

AJAP

AUSTRALIAN JOURNAL OF ACTUARIAL PRACTICE | VOLUME 5



Actuaries
Institute

The Australian Journal of Actuarial Practice (AJAP)

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The Australian Journal of Actuarial Practice is published by
The Institute of Actuaries of Australia
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ISSN 2203-5354

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The AJAP relies upon the goodwill and effort of many people to review papers and notes prior to publication. The Editor is grateful for the help of the reviewers of papers and notes for this Volume.

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FROM THE EDITOR

This will be my last editorial as the editor of the Australian Journal of Actuarial Practice. As you may know council took the decision to discontinue the journal in 2016 and so this will be the final volume.

For those of you who enjoyed reading the articles in the journal and who found them interesting or useful we thank you for your support and note that a number of Australian academics are currently working on the development of a new journal, housed within one of the universities, to replace the AJAP. The decision to discontinue the journal was taken for a number of reasons including low readership and submissions to the journal, and of course in the international world of actuarial science that we all inhabit, the presence of a number of higher profile actuarial journals addressing many similar issues.

Publishing in interdisciplinary areas of research such as actuarial science can be more challenging and naturally attracts a smaller readership than many other research disciplines, but there can be no doubt that the impact of actuarial research is more significant and immediate than in many other disciplines and that is something for all actuarial researchers to be proud of. A showcase of that impact can be found in this final volume of the AJAP.

Darren Robb presents two papers on fair premium pricing. The first paper provides a critique of the existing methods to determine a fair premium within the financial economics space. The later paper provides an alternative approach using a classical microeconomics approach. Richard Hartigan's paper considers reinstatement strategies. In particular determining an optimal reinstatement strategy for short tail excess of loss reinsurance.

Jackie Li et al consider the developing market of reverse mortgages offering a review of the existing market, the supply and demand constraints and a theoretical approach to pricing such products.

Shauna Ferris et al consider the implications of long service leave in the construction industry, comparing a number of schemes in terms of coverage and design, rationale, historical development, legal structures and governance financial status and stability.

The issue of life expectancy continues to be a buoyant area for actuarial research and Paul Hutchinson and Richard Cumpston give us their contributions to this field in this volume. Hutchinson looks at the variability of remaining lifetimes through the average and standard deviations whilst Cumpston considers the impact of education, occupation and partnership on life expectancy.

Discount rates are key to actuarial pricing and reserving calculations and determining an appropriate discount rate forms a core part of many actuarial tasks. Hugh Miller considers the issues that arise in determining an appropriate discount rate and his paper provides a consistent and coherent approach.

Of course the growth of our profession is not just about developing new knowledge but about passing that knowledge onto the next generation of aspiring actuarial fellows. To this end we have a paper by Aaron Bruhn, Bronwen Whiting and Jiajie Du reviewing the strengths and weaknesses of the current education structure and delivery methods in Australia from actuarial educators' perspective.

Finally, we have a review of Alf Pollard, a most remarkable actuary, as John Croucher gives us his account of his intriguing journey from farm boy to the top of the actuarial profession.

Dr Colin O'Hare PhD, FIA, FIAA, FHEA
EDITOR

A partial history of fair premium models

DARREN ROBB



Darren Robb

ABSTRACT

Within the context of fair premium models, we use the term financial economics to represent the approach described by Myers and Cohn (1981), Taylor (1994), and others, which estimates the required rate of return of an insurance product based on the riskiness of the claims expected to arise from the policy, often referred to as the “liability beta”.

While the Myers-Cohn premium is claimed to be equal to a fair premium, it produces rates of return that are much lower than the shareholder returns actually achieved by insurance companies – in fact often much closer to the risk-free rate. This paper demonstrates that the model’s core basis and assumptions conflict with economic theory and with the Capital Asset Pricing Model (CAPM) in particular. We also show that the model described by Taylor (1994) underestimates the fair premium and describe the size of this underestimation.

The current paper provides a critique and refutation of the “financial economics” approach propounded by Myers and Cohn (1981) and Taylor (1994), as well as a discussion of a small selection of other views. An alternative approach to estimating fair premiums that follows a classical micro-economics approach to determining prices in competitive markets, is contained in the concurrent paper in this issue of the journal, “A new approach to fair premium models” (Robb 2017).

KEYWORDS

insurance pricing, fair premium, myers-cohn model, intangible capital, balance sheet risk, underwriting risk, distribution risk, financial economics

1 A PARTIAL HISTORY OF FAIR PREMIUM MODELS

Fair premium models have been developed and used within regulated insurance markets for many decades. An early principle of fair premiums was established in an oft-quoted United States Supreme Court judgement (Federal Power Commission vs Hope Natural Gas Company), which set out the principles for determining the profit contained within a fair premium:

“the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital” (U.S. Supreme Court 1944:320).

Since the 1960s there have been some who have assumed insurance firms can be modelled as a leveraged investment fund and have believed that this analogy provides a useful approach to estimate fair premiums for an insurance firm.

This may originate from Ferrari who observed that “an insurance company operates with a levered capital structure”, where the leverage is provided not by debt but rather by the “insurance liabilities” (1968:296).

Vaughn follows the approach of Ferrari when he “visualize[s] the insurer as borrowing funds from policyholders, then investing the combined policyholder and shareholder funds in financial assets” (2002:404).

For decades many actuaries have claimed that the appropriate theoretical framework for estimating fair premiums in insurance markets is financial economics: “Actuaries need to be able to determine proper rate levels for the insurance product in ways that are fully consistent with modern financial economics” (Derrig 1990:22).

This is probably because financial economics relates to “exchanges in which money of one type or another is likely to appear on both sides of a trade” (Sharpe undated:1).

The first example of a purely financial economics approach to fair premiums was probably Fairley (1979), who developed a single period model that could incorporate a target return on capital set in accordance with the Capital Asset Pricing Model (CAPM). Hill and Modigliani (1981) extended the model to allow for different types of assets, and different betas and tax rates on those investments.

The current author considers the model developed by Myers and Cohn (1981) to be the archetypal financial economics approach. The Myers-Cohn fair premium is a multi-period discounted cash flow model where the key cash flows (being claims payments, expenses and taxes) are discounted at risk-adjusted rates. The sum of the discounted cash flows is claimed to be equal to a fair premium. Although most controversy around the Myers-Cohn model has related to the appropriate discount rate to use on the claims payments (the liability betas), this paper demonstrates that its core basis and assumptions conflict with economic theory and with the CAPM in particular (see section 2).

The Myers-Cohn model allows only for the balance sheet risk of an insurance product (i.e. claims and investment return), with no allowance for the other risks within the profit stream (i.e. revenue and expenses). In addition, the model excludes any allowance for the presence of intangible assets which contribute to the production of insurance. These two omissions mean that Myers-Cohn fair premiums often produce rates of return that are typically much lower than the shareholder returns actually achieved by insurance companies, and in fact often much closer to the risk-free rate.

Taylor (1994) provides a more detailed and mathematically sound basis for the financial economics approach, by first developing a model of an insurance operation and then proposing a measure of the fair return on capital that could be used within a standard Internal Rate of Return (IRR) model to produce a fair premium. Taylor goes on to show the parameters under which the insurance operation will generate the fair return on capital, and the further assumptions required for this to generate a Myers-Cohn fair premium. Taylor concludes that the Myers-Cohn model “produces a return on equity, period by period, which is consistent with the capital asset pricing model” (1994:592) under certain conditions.

In section 3 we identify two key aspects of fundamental importance to an insurance company which

are ignored in Taylor's (1994) model: underwriting risk and sales distribution risk. We also demonstrate that in fact the fair return proposed by Taylor is inconsistent with the Capital Asset Pricing Model (CAPM) under reasonable assumptions. This paper attempts to adjust the Taylor model by inclusion of these two additional non-diversifiable risks and a more appropriate CAPM-based fair return. We thereby demonstrate the scenarios under which the Taylor model will underestimate the fair premium and develop a model that explains the size of this underestimation (see section 3).

Taylor was subsequently a key participant (as scheme actuary) in a lengthy discussion regarding fair premium models to be used for assessing profit margins by the Motor Accidents Authority, at that time the government regulator of the New South Wales compulsory third party scheme in Australia. This commenced with two letters written in 2001, with further details and explanation provided in July 2002, and a final report in 2004. Taylor's 2004 report was subsequently published as an appendix to the Motor Accidents Authority's submission to the Law and Justice Committee in 2006. A number of papers were published in response, including Ward (2002) and Johnston (2004). Due to Taylor's significant contribution to the fair premium debate in Australia (and globally), section 5 includes a brief discussion of his 2004 report and a brief critique of its key ideas in relation to the financial economics approach.

According to Ward (2002), the letters and papers written by Taylor acting as scheme actuary represent the first instance of an insurance regulator in Australia applying a discounted cash flow method with parameters derived using the Capital Asset Pricing Model (CAPM), and so Ward examines the application of CAPM to insurance in some detail. Ward describes the relationship between insured non-diversifiable assets and diversifiable equity investments (including investments in insurers) within the overall wealth system. He shows that the financial economics approach using CAPM is appropriate to set profit margins for a "pure insurer" (2002:5), which he defines as a costless venture that receives premiums net of expenses and pays claims. (We would add the caveat that the pure insurer must be either in run-off or experience no systematic risk from either volume of sales or premium adequacy.) However, Ward also identifies that the manufacture of insurance (including underwriting of risk, distribution of sales and claims management) has the potential to make a material contribution to the non-diversifiable (systematic) risk of an insurer. An important implication from Ward is that both underwriting and distribution risk will affect the required rate of return of an insurer, but Ward does not explain how these should be incorporated into the calculation of the fair premium.

Ward also describes the discrepancy between net financial assets and market capitalisation, and the danger of applying return requirements based on total shareholder returns to a measure of net financial assets (see also Hitchcox et al 2006). However Ward does not distinguish between market capitalisation that may be caused by lack of competition within the insurance market and market capitalisation reflecting the invested economic capital in excess of net financial assets. This leaves the argument open to the rebuttal provided in Taylor's 2004 report that franchise value (increased market capitalisation due to oligopolistic or monopolistic markets) is simply the present value of expected excess rents and this doesn't need or shouldn't receive a specific addition to profit margins in fair premiums.

However Taylor (2004) does recognise the possibility that market capitalisation may include "hidden assets" in addition to net financial assets: that is any balance sheet understatement of assets or overstatement of liabilities, for example risk margins on insurance liabilities. Taylor believes these hidden assets should be identified and explicitly added into the capital base to be serviced by the profit margins in fair premiums.

It is worth noting that intangible assets of the type described by Robb et al (2012) would appear to be included within Taylor's (2004) definition of hidden assets, and Taylor recognises that only the remaining component of market capitalisation defined as franchise value (i.e. excess rents derived from oligopolistic or monopolistic markets) should be excluded from fair premiums.

Johnston (2004) defines the "insurance surplus" (Johnston 2004:7) obtained by consumers (otherwise known as consumer surplus), and then defines the range of feasible insurance premiums in which there is a positive benefit to both shareholders and consumers from entering into an insurance contract. At the lower bound of this range is the fully competitive equilibrium price. Any price above this point would suggest a less-than-competitive market, such as an oligopoly. Johnston believes that it might be justified for a regulator to set premiums "somewhere away from the lower boundary of the feasible range" (2004:12), which appears to condone oligopolistic profits within a fair premium. In section 4 we critique this view in more detail, but for now we only mention Taylor's (2004) view of Johnston.

In reviewing Johnston (2004), Taylor (2004) wrote that Johnston was proposing to accept premiums that were "more expensive than fair premiums" (2004:16) as long as they increased consumers' individual

expected utilities. Taylor's summary of this position is: "This seems a valid application of free market theory, but subject to fairly considerable measurement problems since it depends on the utility function of consumers, or at least of the representative consumer" (2004:16).

We do not believe that Taylor (2004) should be so generous to Johnston. Putting aside the difficulty of measuring consumers' utility function, we believe that the consideration of consumer utility to allow prices higher than would arise in competitive markets to be inconsistent with the principle of fair premiums, and we don't believe that a regulator seeking a fair premium should consider eroding consumer surplus by allowing prices to be higher than the competitive price (see section 4).

Within the actuarial organisations of English-speaking countries the discussion of fair premium models continues. The North American Casualty Actuarial Society (CAS) continues to fund the *CAS Risk Premium Project* (RPP) (2000, 2010, 2012, 2013, 2014, 2015). The initial focus of this project was largely to determine the appropriate discount rates to be used in the Myers-Cohn fair premium model:

"[The Risk Premium Project] RPP was formed to respond to the committee's request: how should actuarially appropriate risk adjustments be computed when losses and expenses are discounted?" (Casualty Actuarial Society 2000:169)

Ten years later the Risk Premium Project 2 published its updated findings and concluded that: "There is an ongoing consolidation between financial and actuarial literature with regard to pricing of insurance contracts" (Casualty Actuarial Society 2010:2).

There was also recognition that the pure financial economics view underestimated fair premiums and that:

"Theoretical models as well as empirical tests have confirmed that given the real-world market imperfections, the price of insurance should be a function of the (1) expected cash flow with adjustments for systematic risk, (2) production costs (i.e. expenses), (3) default risk, and (4) frictional capital costs" (Casualty Actuarial Society 2010:2).

The items numbered (1) and (2) above represent the traditional Myers-Cohn formula, while items (3) and (4) indicate the additional risks that should be considered outside the Myers-Cohn model. However no definitive model of fair premiums has emerged to replace Myers-Cohn.

The UK Institute of Actuaries and Scotland's Faculty of Actuaries (subsequently renamed the Institute and Faculty of Actuaries) published a paper in 2006 authored by a combination of actuaries and financial economists (Hitchcox et al). The paper provides a thorough explanation of insurance capital and target return on capital, including the differences between shareholder return and internal return on capital. It also describes the frictional costs that impact capital invested in an insurer. The paper also examines two studies of actual stock market returns based on US companies.

One element missing from the Hitchcox et al paper is consideration of the level of competition within the insurance market, as market capitalisation is assumed to be equal to the market value of all assets. Hitchcox et al define franchise value as:

"the market value of assets, either tangible or intangible, which is not recorded in accounting statements or is recorded at values below their market value, and of liabilities which are reported at values above their market value" (2006:55).

In this definition, any oligopolistic value contained within market capitalisation is either ignored or assumed to be zero, and so some adjustment is required if market capitalisation may include some value

from less-than-perfect competition. The approach of Hitchcox et al (and Ward 2002) is vulnerable to the argument that it calculates the premiums that would arise in the actual insurance market, rather than the premiums that would arise within a competitive market (if different).

Despite the attempts of the Casualty Actuarial Society and the Institute and Faculty of Actuaries, no definitive model had been developed that could convincingly replace the Myers-Cohn model, and so in 2011 the Myers-Cohn model was used as part of the justification for rejecting premium filings in the New South Wales compulsory third party scheme. In response to the ensuing uncertainty, in 2012 the Australian Institute of Actuaries established its own working party to investigate the question of appropriate profit margins, including the measure of capital that supports the business and the required rate of return on that capital. The Profit Margins Working Party (chaired by the current author) presented a draft paper at the 2012 General Insurance Seminar, entitled “Profit margins in regulated general insurance markets” (Robb et al 2012), which developed a new approach using shareholder returns, rather than liability betas, to set fair premiums. However the paper lacked in-depth discussion and rigorous refutation of any alternative models.

The purpose of the current paper is to provide a thorough critique and refutation of the financial economics approach propounded by Myers & Cohn (1981) and Taylor (1994), as well as a discussion of a small selection of other views relevant to the discussion of fair premiums within Australia. A more detailed and rigorous justification of the approach developed by the Profit Margins Working Party, along with the establishment of a basis upon which actuaries can advise on appropriate profit margins, is contained in the paper “A new approach to fair premium models” on pages 35–45 of this issue of the journal (Robb 2017).

2 VALUE OF EQUITY – RESPONSE TO MYERS AND COHN

Myers and Cohn (1981) developed an approach for determining fair premiums named the Surplus Flow model, or more commonly referred to as the Myers-Cohn model. The Myers-Cohn model is described in “A discounted cash flow approach to property-liability insurance rate regulation” (1981) as:

$$PV_{rf}(P) = PV_{rL}(L) + PV_{rf}(IBT) + PV_{rf,rL}(UWPT)$$

where L = expected losses and expenses

IBT = tax on investment income

UWPT = tax on underwriting profit

In order to derive their model, Myers and Cohn start by imagining an “idealized balance sheet” (1981:55) of a general insurance company. This balance sheet considers purely financial assets and liabilities, and all balance sheet values are “defined as market or present values. The corresponding book values would be different” (1981:56).

Myers and Cohn present a table that documents the idealised balance sheet as shown in Table 1.

Table 1: An Idealised Balance Sheet for a Property-Liability Insurance Company.

Assets	Liabilities
Financial assets	PV losses and loss expenses
	PV tax liability
	Equity value
Total value	Total value

Source: S.C. Myers & R.A. Cohn. (1981). A discounted cash flow approach to property-liability insurance rate regulation. In J.D. Cummins & S.A. Harrington, *Fair rate of return in property-liability insurance*, Springer Science & Business Media, 1987, New York, p. 56.

Given that the items in the balance sheet are defined as market values rather than book values, it is

worthwhile considering how this balance sheet can be constructed. The inherent assumption by Myers and Cohn is that the market value of equity is equal to the market value of financial assets minus the market value of liabilities. No explanation or justification is given for this assumption.

Myers and Cohn assume that an insurance company has negligible non-financial assets and liabilities: “we ignore the company’s modest holdings of physical assets” and “ignoring liabilities unrelated to outstanding policies” (1981:55, 56).

Even allowing for these two simplifications, however, the authors provide no justification to assume the market value of equity is equal to the market value of net financial assets. We can observe that the market value of any firm is generally not equal to its net financial assets. Many firms exist with market values significantly different from their net financial assets.

Even restricting our discussion to the insurance industry, it is relatively easy to imagine scenarios where the market value of equity would vary between insurers with the same net financial assets. Consider three insurance companies operating in separate markets. All have the same value of assets invested in fixed interest government bonds and the same value of liabilities (coincidentally). Company A operates in a small but growing market, with moderate profit but expectations of significant growth in profit to come. Company B operates in a large market with intense competition for customers, and as a result profits are generally low. Company C operates in a large duopoly and enjoys generous profits, but the market is stagnant with no prospect of growth.

These examples highlight the fundamental flaw of Myers and Cohn’s idealised balance sheet, which does not even allow differences in the level of profitability to influence the market value of equity. But let’s consider their approach more formally within economic theory. The field that we are considering is the capital asset market (not the insurance market), because we are examining the market value of a capital asset (equity).

The market value of any firm can be thought of as the present value of a future profit stream, using a risk-adjusted discount rate. One model of estimating market value of capital assets is known as the Capital Asset Pricing Model (CAPM), which states that capital assets in an efficient market will be priced such that the expected return on equity (r) is given by:

$$r = r_F + \beta (r_M - r_F)$$

where β is a measure of the correlation between r and the market return (r_M).

The most important aspect of CAPM is that the market value (or expected return on market value) is a function of the correlation between the future profit stream and the level of market return.

Let’s consider three firms: one with revenue that is 100% correlated with the level of market return, the second with revenue that is -100% correlated with the level of market return, and the third with revenue completely uncorrelated with the market. All firms have a stable expense structure, and all have identical financial assets and liabilities. Under the CAPM framework the market value of these three firms will be different, due to the difference in correlation between the expected future revenue, and therefore future profit stream, with the market. Note that this is true even if the average annual nominal amount of profit is identical for all three firms.

Owing to the differences in correlation between future profits and the market return, CAPM suggests that the market value of equity will not be equal between these three firms, and therefore not equal to net financial assets, and so the assumption made by Myers and Cohn conflicts with the CAPM.

There is no economic principle that the market value of a firm will be equal to its net financial assets. For any company that generates revenue and expenses, the market value of equity would take into account the correlation between the streams of revenue and expenses with the overall market.

The assumption that market value is independent of the risk within revenue and expenses is a fundamental problem with the model put forward by Myers and Cohn. All analysis of the model ultimately rests on the assumption that only balance sheet risk is considered (i.e. claims and investment return), with no allowance for other risks within the profit stream (i.e. revenue and expenses).

Myers and Cohn go on to hypothesise that the balance sheet of the firm can be split into separate balance sheets for every individual policy: “A similar balance sheet exists for every policy the firm writes” (1981:56).

When considering the balance sheet for one individual policy, they assume that the premium is known

and already received, and the initial acquisition and administration expenses are already paid. In other words, the volume of sales is known with certainty (one policy); the average revenue for that one policy is known with certainty; and the expenses for that one policy are known with certainty.

We believe that these extreme assumptions are not helpful when examining the risks that face capital invested into a firm. This approach is similar to saying “imagine there is no risk to the firm from either production or sales”. We observe that firms typically face risk from sales volume, average revenue and expenses, and that these risks can impact the market value of equity. The CAPM indicates that a market value is placed on the risks faced by a productive firm, to the extent that revenue and expenses are correlated with the market.

There are two additional reasons why the market value of a firm is generally not equal to its net financial assets. Market value will be greater than net financial assets owing to the presence of:

- economic capital, which includes intangible assets (non-financial)
- monopolistic value due to markets with less than perfect competition.

By assuming that a fair premium is one that arises within a freely competitive market, we assume that the markets of our discussion are competitive, and so we exclude the second point.

However the exclusion of intangible assets is a serious error within the assumption that market value is equal to net financial assets. The inclusion of intangible assets is discussed in Robb et al (2012).

So the initial assumption made by Myers and Cohn, that an idealised balance sheet could determine the market value of equity, contradicts the CAPM framework and also ignores intangible assets. We now examine the definition of a fair premium put forward by Myers and Cohn.

Myers and Cohn propose a definition of the fair premium as one such that: “whenever a policy is issued, the resulting equity value equals the equity invested in support of that policy” (1981:57).

Note first that the definition of a fair premium proposed by Myers and Cohn makes no reference to the level of competition within the insurance market, but instead the definition refers again to the market value of equity, and so it requires a model of the capital asset market. However, their definition requires equality between net financial assets invested and the market value of equity. There is no allowance in market value for any non-diversifiable risks facing invested capital from revenue and expenses, and we conclude that the definition of a fair premium put forward by Myers and Cohn is inconsistent with CAPM.

We therefore reject the Myers-Cohn model as being inconsistent with economic theory, on the following grounds:

- The primary assumption about equity value put forward by Myers and Cohn is inconsistent with CAPM.
- Their proposed definition of a fair premium is also inconsistent with CAPM.
- Their definition of fair premiums ignores the non-diversifiable risk from revenue and expenses, and excludes the presence of intangible assets.

Note that these grounds could be generalised to other asset pricing models, for example the Fama-French three-factor model (FF3F), that include linear dependence of asset returns on the correlation between asset risk and market risk.

2.1 Leveraged investment funds

The Myers and Cohn idealised balance sheet is effectively a leveraged investment fund rather than an insurance company. Many authors have similarly assumed that insurance firms can be modelled as a leveraged investment fund, and believe that this analogy provides a useful approach to estimate the cost of capital for an insurance firm.

This may originate with Ferrari, who observed that “an insurance company operates with a levered capital structure”, where the leverage is provided not by debt but rather by the “insurance liabilities” (1968:296). Similarly: “From a financial economics perspective, an insurance firm is a leveraged fund with frictional costs” (Hitchcox et al 2006:50).

Unfortunately we believe this analogy of the insurance firm as a leveraged investment fund is the direct cause of the errors within the financial economics approach to setting fair premiums, particularly the Myers-Cohn theorem and the subsequent attempts to reconcile its results with reality. The analogy of the investment fund naturally leads to a focus on the balance sheet risks of an insurance company (i.e. claims and investment return), with no allowance for the other risks within the profit stream (i.e. revenue and

expenses). This is likely to be due to the fact that leveraged investment funds have no revenue or expenses, whereas insurance companies do.

Furthermore, the financial economics approach makes no allowance for the presence of intangible assets which contribute to the production of insurance, because investment funds have no intangible assets, whereas insurance companies often do.

2.2 Application and conclusion

In situations when the Myers-Cohn model has been adopted, most controversy relates to the appropriate discount rate to use on the claims payments (the liability betas). The insurance claims random process is usually thought to be independent of market wealth (for example natural catastrophe risk) or slightly negative (for example bodily injury classes may have higher average claim size during periods of unemployment and economic downturns).

Owing to the nature of the Myers-Cohn model, a liability beta assumption of zero will produce a fair premium that provides a return on risk capital (or allocated financial capital) that is equal to the investment return expected on the financial assets held. In situations where an insurer is heavily invested in low-risk fixed interest securities, this will produce a return that is close to the risk-free rate. A slightly negative liability beta will generate a slightly higher rate of return.

This is in contrast to the actual returns achieved in many insurance markets where the expected rate of shareholder return (measured using the higher base of market capitalisation) is higher than the risk-free rate. Re-expressed as a rate on risk capital, actual returns are even higher than the rate of shareholder return.

Many attempts have been made to explain this large gap between the Myers-Cohn model and reality, including substantial projects within the actuarial organisations of the English-speaking countries (see also section 1). The Risk Premium Project funded by the Casualty Actuarial Society explained the gap as being due to “real-world market imperfections”, such as default risk and frictional capital costs (Casualty Actuarial Society 2010:2). The paper by Hitchcox et al (2006) published by the UK Institute and the Scottish Faculty of Actuaries described the frictional costs as:

- double taxation
- the costs of financial distress, including the impact of the firm’s credit rating
- agency costs
- the role of uncertainty in some insurance returns; and
- the cost of illiquidity due to regulatory restrictions on capital” (2006:5).

However, we have shown that the Myers-Cohn fair premium is inherently inconsistent with economic theory, and with the CAPM in particular, as it ignores the non-diversifiable risk from revenue and expenses, and excludes the presence of intangible assets. These two omissions help to explain why Myers-Cohn fair premiums often produce rates of return that are typically much lower than the shareholder returns actually achieved by insurance companies, and are, in fact, often much closer to the risk-free rate.

Alternatively, by rejecting the financial economics analogy of a leveraged investment fund, and thereby removing these two omissions, an alternative pricing model can be developed following a classical micro-economics approach to determining premiums in competitive markets. This is described in the concurrent paper in this issue of the journal, “A new approach to fair premium models” (Robb 2017).

3 INSURANCE MODELS – RESPONSE TO TAYLOR

Taylor (1994) describes and compares four alternative methods for setting fair premiums in his paper “Fair premium rating methods and the relations between them”. He then sets out his own model of the cash flows of an “insurance operation” (1994:599), and derives the general formula for the return on equity (ROE) of this operation. He also defines the required rate of return on capital under the CAPM for this operation, and establishes the conditions under which the insurance operation will generate its required rate of return. Finally, he sets out the conditions under which this model simplifies into each of the

Myers-Cohn model and the Internal Rate of Return (IRR) model, and hence the conditions under which these two models are equivalent.

We will describe in detail Taylor’s model of insurance operations, and highlight some implicit assumptions of his cohort model. We also highlight two important aspects missing from his model, namely distribution and underwriting risk, and demonstrate that the addition of these two aspects is possible within the same framework. We then critique Taylor’s assumption for the required rate of return on capital, and derive an alternative formulation for this target which is higher due to the inclusion of an allowance for the non-diversifiable risk within distribution and underwriting. In this way we identify the conditions under which both the Myers-Cohn model and the Taylor model underestimate the fair premium, and develop a model that explains the size of this underestimation.

3.1 Taylor's model of an insurance cohort

Taylor (1994) sets out the difference between a portfolio model of insurance and a cohort model of insurance policies. In the former, an ongoing operation is considered, including all cash flows between stakeholders over time. Cash flows could include premiums, claims, expenses, investment income, tax, and payments to and from shareholders that arise from all policies within the portfolio. The cohort model considers only “the subset of this portfolio consisting of policies underwritten in a particular period” (Taylor 1994:593).

In the cohort model, the policies underwritten during a single period are traced over subsequent periods of time. Consistent with Taylor (1994), we use the notation $T+1$ time periods measured over time intervals $t = 0, 1, \dots, T+1$. The policies underwritten at time $t=0$ will generate technical liabilities for the expected value of future claims and expenses (and any margin held on these liabilities) as well as an unearned premium reserve. The policies may also generate a profit or loss, which is recognised immediately.

For all subsequent periods, the cohort is effectively in run-off, with no additional policies underwritten and therefore no new premiums received or expenses paid, only a fixed amount of premium to be earned using a known earning pattern.

Taylor (1994) describes this model of an insurance cohort with the following cash flows paid at time t :

Earned premiums (net of non-claim expenses)	P_t
Claim payments	\tilde{C}_t
Claims handling expenses	\tilde{E}_t
Investment income	\tilde{I}_t
Tax	\tilde{T}_t
Flows to shareholders	\tilde{F}_t

Note that, by convention, the premiums (which are defined as net of concurrent expenses) are assumed to be earned at the start of each period (i.e. $t = 0, \dots, T$), while claims and claims-handling expenses are assumed to be payable at the end of each period (i.e. $t = 1, \dots, T + 1$).

With the exception of earned premiums (P_t), all of the above cash flows are defined as random variables, with the following non-random expected values also defined:

$$C_t = E [\tilde{C}_t]$$

$$E_t = E [\tilde{E}_t]$$

etc.

For each random variable, Taylor (1994) also defines the centralised version of the random variable, notated with an overbar as follows:

$$\bar{C}_t = \tilde{C}_t - E [\tilde{C}_t]$$

$$\bar{E}_t = \tilde{E}_t - E [\tilde{E}_t]$$

etc.

The following definitions of stock values are described at time t :

Insurer’s capital	K_t
Insurer’s financial assets	A_t
Technical reserves	$R_t = R_t^C - R_t^P$

(consisting of claims loss reserves minus the unearned premium reserve)

It is important to note that the stock values are all non-random (i.e. constant and known in advance) for each time period t , which implicitly assumes that:

- The volume of business sold is known.
- The underlying claims distribution for this business is known without model error or parameter error.
- The claims process is only correlated to the return on market wealth within the same period, but is independent of market returns in prior periods.
- The claims reserves are all based on expected values which will not change over time, and so all future reserves are known with certainty.
- The risk margins and capital adequacy (solvency) ratios are all known in advance, and therefore the flows to shareholders are the balancing item to ensure compliance with these ratios.

The random aspects of the model consist of claims payments, claims-handling expenses, and investment returns, which we describe broadly as reserve risk and investment risk (although note that it excludes the risk that the reserves change unexpectedly). However distribution risk, which we define as uncertainty in the volume of business sold (relative to available capital), and underwriting risk, which we define as prospective premium adequacy on that business (the instantaneous profit or loss recognised at underwriting), are assumed to be riskless.

Taylor defines the solvency ratio as capital relative to claims loss reserves:

$$\theta_t = K_t / R_t^C$$

Income from the insurance operation at time $t+1$ (or during period $(t, t+1)$) is defined based on the cash flows and technical reserves as:

$$\tilde{Q}_{t+1} = P_t + \tilde{I}_{t+1} - \tilde{E}_{t+1} - \tilde{C}_{t+1} - (R_{t+1} - R_t)$$

Taylor (1994) defines the flows to shareholders at time $t+1$ as the income from insurance operations plus any change in capital, net of tax:

$$\tilde{F}_{t+1} = K_t - K_{t+1} + \tilde{Q}_{t+1} - \tilde{T}_{t+1}$$

The following definitions of rates of return are also defined:

Rate of return on total assets	$i_A = E [\tilde{i}_A]$
Rate of return on claim liabilities	$i_L = E [\tilde{i}_L]$
Rate of return on market wealth	$i_M = E [\tilde{i}_M]$
Rate of return on risk-free asset	i_F

The rate of return on claim liabilities may need some explanation. It is defined as the “stochastic factor by which a particular set of claims liabilities changes over a period” (Taylor 1994:596), and so this random variable describes variation within the claim payment process. It has nothing to do with the investment income earned on technical reserves.

All rates of return are assumed to follow the CAPM, where:

$$r_x = 1 + i_x$$

$$r_x = r_F + \beta_x (r_M - r_F)$$

$$\beta_x = \text{Cov}[\tilde{r}_x, \tilde{r}_M] / V[\tilde{r}_M]$$

3.2 Return on equity for Taylor's insurance cohort

Using Taylor's (1994) notation and model of an insurance cohort, the return on equity (ROE), defined as net of tax income to shareholders at time $t + 1$ as a proportion of capital held at time t :

$$ROE_t = (1 - \tau_{t+1}) \tilde{Q}_{t+1} / K_t$$

Where τ_{t+1} is the rate of tax in period $(t, t+1)$.

Substituting for \tilde{Q}_{t+1} :

$$ROE_t = (1 - \tau_{t+1}) [P_t + \tilde{I}_{t+1} - \tilde{E}_{t+1} - \tilde{C}_{t+1} - (R_{t+1} - R_t)] / K_t$$

Using the following additional equations to substitute random variables with centralised random variables (see previously) and to substitute for investment income:

$$\tilde{C}_t = \bar{C}_t + C_t$$

$$\tilde{E}_t = \bar{E}_t + E_t$$

$$\tilde{i}_{A_t} = \bar{i}_{A_t} + i_{A_t}$$

$$\tilde{I}_{t+1} = \tilde{i}_{A_t} (R_t + K_t + P_t)$$

$$\begin{aligned} ROE_t &= (1 - \tau_{t+1}) [P_t + \tilde{I}_{t+1} - \tilde{E}_{t+1} - \tilde{C}_{t+1} - (R_{t+1} - R_t)] / K_t \\ &= (1 - \tau_{t+1}) [P_t - (R_{t+1} - R_t) + (\bar{i}_{A_t} + i_{A_t})(R_t + K_t + P_t) - \bar{E}_{t+1} \\ &\quad - E_{t+1} - \bar{C}_{t+1} - C_{t+1}] / K_t \\ &= (1 - \tau_{t+1}) [i_{A_t} K_t + (1 + i_{A_t}) R_t - R_{t+1} + (1 + i_{A_t}) P_t \\ &\quad + \bar{i}_{A_t} (R_t + K_t + P_t) - \bar{E}_{t+1} - E_{t+1} - \bar{C}_{t+1} \\ &\quad - C_{t+1}] / K_t \\ &= (1 - \tau_{t+1}) [i_{A_t} K_t + (r_{A_t} R_t - R_{t+1}) + r_{A_t} P_t + \bar{i}_{A_t} (R_t + K_t + P_t) \\ &\quad - \bar{E}_{t+1} - E_{t+1} - \bar{C}_{t+1} - C_{t+1}] / K_t \end{aligned}$$

(using the substitution $r_x = 1 + i_x$)

The claims liability is defined at time zero as:

$$R_0^C = \sum_{s=0}^T r_{L_0:s}^{-1} (1 + v_{s+1}) (C_{s+1} + E_{s+1})$$

where v_{t+1} is the risk margin applied to claims and expenses in setting technical loss reserves. In words, the technical liability for claims and expenses at time zero is the sum of the expected cost of all future claims and claims-handling expenses, plus a risk margin, discounted at a rate appropriate for the claims process, that is, reflecting the CAPM risk within the claims process.

The unearned premium reserve is defined at time zero as the sum of the future earned premiums discounted at the risk-free rate:

$$R_0^P = \sum_{s=0}^T r_{F_0:s-1}^{-1} P_s$$

The subsequent reserves for claims and unearned premium can then be defined in a recursive relationship such that:

$$R_{t+1}^C = r_{L_t} R_t^C - (1 + v_{t+1})(C_{t+1} + E_{t+1})$$

$$R_{t+1}^P = r_{F_t} R_t^P - r_{F_t} P_t$$

where the R_t are each constants based on expected values.

And therefore, using $R_t = R_t^C - R_t^P$:

$$\begin{aligned} r_{A_t} R_t - R_{t+1} &= r_{A_t} (R_t^C - R_t^P) - (R_{t+1}^C - R_{t+1}^P) \\ &= r_{A_t} (R_t^C - R_t^P) - (r_{L_t} R_t^C - (1 + v_{t+1})(C_{t+1} + E_{t+1}) \\ &\quad - r_{F_t} R_t^P + r_{F_t} P_t) \\ &= (r_{A_t} - r_{L_t}) R_t^C - (r_{A_t} - r_{F_t}) R_t^P + (1 + v_{t+1})(C_{t+1} + E_{t+1}) \\ &\quad - r_{F_t} P_t \end{aligned}$$

Substituting this equation into the ROE equation above gives:

$$\begin{aligned} &= (1 - \tau_{t+1}) [i_{A_t} K_t + [(r_{A_t} - r_{L_t}) R_t^C - (r_{A_t} - r_{F_t}) R_t^P \\ &\quad + (1 + v_{t+1})(C_{t+1} + E_{t+1}) - r_{F_t} P_t] + r_{A_t} P_t \\ &\quad + \bar{i}_{A_t} (R_t + K_t + P_t) - \bar{E}_{t+1} - E_{t+1} - \bar{C}_{t+1} \\ &\quad - C_{t+1}] / K_t \\ &= (1 - \tau_{t+1}) [i_{A_t} K_t + (r_{A_t} - r_{L_t}) R_t^C - (r_{A_t} - r_{F_t}) (R_t^P - P_t) \\ &\quad + v_{t+1} (C_{t+1} + E_{t+1}) + \bar{i}_{A_t} (R_t + K_t + P_t) - \bar{E}_{t+1} \\ &\quad - \bar{C}_{t+1}] / K_t \end{aligned}$$

Dividing through with the K_t divisor and substituting for the solvency ratio defined earlier:

$$R_t^C / K_t = \theta_t^{-1}$$

$$(R_t^P - P_t) / K_t = \theta_t^{-1} (R_t^P - P_t) / R_t^C$$

$$\begin{aligned} ROE_t &= (1 - \tau_{t+1}) [i_{A_t} + (i_{A_t} - i_{L_t}) \theta_t^{-1} - (i_{A_t} - i_{F_t}) \theta_t^{-1} (R_t^P - P_t) / R_t^C + \\ &\quad v_{t+1} (C_{t+1} + E_{t+1}) / K_t + \bar{z}_{t+1}] \end{aligned}$$

where $\bar{z}_{t+1} = [i_{A_t} (R_t + K_t + P_t) - E_{t+1} - C_{t+1}] / K_t$, representing a random variable with zero mean.

This formula shows that the return on equity for an insurance cohort at time $t + 1$ can be separated into a fixed component plus a random variable with zero mean, since everything other than the \bar{z}_{t+1} variable is known (noting that both C_{t+1} and E_{t+1} are expected values). However, this formula only applies to a cohort (i.e. a run-off portfolio) and excludes any additional profit or loss recognised at the time of underwriting a new policy.

Using the original definition of the flows to shareholders, we can write:

$$\begin{aligned}\bar{F}_{t+1} &= K_t - K_{t+1} + \bar{Q}_{t+1} - \bar{T}_{t+1} \\ &= K_t - K_{t+1} + (1 - \tau_{t+1}) \bar{Q}_{t+1} \\ &= K_t - K_{t+1} + K_t ROE_t\end{aligned}$$

where ROE_t is defined above. In words, the flows to shareholders are composed of a partial return of capital plus the rate of return on capital of the insurance cohort earned during period $[t, t + 1]$ multiplied by the outstanding capital at time t . This simply means that the rate of return on capital of the insurance operation is also the rate of return that the shareholder receives, relative to the amount of capital outstanding at each period (assuming free flows of capital as defined by the solvency ratio θ_t).

Taylor (1994) identifies scenarios in which the expected value of ROE is constant from period to period, and compares the actual ROE with the required return on equity for an insurance fund in run-off:

$$i_E = (A i_A - L i_L)/E$$

Taylor (1994) implicitly includes this assumption within his Formula 49 without specific comment or justification, and we believe it deserves considerably greater attention. The key question is whether the required return for an investor in insurance under a CAPM framework can be estimated by reference to only the capital structure of an insurance fund in run-off (i.e. using only the assets, liabilities and the CAPM rates of return on each). We will return to this question later, but first we show how Taylor uses this assumption by first substituting for A and L which gives:

$$\begin{aligned}i_E &= [(K_t + R_t^C - (R_t^P - P_t)) i_{A_t} - (R_t^C i_{L_t} - (R_t^P - P_t) i_{F_t})] / K_t \\ &= i_{A_t} + (i_{A_t} - i_{L_t}) R_t^C / K_t - (i_{A_t} - i_{F_t}) (R_t^P - P_t) / K_t \\ &= i_{A_t} + (i_{A_t} - i_{L_t}) \theta_t^{-1} - (i_{A_t} - i_{F_t}) \theta_t^{-1} (R_t^P - P_t) / R_t^C\end{aligned}$$

which is the non-stochastic part of the equation for ROE above, assuming taxes (τ_t) and risk margins (v_t) are both zero. So in the absence of taxes and risk margins, the expected value of ROE for an insurance cohort (excluding the initial profit or loss on underwriting) is equal to the required ROE for the same insurance fund in run-off.

Note that this conclusion remains valid in the presence of taxes by simply calculating the net of tax required rate of return above as:

$$i_E = (1 - \tau_{t+1})(A i_A - L i_L)/E$$

The scenarios under which this finding remains valid in the presence of risk margins are harder to identify, but Taylor demonstrates two scenarios in which the expected rate of return on equity is constant from period to period and equal to the insurance fund required rate of return:

Condition 1: Ratio of risk margins over solvency varies inversely with the payment pattern:

$$v_{t+1}/\theta_t \text{ varies inversely with } (C_{t+1} + E_{t+1})/R_t^C$$

Condition 2: Risk margins are constant and the payment pattern follows a geometric pattern:

$$\begin{aligned}v_t &= v, \text{ and} \\ C_t + E_t &= cp^t\end{aligned}$$

where v , c and p are constants.

The result Taylor (1994) has derived is the conditions under which any insurance operation in run-off (i.e. no new policies being underwritten), and holding discounted reserves for claims, claims-handling expenses and an additional risk margin, will produce an expected ROE that is equal to that required under CAPM given the capital structure of the insurance fund. In addition to the return generated by the insurance cohort in run-off, there may be an instantaneous profit or loss recognised at time $t=0$.

Using the Internal Rate of Return (IRR) method the fair premium is defined as the premium such that the net present value of the flows to shareholders is zero, where the discount rate is equal to that rate required by those shareholders. So the conditions under which ROE_t is constant for all t will produce premiums with zero instantaneous profit at time $t=0$ if the rate required by shareholders is:

$$i_E = (1 - \tau_{t+1})(A i_A - L i_L)/E$$

Similarly, under these same conditions we can say that the IRR method will produce premiums that include an:

$$\begin{aligned} \text{instantaneous profit at time } t=0, & \text{ if } i_E > (1 - \tau_{t+1})(A i_A - L i_L)/E, \\ \text{instantaneous loss at time } t=0, & \text{ if } i_E < (1 - \tau_{t+1})(A i_A - L i_L)/E, \end{aligned}$$

Taylor (1994) goes on to show the conditions under which the Myers-Cohn model is derivable or consistent with the IRR method with the above assumptions.

We believe that the fundamental question, then, is whether the return required by shareholders for investing capital in an insurance operation is equal to the required return of an insurance fund in run-off.

It is our view that shareholders investing capital in an insurance operation that is not in run-off will face two additional forms of risk that could each be correlated with market wealth, and therefore the required return in a CAPM framework would be different from a run-off portfolio. These were mentioned earlier, and we define them formally as:

- distribution risk, defined as uncertainty in the volume of business sold, measured as the amount of new technical reserves for claims and claims handling expenses relative to available capital
- underwriting risk, defined as prospective premium adequacy on that business, measured as the instantaneous profit or loss recognised in premiums at underwriting.

In the remainder of this section we show that:

1. the actual ROE of an insurance cohort can be defined to include distribution risk and underwriting risk, and the conditions under which this will be constant from period to period
2. the required rate of return for an insurance operation not in run-off can be compared to that of Taylor's insurance fund, with an additional allowance for distribution risk and underwriting risk.

3.3 Alternative model of an insurance cohort

In Taylor's (1994) cohort model, he explicitly assumes that the profit or loss at underwriting is an unknown constant, that is, R_0 is a constant based on the expected value of claims, expenses, investment returns and earned premiums in all future periods. This means that one of the key risks facing an insurance company (i.e. underwriting risk) is assumed to be riskless. Taylor's model instead includes only reserve risk and investment risk.

Taylor (1994) defines the premium cash flow to be an unknown constant with a known distribution over time, that is:

$$\begin{aligned} \sum_{t=0}^T \varphi_t &= 1, \text{ with } \varphi_t \text{ being known constants for all } t \\ P_t &= \varphi_t P \end{aligned}$$

where P is total written premium, and P_t is premium earned in period t .

Premiums are assumed to be independent of market wealth:

$$\beta_P = 0$$

We believe this to be a poor representation of the risks facing most insurance entities, which face risk from both the volume of sales underwritten in any one period, and the underwriting profit earned on those sales. Instead we propose an alternative model of an insurance cohort of policies underwritten in a single period $t=0$, using the same notation as Taylor (1994), except that in our model the level of premiums received and liabilities generated are assumed to be risky, and potentially correlated to market wealth within the underwriting period.

Specifically, we assume $\tilde{\omega}$ to be a random variable representing the volume of business sold during period $t=0$. We define $\tilde{\omega}$ such that $\tilde{\omega} > 0$ and $E[\tilde{\omega}] = 1$, and that in the case of $\tilde{\omega} = 1$ our model will simplify to the Taylor cohort model, that is:

$$\begin{aligned} \text{Claims} & \quad \tilde{\omega} \tilde{C}_t \\ \text{Claims-handling expenses} & \quad \tilde{\omega} \tilde{E}_t \end{aligned}$$

But note that the potential correlation with market wealth during period $t=0$ means that:

$$\begin{aligned} \beta_{\omega} & \neq 0, t = 0 \\ \beta_{\omega} & = 0, t > 0 \end{aligned}$$

We also define $\tilde{\gamma}$ to be a random variable representing the premium ratio factor for the given volume of business sold during period $t=0$. We define $\tilde{\gamma}$ such that $\tilde{\gamma} > 0$ and $E[\tilde{\gamma}] = 1$, and that in the case of $\tilde{\gamma} = 1$ our model will simplify to the Taylor (1994) cohort model, that is:

$$\begin{aligned} \sum_{t=0}^T \varphi_t & = 1, \text{ with } \varphi_t \text{ being known constants for all } t \\ P_t & = \varphi_t \tilde{\gamma} P \end{aligned}$$

where P is the same constant written premium value as used by Taylor.

Similarly, note the potential correlation of premium with market wealth during period $t=0$:

$$\begin{aligned} \beta_{\gamma} & \neq 0, t = 0 \\ \beta_{\gamma} & = 0, t > 0 \end{aligned}$$

Following on from the definition of business volume, the claims liability is defined at time zero as:

$$\begin{aligned} \tilde{R}_0^C & = \sum_{s=0}^T r_{L_{0:s}}^{-1} (1 + v_{s+1}) (\tilde{\omega} C_{s+1} + \tilde{\omega} E_{s+1}) \\ & = \tilde{\omega} \sum_{s=0}^T r_{L_{0:s}}^{-1} (1 + v_{s+1}) (C_{s+1} + E_{s+1}) \end{aligned}$$

$= \tilde{\omega} R_0^C$, using the same definition of R_0^C as Taylor (1994).

The unearned premium reserve is defined at time zero as:

$$\begin{aligned} \tilde{R}_0^P &= \sum_{s=0}^T r_{F_0:s-1}^{-1} \tilde{P}_s \\ &= \sum_{s=0}^T r_{F_0:s-1}^{-1} \varphi_s \tilde{\gamma} P \\ &= \tilde{\gamma} \sum_{s=0}^T r_{F_0:s-1}^{-1} \varphi_s P \end{aligned}$$

= $\tilde{\gamma} R_0^P$, using the same definition of both P and R_0^P as Taylor (1994).

Similarly, it can be shown that:

$$\begin{aligned} \tilde{R}_t^C &= \tilde{\omega} R_t^C \\ \tilde{R}_t^P &= \tilde{\gamma} R_t^P \end{aligned}$$

The recursive relationships for claims and unearned premium will still hold, as they are a feature of the cohort model and the $\tilde{\omega}$ and $\tilde{\gamma}$ multipliers are both independent of t , that is:

$$\tilde{R}_{t+1}^C = r_{L_t} \tilde{R}_t^C - (1 + v_{t+1})(\tilde{\omega} C_{t+1} + \tilde{\omega} E_{t+1})$$

which expands to:

$$\tilde{\omega} R_{t+1}^C = r_{L_t} \tilde{\omega} R_t^C - (1 + v_{t+1})(\tilde{\omega} C_{t+1} + \tilde{\omega} E_{t+1})$$

and then simplifies back to the original:

$$R_{t+1}^C = r_{L_t} R_t^C - (1 + v_{t+1})(C_{t+1} + E_{t+1})$$

And:

$$\tilde{R}_{t+1}^P = r_{F_t} \tilde{R}_t^P - r_{F_t} \tilde{P}_t$$

which expands to:

$$\tilde{\gamma} R_{t+1}^P = r_{F_t} \tilde{\gamma} R_t^P - r_{F_t} \varphi_t \tilde{\gamma} P$$

and then simplifies back to the original:

$$R_{t+1}^P = r_{F_t} R_t^P - r_{F_t} P_t$$

Now we define: $\tilde{R}_t = \tilde{R}_t^C - \tilde{R}_t^P$

And consider:

$$\begin{aligned}
r_{A_t} \tilde{R}_t - \tilde{R}_{t+1} &= r_{A_t} (\tilde{R}_t^C - \tilde{R}_t^P) - (\tilde{R}_{t+1}^C - \tilde{R}_{t+1}^P) \\
&= r_{A_t} (\tilde{\omega} R_t^C - \tilde{\gamma} R_t^P) - (r_{L_t} \tilde{\omega} R_t^C - \tilde{\omega} (1 + v_{t+1})(C_{t+1} + E_{t+1}) - r_{F_t} \tilde{\gamma} R_t^P + r_{F_t} \varphi_t \tilde{\gamma} P) \\
&= (r_{A_t} - r_{L_t}) \tilde{\omega} R_t^C - (r_{A_t} - r_{F_t}) \tilde{\gamma} R_t^P + \tilde{\omega} (1 + v_{t+1})(C_{t+1} + E_{t+1}) - r_{F_t} \varphi_t \tilde{\gamma} P
\end{aligned}$$

This can then be substituted into the formula for ROE by first defining the income from the insurance cohort at time $t+1$ as:

$$\begin{aligned}
\tilde{Q}_{t+1} &= \tilde{P}_t + \tilde{I}_{t+1} - \tilde{\omega} \tilde{E}_{t+1} - \tilde{\omega} \tilde{C}_{t+1} - (\tilde{R}_{t+1} - \tilde{R}_t) \\
ROE_t &= (1 - \tau_{t+1}) [\tilde{P}_t + \tilde{I}_{t+1} - \tilde{\omega} \tilde{E}_{t+1} - \tilde{\omega} \tilde{C}_{t+1} - (\tilde{R}_{t+1} - \tilde{R}_t)] / K_t \\
&= (1 - \tau_{t+1}) [\varphi_t \tilde{\gamma} P - (\tilde{R}_{t+1} - \tilde{R}_t) + (\bar{i}_{A_t} + i_{A_t})(\tilde{R}_t + K_t + \varphi_t \tilde{\gamma} P) \\
&\quad - \tilde{\omega} \bar{E}_{t+1} - \tilde{\omega} E_{t+1} - \tilde{\omega} \bar{C}_{t+1} - \tilde{\omega} C_{t+1}] / K_t \\
&= (1 - \tau_{t+1}) [i_{A_t} K_t + (1 + i_{A_t}) \tilde{R}_t - \tilde{R}_{t+1} + (1 + i_{A_t}) \varphi_t \tilde{\gamma} P \\
&\quad + \bar{i}_{A_t} (\tilde{R}_t + K_t + \varphi_t \tilde{\gamma} P) - \tilde{\omega} \bar{E}_{t+1} - \tilde{\omega} E_{t+1} - \tilde{\omega} \bar{C}_{t+1} \\
&\quad - \tilde{\omega} C_{t+1}] / K_t \\
&= (1 - \tau_{t+1}) [i_{A_t} K_t + (r_{A_t} \tilde{R}_t - \tilde{R}_{t+1}) + r_{A_t} \varphi_t \tilde{\gamma} P \\
&\quad + \bar{i}_{A_t} (\tilde{R}_t + K_t + \varphi_t \tilde{\gamma} P) - \tilde{\omega} \bar{E}_{t+1} - \tilde{\omega} E_{t+1} - \tilde{\omega} \bar{C}_{t+1} \\
&\quad - \tilde{\omega} C_{t+1}] / K_t
\end{aligned}$$

(using the substitution $r_x = 1 + i_x$)

Substituting for $r_{A_t} \tilde{R}_t - \tilde{R}_{t+1}$:

$$\begin{aligned}
&= (1 - \tau_{t+1}) [i_{A_t} K_t + [(r_{A_t} - r_{L_t}) \tilde{\omega} R_t^C - (r_{A_t} - r_{F_t}) \tilde{\gamma} R_t^P \\
&\quad + \tilde{\omega} (1 + v_{t+1})(C_{t+1} + E_{t+1}) - r_{F_t} \varphi_t \tilde{\gamma} P] + r_{A_t} \varphi_t \tilde{\gamma} P \\
&\quad + \bar{i}_{A_t} \left(\frac{\tilde{P}}{P} R_t + K_t + \varphi_t \tilde{P} \right) - \tilde{\omega} \bar{E}_{t+1} - \tilde{\omega} E_{t+1} - \tilde{\omega} \bar{C}_{t+1} \\
&\quad - \tilde{\omega} C_{t+1}] / K_t \\
&= (1 - \tau_{t+1}) [i_{A_t} K_t + (r_{A_t} - r_{L_t}) \tilde{\omega} R_t^C - (r_{A_t} - r_{F_t}) \tilde{\gamma} (R_t^P - \varphi_t P) \\
&\quad + \tilde{\omega} v_{t+1} (C_{t+1} + E_{t+1}) + \bar{i}_{A_t} (\tilde{\gamma} R_t + K_t + \varphi_t \tilde{\gamma} P) \\
&\quad - \tilde{\omega} \bar{E}_{t+1} - \tilde{\omega} \bar{C}_{t+1}] / K_t
\end{aligned}$$

Dividing through with the K_t divisor and substituting for the same solvency ratio defined earlier:

$$R_t^C / K_t = \theta_t^{-1}$$

$$(R_t^P - \varphi_t P) / K_t = \theta_t^{-1} (R_t^P - \varphi_t P) / R_t^C$$

$$ROE_t = (1 - \tau_{t+1}) [i_{A_t} + (i_{A_t} - i_{L_t}) \tilde{\omega} \theta_t^{-1}$$

$$- (i_{A_t} - i_{F_t}) \tilde{\gamma} \theta_t^{-1} (R_t^P - \varphi_t P) / R_t^C$$

$$+ \tilde{\omega} v_{t+1} (C_{t+1} + E_{t+1}) / K_t + \bar{z}_{t+1}]$$

where

$$\bar{z}_{t+1} = \bar{i}_{A_t} [(\tilde{\gamma} R_t + K_t + \varphi_t \tilde{\gamma} P) - (\tilde{\omega} \bar{E}_{t+1} + \tilde{\omega} \bar{C}_{t+1}) / K_t]$$

which represents a random variable with zero mean.

Now the component of this formula that is not \bar{z}_{t+1} is random with respect to $\tilde{\omega}$ and $\tilde{\gamma}$, both of which are independent of t . Therefore the conditions under which this will be constant from period to period will be the same as those conditions found by Taylor. Again this formula only applies to a cohort (i.e. a run-off portfolio).

3.4 Alternative required return on equity

As mentioned previously, Taylor (1994) assumed that the required cost of capital for an insurer is given by the equation:

$$i_E = \frac{(A i_A - L i_L)}{E}$$

Now we don't believe that this assumption (relating as it does to a run-off insurance fund) is relevant or reliable for estimating the required rate of return of a shareholder investing in an insurance operation which faces risk from distribution and underwriting. In fact we don't think that any cohort model is capable of representing the underwriting risk that faces an insurance investor. So instead we now outline a portfolio model of an insurance operation, which includes all cash flows between stakeholders over time, rather than a single cohort of policies underwritten in a single period.

We define the following new model (ignoring any similarities in notation from the previous model) with the following random cash flows during period $[t - 1, t]$:

Earned premiums (net of expenses)	\tilde{P}_t
Claim payments	\tilde{C}_t
Claims-handling expenses	\tilde{E}_t
Investment income	\tilde{I}_t
Tax	\tilde{T}_t
Flows to shareholders	\tilde{F}_t

We have removed the cohort model convention that there is a difference in timing between premiums and claims, and instead we assume that all cash flows with subscript t occur at the end of the period $[t - 1, t]$.

We also define the following random stock values at time t :

Insurer's capital	\tilde{K}_t
Insurer's financial assets	\tilde{A}_t
Technical liabilities	$\tilde{L}_t = \tilde{L}_t^C - \tilde{L}_t^P$

(consisting of claims liability minus the unearned premium reserve)

In our portfolio model the volume of business written in any period and the premium adequacy of that business is not a constant. However, for simplicity, we will retain one assumption from Taylor's cohort model, which is that the underlying claims distribution for each policy is known without model error or parameter error. Therefore the claims reserves for previously written business are not random and will change in a known manner over time.

Income from the insurance operation during the period $[t-1, t]$ (i.e. at time t) is defined based on the cash flows and technical reserves as:

$$\tilde{Q}_t = \tilde{P}_t + \tilde{I}_t - \tilde{E}_t - \tilde{C}_t - (\tilde{L}_t - \tilde{L}_{t-1})$$

The flows to shareholders during the period $[t-1, t]$ (i.e. at time t) is the income from insurance operations plus any change in capital, net of tax:

$$\tilde{F}_t = \tilde{K}_{t-1} - \tilde{K}_t + \tilde{Q}_t - \tilde{T}_t$$

And the net of tax rate of return on capital to shareholders is:

$$\tilde{R}_t = (1 - \tau_t) \tilde{Q}_t / \tilde{K}_{t-1}$$

Where τ_t is the rate of tax in period $[t-1, t]$.

The following definitions of rates of return are also defined:

Rate of return on total assets	\tilde{r}_t^A
Rate of return on claim liabilities	\tilde{r}_t^L
Rate of return on market wealth	\tilde{r}_t^M
Rate of return on risk-free asset	\tilde{r}_t^F

All rates of return are assumed to follow the Capital Asset Pricing Model (CAPM), where:

$$\tilde{r}^x = 1 + \tilde{r}^x, \text{ for asset } x$$

$$E[\tilde{r}^x] = r^F + \beta_x (E[\tilde{r}^M] - r^F)$$

$$\beta_x = \text{Cov}[\tilde{r}^x, \tilde{r}^M] / V[\tilde{r}^M]$$

Using the definition of the rate of return on claim liabilities, and the assumption that claims and claims-handling expenses only relate to business written in prior periods, we can define the claims liability beta as:

$$\begin{aligned} \beta_{L_t} &= \text{Cov}[\tilde{r}_t^L, \tilde{r}_t^M] / V[\tilde{r}_t^M] \\ &= \text{Cov} \left[\frac{\tilde{C}_t + \tilde{E}_t}{\tilde{L}_{t-1}^C}, \tilde{r}_t^M \right] / V[\tilde{r}_t^M] \end{aligned}$$

or:

$$\tilde{L}_{t-1}^C \beta_{L_t} = \text{Cov}[(\tilde{C}_t + \tilde{E}_t), \tilde{r}_t^M] / V[\tilde{r}_t^M]$$

We define the recursive relationship for \tilde{L}_t^C :

$$\tilde{L}_t^C = r_{t-1}^L \tilde{L}_{t-1}^C - (1 + v_t)(E[\tilde{C}_t] + E[\tilde{E}_t]) + \tilde{\omega}_t$$

where v_t is the risk margin applied to the expected value of claims and claims-handling expenses in claims liabilities, and $\tilde{\omega}_t$ is a non-negative random variable representing the claims liabilities for business written during the period (assuming that written business does not have any claims or claims-handling expenses paid within the same time period as underwriting). Note that in this equation the claims discount factor is the constant expected value:

$$r_{t-1}^L = E[\tilde{r}_{t-1}^L]$$

The reason for this is that the underlying claims distribution for each policy is known without model error or parameter error, and hence the central estimate claims reserves for previously written business will change in a known manner over time (although \tilde{r}_t^L is still correlated with \tilde{r}_t^M). Therefore:

$$\text{Cov}[\tilde{L}_t^C, \tilde{r}_t^M] = \text{Cov}[\tilde{\omega}_t, \tilde{r}_t^M]$$

We also define the recursive relationship for \tilde{L}_t^P :

$$\tilde{L}_t^P = r_{t-1}^F \tilde{L}_{t-1}^P - \tilde{P}_t + \varphi \tilde{\omega}_t + \tilde{\gamma}_t$$

where:

- φ is the fair premium for one unit of claims liabilities (assumed to be known and constant)
- $\tilde{\omega}_t$ is the claims liabilities for business written during the period (as above)
- $\tilde{\gamma}_t$ is a random variable representing the additional profit or loss on business underwritten during the period relative to the fair premium (assuming no premium is earned during the same period it is written).

Note that total written premium in period t is equal to $\varphi \tilde{\omega}_t + \tilde{\gamma}_t$, and that if $\tilde{\gamma}_t = 0$ then the premium collected is equal to the fair premium.

Given that all premiums earned during a period will relate to business underwritten during a prior period, \tilde{P}_t is independent of \tilde{r}_t^M . Therefore:

$$\text{Cov}[\tilde{L}_t^P, \tilde{r}_t^M] = \varphi \text{Cov}[\tilde{\omega}_t, \tilde{r}_t^M] + \text{Cov}[\tilde{\gamma}_t, \tilde{r}_t^M]$$

We also define the investment return based on assets held at time $t - 1$:

$$\tilde{I}_t = \tilde{r}_t^A \tilde{A}_{t-1}$$

$$\text{where } \tilde{A}_{t-1} = \tilde{K}_{t-1} + \tilde{L}_{t-1}^C - \tilde{L}_{t-1}^P$$

Now we want to examine the covariance between \tilde{R}_t and the rate of return on market wealth during period $[t - 1, t]$:

$$\begin{aligned} \text{Cov}[\tilde{R}_t, \tilde{r}_t^M] &= \text{Cov}[(1 - \tau_t) \tilde{Q}_t / \tilde{K}_{t-1}, \tilde{r}_t^M] \\ &= (1 - \tau_t) / \tilde{K}_{t-1} \text{Cov}[\tilde{Q}_t, \tilde{r}_t^M] \end{aligned}$$

since τ_t and \tilde{K}_{t-1} are both independent of the market return at time t . Substituting for \tilde{Q}_t , and using the fact that both \tilde{P}_t and \tilde{L}_{t-1} are independent of the market return at time t :

$$= (1 - \tau_t) / \tilde{K}_{t-1} \text{Cov}[\{\tilde{I}_t - \tilde{E}_t - \tilde{C}_t - \tilde{L}_t\}, \tilde{r}_t^M]$$

Substituting for \tilde{L}_t and \tilde{L}_t :

$$= (1 - \tau_t) / \tilde{K}_{t-1} \text{Cov} [\{ \tilde{i}_t^A \tilde{A}_{t-1} - \tilde{E}_t - \tilde{C}_t - \tilde{L}_t^C + \tilde{L}_t^P \}, \tilde{r}_t^M]$$

Now we use the covariance formulas from above and expand the covariance term:

$$\text{Cov} [\tilde{R}_t, \tilde{r}_t^M] = (1 - \tau_t) / \tilde{K}_{t-1} \{ \tilde{A}_{t-1} \text{Cov} [\tilde{i}_t^A, \tilde{r}_t^M] - \text{Cov} [\tilde{E}_t, \tilde{r}_t^M] - \text{Cov} [\tilde{C}_t, \tilde{r}_t^M] + (\varphi - 1) \text{Cov} [\tilde{\omega}_t, \tilde{r}_t^M] \\ + \text{Cov} [\tilde{\gamma}_t, \tilde{r}_t^M] \}$$

Now we define betas to represent the correlation with market wealth for the two variables $\tilde{\omega}_t$ and $\tilde{\gamma}_t$, such that:

$$\beta_\omega = \text{Cov} [\tilde{\omega}_t / \tilde{\omega}_{t-1}, \tilde{r}_t^M] / \text{V}[\tilde{r}_t^M]$$

$$\beta_\gamma = \text{Cov} [\tilde{\gamma}_t / \tilde{\gamma}_{t-1}, \tilde{r}_t^M] / \text{V}[\tilde{r}_t^M]$$

Finally, dividing by $\text{V}[\tilde{r}_t^M]$, and using the definition of the claims liability beta we get:

$$\beta_R = (1 - \tau_t) \{ (\varphi - 1) \tilde{\omega}_{t-1} \beta_\omega + \tilde{\gamma}_{t-1} \beta_\gamma + \tilde{A}_{t-1} \beta_A - \tilde{L}_{t-1}^C \beta_L \} / \tilde{K}_{t-1}$$

And therefore that the required rate of return is:

$$i_R = \frac{(1 - \tau_t) \{ (\varphi - 1) \tilde{\omega}_{t-1} i_\omega + \tilde{\gamma}_{t-1} i_\gamma + \tilde{A}_{t-1} i_A - \tilde{L}_{t-1}^C i_L \}}{\tilde{K}_{t-1}}$$

Which is similar to Taylor's required return on equity (net of tax) except for the inclusion of factors to compensate for the non-diversifiable risk of the profit or loss on the business underwritten during the period ($\tilde{\gamma}_{t-1} i_\gamma$), and the volume of claims liabilities on that business $(\varphi - 1) \tilde{\omega}_{t-1} i_\omega$.

Now i_R will be higher than Taylor's assumed required rate of return if $(\varphi - 1) \tilde{\omega}_{t-1} i_\omega + \tilde{\gamma}_{t-1} i_\gamma > 0$, noting that φ and $\tilde{\omega}_t$ are defined to be non-negative but $\tilde{\gamma}_t$ can be positive or negative.

It is easy to hypothesise reasons why i_ω and i_γ would be positive. During periods of high economic activity and growth, new businesses will arise and new assets will be created, leading to greater demand for insurance products, therefore the volume of insurance industry sales (and resulting claims liabilities) will increase. Furthermore, the greater demand for insurance protection will in itself lead to higher premium adequacy (as demand increases relative to supply), and so both $\tilde{\omega}_t$ and $\tilde{\gamma}_t$ are likely to be positively correlated with market wealth.

Also, if i_ω is positive then $(\varphi - 1) \tilde{\omega}_{t-1} i_\omega$ is positive if $\varphi > 1$ (i.e. the fair premium is greater than claims liabilities). Finally $(\varphi - 1) \tilde{\omega}_{t-1} i_\omega + \tilde{\gamma}_{t-1} i_\gamma$ can only be negative if $\tilde{\gamma}_{t-1} < (1 - \varphi) \tilde{\omega}_{t-1} i_\omega / i_\gamma$.

In summary, the required rate of return for an insurer is higher than Taylor's formula:

$$i_E = \frac{(Ai_A - Li_L)}{E}$$

by the inclusion of an allowance for the non-diversifiable risk within distribution (sales volume) and underwriting (premium adequacy), and the above conditions indicate the conditions under which the allowance for these additional risks will be positive.

4 CONSUMER SURPLUS – RESPONSE TO JOHNSTON

Johnston (2004) postulates the existence of an insurance surplus, defined as “the difference between the sum of the values placed by consumers upon a portfolio of insurance policies and the market value of this portfolio” (2004:4). Johnston believes that the size of the insurance surplus creates a range of feasible insurance premiums in which there is a positive benefit to both shareholders and consumers from entering into an insurance contract. At one extreme, insurance premiums could be set equal to the market value of the underlying portfolio, in which case the surplus accrues to policyholders, and at the other extreme premiums could be set to reflect the consumer’s potential value, with the surplus accruing to shareholders. Johnston demonstrates why consumers in a voluntary insurance market may be willing to pay premiums higher than the fair market value of the insurance portfolio and believes that it may be appropriate to set regulated premiums (even in a compulsory class) above the fair premium, but within the feasible range.

4.1 Consumer surplus

In common economic terms the surplus defined by Johnston is known as consumer surplus (see Mansfield & Yohe 2004). For most goods and services there exists a negative relationship between price per unit of a good or service and the quantity demanded at that price (within a specified market and time period). In other words, the quantity demanded of a good or service increases as the price falls. This is known as the demand curve (see Figure 1). In accordance with common usage we display the demand curve on a two-dimensional axis where price is on the vertical axis and quantity is on the horizontal axis. This is consistent with Mansfield and Yohe that “demand curves almost always slope downward to the right” (2004:11).

We follow Mansfield and Yohe in defining the consumer surplus as “the difference between what the consumer would be willing to pay and what the consumer actually has to pay” (2004:93). Figure 2 shows the consumer surplus as the area underneath the demand curve and above the actual price.

We agree with Johnston that consumer surplus represents positive value to consumers, and that “taking out the insurance policy [at the actual premium] will be an NPV-positive decision for” consumers (2004:450). Johnston implies this result is unique to insurance (“What’s so special about insurance?”), because consumers don’t hold a diverse portfolio of the market assets, but instead tend to have a large proportion of their wealth tied up in a small number of concentrated assets (for example their house and car), and so their risk aversion means they place a much higher value on insurance than the insurance investor. However we note that consumer utility theory indicates that all open voluntary markets with downward-sloping demand curves will produce consumer surplus.

4.2 Producer surplus

Similarly, but in contrast to Johnston, we describe a typical positive relationship between price per unit of a good or service and the quantity supplied at that price (within a specified market and time period), which is known as the supply curve. The existence of this curve allows us to define the producer surplus as the difference between the amount producers receive and the “minimum prices that would have been required to get them to produce and sell their output” (Mansfield & Yohe 2004:325).

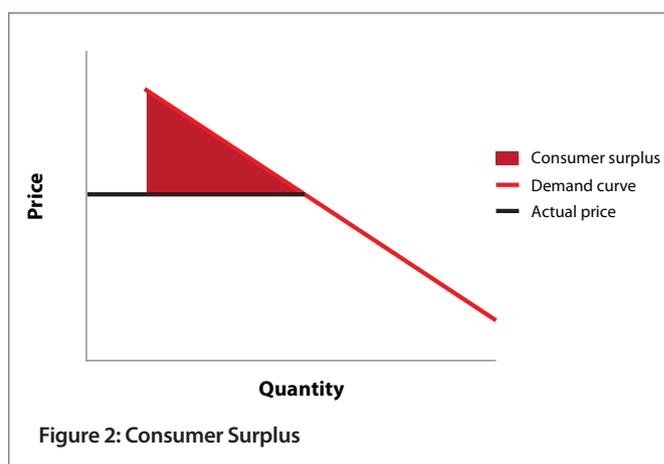
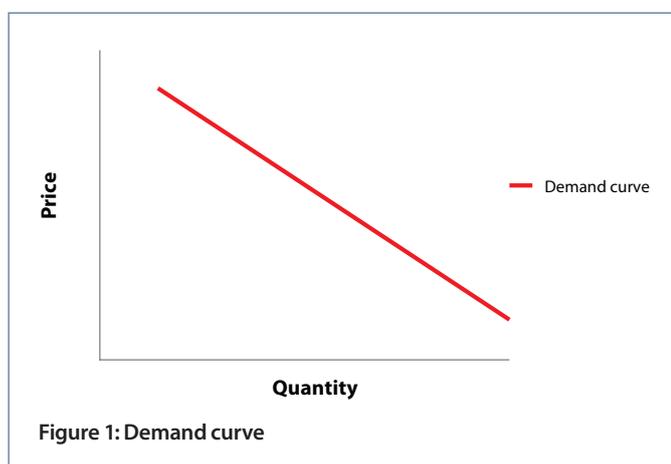


Figure 3 shows the producer surplus as the area underneath the market price and above the supply curve.

It is worth clarifying that producer surplus refers to the excess profit of producers, where producers could be either the firms operating within the market or the “owners of the inputs that firms employ” (Mansfield & Yohe 2004:326). In fact Mansfield and Yohe define producer surplus as:

“the sum of:

1. The aggregate profits of firms supplying good X to the market, and
2. The excess compensation paid to the owners of the inputs employed in the production of X” (2004:326).

In competitive markets the producer surplus usually accrues to the owners of the resource inputs rather than to firms. This is consistent with Miller who states:

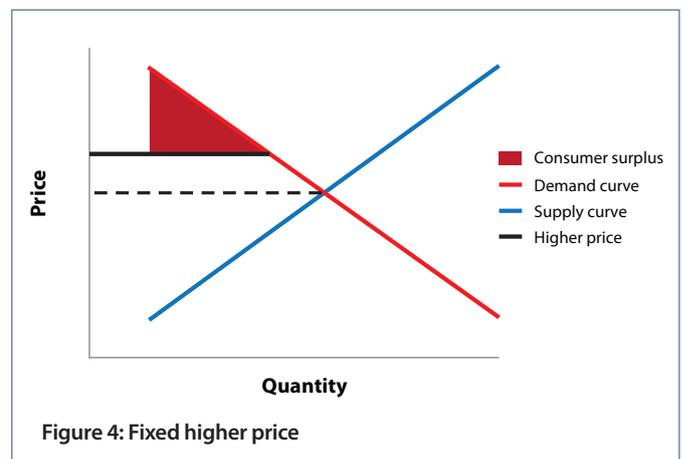
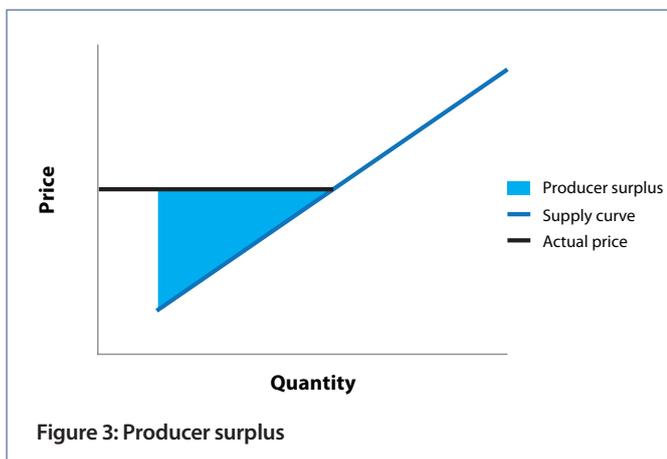
“Even though the long-run equilibrium position of the competitive firm is one of zero economic profits, there may still be some resource owners earning positive economic profits” (1982: 237).

4.3 Surplus in competitive markets

Total surplus is the combination of consumer surplus and producer surplus. It is “a measure of the aggregate net benefit accruing to both consumers and suppliers” (Mansfield & Yohe 2004:326). Mansfield and Yohe demonstrate that “total surplus is maximized when output is at the perfectly competitive level” (2004:328). Any distortion to the competitive price will result in a reduction in total surplus, with the difference referred to as “dead-weight loss” (2004:330).

In particular, if price is fixed higher than the competitive price, demand will be lower, and consumer surplus will be reduced, as shown in Figure 4.

In this situation the consumer surplus is likely to still be positive, meaning there is still a positive benefit to consumers from participating in the market, but the value to consumers will be less than at the competitive price. In effect, the higher price has caused a transfer of wealth from consumers to shareholders *relative to the situation under the competitive price*. We believe this interpretation is consistent with Myers and Cohn when they describe a price higher than fair as resulting in “a wealth transfer from the policyholder to the shareholder” (1981:57), and suggest that Johnston misinterpreted this statement when he stated:



“It is not the case, as is claimed in Myers and Cohn (1987), that setting prices above the lower end of this range implies a ‘wealth transfer’ from consumers to shareholders. On the contrary, consumers entering into insurance contracts at prices in the interior of the feasible range have their expected utility improved. They are better off (‘wealthier’) having entered into the insurance contract than they were beforehand” (2004:451).

To repeat, when price is held higher than the competitive price, some consumers will still benefit from participating in the market (there is some consumer surplus), but there is a transfer of wealth from consumers to shareholders relative to a competitive market.

4.4 Range of feasible premiums

Johnston defines a feasible range of premiums as including any that generate positive value for both consumers and shareholders:

“The feasible range of insurance premiums is the range of premiums that make entering into the insurance contract an NPV-positive proposition for both the shareholders and the customers of the insurance company” (2004:443-444).

Now the minimum premium of this range will generate zero Net Present Value (NPV) for the firm. In this scenario, premium would be equal to the average cost of all inputs (including capital). This is also the long-run equilibrium premium in a competitive market. Johnston agrees with our view that the competitive premium will form the lower bound of this range: “At equilibrium in a perfectly competitive market, premiums will be set at the lower boundary of the feasible range” (2004:452).

The feasible range described by Johnston has the competitive premium as the lower bound and includes any higher premiums that consumers would be willing to pay, each of which would result in a reduced (but still positive) consumer surplus. Premiums higher than average total cost will result in positive economic profits to firms. In a competitive market this would encourage new entrants into the market; alternatively, if premiums remain above the average cost of inputs than the market must not be competitive. At the extreme upper bound, a monopoly would charge the highest premium that each individual consumer would be willing to pay: “In an un-regulated monopoly market, premiums will be set at the upper boundary of the feasible range” (Johnston 2004:452). And:

“In order to actually reach the upper boundary of the feasible region, the insurer would potentially need to tailor premiums specifically to each customer – as to achieve the maximum while retaining all customers they would need to charge each customer the maximum he or she will bear” (Johnston 2004:452-453).

In contrast to our definition of fair premiums, Johnston goes on to advocate that regulators may wish to allow premiums higher than competitive premiums: “In some regulated markets it may also be appropriate to set premiums above the Myers-Cohn ‘fair’ price” (2004:444). And: “Premiums set somewhere away from the lower boundary of the feasible range might be justified” (2004:453).

Any factor that causes the market premium to be higher than the long-run equilibrium competitive premium will result in a transfer of wealth from consumers to producers relative to the competitive premium. This transfer of wealth is a direct result of producers earning an excessive return at the expense of consumers. Furthermore, this will result in dead-weight loss, which reduces the utility, or social welfare, generated by the overall economy. For these reasons we don’t believe that a regulator seeking a fair premium should consider eroding consumer surplus by allowing premiums higher than the maximum competitive premium (subject to uncertainty due to estimation error).

5 ECONOMIC PROFIT MARGINS – RESPONSE TO TAYLOR

In 2004 Taylor prepared a report for the Motor Accidents Authority (MAA) of NSW: “Economic profit margins in compulsory third party premiums” in response to Australian insurance industry concerns in relation to previous correspondence and a spreadsheet model developed by the firm Taylor Fry for the then New South Wales compulsory third party (CTP) regulator to assist with the premium rate filing process in the state’s CTP scheme. This report was subsequently published as an appendix to the MAA’s Review of Insurer Profit, which was submitted to the NSW Legislative Council’s Standing Committee of Law and Justice for the seventh review of the Motor Accidents Authority and the Motor Accidents Council in 2006.

5.1 Arbitrage-free framework

Section 3.1 of Taylor’s report includes an arbitrage-free framework to determine the fair insurance premium (later referred to as the Myers-Cohn method). Taylor states that:

“from an economic viewpoint, the total premium represents the sum such that an insurer is indifferent between:

- paying that (fixed) sum; and
- undertaking to fund the financial obligations arising from the insurance contract” (Taylor 2004:6).

Taylor defines the fair premium for an insurance contract as:

$$P = \sum_t E[m_t X_t]$$

We refer to this as the Taylor premium (although it is simply a generalised form of the standard Myers-Cohn formula). The Taylor premium is described as:

“the present value of the expectation (in the statistical sense) of the obligations payable by the insurer, where the present value is calculated according to stochastic discount factors” (Taylor 2004:6).

Lets consider the arbitrage-free framework in more detail. The first option provided by Taylor in this example is for a company forced to pay a fixed sum – we refer to this as a fixed expense. Therefore we see that the Taylor premium describes the situation of an insurer being indifferent between paying a fixed expense and paying a stochastic expense. This is a form of trade credit or expense management, and we conclude that this arbitrage-free model has no relevance in determining a premium.

However Taylor implies that his fair premium is not just an expense, but is also equal to revenue. He does this by assuming that any profit required (for example to earn a return on capital) is exactly equal to the risk discount factor applied to the stochastic obligations m_t . Taylor states that: “any profit margin in the premium is contained in [the above] expression. No explicit addition of a margin is required” (2004:7).

This assumption that there is no further profit loading required to cover the return on capital, apart from the discounting of claims liabilities, is explored in the following section.

5.2 Profit arising due to risk

Taylor anticipates the objection that his premium does not include any allowance for profit by claiming that his formula makes adequate allowance for the risks facing the insurance company: “These factors make due allowance for the ‘risk’ associated with the stochastic obligations” (2004:6).

It is worth exploring this concept in more detail. The risk allowed for in the Myers-Cohn formula relates only to the correlation of claim payments and expenses with the rate of increase in wealth in the economy generally (“non-diversifiable risk”). For convenience, this is often measured using the Capital Asset Pricing Model (CAPM). Taylor states:

“Stochastic discount factors are discussed in Appendix A. It is noted there that their precise form will depend on the particular model of the economy chosen. One possible model of the economy is that which yields the Capital Asset Pricing Model (CAPM)” (2004:7).

After describing this approach in more detail, Taylor concludes:

- Each ‘payment due from the insurer’ needs to be discounted at its own risk adjusted RoR [Rate of Return]; and
- These RoRs, and hence the insurance premium, include no allowance for diversifiable risk, that part of volatility which may be reduced to a negligible level by aggregating an increasing number of stochastically independent risks” (2004:7).

We agree that Taylor’s approach provides an adequate return to allow for the risk in claim payments. However we understand that insurance providers face more risk than simply claim payment volatility. Some key risks faced by insurers include:

- distribution risk – the risk that sales volumes will be different to those expected
- underwriting risk – the risk that premium adequacy at the time of underwriting (i.e. prospectively) will be different to what is expected.

It is easy to hypothesise reasons why these risks will be positively correlated with market wealth (i.e. non-diversifiable). During periods of high economic activity and growth, new businesses will arise and new assets will be created, leading to greater demand for insurance products, therefore the volume of insurance industry sales (and resulting claims liabilities) will increase. Furthermore, the greater demand for insurance protection will in itself lead to higher premium adequacy (as demand increases relative to supply).

In other words, the profit stream of an insurance company involves two aspects of non-diversifiable risk (sales volume and premium adequacy), which therefore must be considered in the fair premium. Taylor’s approach makes allowance only for the risk in claim payments (the “stochastic obligations” (2004:6)), but does not adequately allow for the other forms of risk faced by an insurance company, and therefore would understate the fair premium for an insurance product.

Arbitrage-free arguments are often used successfully in other parts of financial economics; however, in this example the arbitrage-free argument proposed has nothing to do with deriving a fair premium, as it simply compares two forms of expenses between which the insurer is indifferent. Instead the argument relies purely on the assumption that no additional profit is required over the discounted liabilities.

5.3 First alternative arbitrage-free framework

It may be objected that perhaps Taylor’s (2004) original arbitrage-free argument included a typographical error, and that the arbitrage-free argument should be re-expressed as follows:

The total premium represents the sum such that an insurer is indifferent between:

- *receiving* that (fixed) sum; and
- *undertaking* to fund the financial obligations arising from the insurance contract.

But of course it is quite difficult to establish any arbitrage-free argument for why an insurer would be indifferent between receiving revenue and funding a stochastic expense. This arbitrage-free argument is simply nonsensical and does nothing to derive a fair premium. Setting both equal to zero is the only, but trivial, solution to the problem.

5.4 Proposed arbitrage-free framework

Using an alternative scenario, it is possible to re-express the arbitrage argument by first introducing the concept of opportunity cost of capital (see Miller 1982; Robb et al 2012). We define the fair premium to be the sum such that an insurer is indifferent between:

- receiving that fixed sum and undertaking to fund the financial obligations arising from the insurance contract; and
- not entering the insurance contract, but rather re-deploying the assigned capital to its next best alternative use.

If the insurer is indifferent between these two options, and assuming no possibility of arbitrage, then we can equate these two options as follows:

The fair premium minus the cost of funding the stochastic obligations arising from the insurance contract is equal to the value from re-deploying the assigned capital to its next best alternative use.

In accordance with Mansfield and Yohe (2004), we define the opportunity cost of capital as the value from re-deploying it to its next best alternative use. Substituting this definition and then rearranging, we see that:

The fair premium is equal to the cost of funding the stochastic obligations arising from the insurance contract, plus an allowance for the opportunity cost of capital.

In this way, we can see that using an arbitrage-free approach similar to that used by Taylor (2004), but allowing for the recognition of the opportunity cost of capital, the fair premium can be defined as the Taylor premium (or Myers-Cohn premium) plus an allowance for the opportunity cost of capital. This approach is equivalent to that proposed by Robb et al (2012) and described in more detail in the paper “A new approach to fair premium models” on pages 35–45 of this issue of the journal (Robb 2017).

6 SUMMARY

In section 1 we described a brief history of fair premium models, beginning with the financial economics approach developed in the 1970s and 1980s in the context of North American premium rate regulation. A common characteristic of this approach is estimation of the riskiness of the insurance claims expected to arise from the policy, often referred to as the liability beta of an insurance product. The archetypal financial economics approach is the model developed by Myers and Cohn (1981).

In section 2 we demonstrated that the Myers-Cohn fair premium is inherently inconsistent with economic theory and with the Capital Asset Pricing Model (CAPM) in particular, as it ignores the non-diversifiable risk from revenue and expenses, and excludes the presence of intangible assets. These two omissions mean that Myers-Cohn fair premiums often produce rates of return that are typically much lower than the shareholder returns actually achieved by insurance companies, and in fact often much closer to the risk-free rate.

In section 3 we demonstrated that the model developed by Taylor (1994) under-estimates the fair premium by ignoring two key aspects of fundamental importance to an insurance company, being underwriting risk and sales distribution risk. We also demonstrated that the fair return proposed by Taylor is inconsistent with the (CAPM) under reasonable assumptions. We then adjusted the Taylor model to include the two additional non-diversifiable risks of underwriting and sales distribution, and a more appropriate CAPM-based fair return. We thereby developed a model that explains the size of Taylor’s underestimation of the fair premium.

In section 4 we responded to the argument by Johnston (2004) that regulators should allow premiums to be set higher than the Myers-Cohn fair premium, based on consumers’ willingness to pay premiums higher than the fair market value. We reject this argument on the grounds that it will result in a transfer of wealth from consumers to insurers relative to the competitive premium, and this transfer of wealth is a

direct result of insurers earning an excessive return at the expense of consumers. Furthermore, this will result in dead-weight loss, which reduces the utility, or social welfare, generated by the overall economy. For these reasons we don't believe that a regulator seeking a fair premium should consider eroding consumer surplus by allowing premiums higher than the maximum competitive premium.

Finally in section 5 we described an alternative justification of the Myers-Cohn premium developed by Taylor (2004) using an arbitrage-free framework. However we showed that the proposed arbitrage-free framework simply compares two forms of expenses, and so provides no basis for deriving a fair premium without the additional assumption that no profit is required over the discounted liabilities. Instead we develop an alternative arbitrage-free framework that shows the fair premium is equal to the cost of funding the stochastic obligations arising from the insurance contract, plus an allowance for the opportunity cost of capital deployed.

In summary, the current paper provides a critique and refutation of the financial economics approach propounded by Myers and Cohn (1981), and Taylor (1994), as well as a discussion of a small selection of other views relevant to the discussion of fair premiums within Australia. An alternative approach to estimating fair premiums that follows a classical micro-economics approach to determining prices in competitive markets, is contained in the paper "A new approach to fair premium models" on pages 35–45 of this issue of the journal (Robb 2017).

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Acknowledgements

I would like to thank my partners Mark and Thomas for their enduring patience and understanding over the six years of this project. I would also like to thank Adrian Gould and Geoff Atkins for their support and feedback on earlier drafts of this paper.

A new approach to fair premium models

DARREN ROBB



Darren Robb

ABSTRACT

A definition of fair premiums is proposed, using a classic microeconomics approach, as those falling within a range that is “sufficient” but not “excessive”, where each of those terms is defined in relation to competitive premiums.

A model of fair insurance premiums is then developed, starting with a definition of the inputs to general insurance products, with a particular focus on allocated financial capital, additional financial capital and intangible assets. The opportunity cost of these inputs is then defined and used to develop a model of the rate of return on allocated capital that would produce a fair premium.

The range for rates of return (net of tax) on allocated capital within a competitive market is shown to be higher than the shareholder return for an equivalent company, increased by a factor determined by the proportion of allocated capital, additional capital and intangible assets.

Finally we show that this result is substantially different to those frequently obtained by using the alternative financial economics approach propounded by authors such as Myers and Cohn (1981) and Taylor (1994), which generate rates of return that are typically lower than the shareholder return and closer to the risk-free rate.

KEYWORDS

insurance pricing, fair premium, fair price, microeconomics, intangible capital, financial capital, return on equity

INTRODUCTION

In 2012 the Institute of Actuaries of Australia formed a working party with the purpose of assessing the input that the field of economics makes to the question of appropriate profit margins, including the measure of capital that supports the business and the required rate of return on that capital. The subsequently named Profit Margins Working Party was tasked with developing a framework that Australian actuaries could use that incorporates the input from economics along with other relevant considerations, in order to advise on an appropriate rate of return and profit margin within a regulated insurance market.

The Profit Margins Working Party undertook a literature search and developed some initial ideas, which were presented at an Insights Session in August 2012 (Robb et al 2012). Following further work, the group published a draft paper at the Institute's 2012 General Insurance Seminar, entitled "Profit margins in regulated general insurance markets" (Robb et al 2012).

In 2014 the Insurance Council of Australia commissioned Deloitte Access Economics to review the published draft paper. Although this review has not been made public, the Insurance Council of Australia has provided a copy of the advice to the Institute of Actuaries of Australia and members of the Working Party. The Deloitte review (in brief summary) recommended that actuaries and insurance regulators take into account business risk and intangible assets, in accordance with the proposed framework developed by the Working Party, but some refinements to the draft paper were required to define economic concepts used in the paper more precisely. Despite this in-principle support, it is felt by the current author and others (including the peer reviewers of the Working Party's draft paper) that the draft paper lacked academic rigour, and sufficient discussion and refutation of alternative models.

The purpose of the current paper is to progress the theoretical arguments and provide a sufficient basis upon which actuaries can advise on appropriate profit margins. The present paper also provides a brief critique of the alternative financial economics approach propounded by Myers and Cohn (1981), Taylor (1994), and others, but a more substantive account of the history of fair premium models and a detailed discussion and refutation of alternative models is contained in the concurrent paper in this issue of the journal, "A partial history of fair premium models" (Robb 2017).

1 PRICE

In section 1 we briefly discuss the theory of price within any industry, including the concept of the fair price and the competitive price, and the mechanisms which determine their value. In section 2 we will discuss the fair premium within General Insurance, noting that the term premium is used within insurance interchangeably with price.

1.1 Fair price

The typical criteria for assessing prices established by a pricing regulator (if one leaves aside political criteria) will include the concept of a fair price. While there will often be some legislative or other mandate for regulation of the industry, the mandate is not usually specific about the criterion of price. However, analysis by regulators and advisers routinely ends up with the concept of fair price.

A fair price is usually described as one that provides a sufficient, but not excessive, return to the producer, manufacturer or capital provider. An oft-quoted United States Supreme Court judgement, from *Federal Power Commission vs Hope Natural Gas Company*, set out the principles for a sufficient return for a regulated entity:

"the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital" (U.S. Supreme Court 1944:320).

This description refers to consistency of returns with other entities "having corresponding risks" and sufficiency to attract capital. This principle encourages an estimate of the risks facing capital supplied by a provider, and also a model of alternative returns. This paper turns mainly to the field of economics to establish a framework for assessing fair returns on capital.

1.2 Competitive price

The concept of fair price is often linked to that of competitive price. We define competitive price as a price that would arise in a freely competitive market, wherein the long-run equilibrium price will equal the long-run average total cost. Miller states: "The long-run equilibrium of a perfectly competitive firm occurs when the price ... is equal to the minimum long-run average cost" (Miller 1982:237).

A further explanation is provided by Mansfield and Yohe:

If price were higher than average total costs for any firm, then positive economic profits would be earned and new firms would enter the industry. And if price fell short of average total costs for any firms, then those firms would eventually leave the industry.” (Mansfield & Yohe 2004:307)

In long-run competitive equilibrium with price equal to costs, firms will generate zero economic profit, sometimes called normal profit. Mansfield and Yohe describe this as “economic profits are equal to zero and returns to employed resources are normal” (2004:307).

However, the concept of fair price is not always linked to the concept of competitive price. For example Myers and Cohn propose a definition of the fair price for insurance as one where, “whenever a policy is issued, the resulting equity value equals the equity invested in support of that policy” (1981:57).

We interpret this definition as meaning that a fair price will result in the market value of an insurer being equal to its net financial assets, which implies a model of the capital asset market which has been shown to be inconsistent with the Capital Asset Pricing Model (CAPM), in the paper “A partial history of fair premium models” on pages 5–33 of this issue of the journal (Robb 2017). However if interpreted loosely to mean that when a policy is issued no economic profit is generated for the insurer, then the Myers and Cohn definition is similar to the assumption of zero economic profit implied by competitive price.

We define the fair price as the price falling within a range that is “sufficient” but not “excessive”, where each of those terms is defined in relation to the competitive price. In the remainder of section 1 we further explore the concepts of fair and competitive price, and discuss the mechanisms which determine their value. In section 2 we discuss the competitive premium specifically within the field of general insurance.

1.3 Inputs to goods and services

In many markets, production is undertaken by companies that use inputs to create goods or services that are then sold to consumers. An input is defined by Mansfield and Yohe as “anything that a firm uses in its production process” (2004:205). Schiller identifies four broad categories of inputs, which he calls “factors of production”, being:

- Land (including natural resources)
- Labour (number and skills of workers)

- Capital (machinery, buildings, networks)
- Entrepreneurship (skill in creating products, services, and processes)” (2009:7).

We follow Miller (1982) in noting that labour and entrepreneurship are both forms of human resources, and follow his classification of the inputs to goods and services as:

- human resources
- natural resources
- capital resources.

Capital resources, also referred to as economic capital, is the term used to describe any input that remains largely intact to be used again, rather than being consumed in the production process. It refers to assets held that allow future sales of goods or services. Economic capital is typically considered to consist of the following three sub-categories:

- physical assets
- intangible assets
- inventory.

1.4 Opportunity cost of inputs

The economic cost of using an input is known as its opportunity cost. Mansfield and Yohe describe opportunity cost as the “value of that input if it were employed in its most valuable alternative use” (2004:242). Likewise Miller defines opportunity cost as “the value of a resource in its next-best, alternative use” (1982:179).

The opportunity cost of economic capital is the value of the best alternative use for that capital. When economic capital is first purchased or created, there is usually a monetary cost associated with its creation or purchase. In this case, the monetary cost represents the amount of forgone consumption or forgone alternative investment. For existing economic capital, the best alternative use depends on the extent that it can be diverted into alternative productive uses. In section 1.5 we discuss the potential for economic capital to be diverted into alternative uses.

When a company generates accounting profit equal to the opportunity cost of economic capital, it is said to be generating zero economic profit – for example:

“Zero economic profits mean that all factors of production, including equity capital, are paid their opportunity cost” (Miller 1982:237)

We therefore define economic profit as any profit in excess of the opportunity cost of economic capital.

The opportunity cost of economic capital can be thought of as either an absolute value, or as a *rate*, that is, the annual cost of capital divided by the initial amount of economic capital.

1.5 Sunk capital and flexible capital

We now consider the situation in which production of a particular product requires two types of economic capital:

- flexible capital
- sunk capital.

Flexible capital is capital that can be switched to alternative productive uses. There is always an opportunity cost in using flexible capital, as it could be diverted to other uses if they were more attractive.

Sunk capital refers to assets required by producers within a market, but which have no alternative productive use. The extent of sunk capital depends on whether there are alternative uses for the same assets, often through close substitutes for the product which would use the same assets in production, that is, whether the assets can be switched to alternative means of production where there are higher (expected) returns. To the extent that capital can be redeployed to an alternative use, it would be considered flexible capital, while sunk capital would refer to the remainder.

The opportunity cost of sunk capital is measured differently in relation to a new entrant to a market compared with an existing producer.

A new entrant will need to compare the full cost of replicating all economic capital (including sunk costs) required to compete in the market against all other alternative uses for the capital. The new player will need to assess the time period over which the sunk costs can be recovered, which will have a significant impact on whether the venture is worthwhile. Sunk costs are considered by new entrants to a market as part of their initial investment decision.

For incumbent players who have already invested in sunk capital, there is no alternative use for this capital, and therefore no opportunity cost. Any current or future decisions should not be influenced by the presence of sunk capital. This is consistent with Miller, who states “where there are fixed (or sunk) costs, bygones are bygones” (1982:230), and also with Mansfield and Yohe, who state that “costs incurred in the past often are irrelevant when decisions are to be made in the present or the future” (2004:246).

1.6 Return on economic capital

The return on economic capital of a business refers to the profit derived by that business, divided by the total economic capital used by the business. We define return on economic capital as the economic profit of an

enterprise divided by the total economic capital of an enterprise.

In a freely competitive market, the return on economic capital will be equal to the risk-adjusted return available from other freely competitive markets. By definition, this is equal to the opportunity cost of economic capital.

In a market with a less competitive structure, such as a monopoly or duopoly, the rate of return on economic capital is likely to be higher than the opportunity cost of economic capital.

1.7 Return on equity capital

Economic capital does not specifically refer to cash or equity ownership. However, this section discusses the return to equity ownership (commonly referred to as simply return on capital) and the relationship between the return on equity capital and the return on economic capital.

We distinguish between the return on economic capital for a business discussed in section 1.6, versus the return on equity capital to its equity owners, or shareholders. To elaborate we define total shareholder return as the total return to an equity shareholder (including changes in market value) divided by the initial market price of the equity.

Most companies have equity shares that are tradeable, whether on a formal exchange or in a clearing house or the private capital market. This trading of equity capital is itself a form of market and will have its own market structure and degree of competition. In the case of a large stock exchange in a modern economy, the degree of competition is usually quite high.

The market for equity capital assets traded on a stock exchange is usually thought to be competitive, and this is extended to the hypothesis that the expected returns on assets with corresponding risks will be similar, despite the underlying companies having quite different rates of return on economic capital depending on their respective market structures. For example, the total shareholder return for a company operating within a monopoly would be comparable to the total shareholder return for a company operating within a competitive market (adjusted for any differences in risk), despite the return on economic capital of the entities being substantially different.

Another way of expressing this is that the expected total shareholder return is based on the market price of the equity in the company, which is distinct from (and often fundamentally different from) the return to the company itself from its production activities.

There are a number of models that hypothesise a competitive capital asset market, the most well known being the Capital Asset Pricing Model (CAPM). Others include the Inter-temporal Capital Asset Pricing Model

(ICAPM) and the Fama-French 3-factor (FF3F) model. We note that Cummins and Phillips (2005) preferred the FF3F model and found that the CAPM approach underestimated the cost of capital for property-casualty insurers.

However these models are all fundamentally consistent in that they postulate a strong relationship between total shareholder return and risk (defined according to each of the asset pricing models). Total shareholder return can be separated into a risk-free component (which reflects the time value of money) and a level of compensation for the amount of risk.

These models hypothesise a mechanism that adjusts the various (different) rates of return on economic capital experienced by companies with the same risk (but operating in different market structures) to result in consistent rates of total shareholder return within a competitive capital market. The mechanism identified to achieve this is changes in the market price of the financial capital assets (hence the name *Capital Asset Pricing Model*).

The fundamental prediction of these models is that companies experiencing higher rates of return on economic capital will have correspondingly higher market prices, and companies with lower rates of return on economic capital will have lower market prices. As a consequence, the expected total shareholder return is independent of the expected return on economic capital of the entity, owing to the pricing mechanism of the capital asset market.

1.8 Opportunity cost of economic capital

For an investor considering the purchase of economic capital (such as considering establishing a new company in a market), the best alternative use of their cash would be investment in the capital market. Therefore the opportunity cost of investing in economic capital is determined based on the total shareholder returns available in the capital asset market available for the same level of risk.

For existing companies, economic capital that can be re-allocated to alternative productive uses can also usually be sold. If economic capital is sold, this would allow direct investment of the proceeds in the capital asset market, and so the opportunity cost of any economic capital that can be sold is also determined by total shareholder returns in the capital asset market. Sunk capital cannot be sold or re-allocated to any alternative use and so has no opportunity cost.

In this way we hypothesise that the opportunity cost of economic capital can be observed and measured based on total shareholder returns available in the capital asset market for the same level of risk, other than sunk capital, which has no opportunity cost.

1.9 Minimum and maximum range for competitive price

For industries in which sunk costs are required for production, there are a range of possible values for the long-run equilibrium price. For a given amount of productive capacity in the industry, competitive pressures on incumbent players will lead firms to increase output and reduce prices to their long-run average total costs. For firms that own sunk capital, there is no opportunity cost for that capital, and so it won't form part of their long-run average costs. Hence long-run equilibrium will occur at the average cost, excluding any expense for sunk capital.

If demand increases beyond the level that can be met with existing levels of sunk capital, the price will increase. However the price may initially not be high enough to encourage investment of new sunk capital, either in the form of expansion of existing firms or entrance by new firms. In effect, the last half of the effect described by Manfield and Yohe will not arise: "if price were higher than average total costs for any firm, then positive economic profits would be earned and new firms would enter the industry" (2004:307).

At this point demand has increased prices to higher than the average cost excluding sunk capital, but not high enough to cover the cost of sunk capital. New entrants will not invest while price is lower than the average cost including the cost of sunk capital. Without the incentive for new firms to enter the industry, the long-run competitive equilibrium price would increase owing to demand. In this period, the price may stabilise at a point higher than the long-run average cost excluding sunk capital, but lower than the average cost including sunk capital. Incumbent players would be making positive economic profits, but would not be encouraged to invest more capital.

If demand increases further, the equilibrium price will increase up to the price that is high enough to attract new capital to the industry. Then new capital will be attracted to the industry, effectively limiting any further price increases. Once new capital enters the market, and sunk capital will again be ignored by incumbent players, players will then compete until the price reduces to the long-run average cost excluding sunk capital.

In summary, the minimum long-run equilibrium price in a competitive market will exclude any cost for sunk capital, while the maximum long-run equilibrium price in a competitive market will include the full opportunity cost of sunk capital.

1.10 Sufficient price

A sufficient price can be thought of as the minimum price that is acceptable to a company in the industry (i.e. that would prevent the firm from shutting down).

Based on the previous discussion, this is the minimum long-run equilibrium price and is equal to the average cost excluding any allowance for sunk capital.

However part of the definition of a sufficient price described in the US Supreme Court decision *FPC vs Hope*, noted above, is that it “attracts capital” (U.S. Supreme Court 1944:320). As mentioned previously, in order to attract new capital the price must be at least as high as the average total cost including the opportunity cost of sunk capital. New capital will only be attracted to an industry while prices are in fact higher than the upper bound of the long-run equilibrium price in a competitive market.

We conclude that there is a range for the sufficient price: the minimum sufficient price in a competitive market will exclude any allowance for the cost for sunk capital, while the maximum sufficient price in a competitive market will include the full opportunity cost of sunk capital.

1.11 Excessive price

Our definition of a fair price is one that is sufficient but not excessive. We have defined the sufficient price, and we now turn our attention to the excessive price.

We define an excessive price as one that is higher than that needed to attract new capital into a freely competitive market. This means that the sufficient price to attract new capital (i.e. the average cost including the full opportunity cost of sunk capital) is also the maximum price above which is considered excessive.

2 FAIR PREMIUM IN GENERAL INSURANCE

In this section we discuss the fair premium within General Insurance, with special attention to the various types of capital required by insurance companies and derive a simple model of the minimum and maximum fair premiums. We also compare this result to the financial economics approach commonly used in the literature.

2.1 Inputs to general insurance products

Following the approach of Robb et al (2012), the various inputs required for many general insurance products include:

- acquisition expense (commission and internal sales costs)
- claims handling expense
- administration and other corporate head office costs (legal, finance, actuarial, information technology, etc.)
- expected claim payments

- investment income on positive cash flow balances (an offset)
- allocated financial capital
- other economic capital.

It is worth spending some time defining and discussing the last two items in this list, as the rest are well known to actuaries.

Robb et al (2012) defined allocated financial capital in the Australian context as:

“risk margins on outstanding claims and premium liabilities, capital held to meet regulatory standards, as well as additional capital held to provide a target capital adequacy ratio or to maintain a target credit rating” (2012:section 3.2).

While we agree with this definition, a more general definition is found in Hitchcox et al, referred to there as target capital:

“The target capital is the amount of capital required to be held in the firm, given the shareholders’ risk appetites and return requirements, blended with the constraints of regulatory requirements and rating agency views” (Hitchcox et al 2006:2).

Hitchcox et al differentiate target capital from headroom capital, which is defined as the difference between target capital and accounting net assets. We use a similar concept but instead use the term additional financial capital, which is financial capital in excess of allocated financial capital, and define this as part of economic capital.

The opportunity cost of holding allocated financial capital can be determined by reference to shareholder returns in the capital asset market. However it is important to note that financial capital is usually invested and can be expected to earn an investment return. That investment return contributes towards part of the opportunity cost, while the profits on insurance products must contribute the remainder.

We have already seen that the opportunity cost of economic capital can also be determined by reference to shareholder returns in the capital asset market with similar risk profiles (see section 1.8). Next we will spend some time discussing exactly what economic capital refers to in the insurance context. We first

define the economic capital of an insurance company as the sum of:

- physical assets (if any)
- intangible assets
- allocated financial capital
- additional financial capital (financial net assets in excess of allocated financial capital).

2.2 Intangible assets

As described by Robb et al (2012), an intangible asset in an economic context is an identifiable non-monetary asset without physical substance. Intangible assets have economic value because they allow a business to sell more, sell at a higher price and/or manufacture and distribute at a lower price.

The development of these assets typically occurs over time, and requires some investment from the company (that is, tying up assets that could have been used for other purposes, and therefore have an opportunity cost). For example, to build a brand a business may have advertised significantly over time and invested in developing processes that improve quality and customer service. The business would have foregone profits in the past in order to achieve this.

Additionally, some intangible assets tend to depreciate over time if the legal or frictional barriers that cause them to exist in the first place diminish over time (e.g. patents expire, knowledge is more widely disseminated, or competition produces processes that supersede the value of the asset).

If a business does not have a relevant intangible asset in place, it would have to purchase relevant services or provide a substitute to maintain the same level of volume or profitability or both. For example, a business without a well-recognised brand would need to spend more on marketing; a business without distribution relationships would need to pay higher commissions or invest time in building relationships; and a business without an effective IT system would need to use a third-party solution.

2.3 Additional financial capital (analogous to inventory)

Inventory refers to a stock of goods or materials held by a business for future sale. A large inventory allows a company to make a large volume of sales. For manufacturers and retailers, inventory is a standard component of required economic capital. In the long-run equilibrium state, the competitive price would include an allowance for the opportunity cost of inventory (along with other costs). However for short periods of time, the size of the inventory can lead to either higher or lower returns to capital. For example, for periods of time when demand outstrips supply, a company with a larger inventory will enjoy higher

than normal returns to capital. Alternatively, when demand is weaker than supply, a company with a larger inventory will suffer lower returns to capital.

The sale of a new insurance policy will often result in new business strain on capital, particularly if the sale is not offset by an expiry of an existing policy. This results in an increase in the total amount of allocated financial capital, and a reduction in additional financial capital (any financial capital not included within allocated financial capital). Insurance companies experiencing significant business growth are often constrained by the amount of their additional financial capital. Hitchcox et al refers to additional capital as that which “covers the potential to finance organic or inorganic growth” (2006:3).

Because of the link between additional capital and potential for growth, we regard additional capital as analogous to the inventory of an insurance company. Some level of additional capital is required to smooth fluctuations in required allocated financial capital, and for an insurance company these fluctuations can relate to both retrospective changes in the capital required for prior sales as well as to fluctuations caused by recent sales.

The total amount of additional financial capital is also a direct measure of the potential for growth. This is because additional business sales will often lead to a reduction in the available additional financial capital, because the premium revenue is not sufficient to cover the additional allocated financial capital (e.g. the profit margin in the premium is less than the risk margin on liabilities).

As a form of economic capital, additional financial capital would be expected to generate profit equal to the opportunity cost of capital, in the long-run equilibrium state. This means additional capital should not be considered “lazy” capital, provided the amount is commensurate with that of other companies in a freely competitive market. We note that this approach is in stark contrast to the approach of some actuaries who assume additional capital to be excess capital and therefore irrelevant for the purposes of premium setting (see Addendum).

However this does not mean that excess capital will always generate profit equal to the opportunity cost of capital. There will be times when the size of a company’s additional capital will lead to either higher or lower returns to capital, just like there will be times when the size of a retailer’s inventory will lead to higher or lower returns.

During periods when the amount of additional capital within the insurance market is lower than normal – for example, after a year of catastrophes or poor weather – the demand for additional capital will outstrip supply, and then a company with a larger inventory will enjoy higher than normal returns to

capital. Alternatively, when profits have been high and demand is weaker than supply for additional capital, a company with a larger inventory will suffer lower returns to capital.

2.4 Formula for fair premiums

We first assume that the capital asset market follows the simple Capital Asset Pricing Model, such that the only type of risk relevant to the pricing of a financial asset to be its correlation of returns to the market. We define the systematic risk of a particular insurance company to be beta (β).

According to CAPM the expected total shareholder return of this insurance company is:

$$E[R] = R_F + \beta (E[R_M] - R_F)$$

where

R is the single period total shareholder return for the insurance company

R_F is the risk-free single-period interest rate

R_M is the single period total shareholder return for the capital market

We define the total economic capital of this insurance company to be:

$$K = AFK + XSK + IA$$

where

AFK = allocated financial capital

XSK = additional financial capital

IA = intangible assets

Note that the sum of AFK and XSK is equal to total financial capital.

In accordance with the argument in section 2.3, the opportunity cost of the insurer's financial capital (expressed as a rate) is equal to the expected total shareholder return for the same company, that is $E[R]$.

The intangible assets (IA) of the company may to some extent relate to sunk capital. In the interests of conservatism, we assume that all intangible assets of this company are sunk and therefore have no opportunity cost to the insurer. In accordance with section 1.5, this firm will be prepared to accept a premium that excludes any allowance for sunk capital. In contrast, new entrants will include the cost of sunk capital in their decision-making, and will require a premium that includes the opportunity cost of sunk capital.

In accordance with section 1.10, the minimum sufficient premium is one that provides the opportunity cost of financial capital (i.e. excluding sunk capital), which is equivalent to providing the single-period profit (net of tax):

$$E[R] \times (AFK + XSK)$$

Also the maximum sufficient premium, above which is defined as excessive, is one that provides the opportunity cost of all economic capital, which is equivalent to providing the single period profit (net of tax):

$$E[R] \times (AFK + XSK + IA)$$

It is common in both the insurance pricing literature and the regulatory context to refer to rates of return on allocated financial capital (see Addendum for discussion). So we now re-express the formulas for minimum and maximum sufficient profit (net of tax) as rates of return on allocated financial capital (which we call ROE), as follows:

$$\begin{aligned} \text{Minimum sufficient ROE} &= E[R] \times (AFK + XSK) / AFK \\ &= E[R] \times (1 + XSK / AFK) \end{aligned}$$

$$\begin{aligned} \text{Maximum sufficient ROE} &= E[R] \times (AFK + XSK + IA) / AFK \\ &= E[R] \times [1 + (XSK + IA) / AFK] \end{aligned}$$

Therefore the range for long-run equilibrium rates of return (net of tax) on allocated capital within a competitive market is higher than the shareholder return for an equivalent company, increased by a factor of between XSK / AFK and $(XSK + IA) / AFK$.

2.5 A numerical example

In the following numerical example, we assume the risk-free rate to be 3% and the equity risk premium to be 6%, giving a total expected market return of 9%.

Ragunathan, Faff and Brooks (2000) have provided benchmark betas for various industries based on the Australia stock market between 1984 and 1992. The estimated beta for the general insurance industry is either 75% or 85% (depending on the market index benchmark chosen). Feldblum and Thandi state that in the United States CAPM analysis "shows an average beta for property-casualty insurance companies of 85% to 90%" (2003:595). For this example we assume that the beta for a non-life insurance company is 85%.

Based on the CAPM formula the expected shareholder return for this company is therefore:

$$\begin{aligned} E[R] &= 3\% + 85\% \times (9\% - 3\%) \\ &= 8.1\% \end{aligned}$$

We assume that the value of total economic capital for this insurer is \$1.0Bn, distributed as follows:

Allocated financial capital	\$600m
Additional financial capital	\$100m
Intangible assets	\$300m
	<u>\$1.0Bn</u>

Using the formulas defined in section 2.4, and the economic assumptions above, the minimum sufficient ROE (net of tax) for this insurer in a competitive market is:

$$\begin{aligned}\text{Minimum sufficient ROE} &= E[R] \times (1 + XSK / AFK) \\ &= 8.1\% \times (1 + 100 / 600) \\ &= 9.5\%\end{aligned}$$

Similarly the maximum sufficient ROE within a competitive market is:

$$\begin{aligned}\text{Maximum sufficient ROE} &= E[R] \times [1 + (XSK + IA) / AFK] \\ &= 8.1\% \times [1 + (100 + 300) / 600] \\ &= 13.5\%\end{aligned}$$

Or, in words, the reasonable range of fair premiums would provide net of tax ROE of between 9.5% and 13.5% (measured relative to allocated financial capital). This range is higher than the expected shareholder return of the company of 8.1% (i.e. its opportunity cost of capital).

2.6 Application to insurance premiums

Having identified the minimum and maximum sufficient return on equity, it only remains to convert this into a fair premium. We believe that the range for ROE should be applied as an input to an internal rate of return (IRR) model for a cohort view of a single underwriting period. Particular care is required to ensure that the measure of capital is consistent with the rate of return on that capital.

If the ROE measures above are used, which are based on allocated financial capital only, then the capital measure used in the IRR model should only be allocated financial capital. Alternatively, if the capital measure includes both intangible assets and any additional capital, then the rate of return should similarly be based on total financial capital plus all other economic capital (with the range determined by either including or excluding sunk capital).

2.7 Comparison with financial economics

We use the term financial economics to broadly represent the approach described by Myers and Cohn (1981) and Taylor (1994), along with many others, to estimate a fair premium. This approach is

characterised by estimating the required rate of return of an insurance product based on the riskiness of the insurance claims expected to arise from the policy. The riskiness is often referred to as the liability beta of an insurance product, and while this is notoriously difficult to measure, it is often assumed to be zero or slightly negative.

The North American Casualty Actuarial Society (CAS) founded the Risk Premium Project largely to address this very question. The initial focus of this project was to determine the appropriate discount rates to be used in the Myers-Cohn fair premium model (the discount rates are related directly to the liability beta via the CAPM): “RPP was formed to respond to the committee’s request: how should actuarially appropriate risk adjustments be computed when losses and expenses are discounted?” (Casualty Actuarial Society 2000:169).

Ten years later the Risk Premium Project II published their finding that the pure financial economics view underestimated fair premiums and that:

“Theoretical models as well as empirical tests have confirmed that given the real-world market imperfections, the price of insurance should be a function of the (1) expected cash flow with adjustments for systematic risk, (2) production costs (i.e. expenses), (3) default risk, and (4) frictional capital costs” (Casualty Actuarial Society 2010:2).

The items numbered (1) and (2) above represent the traditional Myers-Cohn formula, with claims discounted using the liability beta, while items (3) and (4) indicate the additional risks that should be considered outside the Myers-Cohn model.

We note that in practice the assumption of the liability beta of zero, when combined with an insurer invested in low-risk fixed interest securities, will typically generate a fair premium that provides a return on risk capital (or allocated financial capital) that is close to the risk-free rate. A slightly negative liability beta will generate a slightly higher rate of return. Inclusion of the additional risks identified by CAS Risk Premium Project II (2010) would generate a slightly higher return again. However no definitive model to estimate these additional risks has emerged to define the fair premium.

We contrast this approach to the fair premium model developed in this paper, which uses the rate of shareholder return as the benchmark for determining

fair premiums, using a measure of capital that includes all economic capital, both financial and intangible. This approach generates rates of return on allocated financial capital that are higher than the shareholder return for an equivalent company and produce fair premiums much higher than those generated using the financial economics approach.

ADDENDUM: FINANCIAL CAPITAL REQUIRED FOR PREMIUM BASIS

This paper has asserted that all financial capital held by an insurer incurs an opportunity cost that should be included within fair premiums (see section 2). However the idea that only the amount of capital notionally allocated to support risk should be included within sound premium rating is remarkably common within the actuarial tradition.

The authoritative Australian actuarial textbook by Hart, Buchanan and Howe, describes in detail the process of calculating sound premium rates, which should include a “profit loading sufficient to provide a suitable rate of return on the capital required to support the business” (1996:305). Note the use of the phrase “capital required to support the business”; to be clear, they clarify that “the capital actually invested is not the same thing as the capital required” (1996:308).

Again Hart, Buchanan and Howe state that: “The profit loading in sound rates . . . is the loading required to give shareholders a reasonable return on the capital required to support the risks underwritten” (1996:308).

The practice of using only required capital within an IRR model is reasonably common; Goodchild, for example, says: “Portfolio required profit margin is a function of [risk based] capital required and return on this capital” (2007:6).

Hart, Buchanan and Howe make a distinction within total financial capital “between unallocated capital and capital notionally allocated to support risk” (1996:149). This corresponds to our distinction in section 2 between allocated financial capital and additional financial capital. However we disagree with Hart, Buchanan and Howe’s statement that only allocated capital should be included in the calculation of sound premiums.

We have shown in section 2 that additional financial capital is an essential part of the economic capital of an insurer, being analogous to the insurer’s inventory. It follows that fair premiums would include an allowance for the opportunity cost of holding additional financial capital.

However, as stated previously, this does not mean that additional capital will always generate profit equal to the opportunity cost of capital. During times when

the amount of additional capital within the insurance industry market is lower than normal, the demand for additional capital will outstrip supply, and then a company with a larger inventory will enjoy higher than normal returns to capital. Alternatively, when profits have been high and demand is weaker than supply for additional capital, a company with a larger inventory will suffer lower returns to capital.

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Acknowledgements

I would like to thank my partners Mark and Thomas for their enduring patience and understanding over the six years of this project. I would also like to thank the members of the Institute's Profit Margins Working Party for their contributions which have now been included and developed within the new approach to fair premium models.

Reinstatement strategy: philosophy, theory and practice

RICHARD HARTIGAN



Richard Hartigan

ABSTRACT

This paper determines the optimal reinstatement strategy for an insurer's short-tail excess of loss reinsurance programme. Mirror layers, 1-shot layers (with or without back-up layers), and reinstatement premium protection will almost certainly be sub-optimal.

KEYWORDS

reinsurance, reinstatement premium, capital

1 SURVEY OF PREVIOUS RESEARCH

Anderson and Dong (1988) incorporated reinstatement premiums as a standard feature of excess of loss catastrophe reinsurance, but they were principally concerned with the (then relatively new) use of catastrophe models to price catastrophe risk.

Mata (2000) focused on how splitting longer layers in an excess of loss reinsurance programme into smaller sub-layers affected the theoretical price of the longer layer versus the theoretical price of the sum of the smaller sub-layers, under varying reinstatement premium provisions.

Campana (2011) focused on the initial risk adjusted premium by varying the number of reinstatements, with the reinstatement premium provision fixed at 100%.

2 INTRODUCTION

Short-tail excess of loss reinsurance programmes are typically placed in a tower of ascending layers, above the insurer's net retention. For example, the insurer may choose to retain the first \$4m of each loss (this becomes the insurer's net retention) and buy \$46m of excess of loss reinsurance above the net retention as follows: \$6m excess of \$4m (i.e. $\$6m \times \$4m$), plus \$10m excess of \$10m (i.e. $\$10m \times \$10m$), plus \$30m excess of \$20m (i.e. $\$30m \times \$20m$).

The reinsurance premium for a layer is often expressed as a Rate-On-Line (ROL), and this is simply the reinsurance premium for the layer (e.g. \$3.3m) divided by the size of the layer (e.g. \$30m for the $\$30m \times \$20m$ layer). The ROL in that instance is $\$3.3m \div \$30m = 11\%$.

Typically, cover is not unlimited for multiple events in a given time period (which is typically 1 year). The most-typical cover limitation (i.e. reinstatement alternative) is expressed as 1@100%, which means the layer must be reinstated once (after the first loss) with the payment of an additional reinsurance premium (i.e. the reinstatement premium) of 100% of the original reinsurance premium (and note: *not* pro-rata for the remaining time period of cover). The reinstatement typically happens automatically and without optionality (for either party).

An example will clarify: the ROL for the $\$6m \times \$4m$ layer is 25% (i.e. a reinsurance premium of \$1.5m), and cover incept on 1 January 2016. A \$10m qualifying event occurs on 15 February 2016. The insurer recovers \$6m (after retaining the first \$4m of the loss) from the reinsurer, and then reinstates the layer by paying a reinstatement premium of \$1.5m. In practice, the \$1.5m is simply netted off the \$6m when the reinsurer pays the insurer. A second \$10m qualifying event occurs on 25 July 2016. Again, the insurer recovers \$6m (after retaining the first \$4m of the loss) from the reinsurer. Having recovered a second time the layer is now exhausted and no further reinstatements are permitted. For the $\$6m \times \$4m$ layer for the balance of the year (i.e. 25 July 2016 to 31 December 2016) the insurer has no cover for losses.

Reinstatement alternatives vary. 1@100% is by far the most common but 1@200% and 1@300% are also observed, especially when the ROL is low. Straight multiples of 100% are not mandatory: for example 1@125% is occasionally observed. More than one reinstatement is possible: for example 2@100%.

Other reinstatement alternatives exist. 1@free is self-explanatory. Cover might be 1-shot, i.e. with zero reinstatements. Cover might be back-up, i.e. covering the second loss only. As an aside (and I shall prove this later) the theoretical reinsurance premium for a 1@free layer is identical to the sum of the theoretical reinsurance premium for a 1-shot layer plus the theoretical reinsurance premium for a back-up layer.

Other reinstatement alternatives exist. The insurer can buy a 1@100% layer, and then separately buy reinstatement premium protection (RPP) to cover the reinstatement premium. As an aside (and I shall prove this later) the theoretical reinsurance premium for a 1@free layer is identical to the sum of the theoretical reinsurance premium for a 1@100% layer plus the theoretical reinsurance premium for RPP. Another reinstatement alternative is a so-called mirror layer: the insurer overbuys a given layer so that any recovery additionally funds the reinstatement premium due.

3 PROBABILITY OF LOSS

I start with the assumption that, for a given layer, the probability of attaching (i.e. a qualifying event being equal to the bottom of the layer) equals the probability of exhaustion (i.e. a qualifying event being equal to the top of the layer). This assumption is valid if the size of the layer is relatively small, say \$1 *reductio ad absurdum*.

Having made the above assumption, I model using a Poisson probability distribution. I note that other discrete probability distributions (e.g. Negative Binomial) may be more appropriate for certain perils, certain geographical regions and/or certain layers in an excess of loss reinsurance programme.

Poisson: $P(k \text{ events in 1 year}) = \lambda^k \times e^{(-\lambda)} \div k!$

Assume the probability of 1 or more events in 1 year is X. Therefore $\lambda = -\text{LN}(100\% - X)$ and:

$$P_0 = e^{(-\lambda)}$$

$$P_1 = e^{(-\lambda)} \times \lambda$$

$$P_{2+} = 1 - P_0 - P_1 \text{ (for the balance of this paper I shall use } P_2 \text{ to denote } P_{2+})$$

4 QUANTUM OF THE NET LOSS

Focusing (for the moment) on just the 1@100% reinstatement alternative, there are three outcomes:

- 0 losses in which case the reinsurance premium (ROL_{gross}) is paid
- 1 loss in which case the reinsurance premium (ROL_{gross}) is paid, one recovery is made, the reinstatement premium is paid
- 2+ losses in which case the reinsurance premium (ROL_{gross}) is paid, one recovery is made, the reinstatement premium is paid, a second recovery is made

At this stage I must recognise an additional factor. Typically, excess of loss reinsurance programmes are placed by a broker who receives brokerage (B, typically 10% of the reinsurance premium). Thus the reinsurer receives less than 100% of the reinsurance premium. Further complicating this issue is that brokerage is typically only payable on the original reinsurance premium, not on any additional reinsurance premium (i.e. the reinstatement premium). Complicating matters even further is the fact that often the broker rebates part of the brokerage received to their client (the insurer) (R, typically 25% of the brokerage).

The reinsurer will calculate the burn (break-even) reinsurance premium (ROL_{burn}) as follows:

$$0 = P_0 \times ((1 - B) \times ROL_{\text{burn}} - 0)$$

$$+ P_1 \times ((2 - B) \times ROL_{\text{burn}} - 1)$$

$$+ P_2 \times ((2 - B) \times ROL_{\text{burn}} - 2)$$

$$\text{Solving: } ROL_{\text{burn}} = (1 - P_0 + P_2) \div (2 - 1 \times P_0 - B)$$

Using a similar approach for other reinstatement alternatives:

$$1@\text{free: } ROL_{\text{burn}} = (1 - P_0 + P_2) \div (1 - 0 \times P_0 - B)$$

$$1@100\%: ROL_{\text{burn}} = (1 - P_0 + P_2) \div (2 - 1 \times P_0 - B)$$

$$1@200\%: ROL_{\text{burn}} = (1 - P_0 + P_2) \div (3 - 2 \times P_0 - B)$$

$$1@300\%: ROL_{\text{burn}} = (1 - P_0 + P_2) \div (4 - 3 \times P_0 - B)$$

$$1\text{-shot: } ROL_{\text{burn}} = (1 - P_0) \div (1 - B)$$

$$\text{back-up: } ROL_{\text{burn}} = P_2 \div (1 - B)$$

5 DETERMINING THE BURN (BREAK-EVEN) REINSURANCE PREMIUM (ROL_{burn})

From above the $ROL_{burn}(1@100\%) = (1 - P_0 + P_2) \div (2 - 1 \times P_0 - B)$, and $B = 10\%$.

Assume the probability of 1 or more events in 1 year is 20% (i.e. X).

Therefore $\lambda = 22.31\%$ (i.e. $-\text{LN}(100\% - X)$).

Therefore:

$P_0 = 80.00\%$ (i.e. $e^{(-\lambda)}$, from above)

$P_1 = 17.85\%$ (i.e. $e^{(-\lambda)} \times \lambda$, from above)

$P_2 = 2.15\%$ (i.e. $1 - P_0 - P_1$, from above)

Therefore the burn (break-even) reinsurance premium, $ROL_{burn}(1@100\%) = 20.14\%$.

What is of more interest, though, is the equivalent burn (break-even) reinsurance premium (ROL_{burn}) for different reinstatement alternatives, and at different ROL_{burn} levels. Table 1 gives a summary (I select $ROL_{burn}(1@100\%)$ at whole percentages):

Table 1: A summary of the equivalent burn (break-even) reinsurance premium (ROL_{burn}) for different reinstatement alternatives, and at different ROL_{burn} levels.

1@300%	1@200%	1@100%	1-shot	1@free	back-up	mirror	RPP
0.98%	0.98%	1.00%	1.00%	1.00%	0.00%	1.01%	0.01%
4.55%	4.76%	5.00%	5.13%	5.25%	0.12%	5.26%	0.26%
8.40%	9.13%	10.00%	10.53%	11.05%	0.52%	11.11%	1.05%
11.73%	13.16%	15.00%	16.18%	17.42%	1.24%	17.65%	2.43%
14.69%	16.94%	20.00%	22.06%	24.41%	2.35%	25.00%	4.41%
17.37%	20.50%	25.00%	28.12%	32.03%	3.90%	33.33%	7.03%
19.85%	23.89%	30.00%	34.33%	40.29%	5.96%	42.86%	10.30%

Table 1 can be interpreted (by example) as follows: the insurer and the reinsurer will be similarly motivated between engaging in a 1@100% layer at 10.00% ROL_{burn} and engaging in a 1@300% layer at 8.40% ROL_{burn} . Note: the mirror layer $ROL_{burn} = 100\% \div (100\% - ROL_{burn}(1@100\%))$, and is the sum of the 1@100% layer and the mirror layer itself.

As an aside, one can see (subject to minor rounding errors):

1@free = 1-shot + back-up; and

1@free = 1@100% + RPP (where $RPP = 1@100\% \times 1\text{-shot}$)

= 1@100% (1 + 1-shot)

Proof (formulae on page 49):

1@free: $ROL_{burn} = (1 - P_0 + P_2) \div (1 - 0 \times P_0 - B) = (1 - P_0 + P_2) \div (1 - B)$

1@100%: $ROL_{burn} = (1 - P_0 + P_2) \div (2 - 1 \times P_0 - B) = (1 - P_0 + P_2) \div (2 - P_0 - B)$

1-shot: $ROL_{burn} = (1 - P_0) \div (1 - B)$

back-up: $ROL_{burn} = P_2 \div (1 - B)$

1-shot + back-up = $(1 - P_0) \div (1 - B) + P_2 \div (1 - B) = (1 - P_0 + P_2) \div (1 - B) = 1@free$

1@100% + RPP = 1@100% (1 + 1-shot)

= $(1 - P_0 + P_2) \div (2 - P_0 - B) \times [1 + (1 - P_0) \div (1 - B)]$

= $(1 - P_0 + P_2) \div (2 - P_0 - B) \times [(1 - B + 1 - P_0) \div (1 - B)]$

= $(1 - P_0 + P_2) \div (2 - P_0 - B) \times [(2 - P_0 - B) \div (1 - B)]$

= $(1 - P_0 + P_2) \div (1 - B)$

= 1@free

6 DETERMINING THE GROSS (LOADED) REINSURANCE PREMIUM (ROL_{GROSS})

The reinsurer is naturally profit-seeking. The above ROL_{burn} figures need to be loaded. Each reinsurer will have their own method for doing this, and therefore I must choose a simple and sensible method. I simply add the square root of the burn (break-even) reinsurance premium (ROL_{burn}). For example, the square root of 15% is 3.87%, and therefore the gross (loaded) reinsurance premium (ROL_{gross}) would be 18.87%. This method results in sensible expected reinsurance recovery rates (expected total reinsurance recoveries divided by expected total reinsurance premium), both by reinstatement alternative and by ROL_{gross} level.

Table 2 gives a summary (I re-select ROL_{gross} (1@100%) at whole percentages):

Table 2: A summary of the equivalent gross (loaded) reinsurance premium (ROL_{gross}) for different reinstatement alternatives, and at different ROL_{gross} levels.

1@300%	1@200%	1@100%	1-shot	1@free	back-up	mirror	RPP
0.99%	0.99%	1.00%	1.00%	1.00%	0.03%	1.01%	0.04%
4.74%	4.86%	5.00%	5.06%	5.12%	0.27%	5.26%	0.43%
8.92%	9.42%	10.00%	10.33%	10.64%	0.78%	11.11%	1.30%
12.59%	13.68%	15.00%	15.82%	16.63%	1.55%	17.65%	2.62%
15.86%	17.67%	20.00%	21.51%	23.11%	2.63%	25.00%	4.44%
18.82%	21.44%	25.00%	27.38%	30.11%	4.05%	33.33%	6.78%
21.54%	25.02%	30.00%	33.43%	37.69%	5.88%	42.86%	9.68%

Table 2 can be interpreted (by example) as follows: the insurer and the reinsurer will be similarly motivated between engaging in a 1@100% layer at 10.00% ROL_{gross} and engaging in a 1@300% layer at 8.92% ROL_{gross}. Note: the mirror layer ROL_{gross} = 100% ÷ (100% – ROL_{gross} (1@100%)), and is the sum of the 1@100% layer and the mirror layer itself.

7 COMPARING REINSTATEMENT ALTERNATIVES

I now compare reinstatement alternatives (as follows), and at different ROL_{gross} levels:

- 1@300%
- 1@200%
- 1@100%
- 1@free
- 1-shot, paired with a back-up
- 1@100%, paired with a mirror layer, such that any recovery additionally funds the reinstatement premium due for the first loss
- 1@100%, paired with RPP

The last three reinstatement alternatives can immediately be identified as being administratively more cumbersome as they involve buying two “things” rather than just one “thing”. It turns out that they are also more capital-intensive and incur more brokerage. In addition, the mirror layer reinstatement alternative results in an over-recovery for the second loss (when the reinstatement premium would not be payable).

To assess the optimal reinstatement strategy I must maximise expected profit to the insurer from reinsuring (as a percentage of the layer), using (in the case of the 1@100% reinstatement alternative):

$$\begin{aligned}
 &P_0 \times (0 - (1 - B \times R) \times \text{ROL}_{\text{gross}}) \\
 &+ P_1 \times (1 - (2 - B \times R) \times \text{ROL}_{\text{gross}}) \\
 &+ P_2 \times (2 - (2 - B \times R) \times \text{ROL}_{\text{gross}})
 \end{aligned}$$

It should be readily apparent that the expected profit to the insurer from reinsuring will be negative. Calculations for all reinstatement alternatives, and at different ROLgross levels, are shown in Table 3 and Figure 1.

Table 3: Expected profit to the insurer from reinsuring (as a percentage of the layer).

ROLgross (1@100%)	1@300%	1@200%	1@100%	1@free	1 shot + back-up	mirror (1@100%)	RPP (1@100%)
1.00%	-0.6307%	-0.6299%	-0.6378%	-0.6344%	-0.6598%	-0.6443%	-0.6726%
2.00%	-1.0627%	-1.0593%	-1.0639%	-1.0525%	-1.1158%	-1.0857%	-1.1529%
3.00%	-1.4308%	-1.4238%	-1.4193%	-1.4096%	-1.5169%	-1.4632%	-1.5674%
4.00%	-1.7615%	-1.7499%	-1.7440%	-1.7269%	-1.8803%	-1.8166%	-1.9526%
5.00%	-2.0697%	-2.0530%	-2.0482%	-2.0200%	-2.2210%	-2.1559%	-2.3179%
6.00%	-2.3650%	-2.3426%	-2.3320%	-2.2986%	-2.5487%	-2.4809%	-2.6638%
7.00%	-2.6526%	-2.6238%	-2.5957%	-2.5682%	-2.8690%	-2.7911%	-2.9910%
8.00%	-2.9288%	-2.8933%	-2.8589%	-2.8257%	-3.1774%	-3.1075%	-3.3166%
9.00%	-3.1965%	-3.1540%	-3.1216%	-3.0741%	-3.4770%	-3.4303%	-3.6407%
10.00%	-3.4610%	-3.4111%	-3.3740%	-3.3186%	-3.7736%	-3.7488%	-3.9552%
11.00%	-3.7236%	-3.6657%	-3.6161%	-3.5604%	-4.0684%	-4.0631%	-4.2605%
12.00%	-3.9820%	-3.9160%	-3.8577%	-3.7977%	-4.3591%	-4.3838%	-4.5647%
13.00%	-4.2374%	-4.1627%	-4.0988%	-4.0316%	-4.6465%	-4.7112%	-4.8678%
14.00%	-4.4904%	-4.4067%	-4.3392%	-4.2628%	-4.9317%	-5.0455%	-5.1700%
15.00%	-4.7445%	-4.6513%	-4.5692%	-4.4946%	-5.2183%	-5.3755%	-5.4634%
16.00%	-4.9945%	-4.8914%	-4.8080%	-4.7222%	-5.5005%	-5.7239%	-5.7637%
17.00%	-5.2465%	-5.1331%	-5.0364%	-4.9512%	-5.7850%	-6.0679%	-6.0554%
18.00%	-5.4952%	-5.3712%	-5.2734%	-5.1770%	-6.0661%	-6.4310%	-6.3537%
19.00%	-5.7466%	-5.6114%	-5.4997%	-5.4049%	-6.3503%	-6.7898%	-6.6436%
20.00%	-5.9981%	-5.8513%	-5.7248%	-5.6328%	-6.6347%	-7.1560%	-6.9327%
21.00%	-6.2474%	-6.0886%	-5.9582%	-5.8583%	-6.9166%	-7.5420%	-7.2280%
22.00%	-6.4973%	-6.3261%	-6.1901%	-6.0844%	-7.1993%	-7.9361%	-7.5223%
23.00%	-6.7482%	-6.5640%	-6.4204%	-6.3110%	-7.4831%	-8.3382%	-7.8155%
24.00%	-7.0002%	-6.8026%	-6.6489%	-6.5386%	-7.7681%	-8.7485%	-8.1074%
25.00%	-7.2534%	-7.0419%	-6.8753%	-6.7672%	-8.0545%	-9.1671%	-8.3982%
26.00%	-7.5080%	-7.2822%	-7.0996%	-6.9970%	-8.3425%	-9.5940%	-8.6877%
27.00%	-7.7617%	-7.5211%	-7.3312%	-7.2258%	-8.6293%	-10.0428%	-8.9828%
28.00%	-8.0171%	-7.7612%	-7.5602%	-7.4561%	-8.9180%	-10.5003%	-9.2763%
29.00%	-8.2744%	-8.0028%	-7.7864%	-7.6882%	-9.2088%	-10.9667%	-9.5682%
30.00%	-8.5311%	-8.2433%	-8.0193%	-7.9197%	-9.4989%	-11.4562%	-9.8653%

Note: The ROLgross used is the ROLgross (1@100%) equivalent. The shading indicates the optimal strategy.

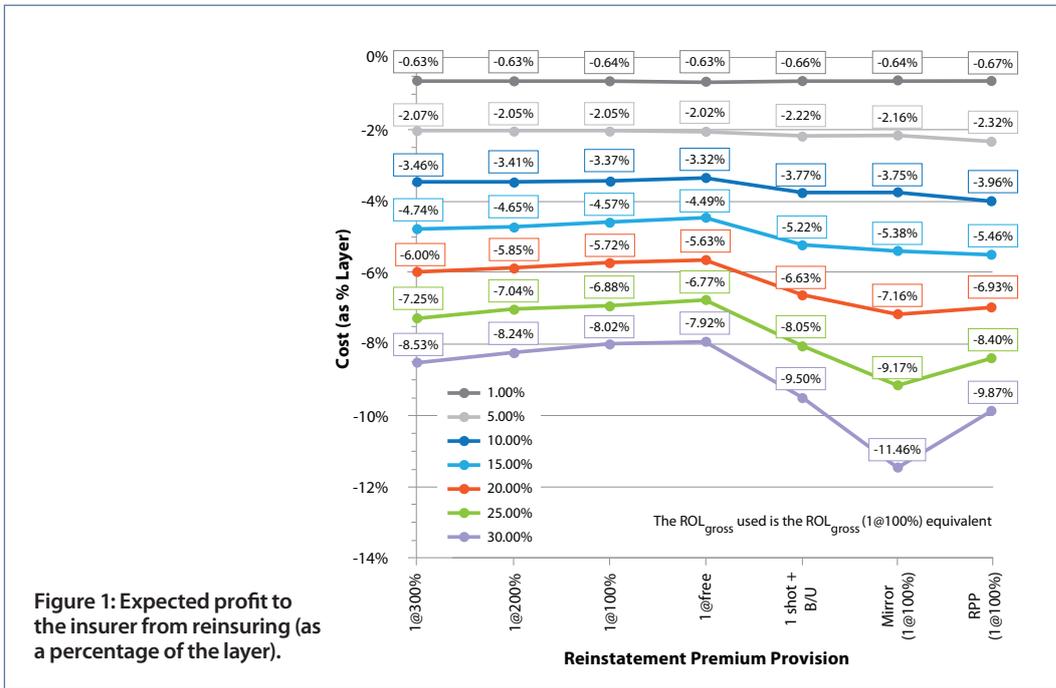


Figure 1: Expected profit to the insurer from reinsuring (as a percentage of the layer).

7.1 Summary

It is clear that, amongst the first four reinstatement alternatives, there is little to choose. It turns out the best reinstatement strategy is as follows:

- if the ROLe_gross (1@100%) quoted is <1.25% ... ask for a 1@200% quote instead, and take that;
- if the ROLe_gross (1@100%) quoted is >1.25% ... ask for a 1@free quote instead, and take that;
- mirror layers, 1-shot layers (with or without back-up layers), and reinstatement premium protection will almost certainly be sub-optimal.

7.2 Varying capital assumptions (away from the “square root” method)

- abandoning the “square root” method and instead marking-up ROLe_burn to ROLe_gross by a variable proportion (higher mark-up for lower ROLe_burn) makes little difference
- retaining the “square root” method and setting the brokerage rebate (R) to 0% makes little difference
- retaining the “square root” method and setting the brokerage (B) to 0% makes little difference

8 CONCLUSION

Under most reasonable conditions and assumptions, and across the vast majority of the ROLe_gross curve (i.e. the excess of loss reinsurance programme), the optimal reinstatement alternative for the insurer is the 1@free reinstatement alternative.

Naturally the up-front ROLe_gross will be higher for the 1@free reinstatement alternative, although not materially so; a selection of ROLe_gross for comparison purposes is as shown in Table 4.

A higher up-front ROLe_gross might be especially appealing to the reinsurer in the current challenging market environment. Otherwise the reinsurer should be indifferent. The broker might be similarly attracted, due to brokerage being applied to a higher up-front ROLe_gross (remembering that brokerage is typically only payable on the original reinsurance premium, not on any additional reinsurance premium, that is the reinstatement premium).

The insurer will recognise that they can, on a probability-weighted basis, reduce reinsurance premiums by opting for the 1@free reinstatement alternative. There will also be administration benefits, and simpler post-event communication to senior management of the final net loss from an event.

Table 4: A selection of ROLe_gross for comparison purposes.

1@100%	1@free
1.00%	1.00%
5.00%	5.12%
10.00%	10.64%
15.00%	16.63%
20.00%	23.11%
25.00%	30.11%
30.00%	37.69%

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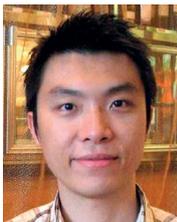
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Acknowledgement

Special thanks to Paul Johnson for review, comments and challenge.

Reverse mortgages – risks, pricing, and market development

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ABSTRACT

As life expectancy and the dependency ratio continue to rise, and because many retirees are “asset-rich-cash-poor”, reverse mortgages would serve as a viable means to unlock the equity in home properties and provide supplementary retirement funding. This market in Australia, however, is still far from reaching its full potential, and these products are relatively new in the Asia-Pacific. In this paper, we provide an overview of different features of reverse mortgage products and the underlying risks of issuing such products, including longevity risk, house price risk, and interest rate risk. In particular, we discuss the demand and supply constraints and recent market development. Moreover, we introduce a theoretically sound and also practically feasible approach, called maximum entropy, for risk-neutral pricing of a reverse mortgage, under the current regulatory environment, which emphasises market-consistent valuation.

KEYWORDS

longevity risk, market risk, risk-neutral measure, maximum entropy

1 INTRODUCTION

It is a global phenomenon that life expectancy continues to improve. In Australia, period life expectancy at birth has increased from 70.2 in 1970 to 81.7 in 2011, and period life expectancy at age 65 has reached 20.2 in 2011 compared with 13.4 in 1970 (HMD 2015). During the same period, the total fertility rate has declined from 2.5 in 1970–1975 to 1.9 in 2010–2015, and though the total dependency ratio has decreased from 59% in 1970 to 48% in 2010, it is expected to increase to 67% in 2050 (UNdata 2015). It is also estimated that life expectancy at birth will reach 88.2 in 2050 (HMD 2015). These trends, together with the fact that governments and employers have been shifting from defined benefit to defined contribution pension plans, represent significant challenges to maintain their living standards for millions of retirees.

According to AMP (2011), the average superannuation balance of their members aged 60 to 64 was around only AUD\$75,457 as of December 2011, while the national average earnings was around AUD\$60,000 p.a. The Report of the National Commission of Audit (Phase One) in 2014 (Commonwealth of Australia) noted that the proportion of older Australians eligible for age pensions will remain at 80% for the next few decades or so. Many seniors, particularly those of the lower social-economic group, are expected to face the problem of having insufficient income to support their retirement. As own-home housing wealth constitutes around half the wealth holdings of older Australians (Bradbury 2010), reverse mortgages can potentially serve as an effective way to alleviate this problem and help manage an individual's longevity risk – the risk of outliving his or her resources during retirement. In broad terms, a reverse mortgage allows the homeowner to borrow against the value of the home property, and the loan is repaid, with interest, from the proceeds of the sale of the property when the borrower passes away or moves out. The loan is often non-recourse, in other words, the lender cannot have a claim on the borrower's other assets. Through this mechanism, individuals can unlock their home equity and acquire additional funding to meet retirement needs, while maintaining the right to stay in the same home property. Brownfield (2014) suggested that home equity release has the potential to become the fourth pillar of the Australian retirement income system.

Despite the potential usefulness of reverse mortgages and their growth in recent years, the market for these products remains small in Australia. As of December 2011, 42,410 reverse mortgage loans were in force (Deloitte 2012), compared with a population of three million Australians aged 65 and over (ABS 2015).

Moreover, the market is still in its infancy stage in the wider Asia–Pacific region. For example, the Hong Kong Mortgage Corporation Limited (HKMC) has launched the Reverse Mortgage Programme in 2011, in which there were 20,686 outstanding loans as of December 2014 (HKMC 2014). In Singapore, only a handful of institutions offer reverse mortgage products, all with a specified term for repayment, and there are suggestions for the government to introduce a reverse mortgage scheme which allows borrowers to live in their mortgaged properties for life and covers any shortfall in the sales proceeds of the properties (*Straits Times* 2013). Apparently, there is much room for this market to develop, where it is necessary to encourage both the demand and supply sides of reverse mortgages.

This paper is organised as follows. First, we provide an overview of the features of different reverse mortgage products and examine the underlying risks of offering such products. Second, we set forth a number of demand and supply constraints in the current market, and discuss the corresponding market development. Finally, we propose a theoretically sound and also practically viable approach, called maximum entropy, for pricing a reverse mortgage, which is potentially very useful as banking and insurance regulations have shifted to more risk-based and market-consistent valuation principles. In particular, we apply this maximum entropy approach to multiple risks simultaneously, including longevity risk, house price risk, and interest rate risk. This method is more consistent than using different risk-neutral measures arbitrarily for different risks in the current reverse mortgage literature.

2 PRODUCT FEATURES

In general, a reverse mortgage allows an individual to borrow against the value of his or her own home property. The loan accumulates with interest over time and is repaid from the proceeds of the sale of the property on termination. The precise product features vary with each provider. A list of key items is given below, where the common terminologies in Australia and the United Kingdom are used. (The corresponding US terminologies are stated in brackets where applicable.) More details can be found in the Equity Release Report 2005 (Institute and Faculty of Actuaries 2005a, 2005b). Table 1 provides a summary of the features of the products offered by different providers in Australia.

2.1 Eligibility

Usually the borrower has to be above a certain age, such as age 60 and over. For a couple, the younger person has to be over the minimum age. The property

to be mortgaged needs to be in good conditions and adequately insured. Any prior home purchase mortgage must be fully repaid, either before entering into reverse mortgaging or from the initial proceeds of the loan. Financial and legal counselling should be sought prior to application.

2.2 Loan-to-value ratio

The maximum amount that can be borrowed is typically expressed as a loan-to-value ratio, which is the loan amount available as a percentage of the property value. This ratio, subject to certain limits, usually increases with the applicant's age – for older ages, life expectancy is lower and the accumulation period, in which the loan interest rate is generally higher than the house price growth rate, is shorter.

2.3 Mode of payment

The funds released from the loan can be taken as a lump sum at the outset; as a series of income payments for life (tenure) or for a pre-specified term (term); or as drawdown based on the borrower's selection of the payment times and amounts until the funds are exhausted (line of credit). A combination of these options is also possible with some providers.

2.4 Interest rate

The loan interest rate can either be a fixed rate or a variable rate linked to a market interest rate or an inflation index. In Australia, products with a variable rate are common.

2.5 Repayment

Repayment of the loan and accumulated interest is made only when the borrower passes away, moves into long-term care, moves out of the home permanently owing to non-health reasons, or pre-pays the debt due to a change in financial situation. Before then, the borrower has the right to continue to stay in the mortgaged property and no repayment of the loan and interest is needed.

2.6 No-negative-equity guarantee (non-recourse provision)

This guarantee ensures that the final total repayment of the borrower is capped at the realised value of the mortgaged property. That is, even when the accumulated loan balance exceeds the property value, the borrower does not have to pay the shortfall and has the right to stay in the property, while the provider cannot claim the borrower's other assets.

Senior Australians Equity Release (www.sequal.com.au), an industry body for the equity release market in Australia, requires all its members to offer this guarantee in their products. In the United Kingdom, the industry representative body, Safe Home Income Plans, makes it compulsory for its members to provide the no-negative-equity guarantee. In the United States, the Home Equity Conversion Mortgage program¹ is insured by the Department of Housing and Urban Development for losses when the property value falls below the loan balance. In Hong Kong, any shortfall will be covered by the HKMC under an insurance arrangement between the provider and the HKMC. (Section 5 presents a market-consistent valuation approach for this guarantee feature.)

2.7 Surrender charges

On prepayment due to a change in financial conditions, such as remortgaging at a lower loan interest rate when market interest rates fall or being offered by a competitor, or moving out permanently because of non-health issues, charges may be imposed on the borrower. In the United Kingdom, these charges can be in the form of a flat scale for a certain number of years, which may go down to zero afterwards, or mark-to-market penalties capped at a certain level. The purpose is to cover the lost manufacture and sales costs, as well as any interest rate loss regarding the funding of the loan. In Australia, many providers do not set surrender charges.

The following are some other possible features which can be embedded into reverse mortgage products to make them more flexible to meet customers' specific needs.

2.8 Portability

The borrower can transfer the loan to a new property. Partial repayment is required only when the new property does not meet the underwriting criteria or has a lower market value.

2.9 Capital protection

The loan is based on a portion of the property only. The remaining portion can then be made as some form of inheritance, regardless of the loan balance on termination.

2.10 Fixed repayment

A fixed repayment amount is agreed at the outset, based on the applicant's life expectancy. This amount does not depend on when actually the borrower dies or moves out and the loan terminates.

¹ More information about the Home Equity Conversion Mortgage program can be found in <https://portal.hud.gov/hudportal/HUD?src=/hudprograms/hecm>.

2.11 Long-term care and other support

Services such as at-home care, long-term health care, moving into retirement homes and home maintenance can be directly incorporated into reverse mortgage products. Alternatively, part of the funds can be used to buy medical insurance and long-term care insurance.

2.12 Impaired lives

For impaired lives, their lower life expectancy means that the accumulation period is shorter, in which the loan interest rate generally exceeds the house price growth rate. The funds released from the loan may then be increased.

2.13 Other equity release products

Apart from reverse mortgages, there are other types of equity release products. Under a reversion scheme (e.g. Homesafe Solutions), the provider buys a portion or all of the customer's property, in which there is a transfer in ownership. In return, the customer receives a lump sum payment from the provider and is entitled to live in the property for life. The lump sum payment is less than the current value of the transferred portion after deducting the cost of the lease for life. Another new product in Australia is called Property Options for Pensioners and Investors, in which the investor makes regular payments to the homeowner, who agrees to sell the home property to the investor at a pre-determined

price. This product involves a one-to-one relationship instead of a portfolio of home properties as for reverse mortgages traditionally.

3 UNDERLYING RISKS

Reverse mortgage providers are subject to a range of insurance, market and business risks. It is very important for providers to understand these risks properly and make adequate allowance in pricing and reserving. Broadly speaking, the major risks include longevity risk, house price risk, interest rate risk and general business risks.

In Australia, the loan interest rate was around 6.5% p.a. in 2015 and the house price growth rate was about 6.5% p.a. in 2014. There is a risk of the borrower living longer than expected, which increases the chance of the accumulated loan balance exceeding the market value of the mortgaged property and correspondingly a loss under the no-negative-equity guarantee. Moreover, for income products, the longevity risk is that the borrower survives for a prolonged period and the income stream payable turns out to be, in total, more than expected. As such, an appropriate stochastic model is required to describe past mortality patterns and project future movements. In this regard, there is an extensive literature on modelling mortality improvement over

Table 1: Product features of reverse mortgages offered by different providers in Australia.

Provider	Minimum age	Loan-to-Value (LTV) Ratio	Payment mode	Interest rate	No-negative-equity guarantee	Surrender charges	Special features
Commonwealth Bank (Equity Unlock Loan for Seniors)	65	\$20,000 to \$425,000 based on age and property value (20% for ages 65 to 69; 25% for ages 70 to 74; 30% for ages 75 to 79; 35% for ages 80 to 84; 40% for ages 85 and over)	Lump sum or income	Variable	Yes	\$0	—
Australian Seniors Finance (Lifetime Loan)	60	\$10,000 to \$500,000 based on age and property value	Lump sum, income, or drawdown	Variable	Yes	\$0	Capital protection of either 10%, 20%, or 50%; loan is portable
St George Bank (Seniors Access Home Loan)	63	\$10,000 to \$250,000 based on age, property value, and location (15% for ages 63 to 69; 20% for ages 70 to 79; 25% for ages 80 and over)	Lump sum or drawdown	Variable	Yes	\$0	—
Bankwest (Seniors Equity Release Home Loan)	65	Up to 25% of property value	Lump sum or drawdown	Variable	Yes	\$0	—

Note: This information was collected from various companies' websites during 2015.

the recent two decades. Some notable examples are Lee and Carter (1992) and Lee (2000), which made use of the declining trend of a mortality index. The family of Lee–Carter models has been shown to produce reasonable projection results for many countries' mortality data. In Section 5, we adopt the Lee–Carter structure to model Australian mortality.

There is also a risk that the property value will fall below the accumulated loan balance. Figure 1 shows that Australia's property market has enjoyed significant growth for the past decade. The Australian economy has benefited from large developing countries' strong demand for natural resource exports. Nevertheless, it is generally perceived that house prices move in cycles, and it is essential to have a reasonable economics model to allow for such trends and volatilities. Because of the existence of autocorrelations and changing volatilities, the geometric Brownian motion assumption commonly used in financial economics is not suitable for this purpose. Alternatively, in Section 5, we apply a vector autoregressive (VAR) model (e.g. Tsay 2002) to Australian house prices. In addition, there are two things to note. First, each mortgaged property is unique and seldom traded, and so there are basically no historical data for analysis. A proxy needs to be used, such as a regional house price index, but then there exists basis risk between individual house prices and house price indices (e.g. Andrews & Oberoi 2015). Second, price-based indices are constructed from actual transaction data, while valuation-based indices are computed from appraisal values and have the valuation smoothing problem, which can be solved by certain desmoothing techniques (e.g. Chaplin 1997).

If the loan is charged at a variable rate, the risk is that market interest rates fall below expectation. Figure 2 demonstrates the cyclical patterns of interest rate movements from 1970 to 2015. To provide an adequate description of interest rate patterns, numerous interest rate models and their applications have been studied by academics and practitioners. These models are well documented in the literature, such as the commonly used Vasicek model and Cox–Ingersoll–Ross model (e.g. Cairns 2004). Time series models can also be used for modelling interest rates (e.g. Tsay 2002). In Section 5, we apply a bivariate VAR model to both Australian interest rates and house prices. On the other hand, even if the loan is charged at a fixed rate, when market interest rates drop, borrowers tend to prepay the loan and remortgage with another provider at a lower loan interest rate. The original provider will then suffer a loss in production and distribution costs.

Unavoidably, there are also various kinds of common business risks. These risks include mis-selling, fraud, legal risk and operational risk (e.g. ASIC 2007; GAO 2009; CFPB 2012). They are relatively more



Figure 1: Australian residential property price index (weighted average of eight capital cities, including Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Darwin, and Canberra), September 2003 to March 2015.

Source: The underlying data were collected from the Australian Bureau of Statistics (www.abs.gov.au).

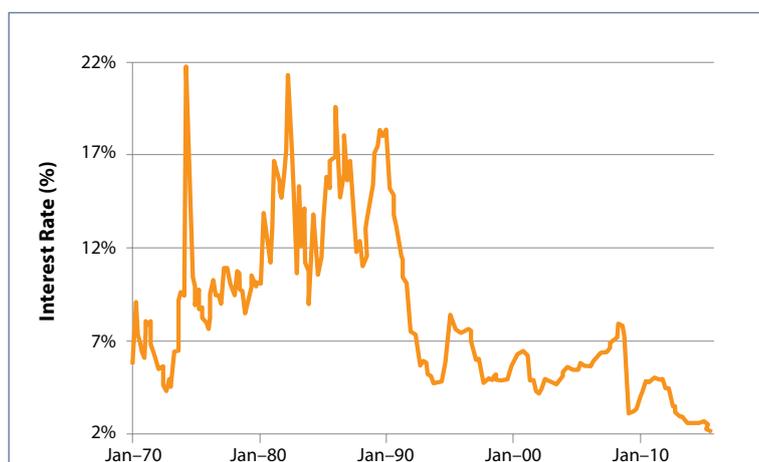


Figure 2: 90-day bank accepted bills yield, January 1970 to August 2015.

Source: The underlying data were collected from the Reserve Bank of Australia (www.rba.gov.au).

difficult to identify and assess compared with insurance and market risks, especially for new markets like reverse mortgages. It appears that one has to rely on a rather subjective approach to allow for these business risks, and more data must be collected for a more proper assessment.

4 DEMAND AND SUPPLY

As discussed, reverse mortgages represent a flexible way of allowing an individual to release his or her home equity and obtain supplementary finance for retirement living, while continuing to stay in the mortgaged

property. Despite the sound rationale, the market is rather small in Australia and is still new in Asia-Pacific. Traditionally, there have been a number of demand and supply constraints which hinder the growth of this market. But these constraints appear to be fading out gradually, under ongoing development of market sophistication and increased public awareness.

On the demand side, bequest motives can be an important factor. It is not uncommon for the elderly to leave some form of inheritance to their family. To cater for this need, the provider can incorporate the capital protection feature, so that an agreed, fixed portion of the property can be preserved for inheritance. Moreover, attitudes towards inheritance are also gradually changing over time. As noted in Olsberg and Winters (2005), more older people nowadays follow the norm of “put yourself first”, and the desire to bequeath assets to the children seems to be diminishing significantly. This trend suggests that in the future more people would accept the idea of equity release to maintain or even upgrade their lifestyle in retirement.

There has also been a general lack of understanding of reverse mortgage products. For example, because entering into a reverse mortgage is likely to be the last major financial transaction an individual makes, they may be worried about once again raising debt, and feel suspicious of the validity of the product, or concerned about the value for money. To protect consumers’ interests and increase public confidence, Senior Australians Equity Release (SEQUAL)², an industry governing body, requires all its members to comply with a code of conduct and aims to ensure professionalism within the Australian equity release market. In particular, SEQUAL stipulates that financial and legal advice should be sought prior to application; all the benefits, costs and obligations should be clearly documented and explained to the customer; and a projection of future scenarios of house prices and interest rates should be demonstrated. It is important to ensure that current and prospective customers fully understand the arrangements and obligations from time to time. Similar industry bodies overseas include Safe Home Income Plans (SHIP) in the United Kingdom and Home Equity Conversion Mortgage (HECM) in the United States. Moreover, the participation in the market by famous brands (e.g. Commonwealth Bank; see Table 1) would help enhance the profile and image of the reverse mortgage market. Deloitte (2012) noted that a number of significant providers remain active in the market, which is expected to continue to grow as the Australian population ages.

It appears that the product design of reverse mortgages has focused on the loan-to-value (LTV) ratio and the loan interest rate (e.g. Equity Release Report by the Institute and Faculty of Actuaries 2005a, 2005b). Naturally, competition tends to be built on offering higher LTV ratios and lower interest rates. The resulting lack of product choices may discourage demand from customers, who may find it difficult to identify a suitable product. As the market develops further, it is expected that there will be more innovations in product design, which aim to tailor to customers’ needs. As mentioned earlier, extra product features can be added, such as capital protection and long-term care. For example, Bluestone introduced a “protected-equity option”, which allowed a borrower to protect up to 20% of the property value; XCapital Health offered a reverse mortgage product embedded with extra provisions such as healthcare, moving into a retirement unit and nursing home services (Creighton et al 2005). More flexibility and choices would help address specific individual concerns and may raise the popularity of reverse mortgage products.

It may also be problematic for people of the lower social-economic group to meet the terms and conditions required by commercial providers. Equity release would provide a way for funding their living expenses, but their properties are likely to be of low value and possibly in poor condition, which would not satisfy certain mortgage requirements. Perhaps, partnerships between the public and private sectors or some form of government backing could help alleviate this problem (Institute and Faculty of Actuaries 2005a, 2005b). Currently, the Department of Veterans’ Affairs in Australia offers a Pension Loans Scheme which provides income payments for a loan charged at an interest rate of only 5.25% p.a. (compared with around 6.5% p.a. in the market). This loan can be recovered from the estate on the death of the borrower. The property used as security for the loan is valued by the Australian Valuation Office, and it appears that no specific conditions are clearly imposed on the property (Department of Veterans’ Affairs 2013). There are also other rates-postponement schemes in South Australia and the ACT.

On the supply side, it is crucial for providers to take proper account of longevity risk, house price risk, interest rate risk, and other business risks in pricing and reserving. As discussed above, stochastic models for assessing many of these risks are already well developed in the literature. The main problem is the availability of data – the market is still immature and reverse mortgage experience is limited. It means that

2 More information about SEQUAL can be found in <http://www.sequal.com.au/>.

providers will have to set aside more risk capital and charge higher risk premiums, which would result in unattractive product prices. In the meantime, proxies can be adopted to tackle this data limitation. For example, annuitants' mortality experience can be taken as a proxy, owing to its close link to that expected for reverse mortgage customers (e.g. adverse selection); and a regional house price index can be used as an approximate guide for individual house prices. For decrements other than death, such as moving into long-term care and pre-payment, overseas experiences would be very useful references (e.g. Hosty et al 2008). In the medium to long term, regular decrement investigation for the whole reverse mortgage market is necessary to provide accurate and relevant information to market participants. Perhaps, the Australian Actuaries Institute can initiate this kind of industry study and invite major market players to participate.

Recent developments in the “life market”, where mortality-linked securities and liabilities are traded, have made it easier for financial institutions to transfer their risk exposures amongst one another or to other investors who want to diversify their portfolios with an uncorrelated market sector. For instance, in the United States, Ginnie Mae issued the first reverse mortgage real estate mortgage investment conduit (REMIC), comprising Bank of America reverse mortgage securitisations worth US\$130.9 million in 2010, and similarly Fannie Mae securitised over US\$9 billion of HECM loans in 2011. Through securitisation, reverse mortgage providers can reduce their exposures to the various kinds of risks mentioned above. Each risk may also be hedged individually, for example, longevity risk hedged by survivor swap; house price risk by property index swap; and interest rate risk by interest rate swap – in which there would be some level of basis risk for the first two cases. On prepayment (due to remortgaging), mark-to-market penalties can be charged to cover any interest rate loss regarding the funding of the loan. Further research and accumulation of market experience are needed to make these securitisation and hedging strategies more efficient and effective in transferring risks. For now, the United Kingdom and United States are ahead of Australia and the Asia–Pacific in life market developments, but it is not unreasonable to anticipate that the latter will catch up gradually, especially under the steady economic growth in the region.

Overall, one can reasonably expect that the reverse mortgage market will continue to grow in the long term, with population ageing, ongoing market development and an increase in public awareness. Further impetuses can possibly be provided by the government, especially after the reduction in market capacity due to the global financial crisis (GFC) and

under the tightened eligibility criteria in the Australian reverse mortgage market in recent years. For instance, some form of government guarantees or sponsorships can be offered to encourage market participation, in a similar way to that in which the US reverse mortgage market has been stimulated by the HECM program. More long-term bonds (say, 30 years and above) could also be issued, with which reverse mortgage providers can hedge their interest rate risk. At present, the maximum duration of government bonds in Australia is only 15 years (compared with 30 years in Singapore and 15 years in Hong Kong.) The government may also consider making the way the retirement income system and reverse mortgages fit together more coherent, in order to encourage more market development, e.g. removing the family home exemption from the pension assets test, and compulsory annuitisation of superannuation (Brownfield 2014).

5 MARKET PRICING

Since Basel I was published in 1988 and enforced in 1992, banking and (subsequently) insurance regulations worldwide have progressively adopted more risk-based and market-consistent valuation principles. In Basel II, for market risk, banks must “mark-to-market as much as possible”, and when marking-to-market is not feasible, banks may mark-to-model, in which the valuation is to be “benchmarked, extrapolated, or otherwise calculated from a market input” (BIS 2006). Under Solvency II in Europe, the computation of technical provisions should “make use of and be consistent with information provided by the financial markets and generally available data on underwriting risks (market consistency)” (Council Directive 2009/138/EC). Under Prudential Standard APS 111 in Australia, an authorised deposit-taking institution (ADI) may measure its financial instruments at fair value, in which the process should “maximise the use of relevant observable inputs and minimise the use of unobservable inputs” and “only mark-to-model where mark-to-market is not possible”. Clearly, an appropriate market-consistent approach to determine the value of a reverse mortgage is much needed under current regulations, even though there are opposing views on the validity of the market consistency paradigm (e.g. Kapel 2013; Stott 2013).

5.1 Valuation methods

Generally speaking, there are two ways to price a security. The first uses real-world probabilities derived from past data, and a discount rate based on the investor's own risk preference. The selection of discount rate (i.e. risk adjustment) is rather subjective and we

do not consider this first method here. In contrast, the second method constructs a risk-neutral world, and uses risk-neutral probabilities and the risk-free rate to discount future payoffs. (In a risk-neutral world, the expected return is always equal to the risk-free rate.) If the market is complete, which means there are many securities traded in the market and any cash flow can be replicated by dynamic hedging strategies, the no-arbitrage principle indicates that there is only one risk-neutral measure (i.e. one equivalent martingale measure) and there is only one price (i.e. law of one price). This concept is the cornerstone of financial economics. Figure 3 gives a graphical summary of the two valuation approaches.

5.2 Incomplete life market

However, it is currently unreasonable to assume market completeness for longevity risk, as the life market is still underdeveloped and illiquid. In an incomplete market, there is an infinite number of risk-neutral measures, and it is necessary to choose one that is suitable to the particular problem being studied. The most popular choices in the literature include the Esscher transform (Gerber & Shiu 1994) and Wang transform (Wang 2000).

Suppose X is the random value of a risk factor at time T , $f(x)$ is the density function, $F(x)$ is the distribution function, and $C(X)$ is the random payoff of a security at time T . The Esscher transform for X with parameter λ is given as $f^*(x) = e^{\lambda x} f(x) / E(e^{\lambda x})$, where $f^*(x)$ is the transformed density function. Using market price data, one can estimate λ and convert the real-world density $f(x)$ into a risk-neutral density $f^*(x)$. The expected present value of the security at time 0 can then be computed as $(1+r)^{-T} \int C(x) f^*(x) dx$, where the risk-free rate r applies to the period time 0 to time T .

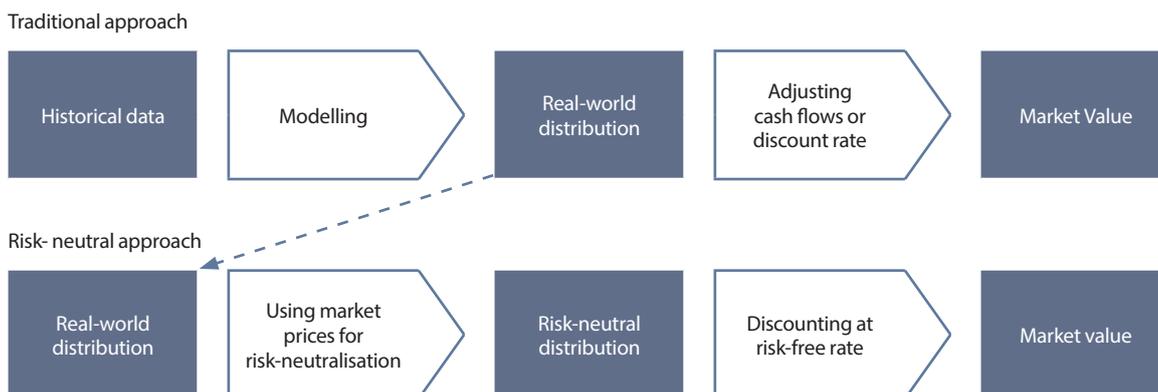
Alternatively, the Wang transform with parameter λ given as $F^*(x) = \Phi(\Phi^{-1}(F(x)) - \lambda)$ can also be used, where $F^*(x)$ is the transformed distribution function.

Although these two methods are commonly used in pricing mortality-linked securities, Li (2010) noted that subjective decisions are needed under the Wang transform when the number of market prices of risk (i.e. parameters of the transform) is different to the number of market prices of securities available, and that it is unclear how to incorporate parameter error. Li and Ng (2011) also advised that incorporation of additional market prices of securities is not straightforward for the Wang transform. Kogure and Kurachi (2010) commented that the Esscher transform depends on a single parameter and usually allows for only one risk-neutral constraint.

5.3 Maximum entropy approach

In comparison, the maximum entropy approach adopted by Kogure and Kurachi (2010), Li (2010), Li and Ng (2011), and Kogure et al (2014) is more flexible and is not subject to these limitations. Under the maximum entropy principle, one should find the risk-neutral density $f^*(x)$ that minimises the Kullback-Leibler information criterion $\int f^*(x) \ln \frac{f^*(x)}{f(x)} dx$, subject to the constraints $\int f^*(x) dx = 1$ and $(1+r)^{-T} \int h_i(x) f^*(x) dx = v_i$, where $h_i(X)$ and v_i are respectively the random payoff at time T and the market price at time 0 of security i ($i = 1, 2, \dots, m$). This approach has a number of key advantages. First, in principle, one can incorporate any number of market prices of securities m , which makes it suitable for a developing but illiquid life market. Second, if there is a complete market with numerous securities in the future, the resulting risk-neutral measure is also the unique risk-neutral measure (i.e. one equivalent martingale measure). Third, it allows the use of different simulation methods (e.g. Li 2014), which avoids complicated analytical derivations and facilitates practical implementation. Fourth, it can be applied to different risks in the same way, which is more consistent than the common tactic of applying different measures or

Figure 3: Valuation methods – traditional approach versus risk-neutral approach.



transforms rather arbitrarily to different risks in the reverse mortgage literature. Lastly, there are theoretical justification and empirical support for the maximum entropy principle (e.g. Li 2010).

In practice, we can perform simulation to generate many scenarios and use the discrete version of the maximum entropy principle. Suppose a total of N real-world scenarios are simulated based on historical data, in which each scenario j ($= 1, 2, \dots, N$) has an equal probability of $\pi_j = 1/N$. We compute the risk-neutral probabilities π_j^* 's that minimise the Kullback-Leibler information criterion $\sum_{j=1}^N \pi_j^* \ln \frac{\pi_j^*}{\pi_j}$, subject to the constraints $\sum_{j=1}^N \pi_j^* = 1$ and $(1+r)^{-T} \sum_{j=1}^N h_{i,j} \pi_j^* = v_i$, where $h_{i,j}$ is the simulated payoff at time T of security i under scenario j . It can readily be derived from Lagrange multipliers that

$$\pi_j^* = \frac{\pi_j \exp\left(\sum_{i=1}^m \gamma_i (1+r)^{-T} h_{i,j}\right)}{\sum_{j=1}^N \pi_j \exp\left(\sum_{i=1}^m \gamma_i (1+r)^{-T} h_{i,j}\right)},$$

where $\gamma_1, \gamma_2, \dots, \gamma_m$ are calculated by substituting these formulae of π_j^* 's into the above market price constraints of v_i 's. In the following numerical example, for illustration purpose, we set $m = 3$ for each future point of time, including one annuity price constraint, one house price constraint, and one zero-coupon bond price constraint. We assume longevity risk and market (house price and interest rate) risk are real-world independent, and apply the maximum entropy principle to these three risks simultaneously. The real-world independence assumption is broadly in line with the illiquid status of the current life market. As mentioned earlier, the current reverse mortgage literature generally applies different risk-neutral measures to different risks (e.g. Lee et al 2012; Alai et al 2013), and our approach here represents the first effort to apply the same risk-neutral measure consistently to multiple risks.

5.4 Illustrative example

Suppose a person aged x ($= 65$) enters into a reverse mortgage at time 0. Let L_t be the loan's outstanding balance and P_t be the mortgaged property's value at time t . Assume the loan interest rate is fixed at r_t and so $L_t = L_0(1+r_t)^t$. If the person dies between time $t-1$ and time t , the provider will receive $\min(L_t, P_t)$ at time t . Then consider a group of such individuals of the same cohort with homogeneous mortality and house inflation experience, and let I_t be the proportion of this cohort group who will die during time $t-1$ to time t . The provider will receive $\min(L_t, P_t)I_t$ at $t = 1, 2, \dots, T$ from each person "on average". Assuming the risk-free rate $r_{0,t}$ applies to the period time 0 to time t , the expected present value of each reverse mortgage at time 0 is thus

$$E^* \left[\sum_{t=1}^T (1+r_{0,t})^{-t} \min(L_t, P_t) I_t \right],$$

where E^* is the expectation operator under the risk-neutral measure and T is the maximum future lifetime. This expected present value must be larger than L_0 (initial lump sum) for the reverse mortgage to be financially viable. Note that the way we calculate the "average" value of a reverse mortgage in a homogeneous portfolio reflects that we deal with only the *systematic* longevity risk (affecting all lives coherently), but not the *non-systematic* component (arising from random fluctuations between lives), which is assumed to be diversified away via pooling.

5.5 Longevity risk

Let $I_t = (1 - q_{x,0})(1 - q_{x+1,1}) \dots (1 - q_{x+t-2,t-2})q_{x+t-1,t-1}$, where $q_{x,t}$ is the (random) probability that a person aged x at time t will die within one year. Assume the force of mortality $\mu_{x,t}$ is constant within each age-time cell and so is equal to the central death rate $m_{x,t}$, then $q_{x,t} = 1 - e^{-m_{x,t}}$. We apply the famous Lee and Carter (1992) model $\ln m_{x,t} = \alpha_x + \beta_x \kappa_t$, where α_x describes the mortality schedule and κ_t is the mortality index with β_x as the sensitivity measure. For each future point of time, we use the fitted Lee-Carter model to generate N paths of $q_{x,t}$ and I_t , each with a real-world probability of $\pi_j = 1/N$.

5.6 House price risk and interest rate risk

In order to allow for the autocorrelations and cross-correlations of the house price growth rates and interest rates, and after inspecting the sample cross-correlation matrices and the sample partial autocorrelation matrices, we find that a VAR(3) model (e.g. Tsay 2002) fits the data appropriately. The sample partial autocorrelations broadly suggest a cut-off at lag 3, and the corresponding residuals do not show significant autocorrelations. For each future point of time, we use the fitted VAR model to generate N paths of house prices and interest rates, each with a real-world probability of $\pi_j = 1/N$.

5.7 Historical data and market prices

We take the valuation date as 31 December 2014. We collect Australian female mortality data from the Human Mortality Database (HMD 2015) for ages 65 to 99 and years 1968 to 2011, and fit the Lee-Carter model to these data. Female life expectancy is higher and it would be interesting to study the corresponding longevity risk. We also obtain the residential property price index (weighted average of eight capital cities) from 2003 to 2014 from the Australian Bureau of Statistics (ABS) and the 90-day bank accepted bill yields for the same period from the Reserve Bank of Australia

Table 2: Market values (in \$1,000) calculated for the reverse mortgage example under different loan-to-value (LTV) ratios and loan interest rates.

LTV \ r_L	3%	4%	5%	6%	7%	8%	9%	10%
10%	49	62	81	105	137	179	237	306
20%	97	125	161	209	273	352	401	421
30%	146	187	242	314	396	428	440	447
40%	195	250	323	411	440	450	456	459
50%	243	312	403	447	457	461	464	465
60%	292	375	451	461	465	467	469	470
70%	341	435	464	469	470	471	472	473
80%	390	465	471	472	473	473	474	474
90%	435	472	474	474	474	474	475	475
100%	466	474	475	475	475	475	475	475

Note: The shaded figures refer to those cases where the market value is smaller than the initial loan size.

(RBA). We then fit the VAR model to these index and yield data. Since the annuity market in Australia is thin, we use the Australian Life Tables 2005–07 published by the Australian Government Actuary in 2009 as a proxy to give the annuity market prices. We use the property index (December 2014) from the ABS as the house market price, and the zero-coupon interest rates (31 December 2014) from the RBA to give the zero-coupon bond market prices. Then we set the constraints with these market prices.

5.8 Numerical results

We consider $H_0 = 500,000$, $L_0 = 50,000, 100,000, 150,000, \dots, 500,000$ (i.e. LTV ratios of 10%, 20%, 30%, ..., 100% respectively), and $r_L = 3\%, 4\%, \dots, 10\%$. Table 2 gives the reverse mortgage's market values under different LTV ratios and loan interest rates. It can be seen that as expected the market value increases with the loan interest rate, the effect of which reduces for a higher LTV ratio because of the no-negative-equity guarantee. Table 2 also highlights those cases where the market value is smaller than the initial loan size (i.e. the reverse mortgage is not financially viable). In the current Australian reverse mortgage market, the loan interest rate is around 6% p.a. and the LTV ratio is about 20% for a person 65 years old. Our numerical results hence suggest that the existing reverse mortgage products appear to be financially sustainable. It also seems that there is much room for Australian providers to increase the LTV ratios and so the attractiveness of their reverse mortgage products. This observation is in line with the results obtained by other authors, such as Alai et al (2013) and Cho et al (2013).

Note that many other mortality models (e.g. Cairns et al 2006), financial models (e.g. Cox-Ingersoll-Ross model), and simulation methods (e.g. Li 2014) can also be used under this maximum entropy approach of risk-neutralisation. Different product features such as variable loan interest rates, the decrements of moving into long-term care and moving out of the home permanently, the mortality of couples, and fees and charges can readily be incorporated into the computations, as long as sufficient past data are available for fitting the models and market price data are available for setting the constraints. The maximum entropy framework is very flexible for performing marking-to-market in practice.

6 CONCLUDING REMARKS

In this paper, we describe the general features of reverse mortgages and the underlying risks for providers, including longevity risk, house price risk and interest rate risk. We also discuss the demand and supply constraints and recent market development, with a focus on the Australian market. In particular, we propose to use maximum entropy to (risk-neutral) price a reverse mortgage and model the three risks consistently and simultaneously. This approach is flexible in handling multiple risks and setting market price constraints. The results of our hypothetical example suggest that the current Australian reverse mortgage market seem to be operated in a sustainable manner. For future research, it would be interesting to apply this approach to other similar products, especially when the longevity market continues to grow. Further

numerical comparison can also be made between maximum entropy and the commonly used Esscher transform and Wang transform.

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Acknowledgements

The authors would like to thank the editors for their valuable comments and suggestions, which have enhanced the presentation of this paper.

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Portable Long Service Leave in the Building and Construction Industry

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ABSTRACT

At present, each Australian state and territory has its own Long Service Leave standards. As a result of the Fair Work Act, there is interest in establishing a uniform national Long Service Leave standard. Some people have suggested that the new standard should allow for better portability of benefits as people move from one employer to another. In order to assess the desirability of doing so, it seems sensible to evaluate the strengths and weaknesses of the existing state-based LSL schemes which provide portable LSL benefits for workers in the building and construction industry. In this paper, we review the financial management and performance of these schemes, looking at legal structures, benefit design, investment strategy, stability of employer costs, solvency, and compliance issues.

KEYWORDS

Long Service Leave, Portability of Entitlements, National Employment Standards, Fair Work Act, Building and Construction Industry

INTRODUCTION

In 1951, the New South Wales government passed legislation to provide long service leave (LSL) for private sector workers in New South Wales. When introducing the legislation, the Minister for Labour and Industry said that the aims of the LSL legislation were:

- (1) “It will be an influence tending to reduce labour turnover which today is costing employers a considerable waste of effort and money;
- (2) it will reward long and faithful service with a single employer; and finally
- (3) it will enable an employee halfway through his working life to recover spent energies and return to work renewed, refreshed and reinvigorated.”¹

In accordance with these objectives, the rules were designed to provide paid leave for workers who remained in service with the same employer for 20 years. Pro-rata cash benefits were available for those who left service after completing at least 10 years’ service; but those who left their jobs after a

shorter period of service forfeited their accrued LSL entitlements.

Over the next decade, other Australian states and territories also passed long service leave legislation. Each state initially adopted the same basic principle: LSL was designed as a benefit for employees who provided long and faithful service to just one employer.

Over time, the LSL rules have evolved. Qualifying periods have been reduced – in most states, paid leave may be taken after just 10 years’ service. Vesting periods have also reduced – pro-rata benefits are generally payable after five or seven years for employees who leave service by death, illness, incapacity, termination by the employer (for any reason other than misconduct), or resignation due to domestic or pressing necessity. Two states (Victoria and Western Australia) also provide pro-rata benefits for those who voluntarily resign from service after completion of seven years’ service.

Nevertheless, there are still many workers who have worked for many years, but have never qualified for LSL benefits, because they have worked for more than one employer. Figure 1 shows the proportion of workers who have been in the workforce for more than 10 years, but have less than 10 years’ service with their current employer. This proportion varies by industry: some industries naturally tend to have high worker turnover.

Some have argued that it would be desirable to extend LSL benefits to a wider range of workers by providing LSL on a portable basis.² In July 2014, two Greens Senators put forward the following motion:

“That the Senate refer the matter of portable long service leave to the Education and Employment References Committee for inquiry . . .

- (a) The creation of a nationwide portable entitlement scheme for long service leave and any other appropriate entitlements, taking into account
 - a. The number of Australian workers in insecure work;
 - b. Increased workplace mobility and increasingly precarious working conditions; and
 - c. Other related matters;
- (b) Developing recommendations as to how any such scheme could be paid for and implemented, including:
 - a. The role of existing portable long service leave schemes operating in some sectors;
 - b. How the scheme should be co-ordinated and by whom; and
 - c. Any other relevant matters.”³

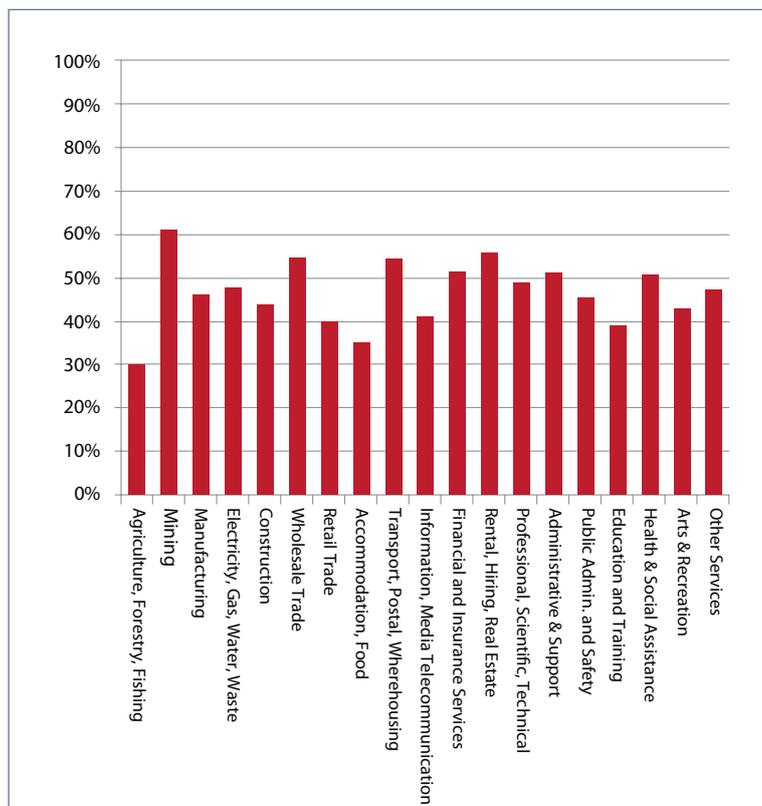


Figure 1: Percentage of workers who have been in the workforce for at least 10 years but have less than 10 years’ service with one employer.

Source: Household Income and Labour Dynamics in Australia (HILDA) Survey Wave 9, cited in Table 2.1 of Ray Markey, Nick Parr, Chris Wright, Shauna Ferris, Tim Kyng, Sharron O’Neill, Salut Muhidin, Louise Thornthwaite, and Catriona Lavermicocca, *The case for a national portable long service leave scheme in Australia*, McKell Insitute, Sydney, 2013.

This proposal ultimately led to a Senate inquiry into the “Feasibility of, and options for, creating a national

long service standard, and the portability of long service and other entitlements”⁴

Many trade union leaders have also repeatedly spoken out in favour of improving portability of LSL entitlements.⁵

The advantages and disadvantages of improving the portability of LSL have previously been canvassed in a discussion paper published by the McKell Institute.⁶ That discussion paper addresses the following question: supposing that we do want to extend LSL to a wider range of workers, what is the best method of doing so?

There are already several industry-based portable LSL schemes in Australia. One option for implementing improved portability would be to create new industry-based schemes which are modelled on the existing schemes. Is this a good idea?

In this report, our aim is to make a contribution to this debate by providing an assessment of the portable LSL schemes which are currently operating in Australia. Are they working well? What are the strengths and weaknesses of this approach?

Most portable LSL schemes have been set up under state or territory legislation. They allow for portability of entitlements within a specified industry. These portable schemes cover workers in the following industries:⁷

- coal mining industry (a national scheme)
- building and construction industry (all states and territories)
- contract cleaning industry (ACT, Queensland, New South Wales)
- community services industry (ACT)
- security industry (ACT).

There are significant differences between these industry-based schemes, and each industry has distinct workforce characteristics.

In this report, we focus on the eight schemes that cover the building and construction industry. The aim is to review:

- scheme coverage and design
- rationale for the creation of the scheme
- historical developments (including the results of prior reviews and employer feedback)
- legal structure and governance arrangements
- investment objectives, strategy, and performance
- financial status (solvency)
- stability of levies
- compliance and administrative issues
- administration expense ratios.

We will start by considering some issues which are common to all of the portable LSL schemes in this industry (section 1). However each scheme has different benefits, different methods of collecting levies, and

different legal structures. To illustrate some of the different issues affecting individual schemes, section 2 examines two of the state-based schemes, in New South Wales and Tasmania, in more detail.

1 OVERVIEW

Every Australian state and territory has a separate long service leave scheme for people who work in the building and construction industry. These schemes all provide portable benefits: that is, workers can continue to build up LSL entitlements as they switch from one employer to the next, as long as they continue working in the building and construction industry. Workers can retain their entitlements even if they have a break in their industry employment: the break may last for up to four years (although this limit varies between states – see Table 1).

The state and territory schemes also have reciprocal agreements which allow workers to transfer their LSL entitlements from one scheme to another, when the worker moves to a new location. This arrangement is particularly important for schemes which have a lot of transient workers, such as the Northern Territory.

Different schemes have different benefit entitlements. Workers are allowed to take long service leave after completing a certain number of days of eligible service within the industry (the qualifying period). They may also be eligible for a pro-rata cash payment of accrued leave in the event of death, disability, age retirement, or leaving the industry, as long as they have completed the vesting period. The rules are summarised in Table 1.

The LSL benefits are all defined benefits, calculated as a multiple of weekly wages, but different schemes have different methods of calculating the correct amount. Some schemes use the worker’s own “ordinary pay” in the week before taking leave, but this sort of rule might allow some employees to game the system by boosting their pay temporarily in the weeks before taking leave. To avoid this problem, the New South Wales benefits are based on the award pay rate or the rate specified in an enterprise agreement. Some states allow for averaging to adjust for variations in pay over time. Queensland applies a cap to the weekly wages (periodically adjusted). The Northern Territory uses a common pay rate set by the NT Build Board, based on average weekly earnings in the construction industry.

Several of the schemes allow sub-contractors and self-employed contractors to join as a separate category of membership, with accumulation-type benefits. This review does not cover the arrangements for contractors.

Schemes generally do not cover administrators, office staff, or supervisors.

Table 1: Portable LSL entitlements for workers in the building and construction industry in Australian states and territories.

State or Territory	Long Service Leave	Pro-Rata Payments
Australian Capital Territory	13 weeks after 10 years' service	For construction workers registered before 1 July 2012: pro-rata payment after 5 years' service if leaving the industry permanently; pro-rata payment after 55 days service if leaving industry due to incapacity, reaching retirement age, or death (payment to estate). For construction workers registered after 1 July 2012: pro-rata payment after 7 years' service if leaving the industry permanently; pro-rata payment after 5 years' service if leaving the industry due to incapacity, reaching retirement age or death (payment to estate). Maximum break in employment is 4 years.
New South Wales	8.67 weeks after 10 years' service (220 days per year)	Pro-rata payments after 5 years' service if permanently ceasing building and construction work. Pro-rata payments after 55 days service if ceasing work due to age retirement (after age 55), total and permanent disability, or death. Maximum break in employment is 4 years.
Northern Territory	13 weeks after 10 years' service (260 days per year)	Pro-rata payments after 5 years' service (accrued LSL entitlement 32.5 days or more), if the person has ceased to carry out construction work or retired. Pro-rata payment after accruing at least 1 day's LSL in the event of death. Maximum break in employment is 4 years; applications for pro-rata benefits must be made within 4 years of ceasing work.
Queensland	8.67 weeks after 10 years' service (220 days per year)	Pro-rata payments after 1,155 days service if permanently ceasing building and construction work or in the event of death. Maximum break in employment is 4 years.
South Australia	13 weeks after 10 years' service (260 days per year)	Pro-rata payments after 7 years' service on death or disability (unable to work for 6 months) or leaving the construction industry for at least 12 months. Maximum break in employment: • 2 years (if less than 5 years' service), or • 3 years (if more than 5 years' service and less than 7 years). Workers with more than 7 years' service will retain their accrued entitlements until they take a benefit.
Tasmania	13 weeks after 10 years' service (260 days per year)	Pro-rata payments after 7 years' service on termination by the employer if the worker is unable to find other employment in the construction industry. Pro-rata payments after 55 days for disability, age retirement, or death. Maximum break in employment is 4 years.
Victoria	13 weeks after 10 years' service (220 days per year)	Pro-rata payments after 7 years' service. Pro-rata payments after 55 days service in the event of death. Maximum break in employment is 4 years if the worker has less than 7 years' service. Workers with more than 7 years' service will retain their accrued entitlements until they take a benefit.
Western Australia	8.67 weeks after 10 years' service (220 days per year)	Pro-rata payments after 7 years' service on termination of employment or death.

Source: ACT Long Service Leave Authority website at www.actleave.act.gov.au/Construction/Construction-Industry.html; Long Service Corporation website at www.longservice.nsw.gov.au/bci/workers/overview/what-are-the-benefits; NTBuild website at www.ntbuild.com.au/worker_info.shtml; Qleave website at [www.qleave.qld.gov.au/webdb/wsmanager.nsf/\(web\)/0523F7E6BBB9B7D14A257030001B70C9](http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/(web)/0523F7E6BBB9B7D14A257030001B70C9); Construction Benefit Services Portable Long Service Leave website at www.portableleave.org.au/workers/how-portable-long-service-leave-works; WorkSafe Tasmania website at worksafe.tas.gov.au/laws/long_service_leave; ColINVEST website at www.coinvest.com.au/workers/worker-faq-s#anchor5; MyLeave website at www.myleave.wa.gov.au/workers/about-the-scheme/; all accessed at 31/03/2017.

Note: 'Service' refers to service with one or multiple employers in the industry.

Where number of days is given in brackets (e.g. WA – 220 days per year), this refers to the number of days of service which provide an entitlement. State laws often specify the number of days of service which will be regarded as one year of service. This is qualified by a specification that no more than a certain number of days will be credited to an employee in a 12-month period. Thus if 220 days is regarded as one years' service, and no more than 220 days may be credited in a 12 month period, then 2200 days constitutes 10 years of service. In South Australia, Tasmania, and the Northern Territory, 260 days represents one year of service; other states use 220 days service per year.

1.1 Rationale for the establishment of the building and construction industry schemes

According to the Final Report of the Royal Commission Into the Building and Construction Industry (the Cole Report), the main factors which led to the introduction of these portable schemes were:

- “the strategic nature of the building and construction industry;
- high union density and industrial strength;
- a well-established industry focus; and
- patterns of employment in the industry”.⁸

Building and construction work is often project-based, so that workers are likely to change jobs frequently. Under the standard state-based LSL legislation, benefits are not portable, so building and construction workers would not normally qualify for LSL benefits. This provided the motivation for the creation of portable LSL schemes.

The first such scheme was set up in Tasmania in 1971, and other states and the ACT followed suit between 1972 and 1991. The Northern Territory finally created a portable scheme in 2005.

The funds have total assets of almost \$3 billion and the total number of registered workers as at 30 June 2013 was 982,273⁹. The average LSL payment in 2012–13 was about \$7300 per person (excluding the Northern Territory, which is a relatively immature fund).¹⁰ (See Table 2.)

1.2 Employer and union support for the building and construction industry portable LSL schemes

In 2001, the Howard Coalition government set up a Royal Commission into the Building and Construction Industry. The Honourable TRH Cole was appointed as the Commissioner. The Cole Royal Commission looked into the management of the portable long service leave schemes for the building and construction industry, and the Commissioner’s final report includes a useful summary of the history of each of the state and territory schemes (up to 2002).¹¹

The Commissioner sought opinions about the schemes, from both employers and trade unions in the industry. He asked:

“Is it appropriate that long service leave entitlements within the industry continue to be made according to the existing arrangements or should greater flexibility be provided through collective or individual bargaining?”¹²

Table 2: Portable LSL schemes in the building and construction industry, by state and territory.

State or Territory	Assets (\$millions)	Registered workers	Benefits paid in 2012–13 (\$millions)	Number of benefits paid
ACT	50	24,330	8	835
Northern Territory	33	13,799	0.65	235
New South Wales	772	319,996	65	10,820
Queensland	777	282,962	63	9,344
South Australia	100	25,900	10	1,602
Tasmania	81	19,068	5	680
Victoria	782	176,959	109	12,670
Western Australia	363	120,259	25	3,112
Total	2958	982,273	286	39,298

Source: ACT Long Service Leave Authority, *Annual Report 2012-13*, ACT Long Service Leave Authority, Canberra, 2013 at www.actleave.act.gov.au/files/annualreports/annualreport2013.pdf; NTBuild Portable Long Service Leave, *Annual Report 2012-13*, NTBuild, Darwin, 2013 at www.ntbuild.com.au/publications_forms/annual_report/NTBuild_AnnRep1213_full.pdf; Long Service Corporation *Annual Report 2012-13*, Long Service Corporation, Gosford, 2013 at www.longservice.nsw.gov.au/_data/assets/pdf_file/0007/11599/Annual-Report-2013.pdf; Building and Construction Industry (Portable Long Service Leave Authority), *QLeave Annual Report 2012-13*, Building and Construction Industry (Portable Long Service Leave Authority), Brisbane, 2013 at [www.qleave.qld.gov.au/webdb/wsmanger.nsf/\(web\)/5C0E967443FEBAD84A2579BF007B92B6/\\$File/QLeave Annual Report 2012-13.pdf](http://www.qleave.qld.gov.au/webdb/wsmanger.nsf/(web)/5C0E967443FEBAD84A2579BF007B92B6/$File/QLeave%20Annual%20Report%2012-13.pdf); Construction Industry Long Service Leave Board, *Annual Report 2013*, Construction Industry Long Service Leave Board, Burnside, 2013, at www.portableleave.org.au/assets/docs/general/AnnualReport2013.PDF; TasBuild Portable Long Service Leave Scheme, *Annual Report for the year ended 30 June 2013*, TasBuild, Hobart, 2013, at [www.tasbuild.com.au/content/tasbuild/download/AnnualReports/AnnualReport 2013a.pdf](http://www.tasbuild.com.au/content/tasbuild/download/AnnualReports/AnnualReport%2013a.pdf); ColINVEST, *Annual Report 2013*, ColINVEST, East Melbourne, 2013; MyLeave Construction Industry Long Service Leave Scheme, *Annual Report 2013*, MyLeave Construction Industry Long Service Leave Scheme, Perth, 2013, at <http://www.myleave.wa.gov.au/wp-content/uploads/2013/07/Ann2013.pdf>.

The Commissioner’s report noted that:

“the submissions received by the Commission without exception supported the retention of the existing schemes. Submissions from both employer and employee groups opposed a proposal that long service leave should be subject to collective or individual bargaining.”¹³

From time to time there have been other state-based reviews of building and construction portable LSL schemes, with mixed results.¹⁴ A summary of the 2011 review of the Tasmanian scheme is given below in the section about the Tasmanian scheme.

1.3 Corporate structure and governance

Schemes in different states have different legal and administrative arrangements.

Each of the portable long service leave schemes

currently in operation is established by statute. The statutes specify the procedures for the creation, constitution and functions of the administrative body managing each scheme. Table 3 provides a summary of the organisational arrangements of each LSL scheme. In most cases, members of the governing body of the organisation are appointed by the relevant minister or the government or the governor.

In Victoria and Tasmania the long service leave schemes were privatised during the 1990s. In both states, the privatisation legislation set up a trust, and the trust deed sets out all of the details of levies and benefit entitlements. The Victorian scheme is run by CoINVEST, a public company in which directors are elected at an annual general meeting from employer and employee constituencies. In Tasmania, TasBuild is a private trustee company. The trustee boards have equal numbers of employer and employee representatives, as well as independent directors, who are selected by the industry representatives. Legislation requires employers to register and pay levies into the trust funds. Ministerial approval is required before any amendment to the trust deeds which might increase employer costs.

Which type of administration is preferable? According to the 2003 Royal Commission report:

“The critical difference between the two approaches is that, in the latter (privatised) model government no longer has any “hands on” involvement in the scheme *or any financial exposure to it.*” (emphasis added)¹⁵

When an LSL scheme is administered by the government, then this raises the issue of ownership of surpluses and/or responsibility for deficits. The ownership of surplus became an issue during the mid-1990s, when several state-run funds had large surpluses.

The New South Wales government (under Labor Premier Bob Carr) took \$120 million out of the Building and Construction Industry fund in 1995–96 and another \$60 million in 1996–97. The money was used to repay state debt. The LSL fund had been in surplus prior to these withdrawals, and as a result the builders had not been paying any levies. However, after the surplus was removed, it was necessary to re-introduce the levy (effective 1 July 1997). Unions and employers in the building and construction industry strongly objected to this withdrawal of funds and questioned the legality of this decision (to no avail).¹⁶

Table 3: Organisational structure of the portable LSL schemes in the building and construction industry, by state and territory.

State	Organisation	Type of organisation
ACT	ACT Long Service Leave Authority	Statutory authority reporting to ACT government and the Legislative Assembly.
New South Wales	Long Service Corporation	New South Wales government agency, under ministerial control with day-to-day management by CEO. The Corporation administers the Building and Construction Industry Long Service Payment Scheme.
Northern Territory	NT Build	Statutory board appointed by the government.
Queensland	QLeave (trading name of Building & Construction Industry (Portable Long Service Leave) Authority)	Board consisting of 8 members appointed by the state governor for terms of 3 years.
South Australia	Construction Benefit Services	Board is a body corporate consisting of 7 members appointed by the state governor to administer the scheme.
Tasmania	TasBuild Limited	Private trustee company acting as the trustee for the Construction Industry Long Service Fund. TasBuild has 6 directors (3 representing employers and 3 representing employees) as well as independent chairperson who is also a director. The fund is administered as a trust fund.
Victoria	CoINVEST Limited	Public company acting as trustee for the Construction Industry Long Service Leave Scheme.
Western Australia	Construction Industry Long Service Leave Payments Board	Board of a statutory authority acting as a body corporate, which has 7 members appointed by the state government. Chair is appointed by the minister.

Source: Ray Markey, Nick Parr, Chris Wright, Shauna Ferris, Tim Kyng, Sharron O’Neill, Salut Muhidin, Louise Thornthwaite, and Catrionna Lavermicocca, *The case for a national portable long service leave scheme in Australia*, McKell Insitute, Sydney, 2013.

The Victorian fund also had a large surplus in the mid-1990s (approximately \$150 million). According to newspaper reports, the Victorian government wanted to privatise the fund and at the same time transfer the fund surplus to the Victorian government.¹⁷ The Victorian fund was privatised in 1997. The legislation that privatised the scheme gave the Victorian government the right to remove part of the surplus before transferring assets and liabilities to the new trust fund.

In Queensland and the ACT, when the funds were in surplus, some of the levies (amounting to millions of dollars over the years) were transferred to an industry training scheme.¹⁸

The Royal Commissioner queried the propriety of such transfers of fund assets. The Commissioner's report said:

"I turn to the question whether fund moneys should be used for purposes unrelated to the scheme, such as training, investment in construction, underwriting of budget deficits, and general industry development.

I consider that long service leave moneys should be used only for the purposes for which they were paid. Transparency is important, particularly in this industry ...

The fact that long service leave funds are siphoned off for other purposes which may be beneficial to the industry is not sufficient justification for that occurring ...

I can see no justification for imposing upon the industry a levy by legislation for long service leave for employees and then using portions of the funds so raised for other purposes."¹⁹

A defined benefit fund might have a surplus or a deficiency. Theoretically, if the fund has a deficit, then the levy can be increased to cover the deficit – however employers are likely to object to sharp increases in the levy. In particular, new entrants to the industry are likely to object to financing deficits arising from previous years. This raises the following question: how would state governments deal with any deficit on winding up of an LSL scheme?

At 30 June 2012, the New South Wales fund had a deficit of approximately \$140 million. The fund has recovered and is currently in surplus, but of course there is a risk that deficits will arise again in the future. In 2013, the New South Wales government announced that it is considering the privatisation of the New South Wales scheme. According to the government's

media release, the aim is to improve the governance and administration of the schemes, and make them more flexible in meeting the needs of their members.²⁰ Any such privatisation might also have implications in relation to potential liabilities for any future deficits.

1.4 Financial management: solvency

The solvency of these funds is important to all involved in the building and construction industries. Employees rely on the LSL schemes to pay their benefits in the future and might suffer a reduction in benefits if the funds are not financially sound. Employers may be required to pay increased levies if funds suffer losses.

Royal Commissioner Cole made some observations about the financial management of portable LSL funds. He noted that most of the funds developed substantial surpluses during the 1990s – largely as a result of favourable investment returns.

The schemes responded by:

- reducing employer contributions; and/or
- increasing benefits (e.g. by reducing vesting periods for pro-rata benefits); and/or
- using fund surpluses for alternative purposes (e.g. payments into government coffers or into industry training funds).

In some cases the unions made a strong push for improvements in benefits, to be funded by the surpluses. For example in 2001 the Victorian unions persuaded the government to improve accrual rates (from two months leave per 10 years of service to three months leave per 10 years of service), and to reduce the vesting period for pro-rata benefits.²¹

It is always tempting to increase benefits when a fund has a surplus, but Royal Commissioner Cole questioned the wisdom of this approach. He pointed out that benefit increases impose continuing costs, long after the fund surplus has disappeared.

Unfortunately, the funds suffered some reverses during 2001–02: investment returns were poor and higher-than-expected wages increases pushed up liabilities (which had already increased as a result of benefit improvements). All the funds suffered operating losses, and in some cases the losses were rather large relative to the size of the assets. Some funds had deficits; some funds were forced to increase employer levies rather sharply.

A few years later, all of the portable LSL funds suffered again during the global financial crisis (GFC). The funds suffered from a combination of adverse circumstances:

- Negative investment returns. Most of the funds had adopted investment strategies with a high weighting in growth assets (typically 60% to 80%, varying between funds). Not surprisingly,

this led to negative returns during the years ending 2008 and 2009, as shown in Table 4.

- The economic downturn led to a reduction in levies. The building and construction industry is a cyclical industry. When the economy slows down, the funds suffer a reduction in levy income.
- The industry contracted, leading to an increase in benefit payments. Workers cashed in their benefit entitlements in order to cover living expenses while they were unemployed.
- In some funds, there was also a sharp increase in the valuation of liabilities due to changes in actuarial assumptions. Since LSL funds have long-term liabilities, the choice of actuarial assumptions is crucial in determining the financial position of each fund. If the discount rate falls, then the value of the liabilities will increase sharply. In the aftermath of the GFC, central banks cut interest rates, leading

to lower yields on government bonds. This adversely affected the reported solvency of LSL funds which used government bond yields to determine the discount rate. (Some funds use discount rates based on government bond yields, whereas others use the long-term expected rate of return on investments – this issue is discussed in section 3.)

The schemes responded by increasing levy rates (sometimes quite sharply); by making even more determined efforts to collect levies; and by waiting for investment markets to recover. Some funds responded by (at least temporarily) shifting to a more conservative investment strategy.

As a result, most of the funds returned to surplus by the end of 2013, although the Victorian fund's deficit was still about \$130 million as at 30 June 2013.

Table 5 shows the ratio of assets to liabilities for each fund as at 30 June 2009, and at 30 June 2013. A ratio below 100% indicates a deficit. Note that the asset/liability ratios are quite sensitive to the actuarial assumptions used in the valuations, so these figures do not necessarily provide a good basis for comparisons between different funds. (Issues relating to the choice of actuarial assumptions are discussed in section 2.1.4 and section 3.)

Table 4: Investment returns for years ending 2008 and 2009.

Scheme	Year ending 30 June 2008	Year ending 30 June 2009
ACT	n.a.	-5.1%
Northern Territory	-7.1%	-4.0%
New South Wales	-10.3%	-10.3%
Queensland	-6.5%	-8.2%
South Australia	-7.0%	-12.8%
Tasmania	-11.0%	-29.4%*
Victoria	-9.2%	-10.3%
Western Australia	-12.8%	-6.9%

Source: ACT Construction Industry Long Service Leave Authority, *Annual Report 2008-2009*, ACT Construction Industry Long Service Leave Authority, Canberra, 2009, at [http://www.actleave.act.gov.au/files/construction/Construction Annual Report 2009.pdf](http://www.actleave.act.gov.au/files/construction/Construction%20Annual%20Report%202009.pdf); NTBuild Portable Long Service Leave, *Annual Report 2008-2009*, NTBuild Portable Long Service Leave, Darwin, 2009 at http://www.ntbuild.com.au/ntbuild/publications_forms/annual_report/NTBuild_AnnRep0809_full.pdf; Building and Construction Industry Long Service Payments Corporation, *Annual Report 08-09*, Building and Construction Industry Long Service Payments Corporation Gosford, 2009 at http://www.longservice.nsw.gov.au/_data/assets/pdf_file/0014/3272/annualreport2009.PDF; Building and Construction Industry (Portable Long Service Leave Authority), *QLeave Annual Report 2009-10*, Building and Construction Industry (Portable Long Service Leave Authority), Brisbane, 2010 at [http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/\(web\)/5C0E967443FEBAD84A2579BF007B92B6/\\$File/Qleave Annual Report 2009-10 with Addendum.pdf](http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/(web)/5C0E967443FEBAD84A2579BF007B92B6/$File/Qleave%20Annual%20Report%202009-10%20with%20Addendum.pdf); Construction Industry Long Service Leave Board, *Annual Report 2011*, Construction Industry Long Service Leave Board, Burnside, 2011, at <https://www.portableleave.org.au/assets/docs/general/AnnualReport2011.pdf>; TasBuild Portable Long Service Leave Scheme, *Annual Report for the 2008-2009 year*, TasBuild Portable Long Service Leave Scheme, Hobart, 2009, at [http://www.tasbuild.com.au/content/tasbuild/download/Annual Reports/AR2009.pdf](http://www.tasbuild.com.au/content/tasbuild/download/Annual%20Reports/AR2009.pdf); CoINVEST, *Annual Report 2009*, CoINVEST, East Melbourne, 2009; *Construction Industry Long Service Leave Payments Board Actuarial Report as at 31 March 2012*, PriceWaterhouse Coopers, 2012 (Appendix B contains a history of investment returns prior to 2012).

Note: * This is the investment return according to the *TasBuild Portable Long Service Leave Scheme Annual Report for the 2008-09 year*. However, the *Annual Report for the year ended 30 June 2011* says that the investment return for the year ending 30 June 2009 was -17.52%, instead of -29.35%. The reason for this change was not stated.

1.5 Financial management: stability of levies

All of the portable LSL schemes in the building and construction industry operate on a defined benefits basis. This implies that the employer levy is likely to vary over time, reflecting the experience of the fund.

All of the schemes are required to have periodic actuarial reviews and to receive actuarial advice about the levy rate. However, those responsible for setting the levy rate might not follow the actuarial recommendations, especially when an increase is recommended. In most schemes, an increase in the levy requires either a change in the regulations (by Parliament) or ministerial approval. Employers may well object to the additional costs and attempt to influence the decision-making process – particularly if the increases occur when the employers are already under pressure as a result of an economic downturn.

Large fluctuations in levy rates are undesirable because this makes business planning more difficult for employers, especially those who are operating on thin profit margins in a competitive industry.

Large fluctuations are also undesirable because they create cross-subsidies between different generations of employers. For example, suppose that a fund develops a large deficit and the scheme's board (or the government minister) decides that the levy must increase in order to restore the fund to solvency. A new employer who

Table 5: Asset/liability ratios in 2009 and 2013.

Scheme	Year ending 30 June 2009	Year ending 30 June 2013
ACT	129%	96%*
Northern Territory	168%	200%†
New South Wales	80%	99%
Queensland	82%	137%
South Australia	88%	103%
Tasmania	101%	113%
Victoria	77%	86%
Western Australia	75%	121%

Source: ACT Construction Industry Long Service Leave Authority, *Annual Report 2008-2009*, ACT Construction Industry Long Service Leave Authority, Canberra, 2009, at [http://www.actleave.act.gov.au/files/construction/Construction Annual Report 2009.pdf](http://www.actleave.act.gov.au/files/construction/Construction%20Annual%20Report%2009.pdf); NTBuild Portable Long Service Leave, *Annual Report 2008-2009*, NTBuild Portable Long Service Leave, Darwin, 2009 at http://www.ntbuild.com.au/ntbuild/publications_forms/annual_report/NTBuild_AnnRep0809_full.pdf; Building and Construction Industry Long Service Payments Corporation, *Annual Report 08-09*, Building and Construction Industry Long Service Payments Corporation Gosford, 2009 at http://www.longservice.nsw.gov.au/_data/assets/pdf_file/0014/3272/annualreport2009.PDF; Building and Construction Industry (Portable Long Service Leave Authority), *QLeave Annual Report 2009-10*, Building and Construction Industry (Portable Long Service Leave Authority), Brisbane, 2010 at [http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/\(web\)/5C0E967443FEBAD84A2579BF007B92B6/\\$File/QLeave Annual Report 2009-10 with Addendum.pdf](http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/(web)/5C0E967443FEBAD84A2579BF007B92B6/$File/QLeave%20Annual%20Report%2009-10%20with%20Addendum.pdf); Construction Industry Long Service Leave Board, *Annual Report 2011*, Construction Industry Long Service Leave Board, Burnside, 2011, at <https://www.portableleave.org.au/assets/docs/general/AnnualReport2011.pdf>; TasBuild Portable Long Service Leave Scheme, *Annual Report for the 2008-2009 year*, TasBuild Portable Long Service Leave Scheme, Hobart, 2009, at <http://www.tasbuild.com.au/content/tasbuild/download/AnnualReports/AR2009.pdf>; CoINVEST, *Annual Report 2009*, CoINVEST, East Melbourne, 2009; *Construction Industry Long Service Leave Payments Board Actuarial Report as at 31 March 2012*, PriceWaterhouse Coopers, 2012; ACT Long Service Leave Authority, *Annual Report 2012-13*, ACT Long Service Leave Authority, Canberra, 2013 at www.actleave.act.gov.au/files/annualreports/annualreport2013.pdf; NTBuild Portable Long Service Leave *Annual Report 2012-13*, NTBuild, Darwin, 2013 at www.ntbuild.com.au/publications_forms/annual_report/NTBuild_AnnRep1213_full.pdf; Long Service Corporation *Annual Report 2012-13*, Long Service Corporation, Gosford, 2013 at www.longservice.nsw.gov.au/_data/assets/pdf_file/0007/11599/Annual-Report-2013.pdf; Building and Construction Industry (Portable Long Service Leave Authority), *QLeave Annual Report 2012-13*, Building and Construction Industry (Portable Long Service Leave Authority), Brisbane, 2013 at [www.qleave.qld.gov.au/webdb/wsmanager.nsf/\(web\)/5C0E967443FEBAD84A2579BF007B92B6/\\$File/QLeave Annual Report 2012-13.pdf](http://www.qleave.qld.gov.au/webdb/wsmanager.nsf/(web)/5C0E967443FEBAD84A2579BF007B92B6/$File/QLeave%20Annual%20Report%2012-13.pdf); Construction Industry Long Service Leave Board, *Annual Report 2013*, Construction Industry Long Service Leave Board, Burnside, 2013, at www.portableleave.org.au/assets/docs/general/AnnualReport2013.PDF; TasBuild Portable Long Service Leave Scheme, *Annual Report for the year ended 30 June 2013*, TasBuild, Hobart, 2013, at [www.tasbuild.com.au/content/tasbuild/download/AnnualReports/AnnualReport 2013a.pdf](http://www.tasbuild.com.au/content/tasbuild/download/AnnualReports/AnnualReport%2013a.pdf); CoINVEST, *Annual Report 2013*, CoINVEST, East Melbourne, 2013; MyLeave Construction Industry Long Service Leave Scheme, *Annual Report 2013*, MyLeave Construction Industry Long Service Leave Scheme, Perth, 2013, at <http://www.myleave.wa.gov.au/wp-content/uploads/2013/07/Ann2013.pdf>.

Notes:

* In the ACT there was some employer resistance to increases in the levy rate, which has delayed recovery. The levy rate increased from 1% at 30 June 2009 to 2.5% in October 2013; this should help improve the solvency position.

† The Northern Territory scheme was first established in 2005, and the initial levy was set at a conservative 0.5% of construction costs. This led to a large surplus. The levy has been progressively reduced and is down to just 0.1% (in 2014).

enters the industry will be called upon to pay the higher levy rate – effectively, the new employer is funding a deficit which arose as a result of the past service obligations of other employers in the industry.

To illustrate the variability of levy rates, Figures 2 to 5 show the variation in levy rates for four of the building and construction schemes over the last 20 years. Low rates applied in the 1990s when the funds had a surplus (as low as 0% in Victoria); but the rates increased sharply over recent years, to make up for the GFC-related deficits. (Similar graphs for New South Wales and Tasmania are shown in subsequent sections.)

In New South Wales, Queensland, and the Northern Territory, levies are set as a percentage of construction costs, for all the other schemes levies are set as a percentage of staff wages.

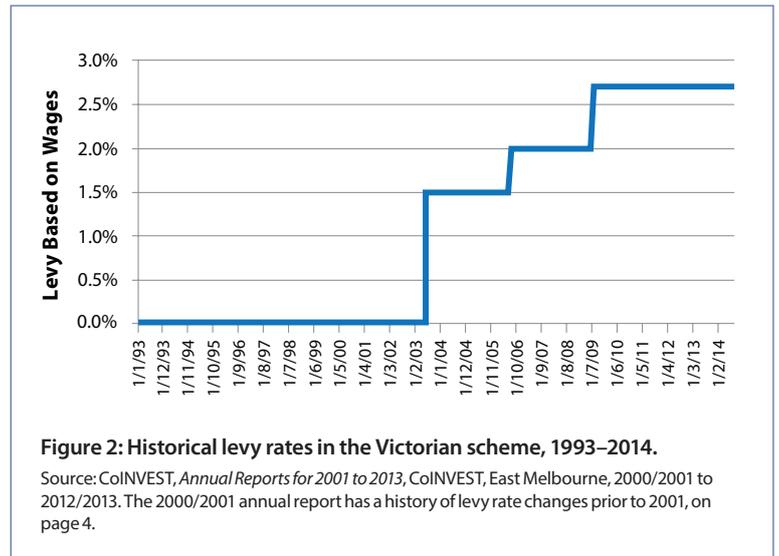


Figure 2: Historical levy rates in the Victorian scheme, 1993–2014.

Source: CoINVEST, *Annual Reports for 2001 to 2013*, CoINVEST, East Melbourne, 2000/2001 to 2012/2013. The 2000/2001 annual report has a history of levy rate changes prior to 2001, on page 4.

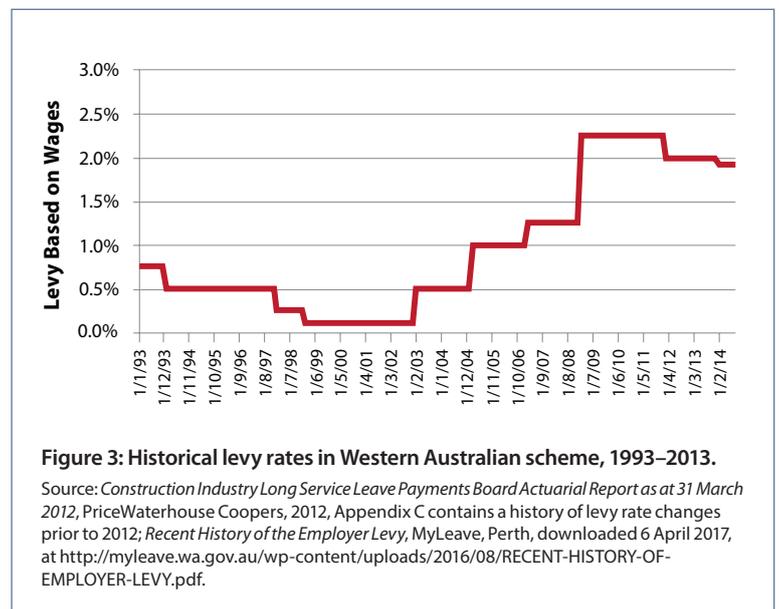


Figure 3: Historical levy rates in Western Australian scheme, 1993–2013.

Source: *Construction Industry Long Service Leave Payments Board Actuarial Report as at 31 March 2012*, PriceWaterhouse Coopers, 2012, Appendix C contains a history of levy rate changes prior to 2012; *Recent History of the Employer Levy*, MyLeave, Perth, downloaded 6 April 2017, at <http://myleave.wa.gov.au/wp-content/uploads/2016/08/RECENT-HISTORY-OF-EMPLOYER-LEVY.pdf>.

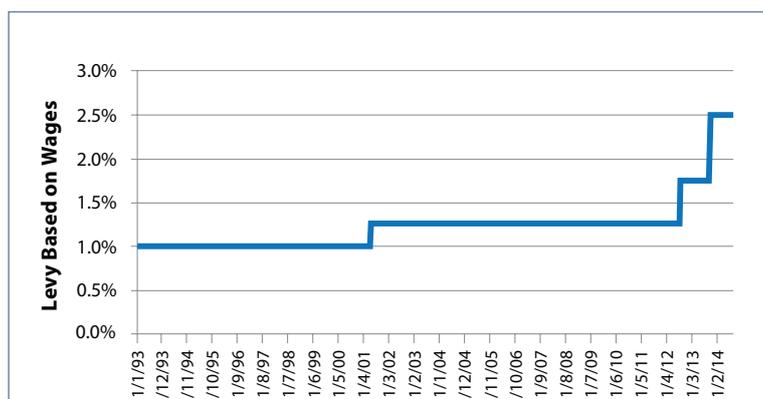


Figure 4: Historical levy rates in Australian Capital Territory scheme, 1993–2013.

Source: ACT Long Service Authority, *Annual Reports* for the years 2009 to 2013, the ACT Long Service Authority (previously named the ACT Construction Industry Long Service Leave Authority), Canberra, 2009 to 2013, available at <http://www.actleave.act.gov.au/Construction-Industry.html>.



Figure 5: Historical levy rates in Northern Territory scheme, 2005–2014.

Source: NTBuild, *Annual Reports* for the years from 2005 to 2013, NTBuild, Darwin, 2005 to 2013, at <http://www.ntbuild.com.au/publications.shtml>.

Although most schemes have increased their levy rates in recent years, the Northern Territory scheme has cut levy rates rather sharply. The Northern Territory scheme was established in 2005 with a levy of 0.5% of construction costs. This reduced to 0.4% in 2009, to 0.3% in 2012, and to just 0.1% in 2014. This illustrates the difficulties involved in setting an appropriate levy rate for a new scheme, when there is considerable uncertainty about worker registration rates and working patterns.²²

1.6 Financial management: benefits

In some cases, benefit adjustments may be used as a financial management tool. As noted previously, when surpluses arose in the 1990s, some schemes improved their benefits. Conversely, when funds were

experiencing large deficits after the GFC, some schemes took steps to reduce benefits or tighten eligibility requirements. For example:

- In 2008 the Queensland scheme introduced a cap on the salary which was used to determine benefits. The cap led to a reduction in benefit payments and liabilities.
- In 2012, in the ACT, the vesting standards were changed: new employees will have to serve seven years (instead of five years) before becoming eligible for pro-rata benefits on leaving the industry.

1.7 Administration

Each scheme maintains a register of workers, recording the eligible service and LSL benefits paid to each worker. The register is updated when employers submit returns showing the eligible service for each of their employees. Each scheme has different rules for the frequency of reporting (monthly, quarterly, etc). Late submission is a common problem, so actuaries usually allow for some Incurred but Not Reported (IBNR) service when valuing scheme liabilities.

A perusal of scheme annual reports indicates that all of the schemes have been making strenuous efforts to use technology to improve administrative efficiency; in particular, they have developed IT systems which allow the employers to enter data electronically. A high proportion of employers submit returns online. This has reduced the burden of compliance for employers, and customer feedback has been positive: it is now relatively easy to submit returns.²³

The portable LSL schemes often conduct surveys of employers and employees in order to assess the level of stakeholder satisfaction. In general, the surveys show a high level of satisfaction with the administration of the LSL schemes.

All of the building and construction industry schemes are working together to improve the efficiency of administration:

“Nationally the Funds from all over Australia are working towards achieving efficiencies via the National Cooperation Project which has a goal of developing a national back office to meet the needs of each fund with a centralised computer system. The basis of this approach is that the eight funds will contribute to the development and purchase of one system creating significant savings through the economies of scale.”²⁴

However, for portable LSL schemes, the scheme design often creates administrative difficulties. There are three major problems:

- ambiguity about the boundaries of the industry
- reliance on employers for information
- broken service periods.

1.7.1 Ambiguity of boundaries

The building and construction schemes cover workers employed in the building and construction industry (excluding clerical, administration and management employees). However it can be quite difficult to define exactly which workers are covered by the scheme. For example, there have been queries about the liability to pay levies for:

- workers who install security systems
- workers who install automated sprinkler systems in the grounds around a new building
- workers who do remediation of mining sites
- workers who manufacture (but do not install) window frames.²⁵

Employers might be uncertain of their obligations; employees might be uncertain about their entitlements; and the LSL scheme must deal with enquiries and disputes about coverage.

There might also be some uncertainty about the definition of “employee”. Again there are grey areas: for example, it may not be clear whether a worker is an employee or a sub-contractor. A person who is sub-contracted to provide “labour only” is likely to be covered by a portable LSL scheme, whereas a person who provides “labour and materials” might be ineligible for inclusion in the portable LSL scheme. A few LSL schemes have had issues with non-payment of levies for workers employed by labour hire businesses.²⁶ Of course, similar problems have arisen in the superannuation industry, where employers may seek to avoid liability for compulsory superannuation guarantee contributions by classifying employees as contractors.

1.7.2 Reliance on employers

The second problem arises from the schemes’ reliance on employers. Each of the schemes must keep records of all of the workers who are accruing LSL benefits, as they switch from one employer to the next. The schemes rely on the employers to provide accurate information about all of their employees. In practice, the employers are not always very diligent or meticulous about providing accurate information, so data integrity is a problem.

The schemes have tried to address this issue by giving workers online access to each scheme’s database, so that each worker can check that his or her work history is accurate and up to date. Some schemes also send out annual statements of accrued entitlements.

If the workers believe that the records are inaccurate, then they can notify the scheme and ask for the missing service to be recorded. This creates a great deal of additional work for the schemes, as they must check with the employers to verify the accuracy of the information provided by the workers. This might be particularly difficult if the missing service dates back several years or if the employer has gone out of business.

There are thousands of claims for missing service every year. For example, the Queensland scheme alone had 1500 missing service requests in 2012–13. If the missing service claim is verified, the scheme must pay the benefits arising from that service – even if the relevant employer has not paid any levies in relation to that service. Theoretically the scheme might be able to make a retrospective claim against the employer – but in practice it might be quite difficult to collect this sum. If this sum cannot be collected, the fund must cover the shortfall (effectively spreading the cost of these benefits to other employers).

1.7.3 Broken working patterns and worker churn

The third problem arises as a result of broken working patterns.

Under portable schemes, a worker is entitled to accrue benefits as long as he or she continues working in the building and construction industry. If the worker temporarily ceases working in the industry (for up to four years),²⁷ he or she retains his or her accrued benefits and remains on the LSL scheme’s register. If the worker subsequently recommences working in the industry, within this four-year period, he or she continues to accrue more benefits.

What happens if the worker does not recommence working within the four-year period?

The LSL schemes periodically check their registers in order to identify individuals who have not worked in the industry for four years or more – these people are removed from the register. As an example, Table 6 shows the number of workers removed from the New South Wales register over recent years.

Table 6: Workers removed from the New South Wales register, 2010–13.

	2010–11	2011–12	2012–13
Registered workers at start of year	281,398	288,481	297,246
Workers removed from the register	21,219	19,683	4,108
Percentage removed	7.5%	6.8%	1.4%

Source: Long Service Corporation, *Long Service Corporation Annual Report 2012/13*, Long Service Corporation, Gosford, NSW, 2013.

Note: This includes all workers removed from the register, which would presumably include retirements and deaths as well as bulk cancellations.

Table 7 shows that Queensland had an even higher rate of deregistration over the same period.

Table 7: Workers removed from the Queensland register, 2010-13.

Queensland	2010-11	2011-12	2012-13
Registered Workers at start of year	267,768	274,162	280,336
Workers removed from the register under the four year rule	23,351	27,324	31,454
Percentage removed	8.7%	10.0%	11.2%

Source: QLeave Building and Construction Industry (Portable Long Service Leave) Authority, *Annual Report 2010-2011*; *Annual Report 2011-2012*; *Annual Report 2012-2013*, QLeave Building and Construction Industry (Portable Long Service Leave) Authority, Brisbane, Queensland, 2011 to 2013.

What is the financial liability for deregistered workers?

- If a worker's benefits have not yet vested, then accrued benefits are forfeited. The vesting period varies between states, for example, benefits vest after five years' service in New South Wales, but after seven years' service in Queensland.
- If the benefits have vested, then the worker may be entitled to some LSL benefits – but the benefits will not be paid until a claim is submitted for LSL. Some workers might be unaware of their entitlements, and so they will never make a claim. The scheme must recognise a liability to pay these benefits, even though the benefit may never be claimed. This problem is analogous to the well-known problem of “lost members” in superannuation funds.

This system creates some uncertainty in valuing the liabilities of each scheme. At any given time, the registers will include a large number of workers who are not currently employed in the industry, but who have been employed at some time within the last four years. It is difficult to estimate the amount of the benefits which will eventually become payable to these workers. Once again, the outcomes will depend on the business cycle: when there is a downturn, fewer workers will return to the industry within the four-year time limit. These complexities mean that estimation of the liability requires actuarial judgement.²⁸

The problem is exacerbated by the reciprocity arrangements between states. Suppose that a Tasmanian worker goes to Victoria. The Tasmanian scheme will not have any records of his or her Victorian service and might assume that the worker will not claim

any benefits. But if the worker completes the 10-year qualifying period while in Victoria, he or she will have a claim against the Tasmanian scheme – this claim might relate to service that occurred 10 or 20 years earlier, so the scheme must keep accurate records for a long time.

The proportion of inactive members can be quite high, so this creates uncertainty in the estimation of liabilities. As an example, as at 30 June 2013 the New South Wales building and construction LSL scheme had the membership categories shown in Table 8.

Table 8: Membership status of members of the New South Wales scheme as at 30 June 2013.

Membership status	Number	Percentage of total members
Active within last two years	196,332	76%
Inactive for last two years, but active within two previous years	48,070	19%
Inactive for four or more years	12,281	5%
Total	256,683	

Source: Long Service Corporation, *Annual Report 2012/13*, Long Service Corporation, Gosford, NSW, 2013.

1.8 Compliance

By law, employers are supposed to register with the LSL schemes and provide periodical reports on their employees. However some employers neglect this responsibility or are unaware of the legal requirements.

All of the portable LSL schemes devote time and effort to informing employees about the scheme benefits and informing employers of their obligations. Typically, the schemes participate in industry events, publish advertisements in trade journals, run information sessions for apprentices via educational bodies, attend union meetings, and so on. Information about each scheme is available online and each scheme provides help by telephone (for example, the New South Wales scheme answers about 85,000 telephone enquiries per annum).

Most schemes (except New South Wales, Queensland and the Northern Territory) collect levies as a percentage of payroll from employers. These LSL schemes have staff who liaise with employers; normally this would include auditing employers to make sure that they are making the correct payments. Staff from the LSL schemes work with employers who are in financial difficulties, to work out payment plans. However, despite these efforts, sometime the schemes suffer losses due to bad debts when an employer goes out of business. When employers are recalcitrant, the schemes devote

resources towards enforcing compliance. Sometimes this involves taking legal action to collect unpaid levies.

Several of the portable LSL schemes have developed relationships with other government authorities or industry bodies in order to share data. Data-matching helps to identify employers who are shirking their obligations. For example, some schemes share information with workers compensation authorities, which need accurate employee data in order to calculate workers compensation premiums. In Tasmania, TasBuild works with training colleges to collect data about apprentices' employers (see below in the section about Tasmania).

In New South Wales, Queensland and the Northern Territory, levies are not collected from the employer, but are charged as a percentage of construction costs. The administrative issues arising from this system are discussed in the section about New South Wales (section 2.1.6)

1.9 Administration expenses

As noted above, most of the schemes aim to improve efficiency by using technology to streamline administration. The average administration cost was \$56.78 per worker in 2012 (averaging across all of the building and construction portable LSL schemes, and excluding investment management fees). This may be compared with the administration cost for a simple MySuper superannuation scheme, as estimated for the Super System Review, and shown in Table 9.

Table 9: Estimated operating costs per member for a MySuper fund with average account balance \$25,000.

Fund size (membership)	40,000	80,000	200,000	400,000
Operating cost per member	\$149	\$114	\$88	\$77

Source: Deloitte, *Super system review: default fund costs under the MySuper proposals*, Deloitte, 19 April 2010, page 24, available at [www.treasury.gov.au/~media/Treasury/Consultations and Reviews/Reviews and Inquiries/2009/supersystem/Documents/MySuper Paper/PDF/Deloitte_report.ashx](http://www.treasury.gov.au/~media/Treasury/Consultations_and_Reviews/Reviews_and_Inquiries/2009/supersystem/Documents/MySuper_Paper/PDF/Deloitte_report.ashx).

However, average LSL benefits are much lower than average superannuation benefits – the average amount of LSL assets per worker is about \$3,000 and the average benefit payment is only about \$7,300. This means that administration expenses are high relative to the benefits provided. Based on figures averaged over the last five years, the larger LSL schemes incurred administration expenses of about \$1 for every \$6 or \$7 of LSL benefits paid (e.g. \$1 per 6.36 of benefits in Queensland; and \$1 per 6.79 in Western Australia, averaged over the five year period to 30 June 2013).

2 INDIVIDUAL SCHEMES

In the following sections, we examine two of the LSL schemes in more detail. The aim is to illustrate the different issues which arise for different schemes. We have chosen:

- New South Wales, which is a large scheme, run by a statutory corporation, with levies based on a percentage of building costs, and investments managed by the State Treasury
- Tasmania, which is one of the smaller schemes, administered by a private company, where the scheme has been set up under a trust deed, collects levies as a percentage of payroll, and invests a proportion of the funds in local construction projects.

2.1 New South Wales Long Service Corporation

In New South Wales, the portable LSL scheme for building and construction workers is administered by the Long Service Corporation. As at 30 June 2013, the fund had assets of about \$772 million. The ratio of assets to liabilities was 99% (recovering from a large deficit in previous years).

The New South Wales scheme has about 260,000 registered workers, and 35,000 registered employers. During the year 2012–13, benefits amounting to \$65 million were paid to 10,820 workers. The average payment was about \$6,000.

Over the last 38 years, the fund has paid out more than \$843 million in benefits to more than 195,000 workers.²⁹

2.1.1 Historical development

New South Wales's portable LSL scheme was established in 1975. During the 1970s, the trade unions involved in the building industry conducted an industrial campaign in order to win better sick pay, better accident pay and better LSL benefits. Conflicts between the unions and the employers culminated in strikes and lock-outs. Unionists claim that the establishment of the portable LSL scheme was one of the most significant victories for the union during this period.³⁰

Initially the portable LSL scheme was administered by the Builders Licensing Board, but in 1982 the New South Wales government set up a separate statutory corporation to administer the scheme. This was originally called the Building and Construction Industry Long Service Payments Corporation.

In 2010 the New South Wales government established another industry-based portable LSL scheme, for contract cleaners. In order to minimise costs, both schemes are administered jointly. The name of the corporation was changed to the Long Service Corporation.

2.1.2 Legal structure and corporate governance

The Long Service Leave Corporation is a New South Wales government entity under the supervision of the New South Wales Treasury (transferring from the Department of Finance and Services in 2012).

Under the legislation, an Industry Committee provides advice on a range of issues, including investment of the fund and the amount of the levy. The industry includes members nominated by Unions New South Wales; members nominated by the Master Builders Association and Employers First; and members chosen directly by the minister. The Industry Committee acts as a “Customer Council”, providing feedback from the industry “to help ensure the quality and effectiveness of services in meeting customers’ needs”.³¹ The minister need not accept any recommendations made by the Industry Committee.

At present, the New South Wales government is considering changes to the LSL scheme. The Treasurer’s press release said:

“Treasurer and Minister for Industrial Relations Mike Baird today announced the NSW Government will undertake a scoping study to improve the governance and administration of the state’s two portable long service schemes for the construction and contract cleaning industries. “

“The NSW Liberals & Nationals Government has been clear that if there is a better way of delivering a government service that exceeds current standards and delivers better results for NSW, we have a responsibility to consider it.”³²

The press release specifically mentions the possibility of privatisation of the scheme (i.e. following the Victorian and Tasmanian models where the schemes are administered by a trustee company).

2.1.3 Investment objectives, strategy and performance

The scheme’s investments are managed by the New South Wales Treasury Corporation. As at 30 June 2013, about 92% of the assets were invested in the Long Term Growth Fund, with the remainder invested in cash and term deposits. The Long Term Growth Fund has roughly 30% invested in defensive assets (cash and bonds) and 70% in growth assets (shares and property). This has resulted in fairly large fluctuations in investment returns in recent years, as shown in Figure 6.

2.1.4 Financial position: solvency

Financial management of the fund is difficult, because the building industry is quite cyclical, and special circumstances can influence the level of building activity. For example, levy income was temporarily boosted by:

- construction work associated with the 2000 Olympics (held in Sydney);
- the Commonwealth government’s Education Revolution stimulus package, introduced in the wake of the GFC.

When there is a downturn in the industry, levy income falls and LSL claims rise. The problems are exacerbated if poor investment returns coincide with an industry downturn. For example, in 2009 and 2012, the New South Wales fund suffered from poor investment returns *and* low levy income *and* high claims costs, leading to large deficits in those years.

The financial position of the New South Wales

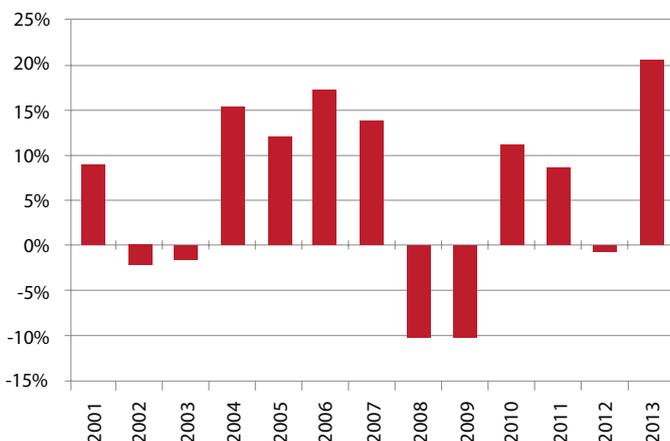


Figure 6: Investment returns from the Long Term Growth Fund for the New South Wales portable LSL fund, 2001–13.

Source: Long Service Corporation, *Annual Reports* from 2000/01 to 2012/13, Long Service Corporation, Gosford, NSW, published annually from 2001 to 2013 (note that the name of the organisation was changed in 2010, previously this was the Building and Construction Industry Long Service Payments Corporation).

scheme for the years 2000–2013 is shown in Table 10.

Although the fund had a large deficit as at 30 June 2012, the accounts show substantial improvement in the following year.

The fund had good investment returns in 2012–13 (the Long Term Growth Fund earned 20.55%). The construction industry was recovering from the GFC, which led to an increase in levy income. The administration made strenuous efforts to increase levy collections. (Note the increase in levy income from \$80 million to \$111 million in just one year.)

The (reported) solvency of the fund was also affected by a change in the method for choosing valuation assumptions. Accounting Standard AASB137 says:

“The discount rate (or rates) shall be a pre-tax rate (or rates) that reflect(s) current market assessments of the time value of money and the risks specific to the liability. The discount rate(s) shall not reflect risks for which future cash flow estimates have been adjusted.”³³

Prior to 2012, the New South Wales liabilities were valued using a discount rate based on the government bond rate. However, in 2013 the discount rate was based on expected long-term returns on fund assets. The 2013 annual report explains that:

“The Corporation was successful in the latter part of the financial year in gaining agreement from Treasury and Audit Office to use a discount rate more aligned with the asset growth rate.”³⁴

The 2012 valuation (for accounting purposes) assumed wages growth of 4% per annum and long-term investment returns of 3% per annum (based on Commonwealth bond yields); for the 2013 valuation, the assumptions were wages growth of 4% per annum and long-term investment returns of 7% per annum (in line with expected long-term rates of return on fund assets). That is, the “actuarial gap” was changed from –1% to +3%. This change reduced the Corporation’s liabilities by \$54.3 million in 2012–13.³⁵

Therefore that analysis of changes in the asset/liability ratios should be treated with caution, since the valuation of liabilities is quite sensitive to the choice of actuarial valuation assumptions. (Issues relating to the choice of actuarial assumptions are discussed in section 3.)

Table 10: Financial data for the New South Wales portable LSL fund, 2000–2013.

Year ending 30 June	Levies (\$millions)	Claims paid (\$millions)	Assets (\$millions)	Provision for LSL liabilities (\$millions)	Assets/provision for LSL liabilities
2000	29	27	384	299	128%
2001	21	35	394	304	130%
2002	29	32	375	361	104%
2003	34	31	361	366	99%
2004	38	36	401	397	101%
2005	35	42	438	483	91%
2006	48	49	500	515	97%
2007	69	51	577	532	108%
2008	80	48	540	558	97%
2009	63	54	486	607	80%
2010	81	58	553	640	86%
2011	84	59	619	678	91%
2012	80	68	622	760	82%
2013	111	65	772	777	99%

Source: Long Service Corporation, *Annual Reports* from 2000/01 to 2012/13, Long Service Corporation, Gosford, NSW, published annually from 2001 to 2013, available at www.longservice.nsw.gov.au/about-us/annual-report (Note that the name of the organisation was changed in 2010, previously this was the Building and Construction Industry Long Service Payments Corporation).

2.1.5 Stability of levy rates

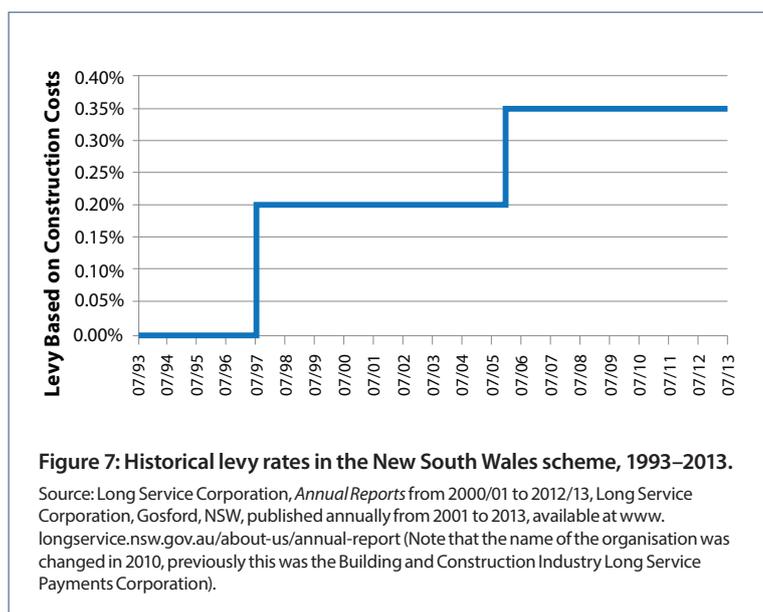
The levy rates for the New South Wales scheme have varied quite widely over the last 20 years, as shown Figure 7.

During the late 1980s and early 1990s, the fund achieved a large surplus. As a result, the levy was set to 0% in 1993.

In the mid-1990s, the New South Wales government removed \$180 million from the fund over a two-year period: the money was transferred to the government’s coffers, in order to repay state debt. As a result, it was necessary to reintroduce levies. The levy was set at 0.20% effective from 1 July 1997. The levy was again increased, to 0.35%, effective from 1 January 2006, after an actuarial review.

The fund’s financial position deteriorated in the aftermath of the GFC, leading to a substantial deficit by 30 June 2012 (approximately \$140 million, according to the accounts).

In 2012, the actuaries recommended an increase in the levy, from 0.35% to 0.45%, to return the fund to surplus.³⁶ However, the Corporation opted to maintain



the levy at 0.35% and pursue other strategies to increase revenue. The 2012 annual report notes that the Long Service Corporation decided to “increase the focus on stopping revenue leakages”.³⁷

Levy income has also been adversely affected by some legal disputes about the correct method for calculation of levies (as explained in section 2.1.6).

2.1.6 Administration and compliance

Before July 1986, employers in the New South Wales building and construction industry paid a monthly levy, which was calculated as a percentage of the workers’ pay. In 1986, the system was changed: the benefits are now funded by a levy on developers calculated as a percentage of the cost of construction. This reduced the administrative burden for employers.

Local councils act as agents for the Long Service Corporation. Normally, construction work requires council approval. A developer makes an application to the council, and the council determines the estimated cost of construction. The LSL levy is calculated as a percentage of this cost (subject to an exemption for projects costing less than \$25,000, discounts for non-profit organisations, etc.). The levy is paid by the building applicant or the person for whom the work is done. The councils collect the levy before granting permission for the development to proceed (i.e. before providing the Construction Certificate or Complying Development Certificate). The councils receive commissions from the LSL fund for providing this service.

The levy is based on the initial estimate of the cost. If the actual cost is higher than expected, an additional levy can be collected. If the actual cost is less than expected, a refund can be claimed.

This system substantially reduced the amount of paperwork for employers. Previously they had to provide monthly returns with details of each employee. Now they only provide notification when a new employee starts work; notification when an existing employee leaves; and an annual return showing number of days worked by each employee.

Although this system has some administrative advantages, it does break down the direct link between the amount of the levy paid and the amount of the worker’s wages. Possible problems are:

- The system is fairly equitable between employers, as long as workers’ wages are a reasonably consistent proportion of overall costs. If not, then this system would create some cross-subsidies between employers.
- Since the levy is not calculated from the employment history, there is less incentive for the employer to provide accurate figures. The New South Wales scheme administrators have noticed that some employers have been recording service for ineligible workers or providing incorrect information about rates of pay (which are used in calculating benefit payments). So there is some potential for fraud.³⁸

Problems have arisen in recent years because some of the larger property developers have taken steps to reduce their levy payments. The developers argued that certain types of work should not be included in the costs of construction for the purposes of determining the levy payments. The developers were successful in obtaining a substantial refund of levy payments.

2.2 The Tasmanian construction industry LSL scheme

The Tasmanian portable LSL scheme for building and construction workers is administered by TasBuild. As at 30 June 2013, the fund had assets of about \$81 million, which means the Tasmanian fund is roughly one-tenth the size of the New South Wales fund. The ratio of assets to liabilities was 113%.

TasBuild has about 19,000 active registered workers, which includes about 11,000 current registered workers. An active worker is defined as a worker who has received service credit within the last four years; a current worker has service credits during the last twelve months.

TasBuild had 4,500 registered employers. This suggests that the Tasmanian construction industry includes a lot of small businesses which operate with just a few employees.³⁹

During the year 2012–13, benefits amounting to \$5.4 million were paid to 680 workers. The average payment was \$7,932.

2.2.1 Establishment of TasBuild

The portable LSL scheme started in 1971, under the Tasmanian *Long Service Leave (Casual Employment) Act 1971*.

Initially, the scheme was run as a termination scheme. Employers were not required to make regular levy payments into the fund. Instead, employers only made a payment when an employee left service or took LSL. No doubt many employers preferred this, since it allowed them to retain the cash value of accrued LSL liabilities and use these funds as working capital.⁴⁰ In 1980, the rules changed. Employers were given the option of making quarterly contributions, calculated as 2% of an employees' wages, instead of making payments on the termination of each employee. The two systems ran in tandem for a long time: employers would pay lump sums for employees who had pre-1981 service, as well as quarterly levies for employees with post-1980 service.

Initially the scheme was administered by the Tasmanian Department of Industry (and subsequently by other government departments). The State Treasury managed the investment of the fund assets. Over time the fund built up a substantial surplus of assets over liabilities.

In 1997 "there was a claim from industry that they could administer the fund more prudently and more cost-effectively than the government agencies actually doing it, and they provided some evidence of how they would do that."⁴¹ The state Liberal government was persuaded to privatise the scheme, effective from 1 July 1998.⁴² The *Construction Industry (Long Service) Act 1997* set up a trust fund, and administration of the scheme was transferred to a newly formed trustee company, TasBuild. Assets and liabilities of the previous fund were transferred to the new trust fund. TasBuild has a board of directors, which consists of three employer and three union representatives, plus one independent director (acting as chairperson).⁴³

2.2.2 Employer and union support for TasBuild

In 2010, the Tasmanian House of Assembly set up a Select Committee to investigate the costs of housing, building and construction in Tasmania. The terms of reference included (inter alia) an investigation into the costs of statutory levies, including the TasBuild levy. The Committee collected submissions and held hearings.⁴⁴

A number of submissions were critical of TasBuild.

Some employers were opposed to portable long service leave on principle. They argued that long service leave should be a reward for long and faithful service: employers should not be expected to provide LSL for an employee who had only been working for them for a short time.

Some employers also argued that it was inequitable to make special LSL arrangements for people in the construction industry. They pointed out that there are many other industries which have high workforce turnover, but the employees in those industries did not benefit from portable LSL arrangements.

Employers complained that the portable scheme increased their costs, compared with the state-based LSL legislation. The portable scheme for the construction industry had initially had accrual rates of 1.67%, in line with the accrual rates for employees in other industries. But in 2006, the portable scheme had increased the accrual rates to 2.5%. (The fund had had a large surplus at that time, which disappeared soon after the benefit increase, as a result of investment losses during the GFC). So the construction industry LSL benefits are higher than the benefits paid to many other Tasmanians.

Some employers were also unhappy about the impact on their cash flows. Under the TasBuild scheme, the employers are required to make levy payments every month or every quarter; whereas employers in other industries were only required to pay LSL benefits when an employer took leave or left service. The employers pointed out that in other industries, no payments at all were required for employees who left a company before completing ten years' service. This issue was more likely to affect small employers with high workforce turnover.

Employers were unhappy about the high levy rates. As noted below, the levy rates increased sharply between 2006 and 2009, in order to recoup the fund's investment losses during the GFC. Employers said that these additional costs made it difficult for them to compete with overseas suppliers (e.g. prefabricated goods from China). And the higher levy rates were considered to be particularly unfair for new companies; effectively, the new companies were helping to pay off a deficit that had arisen during the GFC, before they commenced operations.

Employers complained that it was sometimes difficult to work out which workers were covered by the scheme – the rules were ambiguous. These complaints subsequently led to some attempts to amend the legislation to clarify the rules (such legislation was introduced into Parliament but at the time of writing, this legislation had not yet passed).

Some Committee members were concerned about the level of administration costs. They suggested that it would be simpler to close down TasBuild and allow employers to make additional contributions to a superannuation fund instead.

The Committee's first interim report, which dealt with LSL, was published in 2011.⁴⁵ The majority of the Committee recommended the winding up of

TasBuild, and the distribution of TasBuild assets to the beneficiaries. Two members of the five-member Committee opposed this recommendation. The Tasmanian government did not follow the Committee's recommendations and there have been no moves to wind up TasBuild. Indeed, on the contrary, by 2013 the Tasmanian government was planning to set up another portable LSL scheme, for community services workers.

2.2.3 Management

TasBuild is a trustee company, responsible for managing the Construction Industry (Long Service) Scheme.

The board of directors of TasBuild has seven members: three represent employers, three represent employees, and one is an independent chairperson who is selected by the other Board members. The employer representatives are nominated by the Master Builders Association of Tasmania, the Tasmanian Chamber of Commerce and Industry, and the Building Industry Specialist Contractors Association. The employee representatives are nominated by the Construction, Forestry, Mining and Energy Union, the Australian Manufacturing Workers Union, and Unions Tasmania.

In the past, two of the chairs have been Labor Party politicians (state ministers who had lost their seats). This led to some complaints about "jobs for the boys" and poor corporate governance. However the TasBuild board defended the appointments, asserting that both chairs were well qualified for the job and had been chosen on their merits.⁴⁶

During the hearings held by the Parliamentary Select Committee, some questioned whether the Board of TasBuild had appropriate qualifications for management of the fund:

"There are comments from employers along the lines that they don't particularly feel the scheme has been set up properly; they don't feel that the board necessarily has the skills for this type of scheme. My concern is that if you extend the scheme and make it bigger, you really can't have a group of people who have all good intentions. It really needs to be a very professionally managed board because you are talking about an awful lot of money."⁴⁷

The Board does hire asset consultants and other advisers when it needs specialist advice.

2.2.4 Investment objectives and performance

Since LSL benefits are a multiple of each worker's weekly wage, the liabilities of the fund increase in line with increases in wages. The trustees of the fund aim for investment returns that are at least equal to the increase in wages plus 1.5%, averaged over a five-year rolling time frame.

The trustees rely upon the advice of an asset consultant to determine the fund's strategic asset allocation. Most of the fund's money is invested through managed funds, which allows greater diversification for a relatively small fund (about \$80 million). These funds under management are split into the proportions shown in Table 11.

Table 11: Strategic asset allocation for TasBuild as at 30 June 2013.

Asset class	Weighting
Australian and international shares	42%
Property, infrastructure and resources	23%
Bonds and cash	31%
Alternatives	4%

Source: TasBuild Portable Long Service Leave Scheme, *Annual Report for the Year Ended 30 June 2013*, Tasbuild Portable Long Service Leave Scheme, Hobart Tasmania, 2013, p. 5 - 6, available at [www.tasbuild.com.au/content/tasbuild/download/Annual Reports/Annual Report 2013a.pdf](http://www.tasbuild.com.au/content/tasbuild/download/Annual%20Reports/Annual%20Report%202013a.pdf).

The fund also holds about \$5 million in bank deposits, plus \$6 million directly invested in property.

For several years, TasBuild's trustee board has had a policy of strategically investing in Tasmania's property market, in order to boost employment opportunities for fund members. It appears that this policy was adopted in 1999, soon after the scheme was privatised. At that time the fund had assets of about \$35 million, and a healthy surplus – but the Tasmanian building and construction industry was ailing. The trustee decided to allocate \$8 million as seed financing for property developers. The aim was to create employment opportunities for fund members and potential fund members. The board set up a committee to "seek out and fast track suitable construction developments in Tasmania":

"In deciding which projects to invest funds into, factors such as return on investment, job creation and facilitating projects that might not otherwise occur are the principal objectives towards the allocation of the funds."⁴⁸

The loans were secured by second mortgages over the property developments. TasBuild’s annual reports do not provide any comments on the performance of these investments. Over the years the amount allocated for this purpose has fluctuated. When the economy was buoyant, there was less demand for this sort of funding.

The investment returns on the fund have been quite volatile, as shown in Figure 8. The fund was particularly hard-hit by the GFC, with returns of -11% in 2007-08 and -29% in 2008-09.⁴⁹ The Trustees switched to a more conservative asset allocation after these losses.

The geometric mean of the returns over the last 14 years is just 3.6% per annum.

2.2.5 Financial position

When the Tasmanian fund was privatised (effective 1 January 1998), it started off in a strong financial position, with a large surplus. As shown in Table 12, assets were approximately double the value of liabilities for several years thereafter.

In 2006, the surplus was applied to improve benefits and to reduce the levy rate. The TasBuild benefit accrual rate was initially set at 13 weeks of leave after 15 years of service (1.67% benefit accrual rate). From 1 January 2006, the accrual rate was increased to 13 weeks of leave after 10 years of service (2.5% benefit accrual rate).

The fund still had a substantial surplus in 2007, with an asset/liability ratio of almost 200%. However, the fund was hard-hit by the GFC. Table 12 shows financial data for the fund from 1999 to 2013.

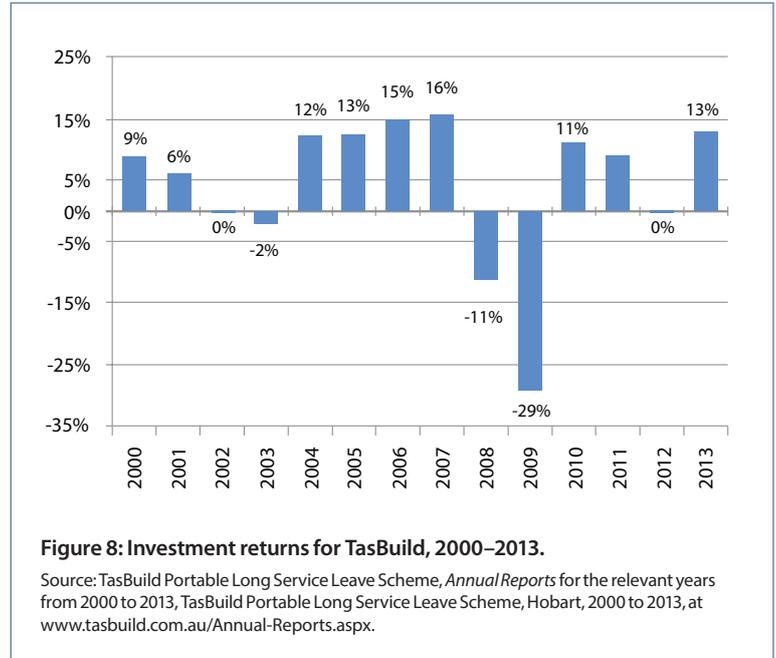


Figure 8: Investment returns for TasBuild, 2000–2013.

Source: TasBuild Portable Long Service Leave Scheme, *Annual Reports* for the relevant years from 2000 to 2013, TasBuild Portable Long Service Leave Scheme, Hobart, 2000 to 2013, at www.tasbuild.com.au/Annual-Reports.aspx.

Table 12: Financial data for TasBuild 1999 to 2013.

Year ending 30 June	Administration expenses (\$millions)	Levies (\$millions)	Claims paid (\$millions)	Assets (\$millions)	Provision for LSL liabilities (\$millions)	Assets/provision for LSL liabilities
1999	0.52	3.62	0.71	34.76	17.48	199%
2000	0.59	1.67	1.12	37.66	17.40	216%
2001	0.55	1.23	1.41	39.16	17.66	222%
2002	0.58	1.41	1.16	38.26	17.81	215%
2003	0.58	1.39	1.14	38.62	19.19	201%
2004	0.72	1.36	1.08	43.40	19.96	217%
2005	0.57	1.71	1.12	49.24	22.67	217%
2006	0.67	1.75	1.04	57.45	27.28	211%
2007	0.67	1.60	1.45	66.08	33.46	198%
2008	0.91	1.73	1.87	59.26	41.05	144%
2009	0.98	2.33	2.30	49.52	49.05	101%
2010	0.94	7.14	3.12	58.00	53.15	109%
2011	1.05	9.09	3.98	67.43	60.90	111%
2012	1.14	9.41	4.45	70.88	69.12	103%
2013	1.10	9.06	5.41	81.27	71.90	113%

Source: TasBuild Portable Long Service Leave Scheme, *Annual Reports* for the relevant years from 2000 to 2013, TasBuild Portable Long Service Leave Scheme, Hobart, 2000 to 2013, at www.tasbuild.com.au/Annual-Reports.aspx.

The GFC had the following effects on the fund:

- First, it suffered very poor investment returns, as shown in Figure 8, so that the value of assets fell sharply from about \$66 million in 2007 to less than \$50 million in 2009.
- Second, the value of accrued liabilities increased sharply from \$33 million in 2007 to \$49 million in 2009. This was partly caused by a change in the valuation assumptions. Since LSL funds have long-term liabilities, the choice of actuarial assumptions is crucial in determining the financial position of each fund. If the discount rate falls, then the value of the liabilities will increase sharply. In the aftermath of the GFC, central banks cut interest rates, leading to lower yields on government bonds, which adversely affected the reported solvency of LSL funds.
- Third, there was an increase in benefit payments. There was a slowdown in the building and construction industry, so more claims for termination payments and pro-rata LSL payments were made.

The surplus was eliminated by the end of 2009: the asset/liability ratio fell to just 101%.

Over the last few years, the fund has slowly recovered from the GFC, and by 2013 the asset/liability ratio was above 110% (the fund's target). Figure 9 shows how a sharp increase in levy income helped to improve the financial position.

As noted previously, changes in asset/liability ratios should be treated with caution, since the valuation of liabilities is highly sensitive to the actuarial valuation assumptions.

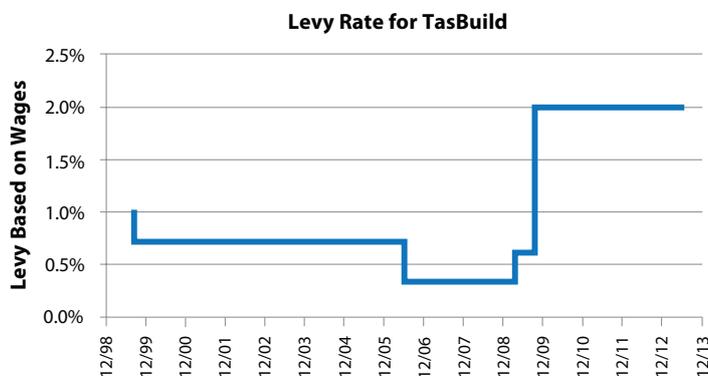


Figure 9: Historical levy rates for TasBuild, 1997–2013.

Source: *Parliamentary Report of the Select Committee on the Costs of Housing, Building, and Construction in Tasmania, Interim Report*, Parliament of Tasmania, Hobart, 2011, pp. 83–85, at [www.parliament.tas.gov.au/ctee/House/Reports/Interim Report - Final.pdf](http://www.parliament.tas.gov.au/ctee/House/Reports/Interim%20Report%20-%20Final.pdf).

2.2.6 Stability of the levy rate

The levy rates have been rather unstable since the scheme was privatised in 1998, as shown in Figure 9.

Under the old (government-run) scheme, the levy had initially been set at 2%. TasBuild took over from 1 July 1998, when the scheme was privatised. The fund had a surplus and in September 1999, TasBuild reduced the levy rate to 0.7%.

The fund remained in surplus for several years. In 2006, the benefits were significantly improved. At the same time, the levy rate was reduced to just 0.3%.

The 2007 annual report said that:

“It is the Trustee’s goal to maintain the lowest possible subsidised rate, currently 0.3%, to employers in the industry for as long a period as possible. Current indications are that we will be able to achieve this for some years to come.”⁵⁰

This prediction was too optimistic. The trust fund had very poor investment returns in both 2007–08, and 2008–09, leading to a sharp fall in the value of its assets. In order to recoup the losses, the levy was increased from 0.3% initially to 0.6%, and then up to 2.0%. Many employers were quite unhappy about the sharp increase in levy rates (as evidenced by their submissions to the Select Committee in 2010–11, described previously in section 2.2.2).

2.2.7 Employer compliance

Like most portable LSL funds, TasBuild devotes a great deal of its resources to informing members about their benefits; to inform employers of their obligations; and to collect levies efficiently. However, it appears that over the years, employer non-compliance has often been a serious problem. The struggle to improve compliance is a recurring theme in annual reports, year after year.⁵¹

TasBuild’s board considers that it is important to pursue employers who fail to pay their levies. Otherwise, dishonest employers will obtain an advantage over honest employers who make the correct payments. The 2001 annual report said:

“The Trustee has successfully taken legal action in respect of some employers that have not complied with the current legislation. In all cases the employers had failed to register themselves or their workers, had failed to provide information requested, or had failed to pay contributions for long service. Significant costs orders were obtained against the employers. TasBuild will continue to take action against employers who fail to comply with their obligations to ensure a level playing field and that workers in the construction industry receive their full service entitlements.”⁵²

The 2002 annual report mentioned that TasBuild was working on a review of the LSL legislation. The legislation, which was passed in the following year, gave the trustee stronger enforcement powers.⁵³

The 2003 annual report mentioned that two additional industry liaison officers had been appointed, and they were targeting areas with low levels of registration and/or poor compliance.⁵⁴

After the GFC, it seems that TasBuild redoubled its efforts to collect the correct amount of levies. TasBuild started working with the Department of Education. Apprentices who are still learning their trade have to be registered and must provide the name of their employer. The Department of Education provided lists of these apprentices to TasBuild, which then followed up by contacting their employers. The annual report noted that:

“Employers identified by this process have demonstrated significant resistance; however a diligent and persistent approach, particularly with the potential threat of litigation, has resulted in a high level of compliance.”⁵⁵

Many of these employers would have been liable for levies for many other employees (as well as the apprentices) – perhaps going back several years. TasBuild charges penalty rates for levies which are not paid on time, so many of these employers would have been unpleasantly surprised by demands for quite large payments. (The parliamentary inquiry held in 2011 heard complaints from some of these employers.)

As a result of these measures, the number of employer registrations increased sharply: by 51% in 2008–09. This suggests that there were serious deficiencies in employer compliance in earlier years.

In 2010, TasBuild starting publishing monthly newsletters for employers (which are also available on the website). The newsletters often include short articles about the importance of compliance, the measures TasBuild might take in order to enforce compliance, and the penalties for non-compliance. The 2011 annual report records an increase in legal action to recover unpaid levies.⁵⁶

It is particularly difficult to enforce compliance when the industry is going through a downturn. The 2012 annual report noted:

“Debt recovery has been a major component of our work during the year. This year we have had to refer over 132 debtors with a value of debts in the order of \$158,783 to the TCS. Add to this we currently have over \$223,000 owed to us from employers who are currently under administration. This is despite our attitude to work with employers to assist them when they are experiencing short-term cash flow issues. These debts adversely impact on the Fund’s liability valuation which imposed pressure on the employers’ contribution rate. It is for these reasons that we will be taking a fair but more hard-nosed approach to debtors. It is unfair to expect good employers operating in compliance with the law to fund those that can’t or won’t.”⁵⁷

2.2.8 Administrative expenses

As shown Table 12, over the last five years (2009–13), the fund has paid out \$19.27 million in benefit payments and \$5.21 million in administrative expenses – that is, the fund incurred administration costs of about \$1 for every \$3.70 paid in benefits.⁵⁸ This expense ratio is higher than the expense ratio for the portable LSL funds in the larger states, which are approximately \$1 of expenses per \$6 or \$7 of benefits.

Previous studies of industry-based superannuation funds have shown that there are economies of scale in the management of superannuation savings: small funds tend to have higher expense ratios (per member) than larger funds. It is likely that the same economies of scale affect administration expenses in portable LSL funds, which would account for the Tasmanian experience.

3 SUMMARY AND OBSERVATIONS

The building and construction LSL schemes are long-established and are now integral to the industry. Based on submissions to the Cole Royal Commission

in 2002–03, these schemes have had the support of the major employer organisations and trade unions which represent the industry.

Portable long service leave schemes meet the needs of workers in the building and construction industry. Workers in this industry often move from one project to another, changing employers frequently. In the absence of the portable LSL schemes, relatively few would be eligible for any LSL benefits: for example, the Victorian and Tasmanian schemes report that 80% to 90% of LSL beneficiaries have had two or more employers during their career.⁵⁹

LSL benefits are particularly useful in providing some income for workers who are “between projects” or temporarily unemployed.

However, the schemes only provide portability within the industry. Experience shows that there is a significant level of worker churn, that is, people who work in the industry for just a few years, and then leave before qualifying for any LSL benefits. The number of deregistrations under the four-year rule provides some indication of level of churn in the industry, which clearly varies over time and across states. The money contributed for the early-leavers is used to fund the benefits for those who remain in the industry long-term. If the scheme rules were changed to reduce the vesting periods then this would provide LSL benefits to a greater range of workers, although, of course, with higher levy rates.

By their nature, portable LSL schemes pose administrative challenges, which impose costs on the LSL funds. The administration costs seem reasonable compared with the estimated administration costs for MySuper superannuation funds, but are high relative to the LSL benefits provided.

The LSL funds incur significant expenses in order to ensure that workers are informed about their entitlements and to ensure that employers and property developers pay the appropriate levies (and this includes taking legal action when necessary). The portable LSL funds are quite proactive in this regard, compared with FairWork Australia, which is responsible for providing information and dispute resolution services to workers in other industries that do not have portable leave.

The existence of the portable LSL scheme also gives building and construction workers greater security in receiving their entitlements. The portable schemes pay benefits even when an employer is insolvent. This is particularly important in the building and construction industry, where there is a relatively high turnover of employers. The LSL costs from insolvent employers are borne by other employers in the industry. By comparison, in other industries, employees of insolvent employers must rely on the Fair Employment Guarantee to pay their entitlements. The Fair

Employment Guarantee is funded by the Australian government.

All of the building and construction industry schemes provide defined benefits (which is consistent with the non-portable benefits provided under state-based legislation in other industries). In a defined benefit fund, the levy rate is likely to vary up and down over time in line with the experience of the fund. The historical record shows considerable variability in the levies over time. This variation is undesirable since it adds to the employers’ business risks. The employers might prefer an accumulation scheme, where levies are fixed and benefits are flexible. It is pertinent to note that the Coal Industry Portable LSL scheme has already been restructured to a hybrid benefit design. Alternative portable LSL models, based on accumulation benefits, are discussed in the McKell Institute report.⁶⁰

The volatility of the levy rates is exacerbated by the growth-oriented investment strategies adopted by most funds. LSL liabilities are long term, and growth-oriented strategies are expected to produce higher returns over the long term – but with more volatility in the short term. This is likely to produce corresponding fluctuations in the funding ratios – that is, they are likely to produce surpluses and deficits.

In the past, surpluses have often been used to improve benefits. The benefit increases may well persist even after the surplus has been dissipated, leading to high LSL costs in the long term.

The beneficiaries of the fund are naturally likely to be concerned about the existence of large deficits – especially if there is any risk that their benefits will be reduced in order to alleviate the deficit. This creates a pressure for increases in levy rates in order to eliminate the deficit quickly.

Hence, fluctuations in the levy rate are likely to be pro-cyclical – pushing up employer costs just when the industry is going through a downturn. Fluctuations in the levy rate also increase generational cross-subsidies between employers: any new employers who have entered the industry recently are paying off deficits arising from the past service obligations of other employers.

Employers in the building and construction industry might prefer a more conservative investment policy, which would produce a more stable levy rate, even if the long-term average returns were somewhat lower.

At present, it is difficult to monitor trends in funding levels over time. The funding levels depend on the actuarial estimates of the fund liabilities, and these estimates are quite sensitive to the choice of actuarial assumption – especially the gap between the discount rate and the rate of salary growth. In the past, some funds have been valued using government bond rates; others have been valued using the expected

long-term returns. In order to improve consistency and comparability, the Accounting Standards Board could revise the Accounting Standards which apply to portable LSL funds (AASB137). A submission from the Actuaries Institute might provide helpful guidance on the most appropriate choice of valuation assumptions.

Endnotes

- 1 NSW Parliamentary Debates, Legislative Assembly, 16 May 1951, vol. 195, p. 2089.
- 2 Refer to statements by Unions NSW secretary Mark Lennon cited in Jim O'Rourke, Long service leave: use it or you lose it, *Sydney Morning Herald*, 25 September 2011; Parliamentary speech by federal Labor MP Mike Symon, reported in Steven Scott, Call to give workers industry specific protection, *Australian Financial Review*, 21 February 2008; comments by Australian Workers Union cited in Steven Scott AWU wants promised tax cuts poured into super, *Australian Financial Review*, 21 January 2008; comments by former minister for employment and workplace relations, Bill Shorten, cited in Matthew Westwood, Is this long service leave I see before me? *Australian*, 8 March 2012; comments by Paul Howes cited in Kate Hannon, Union wants portable leave for all, *Canberra Times*, 30 January 2008; Ray Markey, Nick Parr, Chris Wright, Shauna Ferris, Tim Kyng, Sharron O'Neill, Salut Muhidin, Louise Thornthwaite, and Catrionna Lavermicocca, *The case for a national portable long service leave scheme in Australia*, McKell Institute, Sydney, 2013.
- 3 Journals of the Senate, The Parliament of the Commonwealth of Australia, Number 33, Thursday 19 June 2014, page 918 available at parlinfo.aph.gov.au/parlInfo/download/chamber/journals/4f781117-64c5-4493-a32b-63243bca5a4a/toc_pdf/sen-jn.pdf;fileType=application%2Fpdf#search=%22chamber/journals/4f781117-64c5-4493-a32b-63243bca5a4a/0014%22
- 4 The Senate inquiry was conducted by the Education and Employment References Committee. The committee reported on 25 February 2016. The home page for this inquiry is www.aph.gov.au/Parliamentary_Business/Committees/Senate/Education_and_Employment/LSL_Portability.
- 5 Senator Lee Rhiannon, Labor and Liberals unite to kill off portable long service leave hopes: Bandt, Media Release, 19 July 2014.
- 6 Ray Markey, Nick Parr, Chris Wright et al, *The case for a national portable long service leave scheme in Australia*.
- 7 In the past there was also a portable LSL scheme for the stevedoring industry, which was set up under Commonwealth legislation in 1956, but it was discontinued in 1976, by the *Stevedoring Industry Amendment Act 1976 (Commonwealth of Australia)*.
- 8 *Final Report of the Royal Commission into the Building and Construction Industry*, by the Royal Commissioner the Honourable TRH Cole, Commonwealth of Australia, Canberra, 2003, chapter 12, Long Service Leave Funds in the Building and Construction Industry, paragraph 12.11 (Cole Report).
- 9 This may include some double counting, since workers may be registered in more than one state. For example a worker might work in Queensland for a few years and then move to the Northern Territory to work there. He will remain on both registers.
- 10 The Northern Territory scheme has only been operational since 2005. The average length of eligible service is likely to be lower than for other schemes which have been established for a longer time. Hence we would expect average benefits to be lower. The average payment will vary from state to state as a result of differences in benefit design, e.g schemes which have a shorter vesting period would be expected to have lower average benefits.
- 11 Cole Report, Commonwealth of Australia, Canberra, 2003, chapter 12.
- 12 Cole Report, Commonwealth of Australia, Canberra, 2003, chapter 12, paragraph 155.
- 13 Cole Report, Commonwealth of Australia, Canberra, 2003, chapter 12, paragraphs 156.
- 14 For example, a review of the Western Australian construction industry scheme in 1996 found that 56% of employers and 69% of employees supported the scheme. Nevertheless the report recommended that the scheme be scrapped, because of the high turnover of construction industry workers. The high turnover rates meant that many employees would not remain in the industry long enough to obtain benefits. Shaun Anthony, Scrap leave scheme: review, *West Australian*, 13 November 1996.
- 15 Cole Report, Commonwealth of Australia, Canberra, 2003, chapter 12, paragraphs 154.
- 16 Lisa Allen, Anger over return of long service leave levy in NSW, *Australian*, 7 July 1997; NSW Builders: levy amounts to a new tax, Geesche Jacobsen, *Australian Financial Review*, 5 June 1997; Bernard Lagan, Angry builders levied to top up depleted fund, *Sydney Morning Herald*, 1 November 1996. Bernard Lagan, Plan to plunder \$400m nest egg angers builders, *Sydney Morning Herald*, 9 March 1996; Mike Baird, New South Wales Minister for Industrial Relations, Government to investigate new ways to administer portable long service leave in NSW, media release, 8 November 2013.
- 17 Mark David, Building unions oppose fund grab, *Australian Financial Review*, 11 January 1995.
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Average and standard deviation of remaining lifetime

DR TIMOTHY PAUL HUTCHINSON



Dr Timothy Paul Hutchinson

ABSTRACT

At older ages, the average and the standard deviation of remaining lifetime (ARL and SRL) are both less than at younger ages. Thus ARL and SRL change together. A linear relationship of slope 1 between the reciprocals of ARL and SRL has previously been found. The present paper reports similar relationships when considering different countries, years, and sexes. It is suggested that age and sex of person, their country, and the year all act via the same unobserved variable, that might be called effective age.

KEYWORDS

life expectancy, average remaining lifetime, remaining lifetime (variability), effective age

1 INTRODUCTION

The standard deviation of remaining lifetime is less familiar than the average, but there has been recent interest. Some years ago, I found standard deviation of remaining lifetime to be required in order to make a good estimate of the expected effect on life expectancy of an extra risk (Hutchinson 2001): an extra risk refers to one that is known to apply to the person under discussion, but does not apply to the general population. In that paper, I briefly mentioned an empirical relationship between the average and standard deviation of remaining lifetime (ARL and SRL). At older ages, ARL and SRL are both less than at younger ages. I noticed a linear relationship of slope 1 between the reciprocals of ARL and SRL:

$$1/\text{SRL} = 0.05 + 1/\text{ARL} \quad (\text{Equation 1})$$

That was for a French dataset and referred to males across the whole lifespan from age 0 to age 90. In Hutchinson (2003), I found that the same relationship held in a US dataset (referring to ages of at least 85, males and females separately). There is theoretical reason, based on properties of the dependence of hazard rate on age, to think that at old ages, the ratio of standard deviation to average may increase towards 1 (Banjevic, 2009). That will be a consequence if the plot of reciprocal versus reciprocal has slope 1 and ARL decreases towards 0.

Robine (2001: 187) noted that, referring to ages of at least about 50, both ARL and SRL have increased substantially over time. Robine is dismissive of the

co-variation of ARL and SRL, as different phenomena occur for younger ages. My opinion is that such an attitude is unjustified. Hazards at different ages are different – infancy, young adulthood, mature adulthood, and old age are often contrasted with each other – and it is unsurprising if statistics such as SRL show different features for different ages.

Engelman et al (2010) reported both ARL and SRL for four ages, two sexes, three years (approximately 2006 and either 1900 or 1950), and 23 countries. The present paper considers whether a relationship similar to that reported by Hutchinson (2001, 2003) holds in this dataset.

2 RESULTS

The data points plotted in Hutchinson (2003) refer to a range of $1/\text{ARL}$ from a little over 0.01 to a little less than 0.5, and most of the visual impression of a linear relationship of slope 1 comes from $1/\text{ARL}$ being between 0.05 and 0.5. The corresponding ages of the people that ARL and SRL refer to range from 60 to 100. For consistency with this, what will be discussed here are the results given by Engelman et al for age 75.

The countries for which there were data for 2006 and 1900 were as follows: Belgium, Denmark, England and Wales, Finland, France, Iceland, Italy, Netherlands, New Zealand (non-Maori), Norway, Sweden and Switzerland. The countries for which there were data for 2006 and 1950 were as follows: Australia, Austria, Canada, the Czech Republic, Hungary, Ireland, Japan, Portugal, Slovakia, Spain and the United States. In the case of seven countries, the latest year was not 2006, but instead 2003, 2004 or 2005. Engelman et al obtained their data from the Human Mortality Database, and refer to it as 23 national populations with at least five decades of data.

Some aspects of the results below are simple, and others are quite complex. An additional dimension of complexity would be introduced if some data points might be outliers, but no attempt has been made to identify and exclude outliers.

2.1 Main results

Figure 1 shows the relationship between $1/\text{ARL}$ and $1/\text{SRL}$, for age 75. There are 92 data points: 46 combinations of country and year, and two sexes. It is evident that there is a relationship, and it is very similar to that reported by Hutchinson (2001, 2003). The data point at (0.154, 0.179), some distance from the general trend, is for Iceland, 1900, Males.

In Figure 1, the range of the horizontal axis ($1/\text{ARL}$) is approximately 0.07 to 0.12 for 2006, 0.11 to 0.16 for 1950, and 0.12 to 0.18 for 1900. The visual impression of

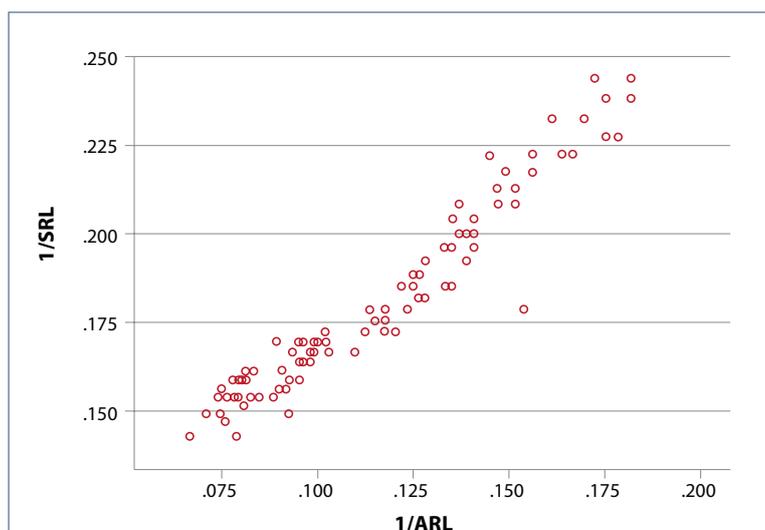


Figure 1: Relationship between $1/\text{ARL}$ and $1/\text{SRL}$, for age 75.

Source: Data from Engelman, M., Canudas-Romo, V., & Agree, E.M. (2010). The implications of increased survivorship for mortality variation in aging populations, *Population and Development Review*, 36: 511-539.

a relationship arises both because of within-year co-variation (variation of country and sex) and because of between-years co-variation. The slope is 0.82 in Figure 1 if all data points are included. That it is different from 1 arises largely from the data for 2006.

2.2 Additional results

If the slope is 1 when plotting reciprocal versus reciprocal, it will be meaningful to examine the differences between the reciprocal of the standard deviation and the reciprocal of average. No pattern would be seen in this difference if Equation 1 were the whole story. Contrary to this, there appear to be some consistencies.

- Sex: for 1900, there was no difference between the sexes, the difference between reciprocals averaging .062 for females and .060 for males. For 1950, there was no difference between the sexes, the difference averaging .060 for females and .059 for males. For 2006, there was a difference between the sexes, the difference averaging .075 for females and .067 for males.
- Year: the averages just given also show that the difference tended to be greater in 2006 than in 1900 or 1950.
- Country: because there are so many countries, a rather different approach from that taken for sex and year is needed in order to briefly describe the results. For 1900, there was no appreciable correlation across countries between the difference between reciprocals for females and that for males. For 1950 and for 2006, there were positive correlations across countries between the difference between reciprocals for females and that for males, suggesting that there is an effect of country.

3 DISCUSSION

The starting point was the phenomenon that at increasing ages, ARL and SRL both decrease, and a relationship exists that may be described by Equation 1. Figure 1 shows approximately the same relationship when the data points refer to different countries, years, and sexes. The first issue for discussion is a possible interpretation of this.

3.1 Hypothesis of effective age

The following interpretation is worth consideration. Change of country, year, or sex may be the same as change of age. By this is meant that there exists an unobserved variable that might be called effective age, that is constructed from calendar age, country, year and sex, and which determines the distribution of

remaining lifetime. The distribution has an ARL and a SRL at any age, and there is a fixed relationship between them.

The reasoning behind this is as follows:

1. It is found empirically that the mean determines the standard deviation of remaining lifetime.
2. Presumably the whole shape of the distribution, not only the standard deviation, is determined by the mean. Thus the distributions constitute a one-parameter family of distributions.
3. To identify which member of this family we are referring to, it is natural to choose the mean as the characteristic we specify.
4. It is found empirically that several variables affect the mean: age, country, year, sex.

The foregoing list is the main substance of the hypothesis. Choice of name for the unobserved variable is not so important, but “effective age” seems reasonable. The several variables mentioned can be regarded as determining effective age, and effective age regarded as determining the mean (and, indeed, the whole distribution) of remaining life. A man aged 80, for example, might be described as having an effective age of 75 if the year and country predispose to longer survival, with ARL being for example not 7.8 (corresponding to 80) but 10.0 (corresponding to 75). Spiegelhalter (2016) uses “effective age” in the context of micro-scale risk factors, such as smoking and blood pressure, rather than the macro-scale factors (country, year) considered here.

If this were developed, one would presumably (for each sex) choose a country and a year such that for this country and year, effective age is defined to be calendar age. Then a formula would be worked out to give (for the same sex) effective age for any other country and year. However, this might be taking the idea too far.

3.2 Concluding comments

Considering the relation between ARL and SRL, it is not definitely settled whether the slope is 1, or what might affect the intercept. The results are presented simply as empirical findings. They are useful if ARL is known and SRL is not known but is needed, as may occur in the context of the expected effect of an extra risk. Circumstances will dictate whether any specific equation is good enough for purpose.

Another context for interest in variability of remaining life is a notion of unfairness: some authors consider that a large standard deviation is highly undesirable. That is beyond the scope of the present paper. However, it is worth saying that when interest centres on the elderly, a large standard deviation is likely to be an indicator of a large expectation of life, and in that sense is good. The population would in this case

have a low effective age. Furthermore, a change in SRL indicates a larger change in ARL: according to Equation (1), if SRL increases from 6.0 to 6.1, for example, ARL increases from 8.6 to 8.8.

The question may arise of what affects SRL (and by how much) at a given ARL, rather than at a given calendar age. Figure 1 shows quite a tight relationship between ARL and SRL, but it is not the whole story, as consistencies have been detected (see section 2.2) in the differences between the reciprocal of the standard deviation and the reciprocal of average. For example, the difference tended to be bigger for 2006 than for 1950 or 1900. To study such effects, it would be desirable at an early stage to determine whether they appear in data prepared on a cohort (as distinct from period) basis.

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Acknowledgements

The Centre for Automotive Safety Research, University of Adelaide, is supported by both the South Australian Department of Planning, Transport and Infrastructure, and the South Australian Motor Accident Commission. The views expressed are those of the author, and do not necessarily represent those of the University of Adelaide or the sponsoring organisations.

Australian life expectancy estimates, allowing for education, partnership and employment

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ABSTRACT

International data show that mortality rates depend strongly on education, partnership and occupation. This may be relevant to actuarial practice in traditional areas such as life insurance and superannuation. This paper uses Australian data on causes of death, and survey estimates of disease prevalences, to estimate life expectancies, taking into account education, partnership and employment.

Disease prevalences by sex, age, education, partnership and employment are here estimated from the Survey of Disability Ageing and Carers 2012, and combined with relative mortality rates to estimate the life expectancies of persons of different education, partnership status and employment status. Sample life expectancy estimates are also quoted assuming that the better health of the employed ceases on retirement, or that it continues until death. These two sets of estimates provide some indication of the uncertainty in our work.

Allowances for occupation groups were found not to add significantly to the estimation model. This may be because education is capturing much of the difference between occupational groups. It may also be that changed industrial risks, and public health campaigns, have reduced the large traditional health differences between occupations.

KEYWORDS

Life expectancy, disease prevalence, education, partnership, employment

1 INTRODUCTION

Lillard and Waite (1995) and Gardner J and Oswald (2004) suggested reasons for the lower mortality rates of married persons. Mortality data from the UK Office for National Statistics (2013) shows that managerial and professional workers have lower mortality rates than other workers, with the differences declining with age. Cumpston, Sarjeant and Service (2015) used Australian data to show the lower mortality rates of married persons, and of some professional workers.

Danish data show that lone persons have higher mortality rates from specific diseases than partnered persons (Frisch & Simonsen 2013). Australian Survey of Disability Ageing and Carers 2012 (SDAC 2012) data (Australian Bureau of Statistics 2014) show that the prevalence of major diseases is higher for unpartnered persons, persons with low education levels and persons in manual occupations (Cumpston, Sarjeant and Service 2015).

We consider that the higher mortality rates of unpartnered persons, and of not employed persons, reflect their higher disease prevalences. The underlying cause of death reported for most persons should provide some guide to the relative mortality risks arising from different diseases. This paper is a systematic attempt to use available Australian data on mortality rates, underlying causes of death and disease prevalences, to construct life expectancy estimates. All our estimates use publicly available data, and should be reproducible.

Our results are not directly applicable to the design and rating of insurance products. Actuaries have traditionally used industry-wide collections of data on the claims experience of insurance purchasers. Such data can be costly and slow to collect, and may give little guidance for new products. The increasing volumes of

Australian data available from different public sources may provide some extra assistance to actuaries.

2 DATA

2.1 Main data sources

Our main sources of Australian data have been

- mortality rates in the “Australian life tables 2010-12” (ALT 2010-20) (Australian Government Actuary 2014)
- numbers of deaths in 2010 to 2012 by sex, 5-year age group and International Classification of Diseases 10 chapter, from the General Record of Incidence of Mortality (GRIM) books (Australian Institute of Health and Welfare 2013), supplemented by additional analyses for ages 85-89, 90-94, 95-99 and 100+ supplied by the Australian Institute of Health and Welfare.
- estimated numbers of persons with each disease, by sex, 5-year age group, education, partnership and occupation, from SDAC 2012
- comparisons of partnership status, education and occupation by sex and 5-year age groups between 2006 and 2011 from the Australian Census Longitudinal Dataset (Australian Bureau of Statistics 2013).

2.2 Disease groups used in analyses

Table 1 was derived from the numbers of deaths by ICD10 chapter in the GRIM books supplemented by additional analyses for ages 85-89, 90-94, 95-99 and 100+. The first 7 disease groups in Table 1 were selected as the ICD10 chapters giving the largest numbers of deaths in 2010-12. “External causes” are broadly accidents, homicides, suicides and medical misadventure. Numbers of deaths by ICD group were

Table 1: Expected deaths for each disease group.

Disease group	ICD10 Chapter	Description	Deaths Female	Deaths Male
Group 1	2	Cancer	22,338	30,230
Group 2	4	Endocrine, nutritional and metabolic diseases	4,235	4,007
Group 3	5	Mental and behavioural disorders	7,908	4,606
Group 4	6	Diseases of the nervous system	5,229	4,090
Group 5	9	Diseases of the circulatory system	36,504	31,937
Group 6	10	Diseases of the respiratory system	8,806	10,002
Group 7	20	External causes	3,777	5,521
Group 8	Other	Other	11,203	9,607
Total			100,000	100,000

averaged over the three years 2010 to 2012, and divided by the populations in appendix C of ALT 2010-12. This gave mortality rates slightly higher than those in ALT 2010-12, and adjustment factors were derived to go balance each five-year age group for each sex. The adjusted mortality rates were then used to construct mortality tables for each sex, subdivided by the eight disease groups.

2.3 Data extent and quality

Deaths are formally recorded, with information on underlying and associated causes of death normally provided by medical practitioners. Mortality rates are based on recorded deaths and census population estimates, corrected for census under-reporting. Diseases recorded by SDAC 2012 are self-reported for persons not in residential care, with some under-estimation of diseases such as dementia and diabetes. The survey was of 77,570 persons, of whom 9,787 were in residential care. The survey is weighted, with much greater weights on persons with disabilities. The disease prevalence estimates provided here are after applying the weights for each person record, and are intended to be nationally representative. The Australian Census Longitudinal Dataset attempted to link a 5% sample of persons the 2006 census with persons in the 2011 census, did not achieve full linking, and randomised some data to help protect confidentiality.

3 ESTIMATION METHODS

3.1 Relative mortality rates for each of 8 disease groups

Deaths by sex and age in 2011 were estimated from ALT 2010-12. Data on the underlying causes of death in 2010-12, from the Australian Institute of Health and Welfare, were used to subdivide deaths into each of the 8 major disease groups. Disease prevalences by sex and age were estimated by logistic regression from SDAC 2012. Comparing the deaths with the prevalences provided relative mortality rates for each of the eight disease groups.

3.2 Transition rates for education, partnership and occupation

The Australian Census Longitudinal Dataset was obtained by attempting to link 979,661 records from the 2006 Census sample with 2011 census records. A linkage rate of 82% was achieved, with a false link rate of about 5% (Australian Bureau of Statistics 2013). We accessed the matched records through TableBuilder, which randomly confidentialised the results to avoid identification of individuals. We tabulated the numbers of linked persons at each age with each combination

of education, partnership and occupation at the 2006 census, subdivided by their education, partnership and occupation in 2011. From these we derived five-yearly transition rates, and converted these to one-year transition rates. Some manual smoothing was applied at the youngest and oldest ages. The confidentialisation process appeared to be giving false transitions back into employment at older ages, so we assumed transitions into employment would cease at 70. These transition rates were applied, starting at age 0, to estimate the numbers of persons with each combination of sex, age, education, partnership and occupation. The effects of education, partnership and employment on disease prevalences were only allowed for from age 20 on.

3.3 Disease prevalences by sex, age, education, partnership and occupation

Our logistic analyses of disease prevalences allowed for three education levels (year 11 and below, year 12, and more than year 12 education). Trade certificates were assumed to be in the year 11 and below level. Two partnership states were assumed (partnered, or not partnered). Four occupations were assumed (not employed, managerial and professional, intermediate, and manual). Manual occupations were plant operators and labourers. From age 15 on, there were thus 24 possible combinations of education, partnership and occupation for each sex at each age. Regression models of disease prevalences by sex, age, education, partnership status and broad occupation group were then estimated from SDAC 2012. As managerial and professional, intermediate, and manual groups had broadly similar effects on disease prevalences, they were combined into a single category “employed”.

3.4 Balancing factors

The fitted models of disease prevalences by sex, age, education, partnership and employment were used, together with the estimated numbers of persons in each category, to estimate the numbers of deaths by sex, 5-year age group and disease group for 100,000 persons aged 0. Because the multi-attribute disease models did not exactly balance with the prevalence models based only on sex and age, balancing factors were used to get exact balances.

3.5 Life expectancy estimates

For a person in a given sex/age/education/partnership/employment category, their distributions of future categories were estimated assuming the transition rates derived in 3.2. Their chances of death in each future year were estimated modifying the ALT 2010-12 mortality rates by the relativities of 3.1, and applying these to the prevalences of disease estimated via 3.3 and 3.4.

This process assumed no future changes in population mortality rates; and reproduces the ALT 2010-12 life expectancies for an individual whose partnership, education and occupation status is unknown.

4 RESULTS

4.1 Expected deaths by twenty-year age-groups

Table 2 shows twenty-year values of expected deaths for each of the eight disease groups, derived as described in 2.2 The row totals balance with the dx values in ALT 2010-12.

4.2 Prevalence parameters fitted for each of eight disease groups

Table 3 show disease prevalence parameters fitted by weighted logistic regression to the data in SDAC 2012. All persons aged 85 and over were assumed to be 90. The coefficients shown are the fitted values, rather than exponentiated values often shown as hazard ratios. Coefficients significant at the 5% level are shown in italics, shaded blue. The log-likelihood reductions (LLR) are measures of the goodness of fit, sometimes called pseudo-Rsquare or McFadden Rsquare. For

disease group 1, the age squared term was omitted, as a linear fit was found to give a better fit at young ages. Fitted prevalence values were calculated by taking the sum-product of the variables and their coefficients, and using a logistic transform. For example, the sum-product for group 4 for a 42.5 year old female was calculated as

$$.036277 \times 42.5 - 0.0002257 \times 42.5 \times 42.5 - 3.8066$$

that is -2.6725 .

Using a logistic transform gives

$$\exp(-2.6725) / (1 + \exp(-2.6725))$$

that is a prevalence of 0.0646.

Figure 1 shows that the actual and fitted prevalences for females for disease group 4 were reasonably close, with some overestimation as ages 70–80, and underestimation at 90+. Graphs of the form of Figure 1 were used to visually check all the fitted prevalence curves. The example in Figure 1 was chosen as having the lowest LLR in Table 3. Even with the low LLR of 0.009, the fit appears reasonable. There is considerable uncertainty about the shape and level of the curve at the oldest ages. The example in Figure 2 was chosen as having the highest LLR in Table 2, of 0.313. Prevalences

Table 2: Expected deaths from each disease group, per 100,000 deaths.

Sex/ age	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Total
Female									
0-19	46	15	3	35	20	17	120	345	602
20-39	195	24	12	40	77	22	318	89	778
40-59	1944	119	44	129	491	169	397	374	3666
60-79	9087	916	613	968	4681	1912	548	1925	20649
80-99	10895	3044	6828	3905	29501	6285	2288	8065	70810
100+	171	117	409	152	1735	400	106	405	3495
Total	22338	4235	7908	5229	36504	8806	3777	11204	100000
Male									
0-19	56	16	1	46	24	20	235	418	816
20-39	183	29	23	58	158	27	1067	123	1669
40-59	2100	185	86	166	1348	202	1061	718	5866
60-79	13298	1309	651	1121	7697	2596	1046	2403	30120
80-99	14459	2408	3704	2656	21980	6942	2043	5790	59981
100+	134	60	141	42	731	215	69	156	1548
Total	30230	4007	4606	4090	31937	10002	5521	9606	100000

Table 3: Prevalence coefficients fitted by logistic regression.

Variable	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Female								
age	0.1597	0.1591	0.0046	0.0363	0.1928	0.0027	0.0463	0.0633
age \times age	-0.0009	-0.0009	0.0001	-0.0002	-0.0009	0.0001	-0.0001	0.0000
constant	-10.019	-7.940	-2.684	-3.807	-9.505	-2.724	-4.813	-4.263
LLR	0.090	0.163	0.023	0.009	0.313	0.009	0.049	0.195
Male								
age	0.1661	0.2068	-0.0137	0.0260	0.1989	-0.0269	0.0437	0.0765
age \times age	-0.0007	-0.0012	0.0003	0.0000	-0.0009	0.0004	-0.0002	-0.0002
constant	-11.436	-9.545	-2.452	-4.363	-9.401	-2.397	-3.904	-4.609
LLR	0.169	0.196	0.012	0.025	0.304	0.013	0.030	0.152

for group 5 are much higher than for group 4, giving lower statistical fluctuations.

4.3 Mortality rate relativities for each of the eight disease groups

The mortality rate relativities shown in Table 4 are the fitted proportions of persons with the disease dying from the disease, relative to the overall mortality rate at that age. If prevalence rates are low, it may take a large adjustment to the base mortality to reproduce expected death numbers.

4.4 Prevalence parameters, allowing for education, partnership and employment

The coefficients in Table 5 were fitted in the same way as those in Table 3, except that allowance was made for three education statuses (less than year 12, year 12 and diploma, degree), two partnership statuses (not partnered and partnered), and two employment statuses (not employed and employed). As expected, the LLR values are all higher than in Table 3. Analyses were originally made with four employment statuses - not employed, managers and professionals, intermediate, operators and labourers. The coefficients estimated for the three occupational groups were all significantly negative relative to the not employed group, but there were few significant differences between the occupations, and no clear pattern of one occupational group having lower prevalences than either of the others.

Our logistic regressions detect association rather than causation. For example, the fitted coefficient for group 3 (disease of the nervous system) for partnership for females is -0.877. This does not show that

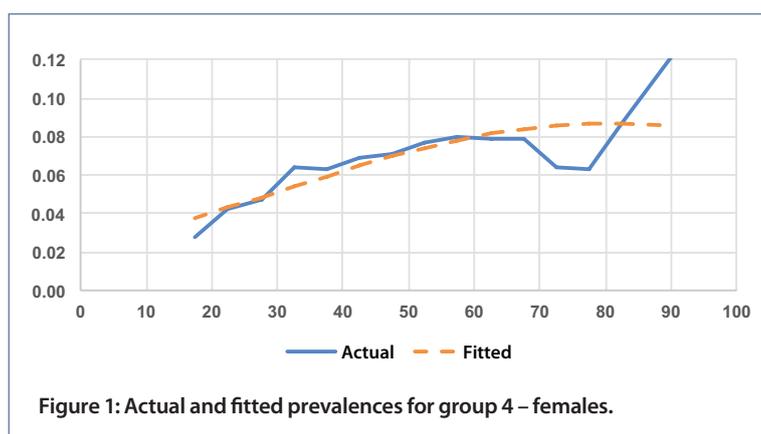


Figure 1: Actual and fitted prevalences for group 4 – females.

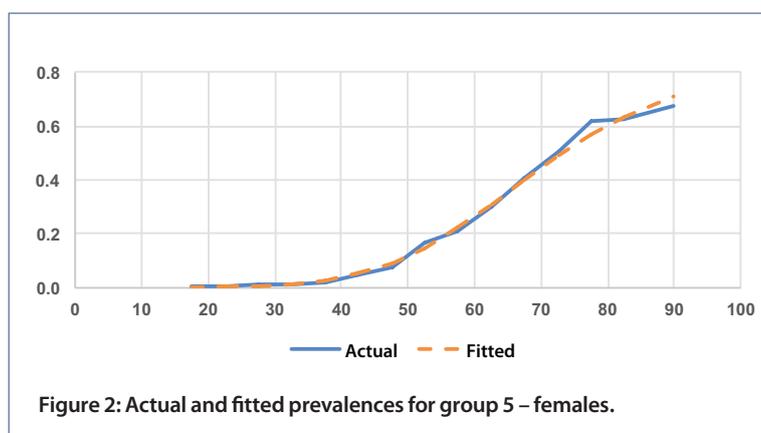


Figure 2: Actual and fitted prevalences for group 5 – females.

Table 4: Sample mortality rate relativities.

Sex/age	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Female								
0	31.3	47.6	0.0	1.8	252.2	0.4	8.4	54.0
20	41.3	4.6	0.1	1.8	14.7	0.4	27.1	1.7
40	53.5	0.5	0.2	0.6	2.3	0.5	4.8	0.7
60	29.1	0.2	0.1	0.5	0.5	0.6	0.5	0.2
80	5.2	0.1	0.3	0.7	0.5	0.7	0.2	0.1
100	0.7	0.1	0.4	0.5	0.6	0.6	0.2	0.1
Male								
0	150.5	171.1	0.0	2.9	206.4	0.3	3.7	75.8
20	64.8	2.8	0.1	1.9	9.6	0.2	16.5	1.0
40	47.5	0.6	0.2	0.9	2.8	0.5	4.5	0.8
60	25.4	0.2	0.1	0.5	0.7	0.7	0.5	0.2
80	4.0	0.1	0.3	0.5	0.5	0.8	0.2	0.1
100	0.7	0.1	0.3	0.2	0.6	0.5	0.2	0.1

Table 5: Multi-attribute prevalence coefficients.

Variable	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Female								
Age	0.1716	0.1700	0.0713	0.0643	0.1959	0.0312	0.0853	0.1027
age \times age	-0.0011	-0.0011	-0.0006	-0.0006	-0.0010	-0.0002	-0.0006	-0.0005
partner	-0.3458	-0.2307	-0.8766	-0.3487	-0.1479	-0.3185	-0.6523	-0.4904
year12	-0.1373	-0.2468	-0.4530	-0.2159	-0.1276	-0.2315	-0.2801	-0.2268
degree	-0.1265	-0.1578	-0.5769	-0.1030	-0.2769	-0.1912	-0.1455	-0.2855
employed	-0.4427	-0.6296	-0.9095	-0.4122	-0.4827	-0.4580	-0.5944	-0.6124
constant	-9.5601	-7.3316	-2.7425	-3.7906	-8.8417	-2.6775	-4.7246	-4.1949
LLR	0.095	0.175	0.080	0.018	0.319	0.019	0.071	0.215
Male								
Age	0.1405	0.2120	0.0893	0.0704	0.2088	0.0001	0.1013	0.1178
age \times age	-0.0007	-0.0013	-0.0008	-0.0005	-0.0011	0.0001	-0.0008	-0.0007
partner	0.2320	0.0601	-0.9145	-0.2345	-0.0250	-0.1002	-0.5493	-0.2120
year12	0.0481	-0.0350	-0.3483	-0.2186	-0.2214	-0.2809	-0.2525	-0.3143
degree	-0.3962	-0.1512	-0.6354	-0.1531	-0.3036	-0.2657	-0.5798	-0.4489
employed	-1.1673	-0.5387	-1.4549	-0.9477	-0.4968	-0.5130	-0.7475	-0.8001
constant	-9.5583	-9.0479	-3.0025	-4.3156	-8.9157	-2.3433	-4.0857	-4.4852
LLR	0.187	0.202	0.110	0.048	0.311	0.023	0.064	0.176

Table 6: Factors to balance disease prevalences.

Sex/age	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Female								
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	2.480	0.723	0.755	0.889	0.695	0.886	0.787	0.793
40	1.116	1.024	1.104	1.018	1.011	1.038	1.031	1.027
60	0.844	1.140	1.239	1.055	1.150	1.093	1.084	1.099
80	1.184	1.101	1.418	1.107	1.090	1.151	1.115	1.088
100	1.852	1.175	1.744	1.225	1.097	1.283	1.220	1.092
Male								
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	1.290	0.752	0.720	0.790	0.753	0.903	0.774	0.774
40	1.251	0.995	1.095	1.048	1.026	1.061	1.071	1.061
60	1.110	1.085	1.096	1.066	1.115	1.107	1.137	1.132
80	1.200	1.070	1.394	1.140	1.082	1.180	1.317	1.151
100	2.006	1.200	1.690	1.391	1.114	1.342	1.433	1.221

unpartnered females are more likely to have nervous diseases, or that females with nervous disease are less likely to become partnered. Rather, when allowance is made for age, education and employment, partnered females are much less likely to have nervous diseases.

The average coefficient for employment for females is -0.568, which after exponentiating suggests that employed females have disease prevalence rates 57% of those for not employed females. The employment effect is stronger for males, with an average coefficient of -0.833, suggesting employed males have disease prevalence rates 43% of those not employed.

The average coefficient for partnership is -0.426 for females and -0.218 for males. Surprisingly, females seem to gain a greater health advantage from partnership. The average coefficient for a degree is -0.233 for females, and -0.367 for males. Females seem to gain less health advantage from having a degree. Some of the partnership and education coefficients estimated for individual disease groups are not significant at the 5% level, making any general conclusions of dubious validity.

4.5 Balancing factors

Table 6 shows the factors needed to balance the disease prevalences generated from regression models in Table 3 with those from the multi-attribute models in Table 5. For each sex, the models in Table 5 are applied separately to each of the 12 combinations of partnership status, education and employment status. The ratios in

Table 6 are the prevalences expected from the models in Table 3, divided by the sums of the models in Table 5. The factors differ most from one at the youngest and oldest ages, where the model fits are likely to be least reliable. The balancing factors were applied to ensure that the deaths assumed in the life expectancy calculations exactly balanced with the deaths in Table 1 by sex, disease group and 5-year ages.

4.6 Life expectancy estimates

Table 7 shows two life expectancy estimates for each class of person. For example, a single female aged 60, with a degree and employed, is estimated to have a life expectancy of 26.8 years, assuming that disease prevalences after retirement are those for not employed persons. A second estimate for this person, of 27.3 years, was obtained by assuming that, for disease prevalence purposes, no change in employment status occurs after age 60. Changing the estimation basis has generally increased the life expectancy estimates for employed persons, and reduced the estimates for not employed persons. This is because assuming that persons employed at 60 retain their employment status for life results in fewer projected deaths for the employed, so that projected deaths for the unemployed at 60 have to be increased to keep the overall balance with expected deaths. In the first set of estimates, employment status makes relatively little difference, as population mortality rates are in general low until employment ceases.

Table 7: Life expectancy estimates in 2011, without mortality rate improvements.

Partner	Education	Employed	Age 20	Age 40	Age 60	Age 80	Age 100
Female							
No	Y11/Cert	Employed	64.6, 64.6	44.3, 44.3	25.3, 26.3	10.1, 10.0	2.9, 2.5
No	Y11/Cert	None	64.5, 64.5	43.9, 43.6	24.8, 23.5	9.1, 8.2	2.1, 1.7
No	Y12/Dip	Employed	65.0, 65.1	45.1, 45.1	26.3, 27.2	11.3, 10.7	3.3, 2.9
No	Y12/Dip	None	65.0, 65.0	44.8, 44.6	25.6, 24.3	9.7, 8.8	2.4, 2.0
No	Degree	Employed	65.1, 65.2	45.3, 45.4	26.8, 27.3	11.6, 10.8	3.4, 3.0
No	Degree	None	65.0, 65.1	45.0, 44.9	25.8, 24.4	9.8, 8.9	2.4, 2.1
Yes	Y11/Cert	Employed	64.7, 64.7	44.7, 44.7	26.0, 27.2	10.7, 10.7	3.2, 2.8
Yes	Y11/Cert	None	64.6, 64.6	44.5, 44.2	25.5, 24.3	9.7, 8.9	2.4, 2.0
Yes	Y12/Dip	Employed	65.1, 65.1	45.5, 45.5	27.0, 28.0	12.2, 11.5	3.6, 3.2
Yes	Y12/Dip	None	65.0, 65.1	45.2, 45.0	26.4, 25.1	10.4, 9.5	2.7, 2.3
Yes	Degree	Employed	65.2, 65.3	45.6, 45.7	27.4, 28.1	12.4, 11.6	3.8, 3.3
Yes	Degree	None	65.1, 65.2	45.4, 45.3	26.6, 25.2	10.6, 9.6	2.8, 2.4
Male							
No	Y11/Cert	Employed	60.2, 60.1	40.1, 40.0	22.4, 24.3	9.1, 8.8	3.1, 2.5
No	Y11/Cert	None	59.9, 59.8	39.2, 38.6	21.2, 18.8	7.4, 5.9	1.9, 1.4
No	Y12/Dip	Employed	61.6, 61.6	41.3, 41.3	23.3, 25.1	10.4, 9.5	3.6, 2.9
No	Y12/Dip	None	61.4, 61.4	40.6, 40.0	21.9, 19.4	7.9, 6.2	2.2, 1.6
No	Degree	Employed	62.3, 62.4	42.8, 42.8	24.7, 26.2	11.1, 10.2	3.9, 3.2
No	Degree	None	62.1, 62.2	42.2, 41.9	23.5, 20.9	8.7, 7.0	2.5, 1.8
Yes	Y11/Cert	Employed	60.3, 60.3	40.3, 40.4	22.4, 24.3	9.0, 9.0	3.3, 2.6
Yes	Y11/Cert	None	60.0, 60.0	39.6, 39.2	21.1, 18.6	7.5, 5.9	2.1, 1.5
Yes	Y12/Dip	Employed	61.7, 61.7	41.5, 41.6	23.2, 25.1	10.0, 9.6	3.7, 3.0
Yes	Y12/Dip	None	61.5, 61.5	40.9, 40.6	21.8, 19.2	7.9, 6.3	2.3, 1.7
Yes	Degree	Employed	62.4, 62.5	42.9, 43.1	24.7, 26.2	11.2, 10.3	4.0, 3.3
Yes	Degree	None	62.2, 62.3	42.5, 42.4	23.5, 20.8	8.9, 7.1	2.6, 2.0

5 DISCUSSION

5.1 Unexpectedly low variations in life expectancies

Variation by status - education, partnership and employment - were lower than we expected. We see two reasons why this could be so

- Differences in risk relativities indicate greatest differences at ages where mortality rates are low. For example, doubling all rates of mortality for males reduces the 2011 published life expectancy for age 0 from 80.6 to 72.5.
- Transition rates calculated provide higher

rates than we might expect. For example, data indicate that a non-partnered male age 40 would have a 29% chance of being partnered 5 years later, and might spend 41% of the remainder of his life partnered. These strong rates of change reduce the impact of current status on life expectancy.

5.2 Differences in mortality rates once a disease has been contracted

We have assumed that the chance of dying from a disease, once the disease has been contracted, is the same regardless of the person's education, partnership

or employment. Australia's lack of longitudinal data on health status makes it difficult to examine the validity of this assumption. It seems that likely that better educated persons with financial resources will have higher recovery rates from diseases. If so, the differences in life expectancies between categories of persons may be greater than in Table 7.

5.3 Changes in health after retirement

The SDAC data show occupation at the date of the survey, rather than any past occupation. Our initial life expectancy estimates thus assumed that the substantial health advantages associated with being employed (see Table 5) disappear immediately on retirement. As this seems unrealistic, we have made a second set of estimates assuming that for disease prevalence purposes there are no occupational changes after age 60. Mortality data from the Office for National Statistics (2013) and Wilson & Boyfield (2014) suggest that the truth is somewhere in between, with mortality differentials between occupational groups declining gradually after retirement.

5.4 Relative importance of partnership, education, employment and occupation

Table 5 shows that partnered persons, and those with degrees, have significantly lower prevalence rates for most disease groups. Being employed is associated with even larger health advantages. But when we replaced "employed" with three occupational groups we were not able to find any consistent or significant differences between the occupational groups. We were surprised by this, as life insurers have traditionally charged much higher temporary insurance rates to blue-collar workers. In part, this may be because education is capturing much of the difference between occupational groups. It may also be that changed industrial risks, and public health campaigns, have reduced the large traditional health differences between occupations.

5.5 Life expectancies of retired persons

Persons with larger than average superannuation balances may have larger than average life expectancies. Data may show that they have been employed for longer, and are more likely to be educated and partnered. Financial planning before and during retirement should take into account potentially long life expectancies. Government policy about superannuation should also be evidence-based. Data on the life expectancies of retired persons could be obtained through the Australian Taxation Office's supervision of self-managed superannuation.

5.6 Value of new data sources

We have relied heavily on SDAC 2012, which was doubled in size as part of the "Living longer living better" government initiative of 2012. We have also used the Australian Census Longitudinal Dataset, a linked comparison of 5% of Australia's population in 2006 and 2011, which became available in 2013. Actuaries may be able to learn from the new big data sets becoming available, such as that in the National Aged Care Data Clearinghouse (Australian Institute of Health and Welfare 2015).

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Acknowledgements

This work has been partly funded by a one-year grant from the Institute of Actuaries of Australia. Although the Australian Institute of Health and Welfare and the Australian Bureau of Statistics provided data, the views expressed are those of the authors.

Views of educators on the education system

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ABSTRACT

In this paper we review the strengths and weaknesses of the current actuarial education system, from the perspective of educators in Australian universities. Thirteen interviews were conducted with actuarial university teaching staff, providing a complement to recent studies which focus on the perspectives of students.

Overall, interviewees consider that the current education system is reasonably effective and robust, with the three part qualification structure involving elements of what might be considered an “ideal” education system. This includes accounting for the characteristics and development of students over time; having general alignment (in parts I and II) between the syllabus and assessments; and developing both technical and generic skills, to some degree.

However, there are also various issues to address. This includes insufficient development of generic skills in earlier stages; large variations in the learning experience for students who have different levels of background knowledge and work experience; and some restriction in educational innovation due to the need for adherence to syllabus requirements.

Perhaps a key tension is between a desire for education to adapt in line with evolving technology and practice, and a desire to emphasise rigour and depth of fundamental, underlying principles. Various educators, however, consider that an education approach that is open to innovation and flexibility could have benefits to both sides of that apparent divide.

KEYWORDS

actuarial education, academic views, qualification process

INTRODUCTION

Actuaries have been described as “people who evaluate risk and opportunity”¹ and “business professionals who measure and manage the financial implications of future events”.² Core to the profession is an understanding of the time value of money; dealing with contingent risks and broader aspects (for example, the impact of selection) of probabilistic events; knowing the detail of a particular context (such as insurance) in some depth; and being able to apply all these aspects to develop effective solutions to a variety of problems. Key to this ability is education, in particular, the education provided within the qualification process. Indeed, as Daykin (2005) states, “actuarial education is at the heart of the profession. It is an essential requirement for a profession that it maintains the level and quality of knowledge of its members.”

A major driver of the quality of this education is the core syllabus of the International Actuarial Association (IAA). The IAA, representing approximately 63,000 actuaries from more than 110 countries (Campbell 2016), has the following mission statement (IAA 2013):

“To represent the actuarial profession and promote its role, reputation, and recognition in the international domain; and to promote professionalism, developing education standards and encourage research, with the active involvement of its Member Associations and Sections, to address changing needs.”

A purpose of the core syllabus is to help maintain a “certain minimum level of educational requirement in admitting individuals as fully qualified actuaries” (Daykin 2005). Each member organisation of the IAA is required to ensure that the contents of their own education system align with the professional requirements embedded within the IAA core syllabus. The core syllabus now covers 10 areas of professional requirements, comprising foundation mathematics, statistics, economics, finance, financial systems, models, data and systems, assets, risk management, and personal and professional practice (Syllabus Review

Taskforce 2015), with further reviews being completed recently (Gladwin et al 2016).

The Actuaries Institute is a member organisation of the IAA and is responsible for the education and professional development of actuaries in Australia. In this paper we consider the relative strengths and weaknesses of the Australian pathway to qualification as an actuary, through the eyes of actuarial academic faculty. Their perceptions and insights are drawn from interviews, which we describe in the following sections. We begin, however, by outlining the overall Australian qualification system, as well as discussing what some consider to be key features of an “ideal” education system.

1 THE AUSTRALIAN SYSTEM OF ACTUARIAL EDUCATION

The Actuaries Institute is the professional body for actuaries in Australia, and it offers two main designations – Fellowship and Associateship. Some points of difference are that a Fellow has a role of legal standing and can sign key documents as an appointed actuary, and a Fellow can stand for and vote in elections of the Council of the Institute. Both qualifications require the completion of the first two parts of a three-part, formal, exam-based education program. An Associate does not need to complete Part III of the program, but does need to meet a three-year practical experience requirement, while for a Fellow, no working experience is explicitly required, but completion of Part III is necessary. Attendance at a short professionalism course and ongoing continuing professional development (CPD) requirements round out the formal education requirements.³

Part I of the formal education program consists of eight core technical (CT) subjects, matching the first eight CT subjects of the (UK) Institute and Faculty of Actuaries (IFoA). Part I is designed to provide students a base of technical knowledge for actuarial work, and it addresses most of the components of the IAA core syllabus – the exceptions being risk management, and personal and professional practice. Students in Australia can complete Part I either through relevant courses at an accredited university,⁴ or by completing examinations provided by the IFoA.

1 Cited from the Actuaries Institute website: <https://www.actuaries.asn.au/becoming-an-actuary>.

2 Cited from the Society of Actuaries: <https://www.soa.org/Actuarial-Profession/Actuary/risk-professional.aspx>.

3 Although CPD and ongoing education post-fellowship is clearly critical to professional capability, this paper focuses on what University faculty are mostly responsible for and closely observe over time – the pre-fellowship qualification process.

4 University-based actuarial education was first introduced at Macquarie University in 1968, and six other universities are now accredited (Australian National University, Bond University, Curtin University, Monash University, the University of Melbourne, and the University of New South Wales). There are slight differences across universities in the required grade(s) for the granting of exemptions from the CT subjects, but the Institute ensures (through checking course outlines, exams and script books in relevant subjects) that there is consistency in terms of meeting Part I (and II) syllabus requirements.

Part II education includes the Actuarial Control Cycle (Part IIA) and Investment and Asset Modelling (Part IIB), with a focus on the principles of actuarial management and the professionalism aspects of the IAA core syllabus.⁵ The only pathway to get exemptions for Part II is completing suitable courses offered through accredited universities, which themselves need to work with the Actuaries Institute and engage with the profession through, for example, the use of guest speakers from industry and having external peer review of exams and exemption standards.

Part III education requires four modules to be passed, with courses mainly offered by the Actuaries Institute through education volunteers.⁶ Candidates are required to focus on a specialty, being life insurance, general insurance, investment management and finance, or global retirement income systems. Formal exam-based education culminates with the module four course “Commercial Actuarial Practice”, which involves an eight-hour, case-study exam.

The Actuaries Institute has made two notable and distinctive contributions to actuarial education at a worldwide level. Firstly, it was the first to implement formal actuarial education through university study that leads to professional exemptions (Daykin 2005). Secondly, the development of the Part II Actuarial Control Cycle had a significant impact on the IAA core syllabus, such that it was incorporated as “principles of actuarial management”, thereby influencing the education system of all other members of the IAA.

The survey of actuarial students by Butt et al (2016) achieved interesting insights on the overall Australian actuarial education system. In terms of Part I, the syllabus content and structure, quality of teaching, material and assessment were rated reasonably strongly. However, weaknesses included insufficient feedback to individual students, an absence of real-world context, and insufficient development in computing and non-technical skills.⁷ For Part II, although a weakness was again a lack of feedback, students appreciated the contextualisation provided in Part II, as well as the development of soft skills, especially in communication. This is partially due to a focus on open-ended questions and requirements to discuss and demonstrate thinking about a problem. In part III, a lack of feedback was again a weakness, as was the nature of assessment. Similarly to Part II however, the enhancement of soft skills was seen more positively.

2 ELEMENTS OF AN IDEAL EDUCATION SYSTEM

There are various aspects to what might be considered an “ideal” education system (both general, and professionally oriented), and we highlight three aspects that arise from the insights of educators and commentators such as Biggs (1999), Shepherd (2005, 2010) and Ramsden (1992):

1. Accounting for student characteristics and development
2. Clear goals with constructive alignment of assessments
3. Promotion and development of generic skills as well as technical knowledge

We discuss each of these in turn.

2.1 Accounting for student characteristics and development

Actuarial students usually arrive at university already in possession of a strong background in mathematics and statistics. They acquire this knowledge either from their high school education or their university education from a prior degree. At this initial stage of their education, students tend to believe there are right and wrong answers and that the lecturer knows the correct answer (Shepherd 2010). In forming his view, Shepherd (2010) referred to Perry’s (1970) nine stages in the development of knowledge, thinking and learning. It is suggested that the undergraduate phase is a good time for students to develop their foundation knowledge and to master approaches to get accurate answers, but that as time moves on, students need to develop skills to address open-ended questions. This change is due to the practical realism of professional requirements, as well as the increase in students’ capabilities themselves. Therefore, at later stages of educational development, students should be encouraged to clearly and precisely express their opinion through oral and written communication, be prepared to make judgements and also be open to reconsideration of their views (Perry 1970).

The learning behaviour of students is also of critical importance when considering the formation of an education system. In general, there are at least two approaches to learning that students can adopt: a “deep” approach or a “surface” approach. According to Ramsden (1992), a surface approach involves

5 Parts I and II together meet the academic requirements of the actuary designation according to the IAA.

6 Some options for module 1 sit outside the direct offering of the Actuaries Institute, such as university study in Enterprise Risk Management at the Australian National University or the University of New South Wales; an ERM exam directly with the IFoA; through the attainment of a PhD, CFA, or chartered accountant designations; or through sitting specialist health insurance exams with the Actuarial Society of South Africa or the IFoA.

7 In the survey, non-technical skills refer to communication skills, leadership, problem solving, professionalism, ethics, strategic foresight and teamwork.

memorisation and recollection of knowledge rather than an attempt to understand concepts. On the other hand, students adopting a deep approach focus effort on the understanding of concepts. Students can of course interchange between the two approaches, which can typically occur in response to the pressure of assessments. For example, students who use the deep learning style at the beginning of their studies could switch from deep to surface learning in order to meet the demands of different assignments and tests building up over time, which arguably is a move from “quality” learning to focussing on achieving “quantity” (Shepherd 2010). Ramsden (1992) also found that students’ behaviours are significantly affected by assessments, where for example students study for an exam by reviewing past exam papers instead of really trying to understand the key learning outcomes listed on the syllabus and demonstrated during lectures. Many actuarial students will be very familiar with this approach and it may be many adopt a view of assessments analogous to statistical forecasting – using historical data to forecast future events.

2.2 Clear goals with constructive alignment of assessments

A syllabus is critical to good education (Daykin 2005). It should serve as a key directive, driving all learning activities and assessments of a course. This is the reason why during education reviews, the structure of a syllabus attracts much attention (Shepherd 2005). However, from a student’s point of view, assessment rather than syllabus is where efforts are made and incentives are aligned with their own. As Ramsden (1992) states: “from our students’ point of view, assessment always defines the actual curriculum”. This leads to what Biggs (1999) calls the “backwash” effect, arising from the students’ desire to obtain a high grade. This is why “assessment” rather than “syllabus” is more relevant to students, as it best aligns with their interest.

Therefore, Biggs (1999) recommends a manipulation of this “backwash” effect to encourage students to adopt a deep learning approach, and to focus on knowledge and concepts outlined in the syllabus. Such manipulation can arise through the way exam questions are set. For example, Shepherd (2010) categorises exam questions into three types: (1) standard or familiar; (2) slightly different; (3) significantly different. With (1), students can answer them according to learned approaches and formulae, but real-world problems tend to be slightly or significantly different from what has been experienced before. Therefore, it would be beneficial to move assessment questions from type (1) to types (2) and (3).

Moreover, Shepherd (2005) highlights differences between two types of assessments – formative and

summative. Summative assessment tasks are used to grade a student’s quality of learning of things they have been told, whereas formative assessment can provide students a chance to learn from their mistakes and discover gaps in their knowledge. Shepherd (2005) also highlights that insightful and timely feedback is of key importance with formative assessment, and that, ideally, this could be provided regularly and on an individual basis. However, the practical reality of large class sizes is that this may be hard to achieve.

2.3 Promotion and development of generic skills as well as technical knowledge

As well as technical knowledge, the development of generic skills is also important. Gribble (2003) points out that a good actuary has characteristics and capacities such as technical expertise, skills in rigorous analysis, excellent communication skills and negotiation skills, as well as integrity and interpersonal skills. In regards to generic skills, Butt et al (2014) point out that:

“A common thread is the tension between (some) employers who feel that graduates should come with mastery of all the generic skills required in the workplace, so that the employer need not spend any time on further training, and (some) academics who feel there is not enough solid theory in how these skills can be developed to warrant their inclusion in a university course.”

However, generic skills do not need to be developed alone; they could be developed within the integration of assessment tasks in core discipline subjects (Shepherd 2010; Butt et al 2016). For example, Shepherd (2005) suggests that asking students to explain numeric answers can enhance their understanding of the concepts and at the same time, develop their written communication skills. Nonetheless, this does not imply that mutual benefit exists in every stage of students’ learning. Shepherd (2010) also points out that “students in the early stages of their studies are not yet ready to develop and demonstrate the capabilities of a mature practitioner”. As such, Shepherd (2010) suggests that “pre-capability” development of such generic skills can occur first, such as through performing reasonableness checks on numeric results, learning useful rules of thumb, understanding implicit assumptions within theories and formulae, critically evaluating the appropriateness of assumptions made by others and documenting technical work. In doing so, students may slowly switch their mindset from a basis of numeric and right-and-wrong-answers, to a basis of discussion and explanation.

Once generic and professional skills are more developed, this may be a time to introduce approaches such as problem-based learning (PBL) in more depth. A traditional study pyramid has three levels: the basic/fundamental knowledge, applied knowledge, and specialised/professional knowledge. However, PBL “turns the traditional pyramidal structure upside down” (Shepherd 2005) with students having to do a significant amount of research and self-directed learning to pass. “Problems are the curriculum”, according to Shepherd (2010). A PBL approach is dominant in health-related areas, and is also found in engineering, earth sciences, management and environmental sciences (Shepherd 2010). With PBL, students not only acquire fundamental knowledge, but also develop their skills in research, problem-solving, communication, documentation, reporting and self-management. This is why both Shepherd (2005, 2010) and Biggs (1999) recommend the PBL teaching style, with Shepherd (2010) suggesting that, given the development of generic capabilities over time, a PBL strategy could be adopted more at the later stage of Part I of actuarial education, such as the final year of an undergraduate degree.

3 DATA AND METHODOLOGY

Recent research from the student perspective has been conducted by Butt et al (2014, 2016). Hence, as a complementary approach, this paper reviews the education system from the perspective of Australian actuarial educators. Various approaches could be adopted to ascertain such perspectives, such as the use of surveys or focus groups. However, issues of practicality and convenience led us to adopt an approach based on individual interviews as this allows a convenient way to explore the “descriptions and interpretation of others” (Stake 1995), and it allows flexibility in discussions as well as assisting the relevance of responses to the topic (Ospina 2004).

Three relevant issues exist with a research approach based on interviews. This first of these concerns the inherent biases of the interviewer, as questions asked can influence the derived results and insights (Mathers et al 2002). To mitigate this risk, interviews were conducted on a semi-structured basis with open-ended questions, so that interviewees had some discretion to choose the topics they wanted to discuss (Ospina 2004; Mathers et al 2002). The structured part of the interview consisted of general questions about views on the strengths and weaknesses of the current actuarial education system, with this openness giving opportunity for interviewees to respond and focus on those aspects that were of most interest and importance to them. Then, interviewees were asked about specific

aspects, such as issues of practicality within the current system, and the consistency between syllabus and assessments. The goal was to give interviewees enough freedom to express their comments on the overall system, and spend more time discussing issues that they had really thought about, in more detail.

A second issue concerns the potential misinterpretation of interviewee comments, by the interviewer, who unavoidably brings a subjective interpretation to any judgement (Marshall & Rossman 2010). To help mitigate this, interviews were recorded, and a written summary of the interview was sent back to each interviewee for their records and for the opportunity to clarify any misinterpretations.

A third issue is the actual tool of analysis used to understand and present insights from interviews. We follow the practice of others in the field of qualitative research by presenting raw data, such as quotations, as one mechanism to give some assurance that what we report is consistent with what has been said in interviews (see, for example, Shank 2002). We also use some descriptive statistics to indicate the number of interviewees holding similar opinions, based on the researcher’s interpretation. Although the overall analysis unavoidably relies on the subjectivity and insight of the researcher, the presentation of direct quotes give readers a chance to validate the researcher’s interpretation(s) for themselves (Eisenhardt & Graebner 2007).

Human ethics approval for conducting interviews was obtained from the Australian National University in June 2016. We then sent interview invitations to 30 lecturers and professors listed as currently teaching actuarial studies at Australian universities. Of the thirty, 25 were Fellows of the Actuaries Institute. Table 1 provides the location of the invited educators.

Table 1: Number of invited educators from each university.

University	Number of invited interviewees
Australian National University	8
Bond University	3
Curtin University	3
Macquarie University	6
Monash University	2
University of Melbourne	5
University of New South Wales	3

Of the thirty invitees, thirteen agreed to participate. Five agreed to a face-to-face interview, seven agreed to a phone interview, and one agreed to do a written interview. The twelve non-written interviews ranged from forty-five minutes to one hour each.

4 RESULTS

4.1 Overall attitudes to the three-part structure

Most interviewees were generally in favour of the three-part structure of the Australian system, given the need to develop technical skills, industry knowledge, contextual appreciation of problems and practical applications involving significant judgement. These skills are not necessarily discrete, although there was an acknowledgement that all skills and attributes were very hard to develop concurrently. Nonetheless, three interviewees highlighted a lack of connection between each part, which can lead to unfortunate student perceptions that knowledge gained in earlier parts is not needed later on.

The major issues that came to the fore in interviews, in respect of the three-part structure of actuarial education, are summarised in Table 2.

Table 2: Major issues arising from discussion of three-part structure.

Education structure	Issue
Part I	Breadth versus depth of syllabus coverage
	Role of introducing more modern techniques
	Soft skills development and application of knowledge in practice
	Requirement for adherence to syllabus
Part II	Role of contextualisation in student development
	Role of student's background in learning outcomes
	Bridging aspects
Part III	Reliance on a volunteer system
	Role of universities

Unsurprisingly, options differed on the strengths and weaknesses of various parts of the education system, in respect of the above issues. We discuss each above issue in turn.

4.2 Part I education

In this section we discuss four main issues raised by interviewees concerning Part I: breadth versus depth of syllabus coverage, the introduction of modern techniques, the development of soft skills and application of knowledge, and implications of adherence to UK IFoA syllabus requirements.

4.2.1 Breadth versus depth of syllabus coverage

All thirteen interviewees pointed out that a strength of Part I is the coverage of a broad range of materials, which provides a technical foundation for future studies. A typical view expressed was:

“The strength of Part I is breadth. Even if people do not know where they will end up, they can have more opportunities with the wide range of materials covered.”

However, due to this high volume of coverage, and the limited amount of time, some argued that important topics are not taught/ learnt deeply enough. An exemplar of such views is that:

“[There are] too many materials covered and students don't have time for deep learning. For example, students ... do simulations without considering the assumption of dependence; they don't understand the application of marginal cost and marginal revenue ... Students have some understanding of theories and concepts, but they haven't understood them deep enough.”

Two interviewees argued that instead of having a broad coverage of materials, it might be better to cover fewer materials, and thus allow students to develop a deeper knowledge of some more widely applicable topics. Materials that were suggested for removal from Part I were those that are specific to particular industries, for example, part of life contingencies (CT5). Additional comments included:

“Some ... content [of CT8] should be in Part III instead of either Part I or Part II ... We need to keep it open and teach the core set of skills that are flexible and adaptable.”

“There are some materials that are too specialised ... these materials should be just moved to Part III. A lot of other areas, such as statistical and data analytics should instead have more emphasis in Part I education. Especially generalised linear modelling should have more emphasis than the current level.”

Some argued that since Part I builds technical knowledge prior to students gaining knowledge of the industry context (Part II) and judgement-laden specialisation (Part III), educators should focus on enabling subjects, such as statistics, finance and economics that act as a base for other things. However, one interviewee believed there is a danger in doing this:

“Knowing data analytics only does not make a student an actuary. Data analytics is something that actuarial graduates can go into. But it is not a unique characteristic for actuaries. On the other hand, life contingencies is unique to actuarial studies. Therefore, for actuarial Part I education, we must put the emphasis on the knowledge that builds the foundation for their actuarial career.”

4.2.2 Introduction of modern techniques

Nine interviewees shared their views on the possibility of capturing more modern techniques, with five highlighting that it would be good to keep the material more up to date. A typical comment is:

“We cannot teach students everything to prepare for their future ... the syllabus has not addressed enough the technology and techniques that we use more often nowadays ... we could teach them in a more updated way. For example, for life contingencies, we don't use the commutation function now, because we could use a computer to do the calculation. But this does not mean the idea behind it is outdated.”

Others commented on a desire to include more programming skills within Part I.

Interestingly, another three interviewees argued that greater change could be introduced, replacing traditional approaches and even some theories with more relevant modern techniques:

“The syllabus has been updated in regards to capturing more modern concepts and theories with abandoning some traditional methods that are seldom used nowadays. This would not lead to a massive problem because students can always learn on their own when they are working (if that is needed).”

“There are some materials that should not be in it anymore. Such as some aspects of ruin theory that is based on parametric approach. But nowadays, there are more and more simulation techniques that we can use. Some life contingencies joint life functions [are the same] as well. There is not enough focus on modern statistical techniques.”

However, interviewees were generally of the view that a strong theoretical base is needed, no matter how advanced technology is, because this provides a basis for developing further skills and techniques. One interviewer argued that traditional techniques and theories should never be abandoned, with technology developments providing an aid for practical use and knowledge but not a substitute for deeper understanding of the underlying concept. It is apparent that conflict exists between these views, and the need to prepare students for their future work by introducing more modern techniques.

4.2.3 Soft skills development and application of knowledge in practice

A shortfall in Part I raised by two interviewees was that it provides insufficient opportunity for development of soft skills, and five interviewees pointed out that Part I does not provide enough application to real-world problems. Four of these five interviewees believe this is a concern, typically because students could learn better when the context is part of the material and learning approach. However, the fifth interviewee did not consider this a major problem, because of the existence of Part II:

“Just a three-year undergraduate education will miss some practical skills. This can be complemented by Part II where students are taught the context of the industry. You don't need to finish your degree with knowing everything about the industry. [It provides a] sound foundation on the main industry that actuaries work in, and then they have the ability to build up the industry knowledge when they start working.”

4.2.4 Strict syllabus alignment requirement

An issue highlighted by most interviewees relates to the requirement to meet 85% of the IFoA's syllabus in part I.⁸ This can restrict the implementation of many innovations, even where they are believed to improve the learning experience:

"If we introduce more business related material in class, but syllabus does not have this requirement and educators do not do assessment on that, then students will simply not pay much attention to those business related materials."

"Universities should have more flexibility to decide what is included and what is not. Educators believe universities will have more discretion to specialise and the education outcome would be better if 85% was reduced to a lower level, e.g. 60%."

"We focus too much on exemptions. We adapt the syllabus to maintain the accreditation ... we don't have space to teach what we believe are needed, for example, programming skills. Final exams are all about theories and calculation. But in real life, it is all about solving problems. We can't test this until [later applied courses]."

4.3 Part II education

In this section we discuss three main issues raised by interviewees concerning Part II: the role of contextualisation in student development, the significance of student background upon learning outcomes, and aspects of bridging between part I and part II.

4.3.1 Role of contextualisation in student development

All interviewees pointed out that a strength of Part II is its provision of contextualisation in a broad range of areas, and the exposure of students to more real-world situations and scenarios. These claims were based on the contents of the syllabus itself, the liberal use of examples and case studies in teaching, the use of guest lecturers from industry and the additional criteria for credentials of lecturers at this level of teaching:

"The diversity of content allows students to pick an area they are interested to specialise in, in the future."

"It provides a variety of practical examples for different areas of the industry, including those non-traditional ones. It gives students practical experience as well as traditional lecturing. They also have guest lecturers come and talk to students with specific industry knowledge."

"Part II helps students to use technical skills that they have learnt, to solve simplified real-world questions. The valuable point for Part II education is that it is required to be taught by Fellows with industry experience."

"It provides the contextualisation of the industry to students. Students are asked to explain things in the real world and write a report and they need to deal with imperfections in the real world. This is the core for actuarial education"

4.3.2 Students' background affects learning outcomes significantly

Six interviewees argued that, because each student absorbs knowledge differently, a student's learning outcomes depend on their work experience, their communication skills and their readiness for solving open-ended real-life problems. Below are comments provided by some interviewees who are currently teaching Part II or who have taught Part II before:

"Students with better first-hand knowledge and better motivation get most out of the education while students who do not understand too much of the context struggle to learn ... work experience facilitates learning, but this is what students who come out straight from undergraduate [studies] do not have."

"Students hate Part II. This may be due to the cultural shock to go from very technical material, having right and wrong answers, to discussion based material which does not have certain answers."

8 In order for the Actuaries Institute to grant exemptions from the equivalent IFoA CT subjects, through university study, 85% of the relevant CT syllabus must be covered and assessed in those university courses that count towards exemption of that CT subject. This "coverage" has generally been taken to mean that 85% of key learning outcomes that are stated in the CT course syllabi, are also key learning outcomes of the relevant university subjects. There is flexibility as to what 85% is chosen by each university, with no established agreement as to consistent coverage between universities, but rather, each university has to demonstrate to the Actuaries Institute that each CT subject is adequately covered as part of regular accreditation reviews.

In light of this, and in the vein of eroding one's own vocational demand, one interviewee even commented that if it was up to them, "I will not accept students to do [all of] Part II ... until they have work experience".

Interestingly, one interviewee commented that Part II is not technical enough:

"Part II assignments go quickly to the other direction from technical. [Assignments] are generally quite simple in Excel. It would be good to continue introducing or reviewing technical knowledge that students learn in Part I."

This insight supports the earlier view that the differences between parts I, II and III lead to significant challenges for students in that technical skills, qualitative skills and judgement skills are viewed as distinct rather than integrated parts of a cohesive toolkit.

4.3.3 Bridging aspects

Another point raised was the possibility of a bridging component from Part I to Part II. Given that a lack of application and soft skill development are a perceived shortfall of Part I, and Part II requires students to have greater industry knowledge, then this suggests that greater connection between Part I and Part II could remedy the problem. Ten interviewees shared their opinions on this issue. Six believed having a bridging element would be useful because communication skills take time build and also, for students who don't continue their actuarial studies after Part I, they would still have some important industry insights:

"It would be better to have more communication skills development in the early stage, i.e. Part I ... those soft skills cannot be developed in a short time and hence they should not be only developed during Part II. If students start practising those soft skills in Part I, they can learn more and better in Part II. This is why students who have law backgrounds find Part II really easy."

"Exams in Part I should test the contextualisation as well. Just something like 'why do you think you need to use this formula and are there any assumptions underlying this concept' etc."

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"Some of the Part II material should move to Part I so that students can get more exposure to the contextualisation during their undergraduate study. Therefore, even if students don't go into doing Part II in the future, they still have some insight to at least what it is and how it is used ... students may have good technical skills and get high grades in Part I, but they fall over in Part II because they don't get used to communicating and writing reports and forming critical analysis. Thus, teaching some soft skills in Part I and providing some context and case study-based questions would make this transition better."

Another two interviewees held a middle position, saying it would be useful to bring some practical examples to Part I to facilitate students' learning. However, the focus should still be on technical knowledge development, because this could ensure that students have mastered the fundamental knowledge, before confusing them even further with industry knowledge:

"Part I is not business orientated enough. But rather than bringing some Part II contents into Part I, we should teach Part I in a slightly different way, i.e. we bring more practical examples into Part I education. We can also teach more software application in Part I."

Two interviewees did not support such bridging, with one commenting that the purpose of Part II is to bridge Parts I and III, and that if some skills, such as communication and language, are lacking, then there is personal responsibility to improve this aspect. It is also important to note that even though many educators support some element of bridging between Part I and Part II, options for doing so are limited, given the issue of aligning to 85% of the IFoA syllabus in Part I.

4.4 Part III education

In this section we discuss two main issues raised by interviewees concerning Part III: the volunteer system, and the role of universities.

4.4.1 The volunteer system

Part III education raises different issues to Parts I and II because of its volunteer system in delivering education to candidates, leading to the issue that "teaching" and

other learning assistance is very limited. Moreover, eight interviewees also commented that there is a lack of alignment between course material and the examination, because the two components are prepared by different people. Some interviewees were quite critical in this respect:

“Materials are delivered to students in a confusing way ... so many different people involved in the Part III curriculum due to the volunteers ... [this generates] a lack of consistency in the course. The exam may be written by a person that may not have involvement in other parts of the course. This leads to a lack of alignment between the exam and the materials.”

One of these eight interviewees further argued that those volunteers are often not appropriately skilled or credentialed for such education roles, despite the relevant industry experience. However, it is also worthwhile to acknowledge that the Actuaries Institute has a detailed process in place for setting and running Part III exams, to help mitigate the issue of some volunteers not necessarily having experience in teaching or delivering formal education. The review of any exam involves contributions from a course leader or exam writer, an exam scrutineer, a chief examiner and assistant examiners, all of whom have different, explicitly defined roles in the process.

4.4.2 Role of universities

In terms of alternatives to the volunteer system, the involvement of universities in Part III education was discussed in interviews. Of eleven interviewees who commented, three supported greater university involvement; five did not; and three were undecided. One of the interviewees in favour of university participation in Part III provided an interesting argument:

“University can also provide the practical teaching that is suitable for Part III education ... Universities should teach Part III because they are the places for professional education (just like medicine, law, architecture, engineering, and accounting) ... [once] involved, they will develop Part III teaching theories that can align with goals of Part III education. In another words, universities can be practical as well.”

The other two interviewees supporting greater university involvement understood concerns around outsourcing Part III exams to external academic institutions. However, they also suggested that this is not a problem as long as the Institute supervises the education process in a similar manner to what is done already:

“It is good that the Institute appoints an experienced senior actuary in the field to oversee the exams and the marking of the exams and awarding of exemptions, just like [they] do in Part II and ERM. As long as the quality of students getting the exemptions is not compromised by university education ... it should be fine.”

Although the three undecided interviewees agreed that there would be benefits from university involvement, they were in doubt as to the effectiveness of full implementation of Part III with universities. For the five interviewees who disagreed with greater university involvement in Part III, the major concern related to the challenge for universities to deliver professionally oriented education. An exemplar of such views is that:

“Universities usually lack the industry knowledge ... In reality, universities even struggle to find people with 5 years of experience. It is very hard to get people with lots of industry experience [to work] full-time in the university.”

Interestingly, interviewees did not really pick up on one possible middle ground for delivering Part III education – that of logistically outsourcing the teaching, materials and exams of Part III to universities, but with assigned industry representatives to oversee and be involved in the process.

Other comments on Part III education included a desire for more specialised study to broaden the profession, such as in health and data analytics. No interviewee strongly objected to this.

5 DISCUSSION

In this section we more explicitly compare the previously discussed “ideal” education system with the major issues in the current system as highlighted in interviews. Elements of an ideal education system included accounting for student development and characteristics; having clear goals with constructive alignment of assessment; and ensuring development of technical and generic skills. We suggest that these main elements are reflected in the Australian qualification process, to some degree. But, as always, room for improvement remains.

5.1 Understanding of student development and characteristics

Arguably, the current education system is consistent with the first component of an ideal education system. Shepherd (2010) pointed out that students at early stages of actuarial education tend to believe there are only right-and-wrong answers, hence there is value in developing technical knowledge at this stage. This is a strength of Part I education, agreed by all interviewees. As students mature, they learn to develop an argument based on judgement through oral and written communication (Perry 1970). This is why Part II then provides contextualisation and prepares students for Part III education, where they specialise and solve real-life problems. Having explicit reference to personal and professional practice in the IAA and Australian Part II syllabus aligns with the general trend of student development over time. One interviewee highlighted their appreciation of this development process:

“Problem based learning style [if used] has to be in later years. Students need to build up fundamental knowledge before they are able to solve the problem on their own. So, not for Part I, but has potential for Part II and Part III.”

However, the timing of when students are capable of dealing with practical problems is unclear, leading to the diversity in opinion of when to explicitly start developing soft skills, and whether and when to bridge Part I with Part II. An earlier start to bridge Part I and Part II assists with the provision of basic industry knowledge, which otherwise is omitted until Part II.

5.1.1 Work experience

As seen earlier, having some level of work experience is valuable for actuarial students, particularly after Part I study. Moreover, some interviewees argued that

it would be inefficient and ineffective for universities to mimic the workplace for the sole purpose of substituting for this inexperience:

“The university’s perspective is the formation of learning rather than simulating all that work experience. If we take this further within a university (other than small case study etc.) it would be time-consuming and hard to be consistent with the syllabus.”

“It is hard for universities to provide similar experience to students as if they are in a true work environment ... university students perform with little connection to the real world and it is really hard for them to put themselves as if they are in the work environment because they don’t have such experience.”

Although it may not be efficient for universities to bring features equivalent to work experience and practicality into courses, some interviewees argued that universities should still have things in place to provide practical insights. There are a variety of mechanisms to assist this:

“It is really hard to introduce enough practicality with only three courses in Part II. But this could be the complement for the issue of lack of working experience of students. This is the reason why there is certain requirement for the experience of educators of Part II (in order to bring the practicality).”

“Universities should bring more practical examples [so] that students can get a handle on real-life questions. This could be achieved by guest lectures, work experience, case studies, etc. The current level of university education is not practical enough. Employers really look at students’ ability to apply knowledge they have learned to solve problems... so, again, communication skills, software application, and general awareness of what is happening in the real world need to be developed earlier in the university education.”

5.1.2 Surface versus deep approach

Educators are aware that students can use either learning approach, and that they may switch from deep to surface learning when assessment pressure builds up (Shepherd 2010). The comments below demonstrate various views regarding this issue:

“To make sure students learn ‘deep’, we need to [give] them more time to learn ... [and] make exams more challenging.”

“Hard to avoid this. People learn things that are important to them. And they learn it through repeatedly practising. Even though students may do the past exam paper again and again, they may still learn something out of it.”

“If I set simple questions, then students may think this is an easy-passing course and they would just learn the pattern from past exams and not actually try to learn the contents ... If the lecturer wants to avoid this, then they could (set) exams that if students rote learn, they will not pass ... if students want to pass the course, they must study hard to master the materials ... the continuing assessment would be better than one mid-term and one final exam. This would stop students from cramming for exams.”

The last comment highlights the use of the “backwash” effect (Biggs 1999), pushing students to study harder with the things they are incentivised for, that is, grades and exemptions.

5.2 Clear goals and alignment with assessments and teaching

Another component of the ideal education system is a clear set of learning outcomes, supported by aligned assessments and teaching. As commented by one interviewee, consistency of the syllabus with assessments and teaching materials is likely, given regular reviews that occur:

“There are internal and external reviews of assessments of actuarial education. It is part of the accreditation process. So, [any] inconsistency [between the syllabus requirement and the actual education process and materials] should not persist very long.”

Although there is a high level of consistency in the system, there is a problem of whether the structure of the syllabus can effectively help students to learn. One comment shows the interviewee’s concern about this issue:

“Actuaries who design the syllabus ... only think of technical knowledge in their areas that need to be in the education somewhere. This top-down approach may not facilitate students’ learning. Part I and Part II allow students to consider them as two separate sections rather than a continuation of knowledge. This lack of connection between the two would discourage students to think in a holistic way and to have a sophisticated train of thought.”

5.2.1 Usage of various assessments

There are pros and cons with all kinds of assessments. While exams may be more suitable to test each individual’s learning outcomes, adoption of various types of assessment might not only increase motivation and interest, but also test mastery of other skills, such as teamwork, which is hard to be assessed through exams. However, because of an emphasis on exams, the use of different forms of assessments, such as presentations and assignments, is restricted. Other reasons also limit the use of such assessments, including issues of resourcing, plagiarism and potential free-rider behaviour.

“It is hard to test students’ true understanding of the material if we rely on group assignments. The contribution from each student is hard to determine as well. The best way to assess each student’s understanding is through examination.”

“It is hard to rely on assessments other than examination. The CAP [Commercial Actuarial Practice] course has an eight-hour exam. So that students can have enough time to complete the task in an exam invigilator scenario. But this is not realistic to be done for earlier courses.”

However, one of the interviewees shared a positive view of formative assessment:

“We could use more formative assessment to facilitate student’s learning. Even if there is a small proportion of marks contributing to the final grade, most students would still try their best to finish the assessment . . . smaller [and] multiple pieces of assessment would be useful to provide students incentive to keep on track of the teaching materials. But resources are another issue to consider. Marking assignments and open-ended questions takes a lot more time than other forms of assessment.”

The use of formative assessment can help students focus on improving their understanding of concepts that they have not mastered (Shepherd 2005). Another two interviewees also pointed out that, before qualification as an actuary, it would be useful to have an assessment in which students individually present and defend orally to a group of actuaries.

5.2.2 Problem-based learning style (PBL)

Some interviewees also discussed PBL, with the majority believing this is a good teaching approach. In fact, the current system has partially adopted this method with real-world problems, assignments and case studies in many courses. However, using this approach is also somewhat restricted:

“It is a better learning system but it may be not feasible given the constraints from the syllabus. It is hard to have all contents in the syllabus covered by a project. Assignments can do a good job in Part II because the syllabus is looser compared with Part I . . . it is very hard to do this with Part I.”

This is something that is worthwhile to be investigated more and potentially incorporated into the education system more fully. The combination of soft skills and technical knowledge being applied in context are likely to allow students learn more effectively and efficiently.

5.2.3 Feedback

Butt et al (2016) reported that students think that there is insufficient feedback provided by educators in both Part I and Part II education. Interestingly, no interviewee mentioned this issue, but perhaps would have, if prompted. If it is the case that insufficient feedback is provided throughout the education

process, this is a shortfall in development, as having the opportunity to review one’s own learning is a critical influence in the success of that learning.

5.3 Development of technical knowledge and generic skills

There is general agreement that the three-part structure does provide a good framework for students to develop their technical knowledge and generic skills. Part I focuses on technical knowledge development, while Parts II and III concentrate more on the practical issues and connection to the real world. However, some interviewees argued that Part I is not practical enough, and Part II is not technical enough. This is why some suggest a bridge between parts I and II and also the potential to interchange some technical Part I material with industry or contextual Part II material. However, this again raises the issue of students’ capabilities of dealing with practical problems early on, and the dilution of technical knowledge development. Nonetheless, it is certainly desirable to avoid perceptions that each part of the education process is a hurdle to conquer and that once passed, it is no longer needed.

The possibility of introducing more modern techniques in Part I is considered important because it demonstrates how improvements in addressing problems can be made, as well as providing specific training and demonstration of how practitioners do operate. However, also considered important is the need for sufficient technical understanding prior to applied extensions, to prevent added complexity and confusion in gaining technical understanding amidst the potential “noise” of learning applied techniques. If formative assessment can be used for the learning of modern techniques, this may assist.

There was broad agreement that development of soft skills whilst studying could improve the learning experience, as well as better prepare students for future careers. But there was not universal agreement that a focus of university study should necessarily be to vocationally prepare students in this aspect. An example of developing such skills came from an interviewee who highlighted the importance of actuaries explaining “numbers to people who do not have actuarial knowledge”. When students are given more opportunities to explain concepts, their soft skills are practised and, more importantly, their understanding of the material can be reinforced during the explanation (Shepherd 2005).

6 RECOMMENDATIONS

Findings from interviews distil down to a small number of main insights that we present for further consideration. Firstly, due to strict syllabus requirements particularly at the Part I level, educators are restricted in implementing innovative ideas, such as greater use of PBL and various types of assessment. This suggests a potential shortfall of the current education system in that it is potentially not open and responsive enough to critical monitoring, review and change if required – effectively a lack of dynamism in applying a control cycle approach to education. It is noted, however, that recent and current reviews of actuarial education intend to be highly constructive and relevant in addressing this, including the current Actuaries Institute review.⁹

Although Parts I and II may be relatively useful in preparing students for Part III, it may well be more effective and efficient to meet earlier learning objectives if some material was moved between Parts I and II. If it is true that Part I is too “quantitative” and Part II is too “qualitative”, moving some material between them would discourage any undesired impressions that each part represents a hurdle to pass, rather than a learning continuum.

In addition, a lack of work experience is a challenge faced by many actuarial students. Industry could be encouraged to provide cadetship schemes, internships, and other engagement practices, such as guest lectures, mentoring services and case study material. Examples include the co-op program from the University of New South Wales whereby selected students undergo a series of industry training placements throughout their degree,¹⁰ and a voluntary internship project at ANU whereby students can complete a supervised internship over one semester which counts for one subject towards a degree.¹¹

With a lack of work experience and potentially limited development of soft skills at early stages in the actuarial education process, it becomes more pressing for universities to partially mimic the work environment as much as possible. One example of this includes a greater focus on PBL. However, given limitations arising from pragmatic concerns and syllabus restrictions, a more realistic goal may be to find smaller and more workable ways to introduce more practicality into the classroom through particular assessment tasks, spending more time on modern techniques, and using class activities that encourage

discussion and explanation, as much as possible.

Finally, an industry/university partnership is a possible alternative to delivering Part III education when compared with the existing volunteer system. Although interviewees did not discuss this in great detail, it may well be one option that addresses the practical challenges of maintaining and managing a large volunteer base, as well as leveraging university education expertise in delivering a professional education program.

7 CONCLUSION

Interviews with 13 actuarial educators in Australia have highlighted that the current education system is perceived to have some effectiveness in delivering key learning objectives. The three-part structure, provides students with the time to develop key attributes from stage to stage, where each stage is suitable for students’ characteristics at that level. Part I focuses on technical knowledge development, while Parts II and III focus on contextual and real-life problem solving, which require additional development and application of soft skills, deep industry knowledge and professional judgement. In addition, given that there are various internal and external education reviews, the quality of education across institutions and the consistency between the syllabus and assessments is reasonably robust.

However, room for improvement remains. Owing to strict syllabus requirements for core technical subjects, it can be difficult for educators to introduce teaching and learning activities or materials that they believe may enhance the learning experience. Many interviewees feel that interchanging some Part I and II content would also be beneficial, by giving actuarial students some basic exposure to industry realities, and introducing earlier an explanation- and argument-based approach to learning and assessment. The lack of work experience of most students studying in Part I, and many students in Part II, also presents challenges. Although it could be impractical for universities to mimic the working environment, they could try to bring more realism into the classroom, through problem-based learning or a more limited selection of open tasks and activities.

With resource constraints such as time and personnel an understandable reality, perhaps a key tension exists between an education system which is adaptable enough to accommodate evolving

9 At the time of writing, the latest update on this important education review was given in the Actuaries Digital publication of 4 November 2016. Available at <http://www.actuaries.digital/2016/10/28/have-your-say-on-the-education-review/>.

10 For details refer to <https://www.coop.unsw.edu.au/>.

11 For more details refer to <https://www.cbe.anu.edu.au/students/student-information/internship-program/>.

technology, practice and industry realities, and an education system which focuses on rigour and depth of fundamental principles which underlie the profession's distinctive skillset. This is perhaps a key perceived difference between many educators and practitioners, and indeed between many educators themselves. However, others do not necessarily see these as competing aims, and suggest rather that an approach to education that is more open to innovation and flexibility over time could have benefits to both sides of that apparent divide.

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Alf Pollard: a most remarkable actuary

PROFESSOR JOHN CROUCHER



Professor John Croucher

ABSTRACT

Alf Pollard was born in 1916 in Melbourne and, as the result of the economic downturn during the 1920s, the business failed in 1925 with the family then leasing a banana plantation on Norfolk Island. During his time there, Alf had no education and, when the enterprise failed in 1930, his family returned to Sydney where Alf enrolled in Year 9 at Canterbury Boys' High School, having done no exams in his life. Less than three years later he topped the state in the 1932 Leaving Certificate and in 1935 graduated from the University of Sydney with first class honours in mathematics and the university medal. He then worked at the MLC, qualifying as one of the world's youngest actuaries and later obtaining a PhD from the University of London. Alf became the MLC deputy general manager, subsequently being controversially embroiled in the H.G. Palmer affair and made to resign. Soon after appointed as the foundation professor in economic statistics at the new Macquarie University, he began the first university actuarial course in the world. This paper gives an account of his intriguing journey from a farm boy to the heights of the actuarial profession and a glimpse of the life of an Australian actuary in the mid-twentieth century.

KEYWORDS

Norfolk Island, actuary, MLC, H.G. Palmer, education

INTRODUCTION

As a result of the Victorian gold rush and the associated economic boom of the 1880s, Melbourne became one of the richest cities in the British Empire.¹ Alf's father, Fred Pollard, was born in Ballarat on 26 July 1880, the eldest child of a Cornish family who had settled in the town during the 1840s, later moving to Ballarat where Fred met and married his future wife, Flo, at the local Methodist Church.

On 10 May 1914, the Pollards had their first and only daughter Florence and, shortly after moving to Glen Huntley, their first son, Alfred Hurlstone Pollard, was born on 9 August 1916. The glory days of the economic boom soon disappeared and slums began to appear across Melbourne's inner industrial suburbs. Alf's earliest memories revolved around his third birthday, when he contracted a form of the deadly Spanish flu, recalling that his eyes were sealed firmly closed every morning and having to wait in bed for someone to bathe them before he could see. But he was one of the lucky ones, surviving with no lasting effects.²

1 THE GREAT DEPRESSION

The arrival of 1923 saw the first appearance of the early Depression and by year's end it also heralded the end of the Pollard family's good fortunes, as Fred's business closed its doors in 1924. By chance, Fred came across a newspaper article proclaiming that the New South Wales government was seeking people who would be willing to lease tracts of land on Norfolk Island³ with a view to growing bananas. He decided to take up the challenge of living on a tiny speck in the Pacific and the family caught the steamer *SS Makambo* to the island.⁴

1.1 Norfolk Island

Fred and Flo took with them an extensive library of 600 classical books, of which Alf read none, his leisure time being completely consumed with outdoor activities. After the family had been on the island for about a year, his parents sent Alf to Middlegate, a school where, for pupils as young as he, the order of the day was to amuse rather than educate them. It was during this period that Alf developed manual skills that would stay with him all his life, including using a post-hole digger, a wire strainer, an axe, a crosscut saw to fell enormous

trees and a plough, as well as acquiring expertise in milking cows. To get to school, he took a long walk or horse ride by himself each way.

From a financial point of view, the move to Norfolk Island had turned into a disaster for the Pollards by 1929 and, added to all this, was the issue of Alf's education – or rather the lack of it. By the age of 13 he was unschooled in anything of academic value. In January 1930 it was decided that Alf, his two siblings and their mother would return to Sydney while Fred tried to unload the lease he had taken.

1.2 School days

The stock market crash just four months earlier had heralded the beginning of the Great Depression and unemployment was soaring. Living in Ashfield, Alf's mother, Flo, and the children managed to survive on the charity of the Methodist Church. Having no telephone at her disposal, Flo simply turned up to the local Canterbury Boys' High School⁵ where she convinced kindly deputy principal, Mr Fraser, to let Alf enrol. Not only that, as he was now 13, she also convinced him to let Alf start in third year, without having done first or second year or indeed any exams whatsoever up to that point.

The headmaster, Ernest John O'Rourke,⁶ was desperately intent on raising the academic standard and flew into a rage upon learning of the deal, claiming Alf was "destined for failure" and didn't want him anywhere near the place. But no matter how hard O'Rourke tried, Flo stood her ground. After only a few days in his first class, Alf was quietly reading a book when O'Rourke marched into the classroom and bellowed "Come out you!! Stand up. T'office lad!" There he was caned for no reason whatsoever. From that point, if ever there was a noise at an assembly, in his class or someone was late, O'Rourke would bellow, "Come out, the kid from Norfolk Island", and Alf received yet another thrashing. Moreover, this first year saw Alf spend almost every lunchtime in the detention room, simply for being a pupil.

During this early period Alf managed to set several academic school records. At the beginning of term his spelling test score of 43 out of 100 was the lowest ever for a pupil in their Intermediate year. Shortly after, he sat for a history exam and his mark of 1 out of 15 was also a new all-time low. He also managed to fail both Maths I and Maths II and was last in just about every

1 See Triposo Travel Guide, Melbourne, Australia, History, available at <http://www.triposo.com/loc/Melbourne/history/background>.

2 Alf Pollard personal diary, family collection.

3 Discover Norfolk Island, Norfolk Island history, available at <http://www.discovernorfolkisland.com/norfolk/history.html>.

4 Mentioned in the *Argus* (Melbourne), 17 June 1911, available at <http://trove.nla.gov.au/ndp/del/article/10910770>.

5 For a history of the school see Canterbury Boys' High School, School history, available at <http://www.canterburb-h.schools.nsw.edu.au/our-school/school-history>.

6 Ibid.

other subject. But by the end of the year he managed a low-level pass in the Intermediate Certificate, an astonishing result by any means, as he had covered three years of high school in a single year.

By the time Fred Pollard arrived in Sydney the unemployment rate there had skyrocketed from just 3% in 1929 to 16%, and it would climb to 25% in the next two years.⁷ There was no work for him and no government benefits, but somehow his parents decided that Alf should have the chance of completing the final two years of high school to obtain his Leaving Certificate, which he did, having just turned 16. He was not only dux of the school, but came overall first in the entire state, collecting honours in four of his six subjects (Maths I, Maths II, Physics and French) along the way.⁸ Alf was awarded the James Aitken Scholarship, John West Medal, a university scholarship and a state bursary. O'Rourke never went near Alf to congratulate him.

Alf found that previous Leaving Certificate students who obtained top passes in the state in maths and physics had invariably entered the combined Engineering and Science course at the University of Sydney and his parents encouraged him to do the same. Although he desperately wanted to be an academic, during the second term of his second year he politely asked his mathematics professor, Horatio Carslaw,⁹ about any information he could give him on actuarial work. Carslaw insisted on writing him a letter of introduction to Hubert Vaughn,¹⁰ who was head of the actuarial department at the Mutual Life and Citizens Assurance Company Limited (MLC). Dated 25 September 1934, it read in part:

“I am giving this letter of introduction to the mathematical scholar Alf Pollard of the second year. He would like to work for the examinations of the Institute of Actuaries with a hope of later getting into an insurance office. He is a very good mathematician, quite young, and I recommend him very heartily.

“I think you will like the man when you have a conversation with him.”¹¹

2 LIFE AT THE MLC

Although he had no intention of becoming an actuary, Alf was now forced to follow it up, sending the letter to Vaughn who promptly offered him a position. The family was still in desperate financial straits and the insurance company offered him £15 for two months' work over the Christmas vacation at the end of 1934. He accepted, but the next year he had to enrol in the actuarial examinations through the Institute of Actuaries in London. And if he were successful, the MLC would offer him full-time employment when he graduated. At the end of his third year at university Alf was awarded the university medal in mathematics, and he also came top in physics. He was immediately offered a one-year lectureship in mathematics at the princely sum of £350, which would tide him over the next twelve months, and he could also take the £100 prize from the Deas-Thompson Scholarship for his outstanding physics performance. At the end of the year, he could then take up another of his awards, the Barker Scholarship to Cambridge University in the United Kingdom, which would cover all his expenses for three years to complete a PhD.

Now well on the way to being a university academic, within a few short weeks everything changed when his father suffered a severe stroke and his mother gradually became crippled with rheumatoid arthritis. Alf had made up his mind to decline the MLC's offer, but felt it was polite to tell them in person. And so he arranged a meeting with the 46-year-old general manager and actuary, Milton Alder,¹² who was well known for his powers of persuasion. Alder offered him a position paying £210 a year, well below the £450 available at the university. When Alf presented him with the facts, Alder pointed out that professors earned only a 'miserable £900 a year' and that he would earn far more than that at the MLC.

After two weeks Alf decided that he simply couldn't leave his parents for three years in their current state of no income and so reluctantly turned down all the scholarships and on 6 April 1936 he started at the MLC without any enthusiasm. He immediately felt depressed at the spectacle of row after row of workers, their heads constantly down, and the open plan office that was deathly quiet save for typewriters clicking at

7 See Judy Mackinolty (ed.), *The wasted years?: Australia's Great Depression*, Allen & Unwin, Sydney, 1981. Also outlined in Paul Kelly, *100 years, the Australian Story*, ABC Books, Sydney, 2001.

8 See honours list in *Sydney Morning Herald*, 25 January 1933, p. 7, available at <http://trove.nla.gov.au/ndp/del/article/16947975>.

9 J.C. Jaeger, Horatio Scott Carslaw (1870–1954), *Australian dictionary of biography*, available at <http://adb.anu.edu.au/biography/carslaw-horatio-scott-5518>.

10 Raymond Nobbs, Hubert Vaughan (1888–1976), *Australian dictionary of biography*, available at <http://adb.anu.edu.au/biography/vaughan-hubert-11917>.

11 Alf Pollard personal diary, family collection.

12 For details on Alder's life see A.F. Deer, Milton Cromwell Alder (1887–1961), *Australian dictionary of biography*, available at <http://adb.anu.edu.au/biography/alder-milton-cromwell-9324>.

a frightening speed. Men wore their suits at all times and, if they harboured any ambition, were obliged to work after hours at no extra pay. And there were very strict rules – no more than 30 minutes for lunch with no breaks for morning or afternoon tea, and everyone was required to arrive for work on time with no excuses.

Still a teenager, Alf's first months were spent on menial duties, such as answering telephones, dealing with counter enquiries, receiving new insurance proposals, arranging medical exams, answering questions from agents, seeing that premiums were paid on time and dispatching papers to have a policy issued. Although navigating his way through the system, he soon regretted declining the chance to study at Cambridge.

Part of Alf's arrangement for getting the job was that he had to study for the actuarial examinations by correspondence through the Institute of Actuaries in London. The MLC gave no study leave and there were essentially no textbooks, candidates having to study original journal articles and provide a discussion and judgement on what line of action they would have taken in both actual and hypothetical cases. At the end of his first year of study he passed the first two Associate subjects.

Eventually he was transferred to the actuarial department and quickly found himself disappointed, as the work there still didn't challenge him. But it was at the MLC that Alf met his future wife, Pearl Cross, and they became engaged on 11 June 1939, her twenty-second birthday. They met at work every weekday and always had lunch together, but seldom went out as a couple, as Alf studied every evening.

With the onset of World War II, Prime Minister Robert Menzies announced the reintroduction of compulsory military training with effect from the beginning of 1940. The arrangements required unmarried men turning 21 in the call-up period to undertake three months' training with the militia. Alf was 23 and, for the time being, not affected, although he later would be.

2.1 Qualifying as an actuary

By the beginning of 1940 Alf had passed all the Associate exams, and the MLC now appointed him head of the actuarial department. It was a position that held considerable status and authority, and Alf had staff reporting directly to him. That same year he enrolled as an evening student in the Bachelor of Economics honours program at the University of Sydney. It was a very demanding time: Alf had to attend lectures every weekday evening, as well as studying for his actuarial

Fellowship exams, to be held in May. In addition, he played first grade cricket and soccer on Saturdays and spent all day Sunday on church activities. And then there was his new fiancée, whom he hardly ever saw outside work hours.

In May 1940 Alf sat for his final actuarial Fellowship exams and passed them all. Aged just 23, he became the then youngest Australian ever to qualify for the award of Fellow of the Institute of Actuaries (FIA). For those who did manage to qualify, they took an average time of 11.3 years. Alf did it all in just two years.

At the end of the year his university results were published in the *Sydney Morning Herald*: he was awarded a High Distinction for honours economics and topped the class. But Milton Alder ordered him to withdraw from the degree on the grounds that if he had any spare time he should be spending it learning more about the MLC. Alf had no choice but to abandon the degree. By the beginning of 1941, World War II had been in progress for more than 12 months, and many of the male staff at the MLC had already enlisted, but the job of actuary was viewed as a 'reserve occupation' and considered vital to the smooth running of the country. Moreover, Alf was such an important resource that the MLC was very reluctant to let him go. But on Saturday 21 June he also enlisted and was immediately appointed to the Department of Physics at the University of Sydney, where he would instruct army, navy and air force officers in radio physics, including techniques in using radar. He undertook a six month full-time course in radar technology and was then posted as the officer in charge at a radar station.

2.2 Helping the war effort

When he finished this role, at age 28, Alf felt strongly that he should continue to do something related to assisting the war effort rather than simply returning to the MLC. As a result of the new experience of war in tropical areas of Australia, problems such as fungus growth in humid climates had caused significant problems, resulting in the failure of vital radio equipment¹³ and on 24 April 1944 Alf commenced duties as an officer, beginning with attendance at a two month officers' administrative training course held at the University of Melbourne. There were 151 people in the course, and by the end of the program Alf had become the only flight lieutenant, the other 150 being pilot officers, two ranks lower.

Alf was seconded to the Acoustic Research Laboratory in the new medical school located at the University of Sydney. It had a small but select staff, including the eminent Sir John Eccles, and there Alf

13 An excellent outline of the problem can be found at Australian War Memorial, *Tropic proofing: the battle against moisture and moulds*, available at <https://www.awm.gov.au/collection/RCDIG1070716/>.

worked on important high-level research projects for the army, air force, navy and civilian organisations. Alf's first task was to design a double glass window for the simulated aircraft noise room such that nobody could look in on any experiment in progress. The idea was to construct it so that minimum noise would escape to interfere with outside activities when an aircraft engine inside was going full blast. He found the following two years quite invigorating, and at the same time also studied the effect of loud gunfire and the influence of bomb blasts on hearing for the army. For the navy he designed a complete communication system for use by crews in noisy naval aircraft. He was also given an RAAF task of uncovering, before they were sent to the Air Training Scheme in Canada, those people who were likely to be prone to airsickness. This involved designing and constructing a lift, external to the building, that was programmed to move up and down for twenty minutes to simulate the motion in an aircraft. His project outcomes exceeded all expectations: in one instance he conducted an experiment in which eight children, previously treated as essentially deaf, were provided with personal amplifiers he designed, which enabled them to hear for the first time.

On one of his regular visits to a public library in late 1942, Alf was browsing the University of London handbook and found that he could enrol, from Australia, in a bachelor degree in economics, a master's degree and a PhD program by correspondence, but with no classes, no study guides and no textbooks. And nobody need know.

To gain his bachelor degree all he had to do was pass two sets of exams over two years. He managed to get himself enrolled to sit for the mid-exams in July and, although he had only three months to prepare instead of the usual twelve, he immersed himself in the topics. The University of London calendar stated that, as an honours graduate, he could obtain a master's degree in economics simply by submitting a thesis and paying a £5 examiner's fee.

The temptation was too great. In no time he wrote a 100-page thesis on some aspect of mathematical statistics, completing it on 1 October 1945, when he duly mailed it to the University of London Registrar, enclosing a cheque for the necessary £5. There was no registration, no supervisor and indeed no contact with anyone. He was awarded his master's degree in economics by mail just six months later.

On 20 February 1946 he left the RAAF and returned to the MLC to resume what he thought would be his former role as head of their actuarial department. Instead he was made head of the medical department.

Three months later Alf sat for his London master's examinations, held in Sydney, and passed with the usual honours, and decided at once to enrol in a PhD in economics by correspondence at the University of London. This had to be done in absolute secrecy, as he had no doubt that Alder would take a very dim view of being disobeyed, and Alf would be instantly dismissed for insubordination. He had seen others let go for much less.

It was now time to find a suitable topic for his thesis. Only weeks before he had been captivated by a research paper by Colin Clark and R.E. Dyne entitled "Applications and extensions of the Karmel formula for reproductivity", in the June 1946 edition of the journal *Economic Record*. This provided the catalyst for him developing a ground breaking set of formulae that was later hailed by the eminent Dutch demographer Luitzen Yntema as "The Pollard Equations".¹⁴ Alf had devised new techniques of mortality forecasting using what he termed the "cause of death" approach. This investigation also led to his developing a means to measure the probability of marriage, taking the relative ages and the relative numbers of males and females into account.

By the end of the year the necessary research and calculations were finally completed and the thesis was duly dispatched to London, where it arrived in June 1947, the earliest time permitted by the regulations, which stipulated that it could not be less than two years after the award of a bachelor's degree. And all he had to do now was wait for the outcome from the examining committee. But even if the thesis was found satisfactory, the University of London rules for obtaining a PhD by correspondence then stipulated that he would have to present himself in person for an oral exam not less than 9 months nor more than 18 months after the thesis submission. But going to London was a very unusual event in those days, even for top company executives. In Alf's case the costs were one thing, but the thorniest issue was finding an excuse to take the time required off work.

During this waiting period he received a circular from the Institute of Actuaries in London inviting submissions for a Rhodes Prize, the winning entry to be discussed at a meeting in London. It was an international essay competition carrying a great deal of prestige, although no monetary value. The award arose from a generous donation to the institute by an American named Rhodes and was the one and only time such a prize was offered in its history. For Alf, the timing was ideal, as winning it would provide the perfect cover for his trip.

Three months later, as he was about to give his first

presentation to the Australian Institute of Actuaries, a telegram was waiting for him in the MLC mail room. It simply read 'Awarded Rhodes Prize. Congratulations'.¹⁵ Two weeks later he received another telegram, declaring that examiners found his PhD thesis outstanding, and requiring him to present himself in London for an oral exam.

The award provided a plausible reason to travel to the United Kingdom, and it would require his presence there for nearly two months. He spoke to Alder, who had absolutely no idea about Rhodes prizes or PhDs. Alf revealed only the former, declaring that he would really like to accept the kind invitation, doing so by using his two months' accrued annual leave. But the question of cost still remained, as the expense of living in London for around seven weeks would be prohibitive no matter how frugal he was. Alder congratulated him and seemed happy enough for him to use his time for this purpose.

Several days later Alder informed him that the MLC Board had authorised a payment of half of the air fare, up to an amount of £325, and so in April 1948, at the age of 32, Alf embarked on the long trip on a Qantas flying boat. He was successful in the defence of his thesis, gaining praise from the great statistician Sir Ronald Fisher. At the same time, Alf was very aware that he had tricked the MLC by enrolling in a PhD against their strict instructions and fully expected to be sacked on his return to Sydney.

However, much to Alf's surprise, Alder seemed delighted, as the AMP was about to appoint Dr Harold Bell¹⁶ as their economist and now the MLC had their Dr Pollard, who was busy publishing outstanding research.¹⁷ With his stocks on the rise, in early 1948 Alf spent three months as acting manager of all operations in Victoria: the company was clearly grooming him for a more senior position. One of Alf's great rivals for the top job was the lawyer and economist Fred Deer and now both were given the title of assistant secretary.

Staff made wagers as to which of them would get the top job when Alder finally retired, with opinion equally divided. In 1954, when Alder did retire, the decision was made. Within a few weeks Deer was announced as the new CEO, with Alf named as his deputy. And so by the middle of 1954, at the relatively young age of 37, Alf

assumed the position of general secretary of the entire MLC organisation, a title changed to deputy general manager seven years later. Deer held his role for 20 years, leading to his being knighted.¹⁸

The period between 1954 and 1960 was a time of major growth for the MLC, with offices appearing in every Australian capital city, New Zealand and a number of large country towns. But there was a special building that meant a great deal to Alf – the MLC Building at 105–153 Miller Street, North Sydney, as he had been instrumental in its construction. Opening on 22 August 1957, it towered a massive 59 metres, and boasted 14 floors, making it, at the time, Australia's largest office building, with over 42,000 square metres of office space.¹⁹

The following year Alf, a man of many talents and interests, was invited to be the vice-president of the newly formed Society of Security Analysts. He also held numerous other positions in his lifetime, including:

- president of the Northern Suburbs Hardcourt Tennis Association (1959–1963)
- vice-president of the New South Wales Hardcourt Tennis Association (1959–1966)
- president of the Longueville Tennis Club (1955–1975), where he was largely responsible for building the clubhouse
- member of the finance committee of the Royal Australasian College of Physicians (1958–1966)
- member of the council of the Australian Squash Association (1960–1963)
- board member of the Medical Benefits Fund (MBF) Council (1954–1988)
- member of the Radio Community Chest (1955–1999)
- member of the Sydney University Appointments Board (1955–1968).

3 THE H.G. PALMER AFFAIR

In 1958 Fred Deer went on nine-months' long service leave and so Alf, as acting CEO, was given the opportunity to display his talent, overseeing the installation of Australia's first commercial computer, a five-tonne IBM650, via a crane into the new North Sydney building.

15 See reference to Alf winning the Rhodes Prize in 1948 in Presentation of an institute silver medal to Professor Alfred Hurlstone Pollard, *Journal of the Institute of Actuaries*, vol. 103, no. 1, 1976, pp. 5–8.

16 Bell's life is outlined in his obituary, Andrew Bell, Master of codes and economics 1921–2008, *Sydney Morning Herald*, 24 June 2008, available at <http://www.smh.com.au/news/obituaries/master-of-codes-and-economics/2008/06/23/1214073145913.html>.

17 See, for example: A.H. Pollard, Female mortality in early life and its effect upon reproductivity, *Journal of the Institute of Actuaries Students' Society*, vol. X, no. 1, pp. 30–38.

18 See University of Sydney, University Archives, Honorary awards, Sir Frederick Deer, available at <http://sydney.edu.au/arms/archives/history/HonDeerF.shtml>.

19 For a modern view of the MLC building in North Sydney see Twentieth Century Heritage Society of NSW & ACT, MLC building at North Sydney, available at http://www.twentieth.org.au/north_pages/north_sydney_mlc_building.html.

Also during this period Alf was introduced to H. (Herbert) G. (George) Palmer, widely known as ‘Herb’ and the head of a chain of popular electronic stores that bore his name. Palmer himself was a salesman who began his trade during the Depression by selling radios door to door, eventually opening his first retail store in Bankstown in south-west Sydney in 1932. Just six years later he expanded his operations to Wollongong, and then made an all-out assault on the electronics market, earning a reputation as a respectable businessman and indeed entrepreneur.



Figure 1: Alf Pollard aged 43 in 1960.

Source: Pollard family collection.

By early 1962 the MLC was performing so outstandingly that the board felt it was time to scan the market for any suitable takeover propositions. Catching their eye was H.G. Palmer (Cons.) Ltd (H.G. Palmer), which had increased the number of its electrical stores substantially from 13 to about 150 in just six years, with retail outlets in New South Wales, Victoria, Queensland and South Australia. The company had grown into the largest retailer of electrical goods in the country.

Even more extraordinary was that their profits had reportedly increased from £96,000 to £435,000 over the same period, and its sales, service and management were highly regarded, both in the commercial world and publicly, with the management of the indefatigable Herb Palmer himself being largely responsible for its success. And so share brokers recommended that MLC make a takeover offer for the ordinary shares of H.G. Palmer.

On the face of it, an MLC takeover would reduce the interest rate on H.G. Palmer’s high borrowings by an estimated 2%, adding to H.G. Palmer’s already excellent profits. If MLC shares were offered to H.G. Palmer’s shareholders, they would receive a one-third increase in market value in their shares. The deal would only cost the MLC £83,000 in dividend payments owing to the high MLC share premium. In return, the MLC would receive from H.G. Palmer, based on 1962 profits and

interest rate savings, an after-tax sum of £600,000 per year. It seemed like an unbelievably good deal for the MLC.

In December 1962 Alf took the figures to Fred Deer and on 31 January 1963 Alf personally placed the proposition to take over H.G. Palmer before the MLC Board. The board also considered the investment an excellent arrangement, on the proviso that Herb Palmer was given a five-year contract to stay on as managing director of H.G. Palmer, and that the whole process be subjected to an independent investigation to confirm the figures presented to them. This was duly done and so on the afternoon of Monday 8 April 1963 the MLC made a takeover offer for the issued ordinary capital of H.G. Palmer (Cons.) Ltd. The share bid was estimated to be worth 21 shillings for each H.G. Palmer stock unit, an astonishing 5 shillings more than the market price beforehand. The commercial reputation of H.G. Palmer was greatly enhanced by the deal and the public image of the organisation was that of prosperity.

The MLC had a very high regard for Herb Palmer and his company, and it was difficult to find anyone who had a harsh word to say about the deal.²⁰ The heroes were undeniably Herb Palmer to the public, and Alf to the MLC, which was keen for H.G. Palmer to continue to operate in the future with the same management, with the same administration and with the same directors as in the past. The board readily accepted Alf’s nomination to the H.G. Palmer board on Tuesday 9 April 1963.

In February 1964, Fred Deer received a curious anonymous letter asserting that H.G. Palmer had bad debts of between £2 million and £3 million and that damning ledgers had been hidden in the ladies’ toilet while the auditor’s investigation of the company took place. The letter simply carried a note of caution, warning that the information wasn’t first hand and may have been completely unfounded. Whatever the truth, it was enough to plant a seed of doubt, which may well have been its objective.

When Alf confronted Palmer with news of the letter, Palmer brushed it aside as nonsense. It was at this point that Alf made an innocent but serious error of judgement, as he was under the mistaken impression that Deer, who had the letter in his possession, had forwarded it, along with an account of Palmer’s response, to the MLC Board.

Two months later it was revealed that H.G. Palmer was experiencing a liquidity problem and the company approached the MLC for a short-term loan pending the inflow of funds from an upcoming prospectus. It was thought that, if there were between 10,000 and 20,000

20 See, for example, H.G. Palmer accepts bid, *Sydney Morning Herald*, 10 April 1963, p. 20.

bad debts, this would amount to between £1 million and £2 million. There was a vigorous discussion of the 1963–64 accounts at the Palmer board meeting on 12 October 1964, where it was decided that bad debts of £444,000 would be written off. But by the board meeting on 14 December 1964, that figure had ballooned to £750,000. In fact, up to this point about 90% of the group's business had revolved around goods sold on credit, subject to a credit sales agreement. To maintain liquidity, between June and October 1964, the MLC injected £1 million into the operation by means of second preference shares.

Although the H.G. Palmer logo appeared as the brand name on many white goods, the company did not actually manufacture anything. Instead, they imported the necessary components and had them assembled by various Australian companies. Given their alleged sales and record profits, Palmer had little difficulty in establishing credit and had unpaid bills to suppliers of around £500,000.

The Palmer board now embarked on a move that would deliver a fatal blow to the company. A new prospectus for H.G. Palmer was discussed at the 14 December 1964 board meeting, and the issue of whether the £750,000 write-off should appear in it provided a topic for vigorous debate. Only a minority of board members, including Alf, argued strongly that the figures should be made public despite them being a possible deterrent. However, the prospectus was signed and issued on 5 January 1965.

3.1 Financial disaster

Within days of the release of the H.G. Palmer prospectus the MLC began to receive complaints from several suppliers about slow payment of the Palmer accounts. Some MLC board members now demanded an immediate investigation into the company's accounts. An interim verbal report revealed possible bad debts of £2.5 million and doubtful debts of a further £1.5 million, which prompted an emergency meeting of the H.G. Palmer board. The situation reached a crisis point, with the recently issued prospectus being withdrawn on 15 January 1965, because of the misleading statements it contained. Good money followed bad when the MLC, in an attempt to cover the losses, issued 4 million 20-shilling 'A' class cumulative redeemable preference shares. MLC hastily subscribed £3,625,000 of preference capital.

At the insistence of the MLC, the Palmer family, acting as Palfam Investments Pty Ltd, put in the

residual £375,000 of their own money to make up the loss of £4 million. A number of new external staff were engaged as consultants, while several existing MLC staff were assigned to projects associated with the debacle, including Alf, who spent all of 1965 at H.G. Palmer headquarters in Bankstown. Between May and July 1965, all but two H.G. Palmer directors had jumped ship, namely Herb Palmer and Alf, whom the MLC would not allow to resign. At the end of September the preliminary accounts were released for the year ending 30 June 1965, revealing that at the end of October 1964 a significant breach of the borrowing ratio of the trust deed had taken place. Herb Palmer was immediately sacked from the board, and the receivers brought in. During November and December 1965 the police were called in to conduct their own extensive interrogations of all Palmer directors and executives, and Alf was singled out for special attention, finding himself subject to four lengthy interviews, each lasting many hours.

The MLC–Palmer affair quickly became sensational headline news, to the extent of it even being raised from time to time in both federal and state parliaments. The MLC by now was under intense public pressure and there had to be a villain who could be blamed for their disastrous position. On Friday afternoon, 14 January 1966, Alf received a phone call from MLC board chairman James Ashton to see him in his office at 4.00 pm the same day. He confided that he had been instructed by the board to ask Alf to sign some documents, but on legal advice Ashton was further instructed not to discuss them with Alf or anyone else. They were, in fact, a pile of resignation letters under Alf's name, effective immediately. Alf signed them all, and at 4.10 pm he was unemployed.²¹ While cleaning out his desk, the first thing Alf noticed was that his name had already been removed from the door, and the document in which the MLC had indemnified him for legal costs was missing from his bottom right-hand drawer.²²

And so there he was, 49 years old and unemployed, with the distinct possibility of criminal charges hanging over his head. He contacted the University of Sydney to see if they had any vacancies, hopefully as a professor. But they showed no interest in him at all. In his own words, he felt this was his darkest hour but, as subsequent events would show, he was wrong about that as well, as no sooner had his resignation appeared in the press than the police contacted him.

21 "Top MLC man resigns", *Australian Financial Review*, 18 January, 1966, p. 1.

22 Excellent accounts of the H.G. Palmer affair can be found in Franke Clarke, Graeme Dean and Kyle Oliver, *Corporate collapse*, Cambridge University Press, Cambridge, 2nd ed. 2003, p. 73; and Michael J. Jones (ed.), *Creative accounting, fraud and international accounting scandals*, John Wiley & Sons, Chichester, West Sussex, 2011, chapter 7.1.5.2, "H.G. Palmer, Australia, 1965".

3.2 Police involvement

However, two weeks later he was offered a chair in economic statistics at Macquarie University and he readily accepted.²³ Soon after, Les Oxby, the chief actuary of the AMP, asked him to set up the world's first actuarial program to be recognised outside the United Kingdom. He immediately set to work on it.

The police still had Alf in their sights, interviewing him on 30 March 1966. More police interrogations followed and several Palmer directors, including Alf, were charged on 11 May. The headlines were sensational, occupying three columns on the front page of the *Sydney Morning Herald* which included a photo of Alf.

Alf was one of seven former directors of H.G. Palmer who were charged under section 176 of the *Crimes Act 1900* (NSW) with knowingly taking part in a false prospectus and under section 47 of the *Companies Act 1961* (NSW) with authorising or causing the issue of a prospectus containing untrue statements or wilfully not disclosing material information. The others were: Sir Norman Nock, Robert Cadwallader, Brian Page, Norman Palmer, Cecil Trenham and William Rose. The court hearing lasted for three months from 28 June to 29 September 1966, the transcript covering some 1400 singled-spaced foolscap pages and involving one of the most impressive line-ups of legal talent ever seen in the country. It seemed that bad debt ledgers (known as 'black ledgers') were indeed hidden in the ladies' toilet of H.G. Palmer's headquarters when the auditor was conducting his investigation. Bad debts at Palmers were long standing, existing well before the MLC takeover, and it was likely that H.G. Palmer had never made a real profit.

Alf was found to have no case to answer on the major criminal charge, but was sent to trial on the *Companies Act* charge of non-disclosure.²⁴ On top of all that, he had forgotten his promise to the Institute of Actuaries of Australia that he would write a paper on fertility in Australia for their August meeting. He found the only time available was during the hearing itself, while keeping an ear out for everything the legal profession was saying. The finished paper was ultimately presented jointly with his son Geoff, and it was awarded the prestigious UK Messenger and Brown Prize, the very first awarded to a paper presented to the Australian Institute.

The case against Alf was eventually dropped, but as a result of the trial Herb Palmer received four years in prison²⁵ with the company H.G. Palmer (Cons.) Ltd delisted at the request of the receiver on 2 March 1973.

3.3 Macquarie University

Upon his arrival at Macquarie University²⁶ in 1966, Alf undertook a great deal of planning. The first students were to arrive in 1967 and, with no established courses, Alf introduced Australia's first full undergraduate program in demography, along with courses for economists and accountants in the mathematics of finance. In addition, he created the actuarial program, which required faculty who would be willing to work for far less than commercial rates, while also needing to find students of sufficient calibre to pass the Institute of Actuaries examinations, with their standards well above a university pass level.

Various life offices offered 21 highly attractive scholarships: so outstanding were all actuarial students that they skewed the grades of every subject they enrolled in. Later that same year Alf was invited to London to assist in setting up a similar program at City University, London.

Among his many outside activities, Alf was awarded membership of the advisory committee of the Bureau of Crime Statistics and Research, made a member of the Australian Medical Association advisory committee, an adviser to the Repatriation Enquiry, adviser to Qantas on their superannuation plan, appointed by Gough Whitlam as the sole commissioner in charge of an enquiry into Commonwealth Public Service pensions and special adviser to the Medical Benefits Fund (MBF). In addition, he was a director of National Properties, a listed public company, lectured at the Institute of Psychiatry, the University of Sydney and the Insurance Institute, and served on advisory committees at both the University of New South Wales and University of Technology Sydney.

By early 1975 the Macquarie actuarial faculty had grown in size and had an outstanding reputation. In the middle of that year, the president of the Institute of Actuaries in London, Gordon Bayley, told Alf that the council had awarded him its silver medal, presented at the 10th Biennial Convention of the Institute of Actuaries of Australia and New Zealand in Melbourne on 8 October 1975.

3.4 Retirement

On 6 February 1976, while on a family holiday in Coffs Harbour, 59-year-old Alf suffered a massive heart attack that landed him in the intensive care ward of the local hospital. While in his hospital bed and using a portable typewriter, he wrote an article that received international acclaim, including the prestigious

23 See announcement: "Macquarie post for Dr Pollard", *Daily Telegraph*, 21 March 1966, p. 11.

24 "More directors of H.G. Palmer summonsed", *Canberra Times*, 12 May 1966, p. 3

25 "False prospectus, Palmer to serve at least 2 1/2 years", *Canberra Times*, 5 June 1969, p. 8.

26 Bruce Mansfield and Mark Hutchinson, *Liberality of opportunity: a history of Macquarie University*, Hale & Ironmonger, Sydney, 1992.

A.M. Parker Prize for the best paper published by the Actuarial Institute of Australia's *Australian Actuarial Journal* in 1976.²⁷

After ten days he decided to retire from Macquarie University, but increased the pace in his other work, including writing a significant government report for New South Wales Premier Tom Lewis. Soon after he became chairman of Citicorp Life and Citicorp General, a position he held with distinction for the next 20 years. He later became the first chairman of the board of MBF and oversaw investments in Country Comfort motels. He was hot property and found himself on the boards of Ernst and Young, Olivetti, National Properties (a share and property investor), H.W. Cottee, and Development Capital Corporate Services.

Alf was also the founding governor of the Sydney Eisteddfod Foundation, chair for 15 years of the City of Sydney Cultural Council, and, for 30 years, honorary secretary of Wesley Central Mission. He also found the time to head two major government inquiries and accepted many invitations to present international keynote addresses. In 1982 he was awarded Macquarie University's first doctor of science degree for his research into human populations, the highest award that a university can bestow. Two years later he was awarded the H.M. Jackson Award by the International Congress of Actuaries for the best paper presented to the Institutes of Actuaries worldwide.²⁸ In 1987 he was made the Australian Father of the Year,²⁹ and in 1990 he was made an Officer of the Order of Australia (AO).

Pearl Pollard passed away in 2000 after nearly 60 years of marriage. The 83-year-old Alf was heartbroken, so much so that just five weeks later on Monday, 4 December, after playing his usual game of tennis he had a massive heart attack, from which death was immediate. He was cremated and his ashes placed alongside those of his beloved wife. They were survived by their six children.

REMARKS

It is impossible to do justice to a man as impressive as Alf Pollard, and this paper has provided only a glimpse of the celebrated life of an outstanding actuary. Coming from such a poor background and watching his parents struggle in very difficult circumstances had a tremendous effect on his philosophies and beliefs. Chief among these was that nothing material should be wasted, and in Alf's case this extended to his time, which he regarded as exceedingly precious. By his own admission he saw little value in simply sitting idly, instead opting to go at full speed in every waking hour, with his mind seemingly never able to rest.

His was a truly remarkable journey from the streets of Melbourne to an upbringing on the tiny Pacific island of Norfolk to the amazing heights of the actuarial profession and academia. It is incredible to imagine that if his parents' banana plantation had not failed he would most likely have led quite a different life as a farmer, using the bush skills that he had already acquired as a youth. Whether he would have been satisfied to stay in such a role will never be known, but it was certainly the way Alf himself considered his life would have panned out.

The full story of Alf Pollard can be found in his biography *The Kid from Norfolk Island* by John S. Croucher, published by Woodslane Press, Warriewood, New South Wales in 2014.

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Acknowledgement

I would like to acknowledge the kind generosity and assistance given by Alf's children: John, Graham, Geoff, Ian, Anne and Christine. They also allowed me access to Alf's personal notes and diary. Their suggestions and amendments to my account were most invaluable and very gratefully received.

27 The A.M. Parker Prize is awarded annually for the best paper published by the Actuaries Institute in the *Australian Actuarial Journal* or presented to a conference that was run by or on behalf of the Actuaries Institute.

28 On the rate of growth of an economic time series, *Bulletin of the Institute of Actuaries of Australia and New Zealand*, The Institute, Sydney, 1968, pp. 137-147.

29 The history of the award, including Alf's name listed as the 1987 winner, is available at <http://archive.today/mP9lv>.

An approach to setting inflation and discount rates

DR HUGH MILLER AND TIM YIP



Dr Hugh Miller



Tim Yip

1 INTRODUCTION

Setting inflation and discount assumptions is a core part of many actuarial tasks. AASB 1023 requires that provisions for general insurance liabilities include an allowance for inflation and are discounted at the risk-free rate. However, there are a number of issues associated with setting these assumptions, including the following:

- What model should be adopted to fit the yield curve from observable risk-free securities?
- How should a discount rate curve be extrapolated beyond the last observable risk-free asset?
- What are appropriate long-term discount and inflation rates?
- How should inflation rate assumptions vary with respect to changes in risk-free rates?

This paper presents an approach to assumption setting that addresses these questions in a consistent and coherent manner. The approach is faithful to the observed behaviour of the market and previous research on the topic.

2 BACKGROUND

The approach presented in this paper relies heavily on previous research undertaken at consultancy firm Taylor Fry, as well as some other sources. The most important papers relied upon are described here. These papers in turn have more comprehensive lists of references for the interested reader.

2.1 Miller (2010)

This paper, “Towards a better inflation forecast”, investigated inflation assumptions and the relationship between inflation and risk-free forward rates. The most important conclusions were the following:

- Available industry forecasts, such as those by Access Economics, had some use in predicting inflation in the short term, but limited effectiveness in medium- to long-term prediction.

- There is an index of models that can describe the relationship between inflation and risk-free forward rates. These range from “fixed rate” models (the long-term inflation rate never changes) to “fixed gap” models (where a 1% increase in forward rates causes a 1% increase in inflation). They are indexed by the “inflation parameter” θ , with $\theta = 0$ corresponding to a fixed rate and $\theta = 1$ corresponding to a fixed gap.
- A range of tests showed that the inflation parameter is closer to 0 than 1. Estimates for the parameter using a range of approaches gave a range of 0–0.3 for the inflation parameter for average weekly earnings (AWE) inflation.
- There is reasonable historical evidence that AWE and labour price index (LPI) inflation are different across states. Higher rates for mining states (Western Australia and Queensland) appear justified, as are lower rates for some other states (New South Wales, Victoria and Tasmania).

2.2 Mulquiney and Miller (2014)

This paper “A topic of interest – how to extrapolate the yield curve in Australia”, contained a detailed look at yield-curve extrapolation, drawing from data in Australia and overseas. Relevant findings include the following:

- Medium- to long-term forward rates (around 10 years) have only partial ability to predict very long-term rates (30 years and beyond). This is indicative of long-term reversion of the forward rate.
- The long-term forward rate can be thought of as the combination of inflation expectations, real interest rate expectations, a risk premium and convexity adjustment. A long-term forward rate assumption in the range 5.4% to 6.2% was judged to be reasonable at this time.
- A linear reversion shape to the long-term forward rate was judged reasonable, although other shapes are possible.
- The rate of reversion was observed to be slow, based on several different tests. Reversion to the long-term forward rate somewhere between 40 and 80 years was judged reasonable.

2.3 Intergenerational reports

The Australian Treasury regularly publishes the *Intergenerational Report*, which contains long-range projections of the Australian economy. The most recent was published in 2015, and included the following assumptions:

- long-term bond rates of 6.0%
- long-term CPI inflation of 2.5%
- long-term AWE inflation of 4.0%.

These assumptions are consistent with previous reports.

2.4 Other background information

A number of changes have been observed in Australian bond markets in recent years that have had a large impact on discount rates and how they are forecast. First, the last few years have seen very low bond rates

(see Figure 1). A consequence of this is that discount rate forecasts have become more sensitive to the assumptions adopted in relation to mean reversion, as the 10-year bond rate is no longer close to the long-term bond rate.

Second, the number and term of Australian government bonds on issue have increased. In June 2005, 11 bonds were on issue with maximum term of 12 years. In March 2014, 21 bonds were on issue with the longest term, 22 years. This increases the possible complexity of the yield curve shape and decreases the scope for a fast reversion of yields.

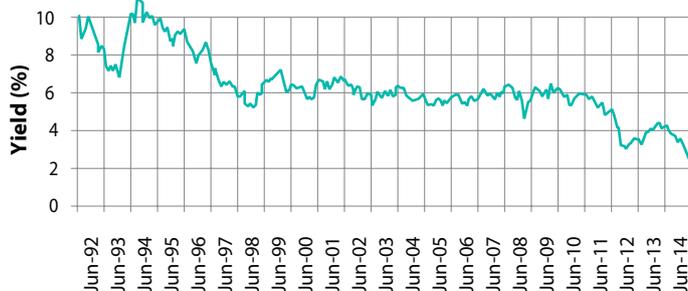


Figure 1: 10-year forward rate, Australian government bonds, 1992–2014.

Source: Reserve Bank of Australia, statistics series F16, available at [<http://www.rba.gov.au/statistics/tables/xls-hist/f16hist.xls>]; <http://www.rba.gov.au/statistics/tables/xls-hist/f16hist-2009-2015.xls>].

3 SETTING DISCOUNT RATES

3.1 Objectives of yield curve fitting

The main objectives of yield curve fitting are to obtain a set of forward rates that:

- **is smooth:** This is generally viewed as a desirable feature. Additionally, non-smooth yield curves tend to present more arbitrage opportunity, so they should be less frequent in practice.
- **fits observable bond prices well:** Each bond is viewed as the sum of zero coupon bonds. A good fit means that the price of those cash flows based on the forward rates is close to the observed bond price.
- **exhibits reversion over the long term:** The model should be able to impose reversion to the long-term rate at terms beyond observable bond prices.

3.2 Adopted approach – constrained cubic spline model

To achieve the objectives outlined in Section 3.1, we have assumed that forward rates follow the shape illustrated in Figure 2. The model assumes a cubic spline shape between term 0 and term t_3 with two additional interior knots t_1 and t_2 . Further it assumes linear reversion between t_3 and t_4 , with a constant forward rate beyond t_4 .

In terms of equations, the model illustrated in Figure 2 is expressed as:

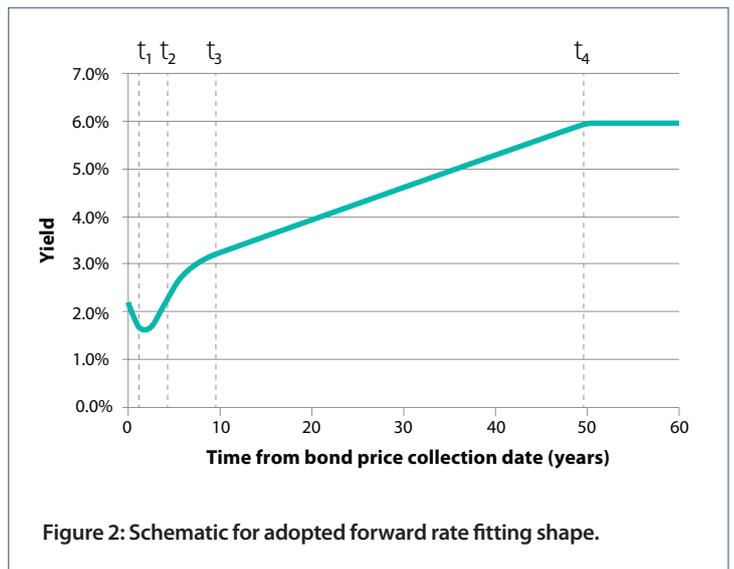


Figure 2: Schematic for adopted forward rate fitting shape.

$$f(x) = a + bx + d[x - 0]^3 + e[x - t_1]^3 + f[x - t_2]^3 + g[x - t_3]^3 \tag{1}$$

Here $[x] = x$ when $x > 0$ and $[x] = 0$ otherwise. Additionally, we impose the following constraints on the curve:

1. Reversion to the long-term rate f^* at term t_4 :

$$f(t_4) = a + bt_4 + d(t_4 - 0)^3 + e[t_4 - t_1]^3 + f(t_4 - t_2)^3 + g(t_4 - t_3)^3 = f^* \tag{2a}$$

For this particular constraint we have set $f^* = 6.0\%$ and $t_4 = 50$.

2. Linear reversion between terms t_3 and t_4 . So in this region, $f''(x) = 0$. Spitting constant and x components gives:

$$d + e + f + g = 0 \text{ and} \tag{2b}$$

$$et_1 + ft_2 + gt_3 = 0 \tag{2c}$$

The equations (2a)-(c), (2b) and (2c) can be solved simultaneously to eliminate e, f and g from (1), giving:

$$e = \frac{\{f^* + a + bt_4 + dt_4^3\} + d\{-t_3(t_4 - t_2)^3/(t_3 - t_2) + t_2(t_4 - t_3)^3/(t_3 - t_2)\}}{-(t_4 - t_1)^3 + (t_3 - t_1)(t_4 - t_2)^3/(t_3 - t_2) - (t_2 - t_1)(t_4 - t_3)^3/(t_3 - t_2)} \quad (2d)$$

$$f = -\frac{e(t_3 - t_1) + d(t_3 - 0)}{t_3 - t_2} \quad (2e)$$

$$g = -(d + e + f) \quad (2f)$$

with the remaining parameters estimated using observed bond prices. While equations (2a), (2b) and (2c) could be used to eliminate any three parameters, we have found eliminating the last three to produce the more stable numerical results when fitting to observed prices.

If B_j is the observed price of the j th bond, and \hat{B}_j is the corresponding price estimate using the forward rate curve, then the parameters in equations (2d), (2e) and (2f) are chosen to minimise the weighted squared error:

$$\text{Error} = \sum_j w_j (B_j - \hat{B}_j)^2 \quad (3)$$

where the weight of each bond w_j is equal to $1/D_j^2$ with D_j the modified duration of bond j .

Two of the parameters in equation (2d), t_4 and f^* , are set subjectively as described in section 3.3. The remaining unknown parameters a, b and d and knots t_1, t_2 and t_4 are chosen to minimise (3) using a non-linear optimiser. We have implemented this using the Solver functionality in Microsoft Excel.

3.3 Further comment on subjective assumptions

There are two important assumptions in this fitting model that are required to be set subjectively. These are the choices for t_4 , the point at which the ultimate long-term rate is achieved (here it is a term of 50 years), and the long-term rate itself f^* set to 6.0%. These assumptions have been selected with reference to the studies cited in section 2.

3.4 Alternative approaches for yield curve fitting

Before adopting the above cubic spline-based fitting approach, we considered the approaches detailed in Nelson and Siegel (1987), Svensson (1994), Li, DeWetering, Lucas, Brenner and Shapiro (2001), and Smith and Wilson (2001).

While all could probably be amended to meet the objectives set out in section 3.1, none did so “out-of-the-box”. Further, differences in fitting approaches tend to be immaterial apart from the assumptions related to extrapolation: as long as the curve is sufficiently flexible, it should give a reasonable fit of the observable securities. Other comparisons of approaches exist – see for instance Bolder and Gusba (2002).

4 SETTING INFLATION RATES

4.1 Our approach

Our approach to forecasting inflation is as follows:

1. Adopt a third party econometric forecast in the short term (the first two years).
2. For the fifth year and beyond, adopt an inflation rate based on the estimated forward rate:

$$i(t) = i^* + \theta\{f(t) - f^*\} \quad (4)$$

3. For the third and fourth years, linearly blend between the two approaches.

This approach is an extension of the model proposed in Miller (2010), which used an equation similar to (4) to estimate medium-term inflation expectations as a function of long-term bond yields. The formulation in (4) makes the further strong assumption that this relationship holds over the term of the yield curve, so inflation forecasts mean-revert with a similar shape (but smaller amplitude) in line with forward rates. While mean-reversion of inflation rates is intuitively appealing, we have not formally tested the speed of reversion relative to that of bond yields. Other approaches to inflation reversion are certainly possible; the attraction of (4) is that linking the inflation and yield curves to have similar shapes makes liability movements more predictable over time.

The blending in the third and fourth years helps avoid a cliff in forecasts, should the econometric and formula based forecasts materially differ.

In terms of explicit assumptions:

- We have selected $i^* = 2.5\%$ for CPI inflation (the centre of the RBA target band and consistent with the 2015 Intergenerational Report), $i^* = 3.6\%$ for LPI inflation (consistent with long-run historical averages) and $i^* = 4.0\%$ for AWE inflation (consistent with the Intergenerational Report and long-run averages).
- We have selected $\theta = 0.5$ as the inflation parameter. Although higher than estimates in Miller (2010), it captures some of the sensitivity of inflation to nominal interest rates and provides a balance between the “fixed inflation” and “fixed gap” extremes.
- We apply capping to the CPI forecast so that it does not exit the RBA target band (2.0%–3.0%). That is, for CPI the adopted formula is slightly modified:

$$i(t) = \min(3.0\%, \max(2.0\%, i^* + \theta\{f(t) - f^*\}))$$

- $f(t)$ and f^* are consistent with the previous section, with $f^* = 6.0\%$ (consistent with the *Intergenerational Report*).

4.2 Modifiers for difference states

In addition to the Australia-level forecasts in the previous subsection, we add modifiers to certain states:

- +0.5% for LPI and AWE inflation for Western Australia and Queensland.
- –0.25% for LPI and AWE inflation for New South Wales, Victoria and Tasmania.

Although these differentials were estimated in 2010, they have proven reasonably accurate over the past few years: see Table 1. However, these factors will have to be reviewed regularly; the cyclical trends in resource markets will tend to influence appropriate choices for state-based differences, and there is already some early evidence of Western Australian inflation falling back to national levels (see for example Nicholls & Rosewall 2015)

Table 1: Historical AWE growth differentials for each state.

Time period	State difference from national average								Aust
	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AWE
Jun 02 – Jun 06	–0.3%	–0.4%	0.4%	0.3%	1.3%	–1.3%	0.6%	1.2%	4.5%
Jun 06 – Jun 10	–0.7%	–0.5%	0.9%	–0.9%	1.8%	0.6%	–0.2%	0.4%	4.9%
Jun 10 – Jun 14	–0.6%	–0.4%	0.3%	–0.5%	1.5%	0.8%	1.5%	0.6%	3.9%

Note: Based on ABS average weekly full time earnings, trend series, available at:

Source: [<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6302.0May%202012?OpenDocument>; <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6302.0Nov%202016?OpenDocument>].

5 CONCLUSION

This paper presents a combined approach to inflation and discount rate assumption–setting that should be appropriate for a wide range of actuarial contexts. Interested readers are encouraged to seek out the referenced papers, as well as contact Taylor Fry directly for further information.

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