and Bonds is highly dependent upon the sample period. For each of these two Pacific Rim markets, we pose two questions - given prospect theory preferences, taking account of a selection of plausible evaluation periods, how do the prospective utilities of stock, bond and optimally mixed portfolios evolve with time, and how does the optimum allocation ratio of stocks in a mixed stock/bond portfolio vary? Our asset allocation profiles indicate both distinctions and similarities between the markets of Australia and Japan; and (by reference to earlier work) differing patterns of behaviour of the Australasian markets when compared to those of the U.S. and U.K. However, perhaps the biggest surprise, given how different the political, cultural and investment experiences of these countries are, is how similar are the optimal asset allocations for much of the time.
1. Introduction

The surprisingly large additional historical return on equities over bonds and cash is a well
known phenomenon referred to as the equity premium puzzle. This has attracted a wide
range of empirical studies and theoretical conjecture following Mehra and Prescott’s (1985)
observation that the puzzle could not be resolved with plausible levels of risk aversion in the
context of power utility functions. Dimson et al (2002) provide an exhaustive geographical
portrayal of this phenomenon for a wide range of markets for the 20th century. For all
countries, they find that equities have outperformed bonds and cash over the longer terms.
For example, in the period 1900–2000, equities beat bonds by 5% in the U.S. and by 4.4%
in the U.K. Analysts typically consider the average historical risk premium to be an
unbiased estimate of the future premium, though an alternative approach based upon
dividend and earnings growth rates (see Fama and French, 2002) produces far lower
estimates of the equity risk premium.

A wide variety of explanations have been put forward for the existence of the equity
premium, including Sundaresan (1989), Constantinides (1990), Epstein and Zin (1989,
the latter part of the 20th century have found that over investment horizons of 20 years and
longer, equities have always outperformed bonds (see Dimson et al, 2002, p. 9). In this
paper we re-examine one novel explanation for the equity premium puzzle which is rooted
doing so, we seek to make methodological improvements as well as presenting new and
more detailed empirical evidence for new market environments. BT(1995) introduce the
concept of loss aversion and mental accounting in this context: ‘Myopic Loss Aversion’
(MLA) is a combination of the tendency to weigh losses more heavily than gains, together
with a high frequency of portfolio evaluation (i.e. short evaluation periods) even if the
investor’s horizon is much longer. This builds on earlier work on decision-making under
uncertainty by Tversky and Kahnemann (1992), henceforth TK(1992), and utilises a concept
known as Prospect Theory (see section 2).

When investors evaluate their portfolios very frequently (say, daily), there will be many
occasions when returns on equities will be lower than those on bonds or similar instruments.
In contrast, when they evaluate investment performance less often, it is more likely that
equity returns will be positive and greater than bond returns. Since losses weigh more
heavily than gains, the frequent comparison of returns on equities and bonds will lead to a
greater level of disappointment with equities. Comparing asset losses less frequently, equities are more likely to be perceived as outperforming bonds and consequently investors will attach a higher valuation to equities.

Whereas BT(1995) merely conjecture that MLA could explain relative investment returns, and find that the 20th century U.S. data is not inconsistent with their hypothesis, subsequent experimental research has provided more rigorous evidence in support of MLA. Thaler et al (1997) find that investors using an annual evaluation time-frame hold significantly more risky assets than those using a monthly time frame, while both Barron and Erev (2000) and Gneezy and Potters (1997) obtain similar experimental results. These experiments involve individual decision-making rather than market interaction, and Gneezy et al (2003) extend the experimental evidence to recognise the market context of equity and bond trading and that traders will observe and learn from the choices of others and from prices. They find that the results are similar to those involving individual decision-making, with investors more willing to invest in risky assets if they evaluate outcomes in a more time-aggregated way. These studies would seem unambiguously to find that the frequency of information feedback and portfolio adjustment affects asset prices in a way consistent with MLA, and hence offer justification for the empirical analysis of BT(1995).

Using the observed equity risk premium for the U.S. for 1926–1990, BT(1995) examine the prospective utility from 100% bonds and 100% equity portfolios for different evaluation periods and conclude that the prospective utilities would be equal at a horizon of about 13 months (or roughly one year). They offer no particular justification for their interest in this equality, but then ask “what combination of bonds and equities gives maximum prospective utility at a time horizon of one year?” (i.e. approximately the evaluation period for that equality); the answer is a persuasive 50:50, given empirical evidence from aggregate asset allocation data. McManus et al (2009) extend this approach by allowing the distribution of returns to vary over time and find that optimal asset allocation can vary substantially over a 200-year period, with equities dominating for long periods, but during periods of low inflation all bond portfolios become more important.

One aim in this paper, recognising the time-varying nature of returns distributions and the equity risk premium, is to investigate what this non-constancy implies for asset allocation. As a close by-product we will examine the optimal allocation between bonds and equities at different time horizons, and for very different historical periods: one might conjecture that
those who had just lived through the Wall Street crash and the Great Depression would aspire to different asset proportions than the ‘baby boomers’ of the latter half of the 20th century.

BT(1995) conduct their empirical analysis both in nominal and in real terms and find little substantive difference, favouring the former on the grounds that returns are usually reported in nominal dollars and that the real returns on Treasury bills were such that holding the bills over any evaluation period would always yield negative prospective utility. However, the precise nature of the series used in constructing the equity premium is important, as emphasised by Dimson et al (2002). For example, in a separate study we replicated the BT(1995) findings using a slightly different equity series and obtained an implied evaluation period of 25 months, (compared to their 13 months).¹

There has been very little additional empirical investigation in this area, despite the prominence given to behavioural finance developments. This is partly due to computational considerations, but also due to the absence of persuasive and definitive tests of the MLA-related hypotheses. de Groot and Dijkstra (1996), conduct a constant risk premium (similar to BT(1995)) analysis for 1978–1994 for Germany, the US, UK and Japan and find evaluation periods of 10, 3, 5 and 8 months respectively. The US figure is not close to that of BT(1995), and suggests a sensitivity to data period and to choice of data series. For an evaluation period of 12 months, the respective optimal proportion accorded to equities is 50%, 70%, 70% and 45%, figures which are certainly plausible given the Anglo-Saxon love affair with equities over this period. Finally, the authors also find substantial evaluation period instability over time within countries. In this paper, we extend the above analysis to consider two important markets of the Pacific Rim, Australia and Japan for a sample period of several decades. This facilitates a much richer range of economic, geographical and political phenomena, including the effects of wars, deflations, depressions and inflationary eras.

The remainder of the paper is structured as follows. Section 2 re-visits the prospective utility of the gamble as expounded by BT(1995), and Section 3 describes the computational model used to implement the principles of MLA. Section 4 analyses the results obtained from the

¹ Our results section will later show that the nature of the Prospective Utility / Allocation / Evaluation Period response surface is such that, when close to the conditions for equality of equity and bond Prospective Utility, small differences in Prospective Utility are associated with relatively large swings in the ‘independent’ variables.
model and section 5 concludes. The evidence shows that no two 20-year periods share the same characteristics; the identifiable parameters which characterise the underlying data generation process are clearly far from stable. Most periods, however, do indicate a notable disposition toward portfolios rich in equities. Only in times of economic distress (and in a period of deflation) do bonds appear to play a dominant role in the formation of optimal portfolios. The evidence supports the concept of Myopic Loss Aversion elucidated by BT(1995).

2. Prospect Theory, Loss Aversion and the Evaluation of Portfolios

An investor’s utility is defined over gains and losses (i.e. asset returns) rather than conventional wealth (see Kahneman and Tversky (1979), TK(1992)). In particular, they specify the following value function:

\[ v(x) = \lambda (|x|)^\alpha \]  
\text{(Eq. 1)}

where \( \lambda = 1 \) for positive \( x \) (i.e. positive returns) and -2.25 for negative \( x \). (\( \lambda \) is the coefficient of loss aversion). The value of the curvature parameter (\( \alpha \)) is set to 0.88 for both positive and negative returns. The chosen value of \( \lambda \) is consistent with other evidence (e.g. Tversky and Kahneman (1991)).

The prospective utility of a Gamble:

\[ V(G) = \sum \pi_i v(x_i) \]  
\text{(Eq. 2)}

where \( \pi_i \) is the decision weight associated with outcome \( i \).

\[ \pi_i = w(P_i) - w(P_i^*) \]  
\text{(Eq. 3)}

Where \( P_i \) represents the probability of a positive outcome which is \textit{at least as good as} \( x_i \), or a negative outcome which is \textit{at least as bad as} \( x_i \); \( P_i^* \) represents the probability of a positive outcome which is \textit{strictly better than} \( x_i \), or a negative outcome which is \textit{strictly worse than} \( x_i \). The computation of the values of \( \pi_i \) is applied separately to gains and losses.

The functions \( w(.) \) above are distinguished further by defining functions \( w^+(.) \) and \( w(.) \), for gains and losses respectively. These are modelled as:
\[ w^\gamma(p) = \frac{p^\gamma}{((p^\gamma + (1-p)^\gamma)^{1/\gamma})} \quad \text{(Eq. 4)} \]

\[ w^\delta(p) = \frac{p^\delta}{((p^\delta + (1-p)^\delta)^{1/\delta})} \quad \text{(Eq. 5)} \]

3. The Computational Model

We use a methodology based directly on TK(1992). This motivates the model that we employ to transform our holding period returns data over 20-year periods into their Prospective Utility equivalents. We take the six-outcome ‘dice’ example model from TK(1992) and extend it to a 240-outcome model that corresponds to the number of monthly observations in our chosen 20-year rolling period.\(^2\) This model was, in a related exercise using US data, extensively calibrated against that of BT(1995).\(^3\) We continue to apply the nonlinear utility function developed by TK(1992) using parameters \((\lambda, \alpha) = -2.25, 0.88\) respectively,\(^4\) and incorporating the nonlinear transformation of probabilities with parameters \((\gamma, \delta) = 0.61, 0.69\) respectively. Once again, cumulative probabilities are calculated for each ‘tail’ of the distribution separately, working from the extreme value in the tail just up to the return value \textit{prior} to that at which the sign of the return changes.

We utilise our 240-outcome model (for the 20-year rolling analyses) employing individual \(n\)-month raw returns from the dataset,\(^5\) together with an associated empirical probability of occurrence (for each observation) of \(1/240\).\(^6\) The Standard Expected Utility (SEU) expected return corresponds (by construction) to the mean of the returns in the sample frame; the model computes both the utility-function-transformed return and the value of Prospective Utility.

---

\(^2\) This choice represents a trade-off between having a sufficient number of observations to establish a reasonable distribution for model calibration, and a period short enough to enable us to investigate time variation adequately.

\(^3\) The details of this calibration are available on request from the authors.

\(^4\) Following BT(1995), we do not attempt to fit new values for the parameters chosen by TK(1992).

\(^5\) We use 3, 6, 9, 12, 18, 24 and 36-month holding period returns in our analysis.

\(^6\) Here we make the usual assumption that the probability of occurrence of any specific value of \((x)\) in the sample equals that of any other, irrespective of its position along the real line. Thus, the (empirical) c.d.f. assigns a probability weight of \(1/n\) \((n = 240\) here\) to each sample point; the cumulative probability corresponding to each actual value of \((x)\) is thus equal to its Rank (on a scale of 1 to \(n\)) divided by \(n\).
The final output of each model forms the product terms $\pi_i v(x_i)$, which, when summed across all $i$, forms the quantity $V(G)$, the Prospective Utility of the gamble, $(G)$. Thus a one-to-one correspondence exists between each selection of 240 monthly returns and the computed value $V(G)$. In order to motivate the generation of time paths for $V(G)$, for different allocations across the range of evaluation periods listed above, the model is programmed to run progressively through the time-period and evaluation period ordered data, as described below.

Our algorithm performs the task of selecting the appropriately-timed subset of data for each evaluation period, and subsequently varies the asset allocation in 1% increments, in order to produce the following five (Prospective Utility) values:

i) The PU value for a 100% Bond allocation.

ii) Similarly for an 'all Stock' allocation.

iii) The PU and allocation values corresponding to the optimum allocation.

iv) The PU for an allocation 5% lower than optimum.

v) Similarly for an allocation 5% higher than optimum.

Our data is supplied by Global Financial Data Inc., and comprises total returns indices for stocks (Series Trauss9m and Trjpnstn9m for Australia and Japan respectively), and total returns indices for bonds (Series Trausg9m and Trjpng9m). We follow the rationale of BT(1995, pp. 82) in choosing bonds rather than T-bills as the alternative investment instrument for comparison against stocks, since “for long term investors these are the closest substitutes”.

---

7 The use of a Newton-Raphson search algorithm was rejected in favour of a 'linear search' algorithm because in a minority of cases, there were local, as well as global maxima appearing in the form of small amplitude 'waves' on a substantially 'flat' plateau. Also, a subsidiary benefit of the chosen technique was the ability to generate 'confidence intervals' corresponding to 5% deviations from the optimum, which provided a measure of the degree of criticality, or otherwise, of attaining the optimum.

8 When within 5% of a bound (0% or 100%), then the bound itself was taken as the value. On examination of the results of these additional calculations, however, it appeared that they provide little additional insight (due to the 'flat' nature of the characteristic in the region of the peak, minimally (+/- 5%) sub-optimal portfolios differ little (in PU terms) from optimal portfolios). Accordingly, these results are not presented here, but are available from the authors on request.
4. Empirical Results

4.1 History of returns

Australia has been the best-performing equity market over the 111 years since 1900, with a real return of 7.4% per year, according to Credit Suisse (2011), and with real annual returns on bonds and bills of 1.4% and 0.7% respectively. Japan, on the other hand, has seen real equity returns of only 3.8% p.a. with real bond and bill returns of -1.1% and -1.9% respectively. This compares with a ‘world’ average of 5.5%, 1.6% and 1.0% for the same asset classes respectively. Of course Australia, often characterised as the ‘lucky’ country, has a vastly different 20th century experience compared to Japan, with no invasion or war fought on its soil and no hyperinflation. To that end the two countries should make a fascinating contrast to earlier work which has focused on the US and UK (including BT(1995), McManus et al (2009)).

Table 1 contains descriptive data for 20-year periods from 1926-1995 for direct comparability with US and UK results. Firstly, one can observe a dramatically different inflation experience with the years 1936-1965 revealing far higher and more volatile inflation in Japan than in Australia. Similarly, the equity risk premium is far higher during that period in Japan. McManus et al (2009, Table 1) find much lower inflation and equity risk premia pre-1936 for the UK, particularly in the 19th century; post-1936 the UK experience is of the same order of magnitude as that of Australia though much lower than Japan until post-1976. Also in sharp contrast, the years since 1966 reveal a far lower equity risk premium for Japan. In fact, from 1900 to 1939, Japan was the world’s second best equity performer (Credit Suisse(2011)). But World War II was disastrous and Japanese stocks lost 96% of their real value. From 1949 to 1959, Japan’s “economic miracle” began and equities gave a real return of 1,565%. Australia had a far more stable investment experience, as can be seen from Table 1. What will be the implication of these two contrasting market histories for Prospective Utility and Optimal Asset Allocation given our Myopic Loss Aversion framework?
4.2 Time-Varying Optimal Asset Allocation: 1926–1995

In this section we examine how the optimal allocation between bonds and equities varies for different historical and mental evaluation periods for the two countries. As we vary the evaluation period from 3 to 6 to 9 months, etc up to 3 years, how do the optimal asset proportions change? Can such changes be identified with changing economic environments? To this end, we extend the behavioural model originated by TK(1992), and applied by BT(1995) to US stock and bond market data by adding a time dimension, allowing utility to vary through the full period for which we have data (1926–1995), by calculating optimal allocations for (overlapping) 20-year periods and then evaluating the utility associated with various asset allocations over rolling 20- year time spans for the seven selected holding (evaluation) periods of 3, 6, 9, 12, 18, 24 and 36 months.

We examine using the two asset classes (stocks and bonds), the variation, over each 20-year time span, of Prospective Utility (PU) versus Allocation, using each of the two Australasian data series, in all cases with Evaluation Period as parameter. The results are presented in Table 2. We can see clearly that for both countries the ‘all equity’ allocations are optimal for most evaluation periods between 1936 and 1985, while for the first and last 20-year periods bonds play a more important role for most evaluation periods up to 3 years despite very different inflation and equity risk premium experiences. Comparing with earlier work (McManus et al, 2009) we see that the optimal allocation to equities for the UK is less than that for both Australia and Japan for the 1936-1955 period but greater than both for the 1976-1995 era, whereas for the middle years of 1936-1985 the ‘all equity’ experience is common to all 3 countries. Note that BT(1995) do not investigate the different time periods as both behaviour and risk premia are assumed by them to be constant.

Results for three selected, non-overlapping time spans are presented in Figures 1 -3 for Australia and in Figures 4-6 for Japan to give a visual picture of the results just described.\(^9\) The evaluation periods which correspond to indifference (in PU terms, in the sense of BT(1995)) between Bonds and Stocks may be inferred by observing the same value PU (for a given evaluation period’s curve) at the 0 (all bonds) and 1 (all stocks) extremes of the Allocation axis.\(^10\) Away from these allocation extremes, we compute the PU’s for mixed

---

\(9\) In the interests of comparability across markets, we choose the same selections (of 20- year periods) as in McManus et al (2009).

\(10\) These values compare with that of 12 months reported by BT(1995) in the context of their single (1926 – 1990) time span of U.S. data.
stock / bond portfolios at 1% increments of allocation, and note particularly the co-ordinates of the optima.

Thus, by way of example, the curve for 18 months evaluation period in the case of the 1926–1945 time span for Japan (Figure 4) represents the closest (of this family of curves) to indifference, with PU values (at the end points 0,1) close to 0.126. Longer evaluation periods (here, 24 and 36 months) exhibit a generally rising PU characteristic as allocation to stocks increases. Shorter evaluation periods demonstrate generally negative slopes. A portfolio consisting of 22% of stocks produces a maximum PU of 0.144 for the 18-month evaluation period. Similarly, for the Australian data for 1971-1990 (Figure 3), the closest to indifference (of the evaluation periods calculated) is that of 9 months, with an essentially flat characteristic with changing allocation. In this instance, therefore, the large swings in the Allocation recommendation would be induced by relatively small (and economically insignificant) changes in Prospective Utility; such variation as does exist between points on the PU response surface in this region is brought about principally by variation in the investor’s evaluation period.11

Our experience of subjectively examining families of curves as suggested by the above examples leads us to three broad classifications of Prospective Utility performance over 20-year time spans (and the associated PU distributions over those time spans). Times of boom, e.g. 1951-1970 for both Australia and Japan, are characterised by positive-sloping plots of PU vs. allocation, indicating 100% allocation to stocks for all but the shortest evaluation period. We label these as Type I. Times of recession are characterised by generally negative-sloping characteristics over most of the allocation spectrum, albeit usually with maxima at low stock allocations, typically of the order of 10% (Type III). ‘More ‘normal’ times are characterised by generally ‘flat’ curves in the middle part of the evaluation period range (e.g. as in the example above, that of Japan, 1926–1945); labelled as ‘Type II’, these families generally exhibit positive slopes in the case of longer evaluation periods, negative slopes in the case of the shorter evaluation periods. In order to explore this aspect further, we examine, in the next section, the results of our rolling time-span analysis.

11 We note that BT(1995), Figure II pp. 85 report a measure of peaking in terms of returns. However, this is indicated by an expanded vertical scale, relative to their Figure I. BT(1995) themselves note that “portfolios between about 30% and 55% stocks all yield approximately the same prospective value”. Additionally, whilst their description (pp. 84) describes these as Nominal returns, the values only reconcile when compared to the Real returns of Figure I (Panel B). Further, the fact that the Figure II displays an instance not exactly corresponding to indifference (indicated by differing PU values at the end points) militates toward a greater degree of curvature.
4.3 The Time-varying case: rolling periods

We now consider further the time-varying aspects of behaviour which constitute the main thrust of our results. As we saw in Table 2, there is a changing Optimal Allocation to equities for different evaluation periods and historical eras, though there is much that is remarkably similar between the countries. However, we can see immediately the differing experiences of the two countries in the years 1976-1995. The Depression years 1926-1945 also proved to offer differing Asset Allocations for the two countries. We now introduce rolling 20-year periods; the results for PU and Optimal Asset allocation through the whole period are presented graphically in Figures 7a-12b, with two figures for each of three of the evaluation periods. PU is calculated for the ‘All Stock’, ‘All Bond’, and ‘Optimal’ portfolios for a given evaluation period in each of the ‘a’ figures. The ‘Optimal’ portfolios are then plotted against the allocation parameter in the ‘b’ figures. Thus, for example, Figure 7a presents the time-series of Prospective Utility for the all Stock, all Bond and Optimal allocation portfolios, for the 3-month evaluation period (in the case of Australia). Figure 7b presents the time-series for the Optimal value of Prospective Utility, along with the value of the allocation parameter (n) which gives rise to that Optimal; again for the (Australia) 3-month evaluation period case. Similar Figures are provided for the other evaluation periods displayed (e.g. Figure 8a, etc. for the 12-month case). Figures 10a – 12b relate correspondingly to the results of the analysis for Japan.

Our 70- year time period appears to have three distinct sub-periods, two of these (those of the early and the late 20- year time spans) dominated (in terms of PU performance) by portfolios consisting largely of bonds, one by portfolios consisting entirely of stocks, even for evaluation periods as short as 3 months. Sub-period I spans the period from the beginning of the series up to (end year) 1948 in the case of Japan (i.e. 20-year periods ranging from 1926-1945 to 1928-1947). All of these 20-year periods do of course include the exceptional instance of the 'Great Depression' of 1929-1931. In the case of Australia, the corresponding year of the transition (out of Sub-period I) is 1951.

---

12 In the interests of clarity, of the seven evaluation periods computed, only those for the shortest (3- month), longest (36- month) and one intermediate (12- month) are shown. The omitted figures merely confirm the expected form of the interpolation.

13 Although we made provision, in our experimental design, for evaluating the effects of allocations displaced by +/- 5% from the optimum, the resulting flatness of the curves produced such small effects as to be not worthy of note.
Sub-period II (c.1950–1972), the period of the post-Second World War boom, is characterised by an unambiguous recommendation to hold only stocks. The returns (expressed in PU terms) from holding stocks are, for many of the 20-year periods concerned, significantly higher (e.g. for the 12-month evaluation period) than the corresponding values for bonds; indeed, most bond PU values are negative, in a way not observed in the case of the U.S. data (in experiments not shown here, see McManus et al (2007)).

Sub-period III (end-years 1973 – 1995) may be considered to have been triggered by the first oil crisis of 1973; the period was also characterised by a second oil shock in 1979 and the stock market crash of 1987. These events themselves led to consequential economic downturns and periods of stock market turbulence. In the case of the Australasian data, the onset of Sub-period III is, however, only apparent from the 3-month evaluation period results; the recommendation to hold exclusively stocks continues for several years further in the case of longer evaluation periods. Although, taken together, these events produced a somewhat less severe effect upon the Prospective Utility picture than did the Great Depression of 1929–31, the recommendation does eventually revert to one of constructing optimal portfolios consisting of a significant proportion of bonds, most especially in the case of the Japanese market as stock returns began to fall after 1989.

14 The reader should note the differing vertical scaling used in order to accommodate the ranges of values delivered by the analysis.
5. Conclusions
Combining loss aversion with frequent evaluations of portfolios, BT(1995) put forward an interesting and persuasive explanation for the equity risk premium which is firmly rooted in behavioural finance. They find that for mental evaluation periods of about one year, the representative US investor allocates about half of their portfolio to bonds and half to equities. Considering asset allocation statistics for the late 20th century, together with well-documented aspects of investor behaviour, these numbers are plausible given the historical average equity premium for the years 1926–1990. We suggest that it is unreasonable to assume a constant risk premium over long periods of time and present Australasian data to illustrate this point. We then investigate the optimal asset allocation between equities and bonds for various 20-year and rolling sub-periods if we consider the BT(1995) prospective utility world with constant parameters.

We have found there to be similar patterns in the Australasian data to those found in the US market (see McManus et al, 2007), particularly in regard to the difficulty of deciding upon ‘appropriate’ asset allocation mixes, given the ex-post variability of the allocation parameter over time. This finding would seem to justify our attention to the dimension of time in analysing this phenomenon, and suggests that the focus on a single long time period (BT(1995)), with an implied single distribution of returns, may be inadequate in promoting a fuller understanding of the underlying processes involved.

As well as identifying the similarities across markets, we have uncovered some interesting differences (in Prospective Utility terms) between, in particular, the markets of the US, Australia and Japan. The combination of the strong performance of stocks and relatively weaker performance of bonds in Japan prior to 1990 militates toward the choice of 100% allocation to stocks over most of the course of the 20th century, even for short-horizon investors. It is also noteworthy that the single period studies involving the years of the Great Depression come within our definition of ‘Type II’ performance in Japan (marginaliy so in Australia), contrasting with the strong ‘Type III’ performance of the US market within the same time span. During the early part of the century, the market in Japan thus appears to exhibit many of the characteristics of a (then) Emerging Market, and to have demonstrated a high degree of immunity to the events of 1929–31 on the other side of the Pacific Ocean.
There are some straightforward differences between countries which could help explain allocation variations: for example, some countries have younger populations than others and hence one would expect them to be more ‘equity friendly’. The percentage of the population aged 65 and over in 2007 was 13% for Australia, 21% for Japan, 16% for the UK, but only 12% for the US. Also, we are beginning to understand that cultural and racial differences between countries can help explain differences in market behaviour. For example, Asian investors have been found to be more confident in general compared to their Western counterparts (Yates et al, 1998) leading to such phenomena as larger premia to momentum investing. One can go further and suggest that different education systems lead to different abilities to process information; for example, experimental study suggests that on average Chinese investors, having received considerably less statistics-related education than in many Western countries are less capable of statistical heuristics in judgement processes (Fong et al (1986)), leading to local investors expressing overconfidence/over-optimism and under-reaction to firm-specific information. Chui et al (2000) claim that less heuristic biases are present in investment decisions by Asian investors due to a more repressed individualism within Asian culture. The differing influences of retail investors in various markets could also lead to different behaviour since they are found to be more prone to heuristics and biases in the judgement process than other investors, leading to chasing good news (Yeh and Leh (2000)) and subject to heavy herding behaviour (Tan et al (2008)).

Given this wide and changing array of investor behaviour, it is perhaps rather surprising that the behaviour described in this study is still so relatively robust across such different countries as the US, UK, Australia and Japan. Clearly, the underlying social and cultural differences merit further investigation.

However, it should be noted that the 20th century itself may be an exceptional investment era; in the longer-run of data back to 1816 studied for the UK in McManus et al (2009), the 20th century was very different to the previous one in that bonds featured much more prominently in Optimal Allocations in most periods, even at longer evaluation periods, than more recent experience. At times, equities were excluded completely even at 3-year evaluation horizons! This should not be forgotten as we possibly move into a lower inflation world in coming years.
References


Credit Suisse (2011), Global Investment Returns Yearbook.


Figure 1: Prospective Utility vs. Allocation (1926-1945) - AUSTRALIA
Figure 2: Prospective Utility vs. Allocation (1951-1970) - AUSTRALIA
Figure 3: Prospective Utility vs. Allocation (1971-1990) - AUSTRALIA
Figure 4: Prospective Utility vs. Allocation (1926-1945) - JAPAN
Figure 5: Prospective Utility vs. Allocation (1951-1970) - JAPAN
Figure 7b - Prospective Utility & Allocation - (3 month evaluation period) - AUSTRALIA
Figure 8a - Prospective Utility - (12 month evaluation period) - AUSTRALIA
Figure 8b - Prospective Utility & Allocation - (12 month evaluation period) - AUSTRALIA
Figure 9b Prospective Utility & Allocation - (36 month evaluation period) - AUSTRALIA
Figure 10a - Prospective Utility - (3 month evaluation period) - JAPAN

End Year (of 20-Year Period)
Figure 12a - Prospective Utility - (36 month evaluation period) - JAPAN
Figure 12b Prospective Utility & Allocation - (36 month evaluation period) - JAPAN
### Table 1: Annualised equity and bond returns, equity risk premium and inflation (for 20 year periods 1926-1995)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1926</td>
<td>1945</td>
<td>9.95</td>
<td>6.80</td>
<td>2.95</td>
<td>0.67</td>
<td>4.18</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>1936</td>
<td>1955</td>
<td>9.48</td>
<td>2.57</td>
<td>6.73</td>
<td>5.76</td>
<td>5.51</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>1946</td>
<td>1965</td>
<td>11.67</td>
<td>1.94</td>
<td>9.55</td>
<td>5.43</td>
<td>5.55</td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>1956</td>
<td>1975</td>
<td>11.54</td>
<td>2.28</td>
<td>9.05</td>
<td>4.75</td>
<td>4.68</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>1966</td>
<td>1985</td>
<td>14.91</td>
<td>4.60</td>
<td>9.85</td>
<td>8.15</td>
<td>4.19</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>1976</td>
<td>1995</td>
<td>16.21</td>
<td>13.36</td>
<td>2.51</td>
<td>6.92</td>
<td>3.53</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1926</td>
<td>1945</td>
<td>6.91</td>
<td>6.75</td>
<td>0.15</td>
<td>7.59</td>
<td>43.23</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>1936</td>
<td>1955</td>
<td>19.93</td>
<td>2.67</td>
<td>16.81</td>
<td>28.47</td>
<td>85.32</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>1946</td>
<td>1965</td>
<td>26.60</td>
<td>3.42</td>
<td>22.41</td>
<td>19.42</td>
<td>78.73</td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>1956</td>
<td>1975</td>
<td>16.55</td>
<td>7.10</td>
<td>8.83</td>
<td>6.26</td>
<td>5.13</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>1966</td>
<td>1985</td>
<td>15.19</td>
<td>9.33</td>
<td>5.35</td>
<td>6.37</td>
<td>5.14</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>1976</td>
<td>1995</td>
<td>9.25</td>
<td>10.69</td>
<td>-1.31</td>
<td>2.75</td>
<td>2.62</td>
<td></td>
</tr>
</tbody>
</table>

Notes:  
'Annualised' equity, bond, ERP and inflation figures represent the geometric annual averages of the 20 year index ratios, i.e. the constant % annual rate which would result in the identical index at the end of each 20 year period.  
'Stdev. Infl' is the standard deviation of the 20 annual inflation 'returns' over each 20 year period.

Notes to Japan data:  
1. Data for Japanese equities is missing for the months September 1945 - April 1946 (inclusive).  
   Linear interpolation over this period is used to enable the computation of the variables which feature in Table 1.  
2. Hyperinflation was a feature of the Japanese economy between the years 1946-49.  
   Any period which includes these years reflects this phenomenon (e.g. the relatively high levels and volatilities of inflation).
Table 2: Optimum proportion of equities in the allocation and indication of 'all bonds' preference over 'all equities'

<table>
<thead>
<tr>
<th>Australia Period</th>
<th>Start</th>
<th>End</th>
<th>3Mth</th>
<th>6Mth</th>
<th>9Mth</th>
<th>12Mth</th>
<th>18Mth</th>
<th>24Mth</th>
<th>36Mth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1926</td>
<td>1945</td>
<td>0.39</td>
<td>0.22</td>
<td>0.21</td>
<td>0.17</td>
<td>0.14</td>
<td>0.17</td>
<td>0.3</td>
</tr>
<tr>
<td>1b</td>
<td>1936</td>
<td>1955</td>
<td>0.81</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2a</td>
<td>1946</td>
<td>1965</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2b</td>
<td>1955</td>
<td>1975</td>
<td>0.27</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3a</td>
<td>1965</td>
<td>1985</td>
<td>0.14</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3b</td>
<td>1976</td>
<td>1995</td>
<td>0.15</td>
<td>0.33</td>
<td>0.70</td>
<td>0.79</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Japan Period</th>
<th>Start</th>
<th>End</th>
<th>3Mth</th>
<th>6Mth</th>
<th>9Mth</th>
<th>12Mth</th>
<th>18Mth</th>
<th>24Mth</th>
<th>36Mth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1926</td>
<td>1945</td>
<td>0.02</td>
<td>0.22</td>
<td>0.39</td>
<td>0.29</td>
<td>0.22</td>
<td>0.51</td>
<td>1</td>
</tr>
<tr>
<td>1b</td>
<td>1936</td>
<td>1955</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2a</td>
<td>1945</td>
<td>1965</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2b</td>
<td>1965</td>
<td>1975</td>
<td>0.64</td>
<td>0.92</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3a</td>
<td>1966</td>
<td>1985</td>
<td>0.80</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3b</td>
<td>1976</td>
<td>1995</td>
<td>0.36</td>
<td>0.44</td>
<td>0.44</td>
<td>0.48</td>
<td>0.56</td>
<td>0.56</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Note: Values in bold type indicate the intersections of historical period and evaluation horizon in which an 'all bond' portfolio is preferred to an 'all equity' portfolio.