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**Feature Articles**

Presidential Address: Pathways to the Future -  
*J Trowbridge.*

Asset Liability Modelling for Life and General Insurance  
Companies -  
*J Lang.*



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### 1. INTRODUCTION

“Yesterday is not ours to recover, but tomorrow is ours to win or to lose.”

Lyndon B Johnson

We are at the end of our centenary year, an eventful year at the beginning of which my immediate predecessor as President, Trevor Matthews, adopted the theme Shaping the Next Century. Should I look for a new theme? Perhaps not ... the challenge to influence the future is entirely appropriate, continuity is important and in just one year we have not yet changed the shape of the next century.

At the same time, it is not obvious how we convert the vision and the potential into reality. It is valuable to be optimistic yet important to be realistic about what we can do to shape the future. The challenge is not only to describe our preferred future, through our vision and our aims, but also to determine how we get there. Hence the theme for 1998 Pathways to the Future.

This theme actually contains several messages –

- it is unambiguously about the future, and that fits with the primary role of the actuary which is to consider the future and to make financial sense of it
- it is about being pro-active and optimistic regarding future events, about influencing them rather than waiting for them to happen
- it concerns both the future of the profession itself and the profession’s influence on the financial future of the community
- it is about actuaries engaging in forecasting and modelling and monitoring, which means it is about the actuarial control cycle

- it is about our traditional work: a re-assessment of our role in life insurance and superannuation has become part of our fate in the 1990's and a different future must be embraced
- it is about the 'wider field', about extending the frontier because, although much has been promised over the last decade, most of the potential is yet to be realised
- it is inevitably about the culture of the profession, and
- it is about understanding and forging our place in the professional world of the future, noting that we are increasingly sharing with other professionals rather than dominating our main areas of activity.

All of these ideas are traversed in this address, which is my opportunity to outline not only the direction of Council and the Institute for the year ahead but also to develop further the vision and objectives of my predecessor Presidents.

### A Personal Tribute

It is an honour to take up the office of President of our Institute. For me it means, among other things, an opportunity to pay tribute to a great profession and to a great many individual actuaries, in Australia and elsewhere, who have assisted me in various ways during my career. Much of what I have to offer as your President, however, is due to the influence of two special friends and mentors.

One is Sid Caffin, who gave me my first actuarial job in 1970. I learned from his profound sense of professionalism, steadiness of purpose and actuarial thoroughness.

The other is the late James C H Anderson, with whom I was privileged to work closely for five years in the 1980s. Jim stands as a giant in our profession, perhaps a genius,. He changed the life insurance industry and actuarial consulting around the world, Australia included. He was a great intellect, a great orator and a great leader. He opened my eyes.

## 2. OUR CENTENARY

"That in the interests of Actuarial Science in Sydney it is desirable that an Actuarial Society be formed."

Motion carried unanimously at a preliminary meeting

on 12 August 1897, confirmed at the inaugural meeting on 19 October 1897.

We have come a very long way from this first meeting of seventeen members in October 1897 to an Institute today with 1,000 Fellows and another 800 students and associate members. The quotation, incidentally, is recorded in *The Future– Managers*, which is Clare Bellis' painstaking work on the history of the profession in Australia. It is a superb reference and a fascinating story for all members of our profession. Its launch was one of the major events of our centenary year.

The primary event to celebrate our centenary was the Centenary Convention held in August at the Gold Coast. It was an extraordinary success locally and internationally. The Convention will be remembered tangibly in two ways: by the many beautiful gifts made to the Institute by our international brethren, and by a special centenary report in what will be the last edition of the Institute Transactions in their current form.

Other important events for the Institute during 1997 were –

- appointment of our first Executive Director
- preparation and release of our first IAA Strategic Plan

- the first pair of overlapping ASTIN and AFIR meetings and the first such meetings in Australia, held in Cairns in August
- the presentation of our first ever Gold Medal (to Greg Taylor for his magnificent contributions, recognised internationally, primarily in the field of general insurance)
- full operation of our web site on the Internet, and
- major advances in the scope and presentation of Actuary Australia.

These events have given us both a stronger infrastructure and a stronger identity. And they have launched us headlong into our own second century.

### 3. MANAGING THE INSTITUTE

“Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!”

Lewis Carroll

A major innovation for the Institute in 1997 was the appointment by Council of our first ever Executive Director.

Jock Rankin is not an actuary but he is a professional in the role of Executive Director. He is beginning to carry us where we have not been before, into places where we want to go. As a result, the President and the Executive Director can more readily offer leadership and concentrate on advancing the Institute and the profession rather than simply ‘keeping the wheels turning’. And that is also my challenge as President, especially in a period of great change in the career patterns of actuaries.

The appointment of an Executive Director marks a new era for the role of President and Councillors, for the President can now operate more like a chairman than a managing director, with a greater opportunity to consider strategy, direction and structure of the Institute and the profession, and less need to dedicate time to matters of administration and management. The role of Council and the work of Councillors, who legally have the responsibilities of directors, can be lifted to a higher level. Institute committees can be better briefed and can interact better with Council. In short, the President, Council and Institute can operate on a higher plane.

There is a price of course. Greater promotion, greater participation in public affairs and a generally more ambitious agenda put greater pressure on the quality of Institute activities and especially the work of Council and our committees.

Overall, the management of the Institute has taken a great step forward in 1997.

#### The Institute’s Committee System

Our committee system and the enormous amount of honorary work done each year by so many members is immensely valuable to the profession. But it is more: it is the life blood of the Institute and a part of the culture of the profession that binds us together into a genuine and influential profession.

Each year the incoming President tackles the difficult task of reviewing the structure and membership of committees. There are more than fifty committees and some increase in importance over time while others decline. To respond better to needs which are not permanent, we are making more use of task forces which have a limited and specific brief. When its brief is fulfilled, the task force ceases to exist.

Our committee system has included since 1990 a set of Council Committees which form links between Council and the Practice Committees. Council Committees are like board committees and as such include one or more Councillors. Their role is to propose and formulate policy for consideration by Council and to ensure Council policies are communicated effectively to the Practice Committees and are being followed. They are also expected to ensure that the right issues are being considered by and communicated between Council and the Practice Committees.

I am a supporter of this system. Some of the Council Committees are effective but others have operated as mailboxes only. Further efforts are needed, therefore, to ensure the vitality of all committees and effective relationships between Council, Council Committees and the Practice Committees.

The Presidency

One of the debates about Institute structure is whether we should have a presidential term of more than one year. I wish to record my satisfaction with the current system of Vice President, Senior Vice President and President over three years. Among other things, the system leads to each President working with four other previous or subsequent Presidents during his or her own three years in office.

The Presidential group has worked as a strong team during my term of office. I wish to thank Geoff Burgess for giving me a valuable year's apprenticeship in 1996, Trevor Matthews for a year of close co-operation and excellent leadership in 1997, and Richard Mitchell for his contribution in 1997 and his offers of substantial assistance for 1998. I also congratulate David Knox on his recent election as Vice President and look forward to welcoming him into the Presidential group.

#### 4. PURSUING A STRATEGY FOR THE PROFESSION

“Amateurs talk strategy, generals execute it”

Napoleon Bonaparte

The IAA Strategic Plan was presented at the Centenary Convention and is to be debated and acted upon into the future. It is not intended to be static and will be refined and reviewed regularly. Its Executive Summary is reproduced in Appendix A.

Its articulation is of great significance to current and future Presidents of the Institute:

- it represents a framework for the direction of the Institute which endures beyond each President's term of office
- rather than proscribing the liberty of each President to set his or her own agenda, it releases the President from setting the whole agenda, allowing concentration on emphasis, priorities and modifications of the agenda.

The strategic plan now becomes a primary focus for the President and the Executive Director and, through the President, for Council as well.

The strategic plan was developed following an audit of the profession undertaken by the Institute's Marketing Committee for the 1995 Biennial Convention. Its elements were discussed in 'brainstorming' fashion by Council and Committee chairmen in 1996. The plan makes strong reference to developing an outward focus for the profession and its members, and concerns itself primarily with six issues (some of which are expressed in marketing parlance). The paper goes on to nominate many initiatives that might be taken

or should be taken in relation to each of these issues. They are too numerous to mention here but it is useful to nominate the six issues and outline the objectives for each –

- 1 Customer focus of the profession and the Institute:
  - the profession to build an outward focus and work on external perceptions
  - the Institute to concentrate on being relevant and valuable to all members
- 2 Market penetration (in existing avenues of employment):
  - members to promote their utility in traditional fields beyond narrow professional roles
- 3 Market development (for non-traditional employment):
  - numerous members to gain employment outside traditional areas
  - more members to be employed overseas
- 4 ‘Product’ development (a broadening of the education and skills of actuaries):
  - the Institute to work on matching training and development to needs of target employers
  - all actuaries to become competent and effective in communication and in business generally
- 5 Role of the Institute:
  - the Institute to –
    - assess its internal operations and structure itself to be able to respond to its major objectives
    - increase the involvement of members, especially younger actuaries and ‘lost members’
    - encourage efforts to raise the self-image of the profession
- 6 Extending the profession’s influence:
  - the Institute to influence actively the policies of governments, regulators, industry bodies and other professional bodies.

These objectives are recorded and also endorsed as describing the direction of Institute affairs. As will be evident on reading them, however, the Institute itself can take responsibility for some of the objectives only. Others are primarily in the hands of individual members or the profession as a whole. As an example, while the Institute might encourage employment outside traditional areas, it is individual members who will respond to job advertisements or approach employers or clients, not the Institute.

On the question of division of responsibility between individual members and the Institute, my version of the division is:

the institute	the individual
education	initiative
Custodian of the profession	opportunity
voice of the profession	personal characteristics
public policy	career strategy
like-minded support	pioneering
general promotion	employment

The role of the President and Council is to see that these Institute responsibilities are fulfilled. Effective work by the Institute then encourages and facilitates the success of individual members.

Conclusion

The strategic plan and the objectives are consistent with the Institute's mission statement as developed by Council in 1995 and recorded in Appendix B.

I look forward to Council debating the plan and to the membership at large having a greater involvement than previously in the affairs and direction of the Institute.

## 5. POSITIONING THE PROFESSION

“Marketing is not a battle of products, it's a battle of perceptions.”

Ries and Trout

Perception and Reputation

We are being constrained by our history and our past successes -

- internally, we are accustomed to being not only experts in certain fields but the dominant experts in these fields (especially in life insurance and superannuation, which have been great triumphs for us historically)
- externally, we are seen as having a narrow perspective and narrow experience (precisely because of our dominance in specialist areas).

We have an ambiguous position both within our traditional areas of engagement and outside those areas. The ambiguity is that we are widely respected for our numeracy and our intellectual capabilities, and also for our expertise in certain specialist areas. At the same time we are often regarded as academic and impractical, as obscure and indecisive. We can be seen as obsessed with detail without appreciating the 'big picture'.

Hence our positioning, as represented by our image and reputation, is not conducive to extending our activities beyond our traditional areas.

Furthermore, increasingly with advances in technology (especially software) and the diversification of educational courses and of careers that have both mathematical and financial content, we find ourselves just one of several professional groups of experts in some fields.

We need to become accustomed to sharing responsibility in many areas while still asserting our credentials and demonstrating our capabilities. An illustration of our territory appearing to be usurped by others is the currently fashionable EVA (Economic Value Added) techniques which depend heavily on discounted cash flow analysis. Another fashion is 'data mining' which should be fertile ground for actuaries but which appears to be a field dominated by others.

The challenge is to be realistic about the limits and the scope of our professional role and at the same time to promote ourselves in such a way as to avoid being 'out-sold' by other interest groups, especially those whose skills, understanding and techniques are less expert than our own.

What, then, is the realistic role and place of our profession in commercial and government affairs in the next 20 to 30 years?

Our Strengths

In all of the frequent exhortations for us to extend our frontiers, one cannot avoid noticing the great confidence and strong belief that we have in ourselves as a profession. It is worth examining what is behind this confidence and self-belief.

In the periods of development of the actuarial science of life insurance, general insurance and pension funds, actuaries were widely seen as researchers, calculators and thinkers. We

developed and applied techniques in such areas as probability and financial risk (especially insurance), discounted cash flows, demography, financial equity, longer term financial affairs and the actuarial process we have come to call the control cycle.

We need not be restricted, of course, to these fields and in any event their evolution is forcing us to expand our horizons. Today, however, when the life insurance and pensions industries, and the associated actuarial activity, are mature –

1 much of the essential research has been done, techniques are generally well established and application is often more or less routine except during periods following regulatory change

2 many others besides actuaries do some of the calculating, especially now that there is clever computer software and there are graduates in many disciplines who can use the software

3 we remain thinkers but the scope and value to be added for good thinking may have diminished as a result of accumulated research and experience along with the maturing of these industries.

In fact our strengths go well beyond these perceptions. The philosophical foundations of actuarial work are both profound and practical. They revolve around the study of probability, which is a difficult subject conceptually beyond its mathematical aspects, and scientific inference. They also include some of the statistician's armoury in the form of data collection and analysis together with hypothesis formulation and testing.

We are often engaged in careful consideration of cause and effect vis-à-vis statistical correlation. This point is worth emphasising. It differentiates actuaries not only from many statisticians but also from many management consultants. It is also a particularly important aspect of financial modelling and is now systematised through the actuarial control cycle. By adding ideas of finance and the time value of money to probability and data analysis, we create much of the modelling and related work which is at the heart of 'actuaryness'. Making one further crucial addition, the existence of a profession (so that one can be held accountable professionally for advice offered) establishes the actuary as indeed a capable and expert professional.

#### Financial Risks and Risk Management

It is notable that financial risk is now seen to include not just insurance and related risks, but also a wide range of risks associated with credit, banking, investments, derivatives and other activities in the financial services industry.

Are actuaries the best professionals to assess financial risks?

We are undoubtedly the best at mortality, morbidity and other contingencies of life. We are probably also the best at assessing general insurance risks on a statistical or portfolio basis. We are the best in these areas because we have made it our business to be so.

We cannot, however, claim a pre-eminent position on investments, derivatives, credit, banking and other risks in the financial sector. Nevertheless, there are some actuaries who are experts in these areas.

It is to be hoped that more actuaries will be involved in these areas in the future, and will make their marks there. Furthermore, there is every reason for actuaries in these fields to be proud to be actuaries and to be happy to work in a multi-disciplinary environment. They can use their actuarial skills and professionalism without needing either to deny association with the profession or to be overtly recognised as actuaries.



Risk management is a crowded field today, including for example finance and investment professionals, insurance broker specialist employees, economists and econometricians, and some accountants.

What do we have that is unique? What is as good as or better than others? What are our limitations? How do we best contribute?

In my experience, which includes working on occasions with a wide range of other professionals (for example accountants, merchant banking staff, econometricians, management consultants), the actuary has a better understanding of risk and is generally more disciplined and more effective commercially in building and using financial models. I attribute this success to the actuary's combination of mathematical skills, actuarial techniques and professional accountability.

Is this claim to superior modelling work valid, and is this explanation valid? If so, we have some good clues as to where future energy might be put in extending the frontier.

#### Limitations

A flaw in the thinking of many actuaries, and indeed many other professionals too, is a belief that the quality of what they do will be both visible and recognised by all potential audiences: if the intellectual position is a strong one or the correct one, it will triumph. Marketing history says no: there has to be awareness, acceptance and recognition. Image and reputation depend not only on facts but on perceptions. Promotion and persuasion are important.

#### The 'Wider Field'

Every Presidential Address for the last fifteen years has talked of actuaries entering the 'wider field'. The subject is popular and interest has escalated in recent years because of both the increased supply of young actuaries and an impending decline in demand in Australia for life insurance and superannuation actuaries.

Progress in the 'wider field' has been slow, although it is difficult to measure. The Institute's Annual Reports disclose the following -

Principal Activity	1992	1997
life insurance	224	317
superannuation	178	218
general insurance	31	94
investment	32	73
banking	3	31
health insurance	3	5
software	5	5
education	10	13
management	63	67
'other'	58	47
total non-retired	607	870

These statistics give very limited information. They refer only to each Fellow's principal activity and the classifications are not really adequate for understanding well the range of activities of our Fellows. Nor do they cover university graduates, Associates and other non-Fellows. Nevertheless they show some interesting features –

- continuing strong and steady growth in life insurance, despite predictions of gloom
- superannuation static (in 1994, the recorded number was 219)
- general insurance and investment growing rapidly
- banking curious: the numbers recorded in the intervening years were 1, 1, 1 and 0, so 31 in 1997 suggests inconsistent recording (previously or now? – I suspect previously)
- 'other' declining.

Even if we add banking and 'other' to indicate the 'wider field', the numbers have moved from 61 to 78, a growth rate of only 5% per annum, compared with 7% per annum and more than 90 new actuaries in life insurance! Adding management and software would translate to an even lower growth rate.

Even if the figures are not entirely accurate, it is very hard to see a serious 'wider field'. If there is one and it is represented by some of our younger members, we need to extend the scope and quality of our information to understand it.

The real debate, however, should be about extending the frontier rather than the 'wider field'.

To extend the frontier, the profession has to be re-positioned. It is no easy task and it has both individual member components and Institute components.

The next section on extending the frontier seeks to explain some of the conditions for repositioning and is mainly concerned with the efforts required of individuals. A later section on influencing public policy is aimed, among other things, at the Institute's playing its part in contributing to a higher and wider profile and thereby to a better positioning of the profession.

## 6. EXTENDING THE FRONTIER

"To get others to come into our ways of thinking, we must go over to theirs; and it is necessary to follow in order to lead."

William Hazlitt

Extending the frontier means not only doing things which are actuarial in a non-traditional field. It also means extending the scope or range of activities of individual members in traditional and related fields.

Looked upon in this way, there are some important statements to be made:

- 1 Life insurance is coalescing with other financial services including funds management and investment –
  - for a very long time there have been actuaries in life companies who have been extending the frontier into management, marketing, IT, funds management, investment and other areas
  - there are now increasing numbers of actuaries working in bank-owned insurance companies, banks themselves, merchant banks and fund management companies, some as actuaries and some in management and other activities

- there are increasing numbers of consultants spending some or all of their time with clients in financial services on matters other than actuarial aspects of life insurance. Hence our profession has enormous potential for extending the frontier within the financial services industry, while continuing to be very active and influential in life insurance!

2 The general insurance industry is making increasing use of actuaries in both technical matters and non-technical matters, including management. The frontier is being extended continually as more actuaries try their hand at more aspects of the industry. That is one of the reasons that our involvement in general insurance and reinsurance is growing. There is likely to be considerable extension yet into the future.

3 In funds management, investment and finance, the frontier is unclear to many of us. In terms of formal professional advice, the frontier seems narrow but the influence of executives who are actuaries suggests a much wider frontier. The field is recorded as already taking nearly 10% of our members and there is destined to be much growth yet in actuarial employment here as demands for numeracy and mathematical understanding increase.

4 Health insurance can be thought of as a traditional field where our penetration has been very low, partly because of the very highly regulated nature of the industry. Extension of the frontier is now occurring quickly and further extension into non-insurance financial aspects of health care and long term care are open to us.

5 Asia represents an extended geographical frontier where there is considerable and growing demand for traditional actuarial expertise and as yet low penetration. Hence there has been and is much extending of the frontier from our traditional bases. There are also other extensions that can be and should be made. The discussion on this subject at the Centenary Convention elicited some very interesting ideas including, among others –

- the idea of the suburban actuary, built on a financial planning base
- an increased role for the Government Actuary and other public sector employment
- the likelihood of ‘osmosis’ within organisations who take on actuarial staff
- the claim that we can take our place amongst other professionals in providing business solutions.

Some advice was also forthcoming –

- “to penetrate new areas, actuaries need to show humility”
- “we should be more creative and interesting when advising our clients, perhaps even including cartoons in our reports”
- “participation in a new business can add excitement, sparkle and enjoyment”.

In all of this enthusiasm about the wider field, we need to take note of three things: our lack of serious progress, the advice on humility and the importance of realism.

We have all heard it said around the profession that we are clever people, perhaps the smartest profession, that our skills are widely applicable and that we can do almost anything. But is it not what we can do but what we actually do that matters? We risk being seen as arrogant, and we are also demanding: we seem to expect not only to be invited to participate in the affairs of others but to be influential and well paid ... so let us be more humble yet pro-active and positive, let us plan realistically what we can do and what we want to do, and let us then persevere with enthusiasm and optimism.

I was struck recently by the spirit of successful entry into a new field which shone out of a short article in the June 1997 edition of *The Actuary* (from the London Institute). It was an interview with Michael Clark, a young actuary who switched from a life insurance career to one in project finance. The interview, reproduced at Appendix C, illustrates well the optimism, skills and approach needed to enter a new field.

#### Market Entry

One could also ask: what are the criteria for success in a new field? I wish to suggest that entry into a new field is successful when –

- the pioneers are being paid at commercial prices for their work (whether as employees on market salaries or as consultants on market fee rates) – this is a very important test: it is a measure of the degree of recognition by any user of actuarial services
- there is opportunity for other actuaries to follow or support the pioneers in expanding the profession's involvement
- the actuaries involved are having a positive influence on the affairs of their employers or clients
- there is some form of advice being given which is being signed by the actuary in a professional capacity – this test is clearly not passed by an actuary who works in a management role but it is also not passed by an actuary who does not aspire to be seen in a professional role and/or who does not complete his or her work with a written report of some kind which includes findings or conclusions or recommendations which might be recognised as actuarial advice.

The last test here is the professional test. It clearly goes beyond the preceding positive influence test. Those of us who believe in the actuarial field being a profession and not just an education have a responsibility to encourage actuaries in newer fields to operate as professional actuaries and to give them guidance and leadership on how to do so.

In most areas of consulting practice and in full-time employment in traditional fields (for example life insurance), there are usually role models and opportunities to learn through working with actuaries experienced in giving professional advice. This is clearly not so in areas of full-time employment where there is no tradition or history of giving formal professional advice. This situation appears to occur widely in funds management, investment, finance, banking and merchant banking.

If we are to prepare new actuaries for professional careers in areas where actuarial advice is not yet recognised, perhaps we need to extend our Professionalism Course or take other initiatives to assist new actuaries to look for and take professional responsibility.

There will be debate over whether it is appropriate for actuaries in newer areas to try to present their work as actuarial advice. This is a matter for the actuaries concerned, but I wish to suggest that, for those actuaries, it is often a question of their own aspirations and confidence, and also their identification with the profession.

#### Market Development and the 'Pioneers'

The strategic plan proposes, as one tactic for broadening the employment of actuaries, that we “leverage off ‘pioneers’ who have moved into new areas of actuarial work”.

The history in general insurance can be seen as a success in doing just this. In the mid seventies, there was a small band of pioneers who, by a combination of their own individual efforts and of drawing on the support of the Institute, have led us into an era where actuarial involvement is taken for granted.

Undoubtedly we need pioneers. The Institute itself cannot actually lead the profession into new areas of employment. We rely on the individuals who will be seen as pioneers to –

- establish their own personal positions in areas not well recognised for the use of actuaries
- be accepted in such a way that other actuaries gain employment in the same area
- be recognised as being actuaries and thereby contribute to the positioning and image of the profession in this area of activity.

History tells us, of course, that entering new fields is difficult. In the beginning, recognition and acceptance may be slow and it may not be financially rewarding.

The pioneer is therefore bound to be something of a risk taker and an enthusiast. The pioneer will also need faith and self-confidence to pursue a path that is not well understood or recognised.

What can we learn from the general insurance story? The opportunity arose because the industry had certain difficulties to which the profession could make a contribution. The early opportunities to contribute appear to have arisen mainly through life company owners of general insurance companies asking their actuaries to try their hand at general insurance. In time, the role developed and became a specialised one.

From the profession's viewpoint, general insurance developed nicely because it became a genuine practice area, where professional actuarial advice was being given as a matter of course. As the field became established, conventions and other inter-action with non-actuaries obliged us to demonstrate our contribution continuously and practically, without retreating too often into an 'actuarial corner'. Professional standards were eventually produced, regulatory recognition has emerged and, with increasing competitiveness and sophistication in the industry, the profession is now a part of the industry.

The diligent and energetic efforts of the pioneers gave vitality and momentum in an environment that was often sceptical and occasionally hostile. The conditions and the success factors belong largely to the time. Nevertheless the lessons should be distilled for the benefit of our new pioneers.

One might well ask: who and where are today's pioneers?

Are they in funds management, investment and finance, or are they the life insurance actuaries who are extending their reach across other financial services?

Are they the financial planners who may become the suburban actuaries of the future, recognised alongside suburban accountants and lawyers as an accepted and valuable part of the professional landscape in Australia?

Are they the actuaries now working with merchant banks and stockbrokers?

Are they the superannuation actuaries who consult widely on employee benefits, remuneration and other corporate employment questions?

Are they the actuaries doing financial modelling and forecasting, or risk analysis, for organisations who are not financial services businesses (for example infrastructure, privatisations and utilities)?

Let us encourage the pioneers, let them emerge and succeed!

## 7. RIDING THE CONTROL CYCLE

“As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality.”

Albert Einstein

Modern day financial graduates, accountants, MBA's and econometricians all know much about discounted cash flows, risk analysis and financial modelling. The actuary will observe that we have been using these techniques for a very long time. So what is new?

Answer: the use by other professionals who are discovering, promoting and applying techniques that we have tended to regard as our own.

These techniques are no longer the exclusive preserve of the actuary and we are competing for recognition and influence in many ways. Nevertheless, we still understand more about these techniques and their underlying theory than any other professional group. Furthermore, we understand their application in terms of the control cycle.

An actuary who qualified before 1995 will ask, in respect of the control cycle, "so what is new?". Answer: in substance, nothing, but in presentation, everything. Articulation of the control cycle leads to recognition that it is the fundamental actuarial process. It is a very disciplined form of forecasting, learning and understanding the future as it unfolds.

Arguably it was invented by John Graunt in the seventeenth century when he created the first life table. He set up a basis for expected against which actual could be compared. It has been used extensively in the field of life insurance and pensions ever since.

The conceptual basis of the control cycle is not unique. Indeed it is well developed in engineering. Our control cycle is a slow and interventionist form of engineering control system.

Engineering control theory and control systems are characterised by –

- measurable input
- measurable output
- a feedback loop from output to input which modifies the next cycle of input in order to obtain a more accurate output
- processes which are reproducible and governed by unchanging laws, thereby enabling automatic feedback.

A simplified comparison might be –

engineering control system      actuarial control cycle

System is usually a mechanical or electrical process      System is usually a financial model of a social or commercial process

Process reproducible under unchanging laws      Process not fundamentally reproducible

Feedback leads to automatic adjustment of input      Feedback leads to actuarial intervention

in model input

Cycle time is usually less than a day – hours is long, could be nanoseconds      Cycle time is usually more than a month – quarterly and annual are common

Now that we have articulated the actuarial control cycle and can compare it with engineering control systems, the latter may well provide fertile ground for further development of the theory, practice and language of the actuarial control cycle.

Forecasting and the Control Cycle

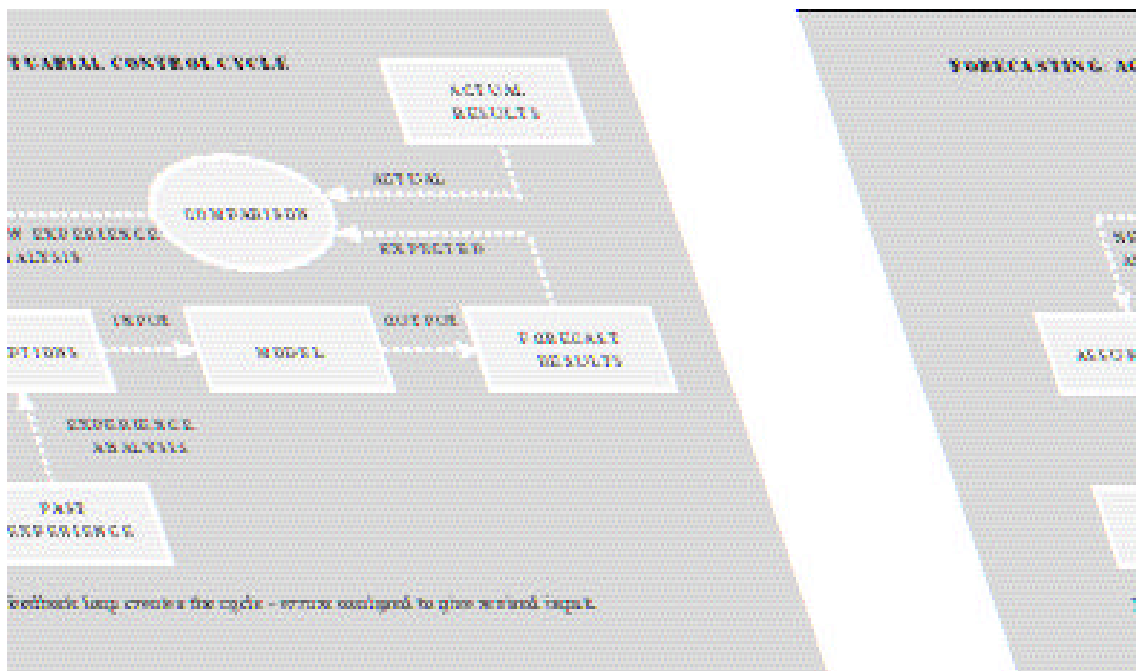
It is interesting to consider a little of the history of the field of forecasting. Bernstein, in a recent interesting book on the history of risk, notes that "... forecasting – long denigrated as a waste of time at best and a sin at worst – became an absolute necessity in the course of the seventeenth century for adventuresome entrepreneurs who were willing to take the

risk of shaping the future according to their own design.” Perhaps one looks ahead less when the normal life span is more like 40 years than 80 years!

Today, forecasting is widespread and in some ways appears routine. We have forecasting of weather, election results, economic conditions, investment performance, sporting contests and financial results of corporations.

Many forecasts are very short term – weather, sport, elections – and some are longer term. Professional forecasters are few – meteorologists, some economists and econometricians, corporate planners, some investment analysts and merchant bankers, and actuaries.

In relation to the techniques of business and economic forecasting, I believe the actuarial control cycle to be unique because it uses a feedback loop to compare the actual with the expected. It can be depicted as follows –



The analysis and the learning that take place through comparing actual with expected and revising the assumptions, through separating experience analysis from 'valuation' (i.e. from calculations within a model), at each cycle can be profound. Furthermore, the technique allows actuaries to be accountable for their forecasts, through applying actual vs expected comparisons at each cycle. Therein also lies the opportunity for professional advice.

Being 'wrong' is an occupational hazard for the forecaster. Yet we need to be fearless about being wrong – difficult as that may be because the actuary's whole psyche is built around being right! – and about demonstrating the deviations through some form of 'analysis of surplus'.

Without an explicit feedback loop, models tend to become 'black boxes'. In my experience, many non-actuarial forecasting models use assumptions which are not explicit or are hidden inside an extrapolation formula. Differences between actual and expected are not analysed and often cannot be analysed against assumptions or understood systematically. As a result, the only feedback is an empirical adjustment to the model. Extrapolation and model details may mask assumptions. In particular, cause and effect will not be well understood.

This form of 'black box' modelling can be contrasted with the control cycle as follows –





I have had personal experience of using the control cycle in the financial management of industrial companies as well as in life insurance, superannuation and general insurance. I am not about to claim that it is a concept that can only be learned and applied by actuaries. My own experiences have taught me, however, that other professionals who do forecasting do not seem to have the mindset or the skill base to be effective and confident and accountable in creating and operating a control cycle.

Hence the control cycle has the potential to carry us a long way, both in and beyond insurance and other financial services. Promoted well, its applications can only increase as business and government become more numerate, more aware of risk and more active in using and then monitoring financial forecasts.

Let me conclude this section by re-asserting that the control cycle is the fundamental actuarial process.

## 8. MAJOR IMMEDIATE CHALLENGES

“We may become the makers of our fate when we have ceased to pose as its prophets.”

Karl Popper

We are the dominant profession in life insurance and superannuation. We have a major position in general insurance and our members are exerting influence in the fields of funds

management, investment, finance, banking, health and risk management. We also have some 'lost members' who tend to be at a distance from the Institute and the profession. We have some major current challenges in each of these areas –

#### Life Insurance

This industry is changing quickly and profoundly, both in its internal operations and its market position –

The actuary and the accountant: for decades the actuary dominated financial management so much that the concept of Chief Financial Officer did not really exist and accounting in life offices was very much in the background. The advent of the new Margin on Services (MoS) financial reporting standards has elevated financial control of life companies to a level commensurate with other industries and is bringing actuaries and accountants much closer together. There are three challenges –

- to work constructively with the accounting profession in exercising effective financial control
- to co-operate effectively with the profession and the industry in New Zealand to create a common form of MoS to apply in both countries
- to build the credibility of MoS in the eyes of fund managers, bankers and others in financial services in Australia, and also in the eyes of the life insurance industry outside Australia – can we go further and have MoS embraced by international accounting standards?

Actuaries in management: the decline in the fortunes of the life industry has been accompanied, for better or for worse, by a decline in the employment of actuaries in the senior management ranks of the industry. The challenge is to retain credibility in a period when the profession is being held responsible in some quarters, at least in part, for the industry's decline.

#### Superannuation

The profession in Australia prospered greatly from the 1950's to the 1980's in the field of superannuation. It is remarkable, however, how much employment has been generated on matters of small detail, on responding to tax and other regulatory matters. Due to an excess of demand over supply, we have been able to command good incomes and good fee levels while increasingly advising on compliance issues, when our preferred emphasis must be on adding lasting value for our clients.

While this kind of employment of actuaries is still prevalent, the transition to accumulation plans is changing the landscape. The transition is being accelerated by the superannuation surcharge and an unsympathetic Government as well as general trends in employment relationships and remuneration. Superannuation is being 'packaged' more and becoming 'commoditised' through accumulation plans, master trusts, third party administrators and fund managers. More professionals of other kinds, especially lawyers and accountants, have become superannuation specialists and the exclusive actuarial needs are declining. The challenge is to emerge from the depths of detail to do justice to our capabilities, our clientele and the community by applying ourselves to questions and problems that utilise well our abilities and our training.

The superannuation field will continue to be of very high interest to our profession and, for current practitioners and those who choose to enter the field in future, there are three kinds of opportunity –

- to re-assert the importance of financial management (target benefits and the like for fund members, remuneration and employment planning for the employer) even though the quantum of exclusively actuarial work is reduced
- to retain and perhaps extend the role of expert adviser to employers on superannuation and related matters (and in doing so to stay above the minutiae), on both the liability side and the asset side
- to become influential as a profession in simplifying and demystifying the business of superannuation.

#### General Insurance

The actuary's role continues to evolve and expand in pricing, reinsurance asset/liability management and other areas. In our largest field, however, namely long tail business, we have a dilemma. Whenever claims provisions are re-assessed upwards by the actuary or prices are seen with hindsight to have been unprofitable, actuaries suffer criticism.

The general problem is not new. It was very visible in the 1980's in private sector workers' compensation and again in the 1990's in private sector CTP (compulsory third party motor insurance) in NSW. The main elements are –

- The estimation of liabilities for outstanding claims is inherently difficult and uncertain, due partly to systemic risk arising from the human behaviour component and the legal system dependency of the claims experience.
- Accounting principles and the Accounting Standard AASB1023 do not allow any smoothing. Any changes in valuation basis are fully reflected in the profit and loss account each year, as are changes in market values of assets (for realised and unrealised gains and losses).
- Although prudential margins are accepted, there is heavy emphasis on an explicit central estimate of liabilities.
- International accounting standards are quite different from Australia's.
- Pricing issues are intertwined with claims measurement issues.

Insurers, the ISC and the Tax Office all rely very heavily on actuaries for the assessment of claims provisions and many insurers also use actuarial advice in doing their pricing.

The problem was examined by the Institute's 'Long Tail Working Group' in 1996. The next phase has begun with the ISC setting up a joint working party with the Institute in 1997 on 'the Consistency and Reliability of Outstanding Claims Provisions'. The terms of reference are reproduced in Appendix D.

Part of the dilemma is that every interested party has a different 'holy grail': the insurers want freedom and flexibility in setting claims reserves, actuaries want to use their own judgement, accountants want precision and no smoothing, management wants certainty and no surprises. The actuary is almost certain to disappoint management whenever adverse claims experience is seen to occur.

We do not have good answers, even though we are better than any alternative!

The challenge is to do better, even if it means changes to the accounting standard.

#### Investment, Funds Management and Finance

It is clearly more difficult to establish a clear and differentiated role for the actuary in the investment, funds management and finance fields than it is in the traditional liability fields. We share these fields with many other experts and professional actuarial advice is rarely if ever given.

There is a dilemma here: do we provide only educational services for the investment and finance professional who chooses to do actuarial studies (a lesser aim than at present), or do we try harder to improve the relevance of the profession and the Institute to members who work in investment, funds management and finance?

The challenge is threefold –

- Recognition: we do not need a position of actuary within an investment or funds management or finance business but we do need more employers in these fields nominating actuarial training as a preferred or desirable qualification for certain types of employment.
- Education: investment professionals often complete a full set of SIA (Securities Institute of Australia) exams or they sit for the American CFA (Certified Financial Analyst) exams. These courses contain a wider range of investment knowledge than do the actuarial courses. Should actuarial students forsake their Institute exams for a specialist investment course? Should the Fellowship Investment course be modified to be a substitute for the SIA and CFA courses? Or should we continue to rely on actuarial standards and training to supplement these other courses with our own special layer of expertise?

– if our current direction is right, we need to confirm it unambiguously and to direct our efforts accordingly

- Professional relevance: Institute members who work in investment or finance often claim that they do not give actuarial advice and also that, if constrained by Institute professional standards which non-actuarial investment or finance people do not have to meet, their work may be compromised.

The task therefore is to identify a meaningful position for the Institute, its educational courses and its professional activities in the careers of investment, funds management and finance professionals who pursue actuarial qualifications.

#### Banking

The boundaries between banking, life insurance and other financial services will continue to blur and dissolve. The regulatory environment post Wallis will likely hasten and facilitate the process.

At present in Australia there are numerous actuaries working in banking. As with funds management, investment and finance, however, these actuaries are generally not operating in professional actuarial roles.

The banking challenge is a major one for our profession –

- The competitive environment for banks is such that the next few years are propitious for actuarial involvement.
- The Wallis aftermath could become a major opportunity: with prudential regulation of all financial institutions to come under the one regulator, the opportunity for the profession is to continue in its existing role with insurers and friendly societies and to take on a new role contributing to the prudential financial management of banks, credit unions and fund managers.

There is also a threat: Although the status quo could simply continue, the other possibility is that actuaries come to have a lesser role in the capital adequacy and solvency of insurers and friendly societies.

- Our role in banking could well include professional actuarial advice in such areas as pricing, management of credit and other risks, profit measurement, asset/liability management, modelling and forecasting.

#### Health

Health insurance in Australia is in crisis at present and the health care financing debate is in full flight. Related events of the last year include further declines in private health fund membership and further increases in their rates, an investigation and report by the Industry Commission, including its advocacy of unfunded lifetime community rating, high political interest, tax incentives, funding controversies in private hospitals and long waiting lists in public hospitals.

Our profession has a relatively minor position in health insurance, due largely to the highly regulated nature of the industry, and we also have a minor position in other aspects of the financing of health care and long term care.

The community desperately needs reform and good financial management of health care. It is a huge and growing industry (around \$40bn annually or around 9% of GDP, compared with about \$20bn for the whole of the general insurance industry and just \$1bn for the risk classes of life insurance).

One of the financial pressures in the system arises from the Commonwealth Government's efforts to reduce its own risk. In principle it is no longer simply meeting costs but forcing State governments, the hospital system and other parts of the industry to operate to fixed budgets. These participants are therefore being obliged progressively to accept and therefore manage more risk.

The profession's challenge is to grasp firmly the opportunity to bring health care and long term care under good actuarial financial management.

#### The 'Lost Members'

The 'lost members' are mostly those who do not work in traditional fields and who have little contact with the profession and the Institute. In many cases these members are successful and influential in their own careers but are working in fields where formal professional recognition does not exist or is not seen to be important. The most prominent areas are funds management and investment, where actuarially trained people are prevalent but where it is primarily the actuarial education and the capability of understanding actuarial studies which are relevant to employers and practitioners alike, rather than holding and using a professional qualification.

I believe it is very important to the reputation and influence of the profession that we locate and 'bring into the fold' the lost members. More easily said than done, of course, but I urge the following on all members with an interest in funds management, investment, finance, banking and other areas of employment where full professional recognition is not generally seen as important:

please make a contribution to the profession by assisting the Institute to promote the benefits of an actuarial education, to enhance the benefits of membership of the Institute and to generate opportunities for offering professional actuarial advice.

These members are important for it is in the interests of all actuaries for our profession to be well regarded in these fields. Our challenge is to increase the relevance of the Institute to these members.

## 9. INFLUENCING PUBLIC AFFAIRS

“The important thing for Government is not to do things which individuals are doing already, and to do them a little better or a little worse; but to do those things which at present are not done at all.”

John Maynard Keynes

The characteristic of our professional work which is uniquely relevant to public affairs is our interest in the longer term. To play our part –

1 We should continue to look at the long term.

The mentality of the community has changed over the last century: everyone used to look at the long term and to regard thrift as a virtue. It was a cultural phenomenon borne out of our religious heritage from an era when individuals were obliged to prepare financially for old age and infirmity because social welfare could not be relied upon.

The ‘long term’ used to be decades but now it is just five years or even three years in many people’s minds.

We need to keep looking 10 to 50 years out (a little too long for people to envisage) in order to make sense of the needs of the next 5 to 10 years.

2 We should interest ourselves in the financial and other quantifiable aspects of –

- demography (especially the ageing of the population)
- retirement incomes
- finances of health care and long term care
- accident compensation
- other social security
- life and disability insurance
- stability of our financial institutions including their prudential financial management.

These are the aspects of public affairs in which our profession has a great interest and where we have more expertise than others. They are primarily matters affecting the financial future of the community.

3 We should participate in the public debate and, to do so, work actively to undertake the research, analysis and synthesis that enable us to offer relevant advice.

4 We should work actively to promote the role and the significance of the office of the Government Actuary.

We have an interest and, due to our expertise, arguably a public responsibility to take an interest in the financial management of government-sponsored activities where risks and long term financial issues are involved. Indeed these fields are our ‘natural’ public agenda –

- we want to see rational debate built on sound information
- generally we will aim for advance funding
- we are not policy makers but we are the suppliers of advice to enable the policy makers to make soundly based decisions.

Our first public statement in this direction was the press release issued by the Institute on 13 May, the night of the 1997 Budget. Among other things, it advocated that the Government “develop a long term vision to address the significant financial problems arising from an ageing population, increased health costs and low rates of savings.” It

went on to say “The Institute of Actuaries of Australia believes that the Government should develop a national savings strategy which provides genuine incentives for medium and long term savings, integrates superannuation, the age pension and the taxation regime fully and encourages more rapid progression to income streams in retirement.”

These statements can be regarded, I believe, as the first expression of a manifesto for the profession in public affairs in Australia.

We have already, however, gone beyond just a statement. In 1997 we have responded actively to three government initiatives which are momentous for the profession –

- release of the Productivity Commission’s report on health insurance: a ‘Pandora’s box’ on health care financing has been prised open and an era of inexorable reform has commenced
- release of the Wallis report and the Government’s substantial endorsement of it: as already noted, the profession’s role in prudential regulation will not remain static but will eventually be either more prominent or less prominent, and we can influence the direction
- the superannuation surcharge: among other things, it accentuates the interest in and the shift to defined contribution plans

On health insurance, an Institute task force has issued a public discussion paper on unfunded lifetime community rating, in response to a request from the Minister for Health. On the superannuation surcharge, the Institute made strenuous efforts to have the surcharge withdrawn or modified, including presenting a well designed alternative to the Prime Minister. Ultimately we have assisted the Government to implement its legislation while steadfastly insisting that the terms of its implementation be the responsibility of the Government and not of our members.

Prudential regulation issues arising from Wallis are yet to emerge.

There is a fourth 1997 government initiative which is relevant to our members and that is tax reform. A task force, led by Ian Salmon, is being established to consider how the Institute might influence the tax debate, especially in relation to our traditional practice areas.

We have also begun to work on the manifesto referred to above. A working party was established in 1997 to begin examining retirement income and health financing options which recognise the ageing of the population. This working party will be formalised in 1998 and will most likely produce, among other things, a successor to our RIP (Retirement Incomes Policy) 1.

1 The RIP has served the Institute superbly, notwithstanding that it was controversial in some quarters both inside and outside the profession, due not only to its content but also to its very existence (as a statement of policy which would inevitably not be supported unanimously within the profession). Developments since its preparation in 1992, however, especially the superannuation guarantee charge, dictate that it be reviewed.

## 10. RECRUITMENT AND EDUCATION: MAINTAINING THE QUALITY

“The direction in which education starts a man will determine his future life.”

Plato

Supply and Demand

The debate on whether the Institute should attempt to control the supply of new entrants is over. Despite expected falling demand in life insurance and superannuation, there has

been consensus at Institute discussions that the supply of new actuaries should not be artificially limited.

There are indeed views that the supply should be expanded. For example, Duncan Ferguson, in his 1996 Presidential Address to the London Institute, appealed to the profession to “launch new recruits with an actuarial training and qualification in large numbers” and to “welcome into the profession respected applied mathematicians who will embrace our creed”. Trevor Matthews in his Presidential Address for 1997 referred to ways “we can broaden our membership and our influence”.

Our profession is limited in recognition and influence because it is so small. The message that I wish to reiterate, in the belief that we have much to offer the community, is that we should make strenuous efforts to expand the membership.

#### Maintaining and Building the Supply

The challenges are –

- to maintain standards, educational and professional
- to give suitable professional recognition to members with increasingly diverse skills and training, including our ‘unqualified successes’, selected non-members and actuaries qualified in other countries
- to attract new entrants of the right calibre into the profession.

#### Education and Professionalism

Education is one of the Institute’s largest and most important activities. The Institute has been moving progressively towards more out-sourcing of education, as evidenced for example by the control cycle which is being taught only through universities. The Institute offers exemptions according to standards that are discussed and agreed with the professors of the actuarial schools.

The Professionalism Course has been operating very effectively and evolving for 9 years now. It has become an integral part of our professional education.

CPD (continuing professional development) was launched in 1992. The requirements are specified by the Institute and the Institute provides many direct opportunities for CPD credits (e.g. sessional meetings, seminars, Educational Topical Discussion Groups). CPD operates, however, on an honour system.

... is there a need to monitor CPD activities in the interests of promoting continuing education and maintaining standards among qualified and experienced actuaries?

This question is not readily answered but should be explored. The CPD programme has been operating long enough to warrant a review of its success to date and its potential future value to the profession and members.

Education finance has taken a decided turn for the better in 1997. An Education Finance Task Force led by Steve Miles was established this year to investigate and report on the complexities and uncertainties that have plagued this aspect of our affairs (as explained extensively in Trevor Matthews’ Presidential Address).

The Task Force has proposed simplified and more transparent accounting. The primary outcome, however, is that, provided the universities keep up their side of the agreements regarding sharing of salary supplementation for actuarial staff, and provided Institute subscriptions continue to contain the current contributions ear-marked for education, we can continue to support the universities according to past plans and agreements.

#### Professional Recognition without FIAA



If we are serious about broadening our membership, we will need to re-assess our treatment of the ‘unqualified successes’, selected applied mathematicians and others, and those who have qualified through other actuarial bodies.

The ‘unqualified successes’ are those who are not fully qualified, in many cases Associates of the Institute, and who have successful careers, professional or otherwise, despite lacking full professional recognition. Some are also ‘lost members’.

There are difficult issues to be faced here. The most tractable is the international one – see next section. Nevertheless, to make progress on the ‘unqualified successes’ and selected non-members is a strategic objective of the Institute. A new task force on membership, chaired by Geoff Burgess, will examine this issue in 1998.

#### New Entrants

We need, as in the past, new entrants of high calibre. Macquarie and Melbourne Universities, and also ANU, are attracting and training them.

University education is now an essential feature of our education system. The support we have had over 30 years from Macquarie University (yes, three full decades) and more recently from Melbourne University has been spectacular.

Interestingly, there also continue to be many capable graduates of other universities, graduates usually in mathematics or statistics, who are entering the profession in the time-honoured manner of correspondence study.

Hence, it is the universities, both with and without actuarial departments, who represent the ‘breeding ground’ of the profession.

Statistics continue to show that, while the minimum entrance standards to university actuarial courses have declined to some extent, especially at Macquarie, there remains a high correlation between capability as measured by university entrance exam results and success in actuarial studies.

The establishment of Melbourne University School of Actuarial Studies has added a valuable dimension to university support. There are some elements of competition between it and Macquarie, and that is not unhealthy, but perhaps more important is the opportunity created by this modest diversity to learn and compare from a wider experience.

Given the growing competition the profession is encountering for mathematics and other students, important strategic questions for us are –

- are single degree undergraduate courses the best entry point for our best recruits?
- the trend towards double degrees and more masters degrees by the more capable students is visible and growing
- are Macquarie and Melbourne universities the most appropriate institutions to cater for the profession’s future recruitment aspirations?
- is the formula that served us so admirably for the last 30 years the right one for the next 30 years?

## 11. THE INTERNATIONAL DIMENSION

“Peace, commerce and honest friendship with all nations – entangling alliances with none.”

Thomas Jefferson

Our Institute has, as I see it, four components to its international interests –

- 1 participating actively in the globalisation of the profession, by supporting the initiatives and the objectives of the IFAA (International Forum of Actuarial Associations)
- 2 continuing the very strong links that have existed for many years with our professional colleagues in the UK, USA, Canada and New Zealand
- 3 building closer links and increasing understanding with actuarial associations in Asia and with our own members working in Asia
- 4 developing our own individual links with actuarial bodies in other countries.

#### Globalisation of the Profession

The IFAA (International Forum of Actuarial Associations), which was formed in 1995, is a vehicle for international co-operation on numerous topics of interest to our Institute and our members.

A major breakthrough would be an international educational qualification. We continue to support this initiative and to promote the Control Cycle, otherwise known as Principles of Actuarial Management, as the standard.

Areas of co-operation in which we have an interest are education, mutual recognition, promotion of the profession, accounting standards and solvency requirements, especially in life insurance, general insurance and pensions.

There are also discussions taking place about coalescing the IFAA and the IAA (International Actuarial Association), the latter comprising as members individual actuaries only. The potential benefits include stronger co-operation and cohesion within the profession around the world.

Globalisation of the profession is a little more real each year. No longer is it enough for us to consider ourselves to be closely linked only with the Institute in London, the Faculty and the Society. Yet extending the list, for example, to the Casualty Actuarial Society and the Canadian Institute would be only a modest move. It is the efforts of the IFAA together with various opportunities to meet our international friends, as occurred at our Centenary Convention, which broaden our relationships and our horizons.

We have also begun attempts to be closer to our good friends in New Zealand. With recognition by the London Institute of the FIAA after a year of residence and practice, a major barrier to New Zealand students selecting FIAA as their qualification has been removed. Hence our links with New Zealand can now fully embrace education.

#### Recognition of International Qualifications

The issue of professional recognition in Australia is at this stage largely confined to other actuarial bodies which conduct their own examinations. As Canada, New Zealand and South Africa do not, and nor do any Asian countries, the debate for us in these countries is their recognition of our qualification.

Although we have been a 'republic' for some time, arguably since we introduced our own fellowship examinations in 1980, our links with the London Institute and the Faculty are very close. The relationship has been enhanced through recognition by the Institute, since 1995, of an FIAA as an FIA after twelve months of residence and practice in the UK. But even the debate is changing. Reciprocal recognition is desirable in principle but not always achievable.

The IFAA may contribute a partial solution: it is now looking for an international minimum qualification (will it be the control cycle?). Such a qualification would have

immense value, especially in Asia where as yet no actuarial association is setting its own examinations. It would also be of great value in other countries where at present our own Institute is offering no recognition of local qualifications through a belief that these qualifications do not match our own.

We also need, however, mutual international acceptance at Fellowship level. An international minimum qualification would undoubtedly facilitate such recognition. We need not wait for the IFAA, however, and the Institute in London has shown the way with its rules for accepting FIAA's.

Will our own views of our own standards act as barriers to recognition of other countries' actuarial qualifications? ... almost certainly yes. Let us, however, take the question forward case by case (and top down from a professional viewpoint) and simultaneously support the IFAA in its international education ambitions (which are bottom up in relation to qualifications).

#### Links in Asia

The profession is growing quickly in Asia. There are increasing numbers of actuaries going to Asia who have qualified and worked elsewhere. There are increasing numbers of students studying the exams of the London Institute, the Society in the US and our own Institute.

There is much to be gained for everyone through co-operation between our Institute and each of the actuarial associations in Asian countries. There is also great benefit in co-operating, particularly in education, between the Institute, the Society, and our own Institute. In conjunction with the IFAA initiatives and the emergence of full professional actuarial associations in several Asian countries, one can readily foresee a maturing of the profession in Asia and a strengthening local role for each country's association.

We will continue to encourage and support the development of the profession in countries where we can make a contribution. At present, these countries are Singapore, Hong Kong, Malaysia and Indonesia. The list is certain to expand in the next few years as the profession and its role grow in these and other countries.

## 12. CONCLUSION

"Never let the future disturb you. You will meet it, if you have to, with the same weapons of reason which today arm you against the present."

Marcus Aurelius

By this Address my aims are to encourage members to –

- be proud of our heritage and our achievements as a profession during our first century
- think more widely about our position in the professional community and our contribution to society
- generate opportunities for offering professional actuarial advice in non-traditional fields
- continue to support the recruitment of high calibre young people into the profession
- contribute to the globalisation of the profession, and
- encourage members either to be or to support our pioneers, our risk-takers and our leaders, in seeking to broaden and strengthen the profession.

I have also introduced the idea of a manifesto for the Institute in public affairs, building on public statements we made in 1997 on the ageing of the population and the financing of retirement incomes, health care and long term care.

If there had to be just one message from this address, it would be that the great opportunities to extend the frontier, both in our traditional fields and in other areas where we are not currently prominent, are there for all to see. The Institute will promote and follow and support, but it takes a special effort of initiative, risk-taking, faith and self-confidence by individual members to capitalise on these opportunities.

Recent events, including development of an IAA Strategic Plan and the appointment of a very capable Executive Director, give the Institute a greater ability than ever before to shape the next century (as was our theme in 1997) and to make financial sense of the future (the by-line of the London Institute), as we select and embark upon our pathways to the future.

#### References

- 1 Past Presidential Addresses (various).
- 2 IAA Strategic Plan: paper at IAA Centenary Convention 1997.
- 3 Institute of Actuaries of Australia Annual Reports 1992-1996.
- 4 Clare Bellis: The Future-Managers: Actuaries in Australia 1853–1997
- 5 Peter L Bernstein: Against the Gods – The Remarkable Story of Risk.
- 6 Morrisson and Crossland: An Introduction to the Mechanics of Machines.
- 7 Ries and Trout: The 22 Immutable Laws of Marketing

#### Appendix A

##### IAA Strategic Plan: Executive Summary

Extract from paper presented to the Centenary Convention, Gold Coast, 1997.

The actuarial profession operates in an increasingly dynamic environment. The industries we serve and emerging areas of opportunity are being reshaped by major forces of change – technology development, the ageing of the population, globalisation, industry convergence, legislative development, privatisation and so on. Many of these changes are very positive developments but they do affect (and some will reduce) traditional areas of actuarial endeavour.

Simultaneously, the profession is growing at a healthy rate.

In this dynamic environment, emerging areas of opportunity will be best exploited if we do what we do best .... contemplate and model the future .... and translate into present day implications, required strategies and action. The role of the Strategic Plan is to set out the framework under which we address our development into the future.

The Strategic Plan is structured around six key issues:

- Customer Focus of the Institute and the profession
- Market Penetration of existing markets – ie more of our services to existing customers
- Market Development (‘non traditional employment’) – ie applying our services and contribution in a wider range of industries and fields of endeavour

- ‘Product’ Development – where the actuary is the product, and skill development enhances our marketability
- Role of the Profession represented by the Institute and its Members
- Role of the Institute in extending our influence – there are significant public affairs where we have a valuable, and in some cases unique contribution to make.

Strategic plans are dynamic and evolving – this is Version 1 for the Institute. Discussion of this document and unresolved issues will be reflected in enhanced later versions. So too will debate of the Vision for the Institute and the profession, to complement the Mission developed by the Institute two years ago. Continued evolution of the forces shaping our operating environment will also require annual updates to the Strategic Plan.

The intended process to ensure that this Strategic Plan is relevant and representative for the profession is:

- Centenary Convention presentation and discussion by members
- Post Convention workshops
- Council adoption of Strategic Plan (incorporating feedback from Convention discussion and subsequent workshops)
- Confirmation of key themes and resourcing in Presidential Address.

All members of the profession are responsible for creating our future – the Strategic Plan is intended as a guide for us all to give direction to our shaping of the profession and shaping of the future.

## Appendix B

The Institute of Actuaries of Australia

Mission Statement

(prepared in 1995)

The Institute represents the actuarial profession in Australia. It is committed to promoting the profession and creating, expanding and maintaining an environment where the skills of actuaries are widely used and valued.

The profession has expertise in life, general and health insurance, superannuation, investment and finance.

In these, and increasingly in other fields, actuaries produce practical solutions to problems involving the impact of uncertain events, often in the distant future, on assets, liabilities or revenue flows.

Actuaries’ uniqueness lies in their use of judgement and a combination of mathematical, statistical, demographic, economic, financial, analytical and modelling skills.

The Institute:

- provides education, encourages continuing professional development, promotes research and fosters the advancement of actuarial science;
- sets and enforces professional standards and a code of conduct which embody integrity, expertise and relevance;
- provides professional accreditation for the protection of the public; and
- provides advice on the development and implementation of public policy.

## Appendix C

## Extending the Frontier – An Interview

This Interview with Michael Clark is reproduced from the London Institute's The Actuary of June 1997

Michael Clark is an actuary who quit his job at Scottish Life to work as a project financier for Hambros Bank. He spoke to Zaki Khorasaneh about his new career.

Q What kind of work were you doing at Scottish Life?

A Having started my career at JA Carson & Partners in Johannesburg, I moved to Edinburgh and joined Scottish Life where I spent most of my time in the marketing department. My role covered product development, competitor analysis, and sales staff support as well as managerial responsibilities.

Q Why did you decide to seek employment in a field in which actuaries have not so far made so much of an impact?

A Actuaries are highly respected in their traditional fields, but I was always curious as to how we would succeed in areas where there is no perceived advantage associated with the professional qualification. The capital projects conferences run by the profession sparked my interest in project finance. The more I discovered, the more I realised that non-retail financial services offered me more exciting challenges.

Q How did you convince your current employer that you, an actuary, were the right person for the job?

A When seeking employment opportunities I chose to contact only those individuals who had at least some appreciation of actuarial skills. While the question is best answered by my employer, I would advise others to stress their ability to work within someone else's framework, show a willingness to learn and, most important, express their enthusiasm that can make up for a lack of experience.

Q What techniques have traditionally been used in project evaluation?

A The defining principle of project finance is that it is limited recourse. In other words the finance is not fully secured against the sponsors, contractors, or operators, but primarily by means of a charge over all future cashflows from the project. Discounted cashflow (CDF) techniques have therefore been the obvious basis of evaluation. In most instances a spreadsheet model is used to test the sensitivity of the internal rate of return (IRR) and debt coverage ratios to assumptions regarding inflation, cost overruns, delays and so on.

Q Most people involved in project evaluation are not actuaries. Has it been easy to convince them that actuarial techniques might add value?

A Much of the work is based on precedent and, while actuarial techniques can add value, there is greater scope for actuaries to apply the professionalism of the actuarial methodology to what are often sound evaluation techniques. For instance, checking sources of data, stating assumptions, checking for consistency, and interpreting results are actuarial skills which can be immediately applied with great effect. I believe that actuaries' unique grounding in the principles of compound interest gives them the ability to add real value.

Q Actuaries who work in traditional areas can consult professional guidance or ask experienced colleagues for advice when they are uncertain of what to do. How easy has it been to cope without these forms of support?

A This has been a greater issue than envisaged and I am grateful for Chris Lewin's advice on a number of technical and professional issues. As a general rule I try to imagine myself being called to account for my actions by some of the senior actuaries for whom I have worked, which usually provides clarity as to the right course of action.

Q How does your current work environment compare to what most actuaries are used to?

A Actuaries in this field often work in small multidisciplinary teams, on projects which involve co-ordinating inputs from many areas, producing proposals, undertaking contract negotiations, and obtaining board approval. In this dynamic environment one could be working on two or three such projects, requiring a fairly detailed understanding of such diverse areas as the operating risks for rolling stock, the basis of traffic projections, and the operation of the capital markets. This requires greater flexibility, speed of response, and initiative than in the traditional areas of actuarial employment. Most significantly, one is closer to the decision-making process on a regular basis at a much earlier stage in one's career.

Q Do you believe that many actuaries could compete in this and other potentially lucrative areas of finance currently dominated by other professions?

A Yes. There will always be individuals who will infiltrate these areas – for instance, there are actuaries in the cross-border leasing team at Hambros. As for consultancies with no experience, I think it would probably be necessary to bring in experienced individuals to work with actuaries so as to develop the all-important track record.

## Appendix D

### Consistency and Reliability of Outstanding Claims Provisions

A working party was established in 1997 by the Institute's General Insurance Practice Committee at the request of the Insurance and Superannuation Commission.

#### Terms of Reference

1. To determine the degree of consistency among insurers which is provided by current practice in the establishment of provisions for outstanding claims, and the reliability, over time, of the provisions so established.
2. To examine whether actuarial estimation of outstanding claims liabilities improves the consistency and reliability of outstanding claim provision of general insurers.
3. To assess whether material improvements in the levels of consistency and reliability of outstanding claims provisions are necessary, and the extent to which these could be achieved by:
  - (i) alterations to actuarial and/or accounting standards, and/or
  - (ii) further requirements on the general insurance industry.

## Appendix E

### 1997 News Releases

#### Date Headline

28 February 1997 Medicare likely to collapse without strong private health insurance industry

18 March 1997 High demand for actuaries

7 April 1997 Key to Wallis is in detailed implementation

- 10 April 1997 Government must adopt age at entry lifetime community rating
- 27 April 1997 Wallis presents opportunity to strengthen investor protection through consistent capital adequacy
- 6 May 1997 Government urged to reconsider surcharge
- 13 May 1997 Budget Savings Measures Lack Long Term Focus
- 18 June 1997 IAA study tips new directions for friendly societies
- 13 August 1997 Dr Gregory Taylor wins actuarial Gold Medal
- 15 August 1997 Preparing For The Future - Actuarially Speaking
- 19 August 1997 Faster, smaller and smarter: the world by the year 2097
- 20 August 1997 Bob Glading named Actuary of the Year
- 20 August 1997 Institute of Actuaries puts health insurance options to Government



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# The Institute of Actuaries of Australia

Sessional Meeting  
March 1998

**Asset Liability Modelling for Life and General  
Insurance Companies**

JENNIFER LANG BEd FIAA FIA

February 1998

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**The Institute of Actuaries of Australia**

**Asset Liability Modelling for Life and General Insurance  
Companies**

*Jennifer Lang*

**Abstract**

*This paper develops some practical examples of asset/liability modelling for life and general insurance companies. The main examples are concerned with the variability of profits in life and general insurance companies, and these examples show that useful conclusions can be drawn about profit variability in life and general insurance companies using some reasonably straightforward models of the assets and the liabilities. In the process of developing asset liability modelling examples, the paper considers the necessity of complex asset models, and concludes that provided care is taken, an understanding of the parameters and limitations of asset models may be more important than a perfect fit of past asset returns. However, some asset liability modelling applications will require a better asset model than others.*

**Key Words**

Asset liability modelling, profit, actuarial appraisal values, life insurance, general insurance, margin on services.

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## 1. INTRODUCTION

1.1 The aim of this paper is to suggest simple ways in which asset liability modelling can be used to enhance the management of a general insurance or a life insurance company.

1.2 This paper provides a set of worked examples of asset liability modelling in the context of life insurance and general insurance companies.

### **What is asset liability modelling?**

1.3 Asset liability modelling, for the purposes of this paper, is taken to be a model which considers the interrelationships between the assets and the liabilities of an insurance company. Changes in the value of the assets will usually result in changes in the value of the liabilities.

1.4 These changes could result from a change in the basis for the calculation of liabilities (as for example when the value of outstanding Compulsory Third Party (CTP) claims will change as a result of changes in the valuation interest rate which is based on market interest rates). The changes could also result where the actual liability was based on the market value of the assets backing it (as for example with a unit linked life insurance contract, where the unit liability moves with changes in the underlying asset values)

1.5 Asset liability modelling does not necessarily have to be stochastic (ie involving many random simulations). Financial projections of a company's business under different asset and liability scenarios is, fundamentally, asset liability modelling. Scenarios in this context refers, for example, to changes

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in future asset values due to movements in investment yields or changes in future liabilities due to variations in claim rates.

- 1.6 This paper primarily examines the changes in the asset side of projected balance sheets; a stochastic approach has been used.
- 1.7 Because the main source of variation investigated comes from the asset side, the paper provides an introduction to some commonly used asset models which have been published, and a discussion of their theoretical and practical advantages and disadvantages. In particular, it considers the importance of looking at the asset model to be chosen in the context of the proposed use of the asset liability model.

### **Asset model complexity**

- 1.8 Asset liability modelling has a reputation as being complex. The reason lies mostly in the modelling of the asset side of the projected balance sheet. The derivation of asset models can be a complex process, and by its nature, is unlikely to result in a unique uncontested outcome, or model. However, once an asset model has been derived, and documented, as those discussed in this paper, they are relatively simple to use. The complexity of the discussion of the method of *derivation* of the asset model tends to obscure the fact that the asset model finally derived is not as complex to understand in its practical usage.
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## 2. WHY USE ASSET LIABILITY MODELLING

2.1 Asset liability modelling in an insurance company involves investigating part or all of the possible future financial outcomes of a company under conditions where the assets, liabilities or both may vary. The company business or a particular portfolio will have a set of interrelationships between its assets and liabilities, so that the possible financial outcomes of the company (eg solvency, profitability or some other measure) can be investigated under a variety of scenarios relating to the value of assets and/or liabilities.

2.2 The possible uses of this type of modelling are described below.

### **Solvency requirements**

2.3 A common use of asset liability modelling in the literature for both life and general insurance companies relates to capital needs or solvency and “probabilities of ruin”.

2.4 A capital needs investigation usually focuses on a particular undesirable event. This could include breaching minimum solvency requirements, forcing the regulator’s attention, or requiring a call on capital from the parent company. First, the undesirable event is determined that might be investigated. Then, a model of the company is set up, which models possible future financial outcomes of the company under a range of scenarios. These would usually (but not always) involve varying the asset returns, with the liabilities of the company varying in response to these changes in asset returns.

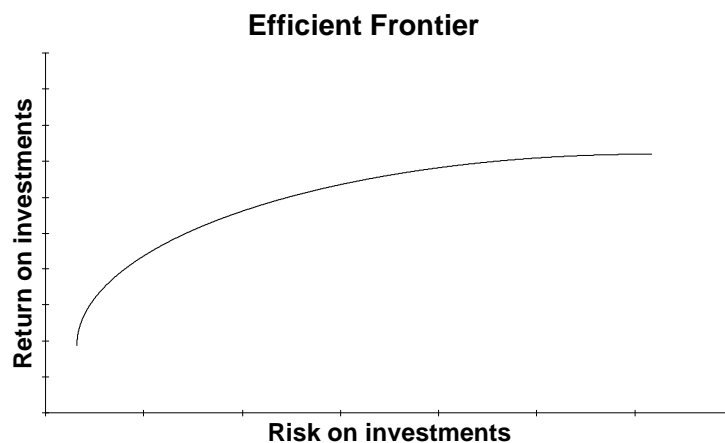
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- 2.5 These scenarios might be stochastic, or determined specifically during the investigation. In either case, in each scenario referred to above may occur. The investigation involves looking at the number of times this event would occur, compared with the total number of scenarios examined. This will help the company to understand the adequacy of its reserves and capital currently being held in the company. If the scenarios are stochastic, the probability of the undesirable event occurring can be measured. If the scenarios were deterministic, the investigation will have enabled understanding of the circumstances in which the undesirable event occurs.
- 2.6 Alternatively, under a stochastic investigation, a particular probability of the undesirable event occurring can be chosen. The solvency reserves or capital required so that the undesirable event would not occur can then be calculated so that the probability of the undesirable event occurring is not greater than the probability chosen.

### **Asset Allocation**

- 2.7 Asset allocation investigations involve looking at the trade-off between return and risk from different asset allocations in the company.
- 2.8 A model of part of, or all of a company business is set up. For this type of investigation, generally the only source of variability modelled is the variability of the asset return, with the liabilities of the company changing only as a direct consequence of future changes in economic conditions related to variations in asset values.
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- 2.9 This will enable the investigation to look at the changes in expected return as the asset mix is changed, and look at the differences in risk as the asset mix is changed. An important decision in this type of analysis is how to measure risk - as the probability of loss, or the probability of a return lower than a risk free rate of return, or the requirement to raise more capital.
- 2.10 Using an asset liability model to look at asset allocation is similar to efficient frontier analysis, which is often used in asset allocation. Efficient frontier analysis looks at the tradeoff between return and risk in asset return when changing asset allocations, as the investigation described above does.
- 2.11 In investigating an efficient frontier, it is assumed that in an investment market place, there are a number of portfolios which will lie along the efficient frontier. These portfolios will provide the maximum return for a given level of risk; or the minimum risk for a maximum level of return.





2.12 Most efficient frontier analyses look only at the assets. In determining the return and risk numbers to show in the graph above, they look at the absolute return on the assets, and the risk is generally measured as the standard deviation of that return. An asset liability investigation of asset allocation will allow the efficient frontier above to be investigated more completely for the whole company. There are a number of ways in which performing an asset liability analysis will assist the company when compared with an asset analysis in isolation:

2.13 Asset liability modelling enhances the efficient frontier analysis in a number of important ways:

- looking at the interaction between the assets and the liabilities

An efficient frontier analysis generally looks at the asset returns only. It implicitly assumes that the liabilities will not be affected by either economic conditions (such as fixed interest yields) or by the returns on the asset themselves. While in many cases this is true, it is not necessarily true for insurance companies. An asset liability analysis, which looks at the interaction between the assets and the liabilities can enhance understanding of the risk and reward tradeoff involved in particular asset allocation decisions.

An example of this would be looking at the outstanding claims liabilities for a general insurance company. A traditional efficient frontier analysis might show the impact of moving from an investment in cash to an investment in fixed interest as a slight

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increase in volatility for a slight increase in return. For a general insurance company, however, with a set of long tail liabilities, investing in assets with a duration matching the liabilities (such as a portfolio of fixed interest assets) will give a much lower risk to the reported profit of the company than an investment in cash, with a higher expected return.

- using measures of risk other than the standard deviation.

An efficient frontier analysis generally looks at risk by looking at the standard deviation of the portfolio. An asset liability analysis enables investigation of other measures of risk, such as the chance of a loss on the portfolio, or the chance of insolvency. This may give different answers to the standard deviation of the asset portfolio because of the interaction of the assets and the liabilities, and because the asset model used may not be symmetrical.

- modelling tax more accurately

Using an asset liability model allows modelling of the tax paid by the company, not just modelling of an after tax return including interaction with the liabilities where this occurs (for example offsetting tax on asset returns with taxes on expenses)

- modelling the effect of options and futures to determine the likely usefulness of such a strategy

Options, and to a less extent futures, will generally not give symmetrical effects to an asset return. They can not generally be

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modelled using means and standard deviations, which is what is needed for an efficient frontier analysis. An asset liability model allows a more direct investigation of the usefulness of such derivative strategies.

### **Crediting Rate investigations**

- 2.14 For investment account type products, asset liability modelling has been used to investigate the effect on various outcomes of return and risk to the company of different strategies for determining crediting rates.
- 2.15 For this type of investigation, the investment account product is modelled using a financial projection, with the liability being determined based on an amount credited to the policy. The amount credited to the policy will depend upon the crediting rate chosen, which will, in turn, depend upon the method used for smoothing the asset return to arrive at a crediting rate.
- 2.16 In order to determine an appropriate crediting rate strategy, some measure of the return to the company and the risks associated with that return will need to be used. These measures will generally be similar to the measure used in solvency investigations (as discussed at the beginning of this section) - probability of a loss, of breaching solvency, or needing a capital injection from another part of the business or from external sources of capital. However, there will be another important element to this investigation, which will be the equity of the proposed crediting rate method for policyholders. The investigation will also, therefore look at the level of under and over crediting to policyholders during the life cycle of a policy.
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**Profit Variability**

- 2.17 In recent times, both general insurance and life insurance companies have moved to a measure of profit which brings asset movements straight through to the bottom line.
- 2.18 For general insurance companies, all assets and liabilities are now required to be marked to market under AASB 1023. This means that asset movements are generally directly reflected in the bottom line, and if the company has long tail outstanding claims liabilities, movements in interest rates will also affect the value of those liabilities. If the assets backing these long tail liabilities are invested in fixed interest assets with a duration similar to the liabilities, then the effect of movements in interest rates will be reduced.
- 2.19 For life insurance companies, the introduction of margin on services (MoS) profit reporting has meant that there is now an identifiable reported profit for life insurance companies. This is calculated using the market value of assets, together with policy liabilities which are generally calculated using a discount rate which is dependent upon market interest rates (although the actuary has some discretion in how the discount rate is linked to the market interest rates).
- 2.20 As more companies are listed, there is increasing public interest in profit figures for both general and life insurance companies. There is, therefore, increasing interest from the management of both general and life insurance companies in the sources of variation in this profit, and how their
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management actions might affect profit variation - both its source and its size.

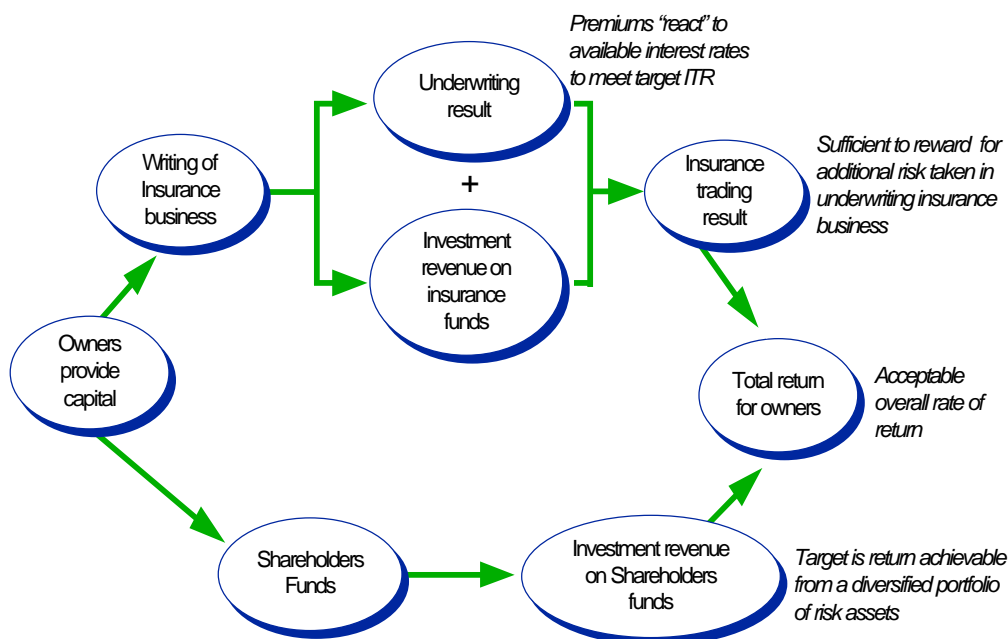
### **Sources of variation - general insurance**

2.21 The diagram below shows the sources of equity return for an investor in a general insurance company. The return to shareholders comes from two sources. The portfolio of insurance business will generate a profit (or loss) from underwriting activities (including the investment return on reserves held to meet portfolio liabilities). The return to shareholders is also generated from the shareholders funds, which are required for the company to be in the general insurance business, but which are not required to be tied up in reserves.

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## Asset liability modelling for Life and General Insurance Companies

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2.22 Investing in a general insurance company involves an investment in the assets of the shareholders funds and earning return additional to the return on those shareholders funds from the underwriting activities of the company. This extra return is a reward for the risk taken in investing in the general insurance company.

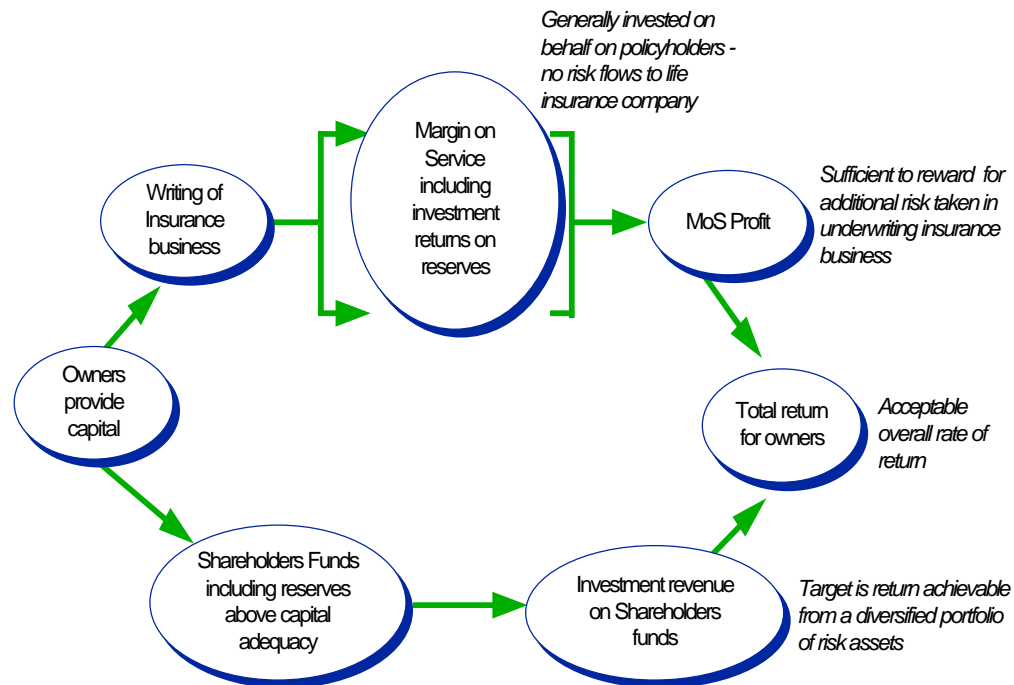
### Sources of variation - life companies

2.23 A life company is in a similar position to a general insurance company in that the profit arrives from two sources - the profit from the insurance and investment activities (on behalf of policyholders) of the company, and the profit from investing the shareholders funds directly, as shown in the diagram below.

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## Asset liability modelling for Life and General Insurance Companies

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2.24 However, the actual variability of the resulting profits is likely to be quite different. Investing in the business activities of life insurance generally provides different sources of profit variation from general insurance. Where for general insurance, the variation in profit on the insurance activities will usually come from claims cost variation, this is not as generally true for a life insurance company (with the exception of risk specialists). The life insurance profit variation is likely to also come from variations in asset returns, variations in lapse rates and their interaction with the liabilities of the company. This is explored further in Section 5.

2.25 For some simple examples of life insurance and general insurance companies, this paper looks at the variability in reported profits which occurs because of movements in asset values, and also for life insurance

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the variability which occurs through other types of variability (such as claim variation).

- 2.26 The paper therefore uses one particular investigation each of a life insurance and a general insurance company (the variability of profits in the company) to show an application of asset liability modelling, and to assist in understanding the return to shareholders of each company compared with the returns they might receive on investments in other equities.
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### 3. DOES THE ASSET MODEL MAKE A DIFFERENCE?

- 3.1 To carry out asset liability modelling, a key requirement is an asset model. This paper looks at stochastic asset models only. This is not to say that deterministic asset models are not useful. For example, to enable understanding of the impact of historic movements on a company's current results, a powerful analysis could involve applying historic asset returns to the company as it stands today. This would enable understanding of the impact of those returns on the company if they were to occur today.

#### **Stochastic asset models**

- 3.2 Attachment A describes the three asset models which are tested in this research. These are, in ascending order of complexity, a random walk model (RW), the Institute of Actuaries 1992 model, and the regime switching vector autoregressive model (RSVAR) developed by Glen Harris in 1997.

#### **Random Walk Model**

- 3.3 The random walk model is the simplest, easiest to understand, and least theoretically justifiable model of those which have been used in published work. The model assumes that the return on each asset class (such as Australian equities, Australian fixed interest, property, cash, international equities, etc) can be represented by a normal distribution, which is correlated with the other asset classes. There is "no memory" in the distributions, so a high or low return in one year will not have any effect
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on the return in the next year. Most analyses of the Australian and other countries' markets (Carter, Harris, Wilkie) have concluded that both the assumption of normality and the assumption of "no memory" is questionable.

3.4 However, on the plus side for the random walk model, the parameters are simple to understand, and the calibration of those parameters can take into account the views of the practitioner about the future of investment markets. In the example in this paper, the model has been calibrated by looking at historic data, and forming a view on how the data should be used looking forward.

3.5 The mean returns used in the model have been calibrated based on views about the relativity of the mean returns of different asset classes. For example, the equity premium (the return of equities above fixed interest) is assumed to be 5.5%. Historically, the equity premium has varied widely, and by choosing different calendar periods, it is possible determine an equity premium ranging from 0% to around 10% by choosing different periods to analyse.

3.6 However, the equity premium is a number which is often used to determine risk discount rates, where numbers from 4% to 7% are often used. If we are to be consistent with risk discount rate analyses, it seems appropriate to calibrate the asset model with a similar equity premium.

3.7 The standard deviations have been calibrated in relation to the mean returns. The historic returns for different asset classes were analysed, to determine a mean and standard deviation. The relationship between the

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historic standard deviation and historic mean was used to determine the standard deviation used in the model.

- 3.8 The correlations used between each asset class (eg Australian equity correlation with Australian fixed interest) are based on historic correlations between asset classes. They have not been changed by making broad assumptions about the future.
- 3.9 The calibration of the random walk model is straightforward. This is both a strength and a weakness. It is a strength as relationships which are used in other parts of a company model (such as the equity premium) can be easily perpetuated in the model. It is a weakness because the ease of setting the parameters may give the illusion of accurate modelling, even if the parameters are not appropriate.
- 3.10 The models below are more theoretically justifiable, but more difficult both to fit parameters to, and to calculate the asset returns emerging from them.

### **The IAA (92) model**

- 3.11 For the early work in investigating appropriate capital adequacy reserves for life insurance companies in Australia, a subcommittee of the Life Insurance Practice Committee of the Institute of Actuaries of Australia used a model of the Australian economy which had been developed by one of its members. The development of the model was not published, but the parameters and model were published.
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- 3.12 The model used the same structure as the UK Maturity Guarantees Working Party (MGWP 1980) model developed to investigate the cost of guarantees on UK conventional with profits contracts. It is a simple time series model of equity, property and fixed interest investments, where income and income yields are modelled separately, and income yields are assumed to have “memory” - a low income yield in one year is more likely to increase towards the long term mean of income yields than decrease. This provides a long term trend line around which returns will tend to move.
- 3.13 Cash is also modelled, where the cash return is determined as a random difference from the fixed interest yield. This also enables a full fixed interest yield curve to be modelled.
- 3.14 This model, because of the “memory” in the returns, enables a simulation to be done from a starting point that is chosen to be high or low in terms of the long term position of the markets. An example of this would be September 1987. Most observers would have agreed at that time that the share market was overpriced, and the model would bear this out, as the dividend yield of the Australian share market was around 2.5%, compared with a long term mean in this model of 5.5%. Any simulation starting from this point would give a high probability of an immediate fall in share market prices.
- 3.15 The effect of the more complex structure of this model is that the variance in total returns tends to be larger than a random walk model, which fits the observed experience slightly better. However, Glen Harris in his 1995 paper (Harris 1995c) showed that the model still did not fit the available data as well as his GARCH model.
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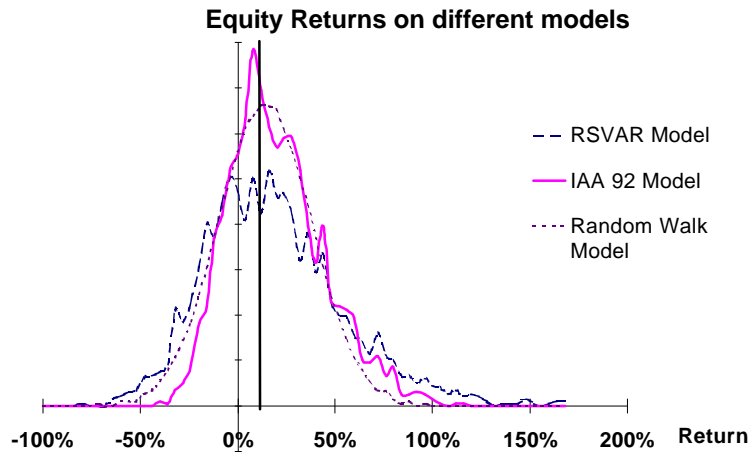
**RSVAR model**

- 3.16 This model was developed by Glen Harris to supersede his GARCH model, and was fitted to quarterly data since 1959. It models GDP growth, change in CPI, change in bond yields, and Australian equity price increases.
- 3.17 Its structure is fundamentally different from the two models above, in that it has effectively, two states. One state is more common. In this state, asset returns are expected to be positive, and the variance of asset returns is not all that high. In the second state of the model, however, asset returns are expected to be negative, and the variance of the asset returns is very high. Each quarter, if the model is in the first state, it has around a one-sixth chance of moving to the second state, and if it is in the second state it has around a 50% chance of moving back to the first state. The effect of this is to give a model of asset returns which is generally quite close to the mean, but which occasionally moves to another state with a very large variance, and expectation of negative returns.
- 3.18 The model has been developed using the parameters which exactly fit the data, whereas the other two models have both started with parameters which exactly fit the data, but have been changed them based on views about the relationship between different asset classes and the future returns on those asset classes.
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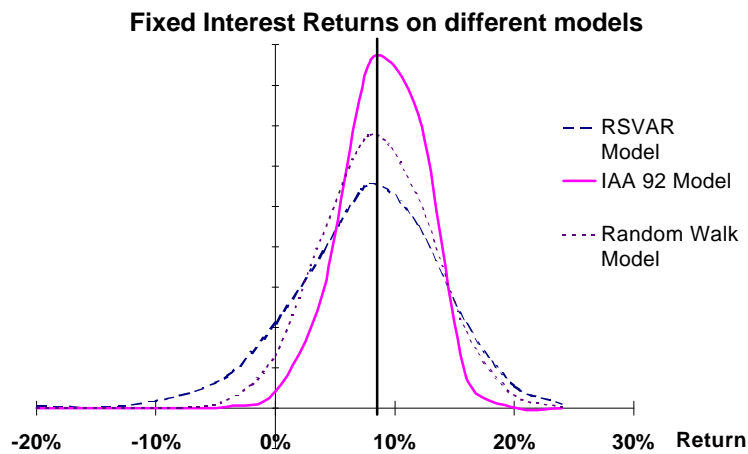
**Does the model make a difference?**

- 3.19 The IAA 92 and RSVAR models each cover a different set of asset classes. The only two asset classes which are covered by all models are Australian fixed interest yields (for 10 year bonds) and equity returns. Even for equity returns, the RSVAR model only looks at price returns, and doesn't include income, so it is not completely straightforward to compare the models.
- 3.20 To look at the differences between the models, the graphs below show the range of returns at each probability level for each of the three models for equities, fixed interest and the difference between equities and fixed interest.
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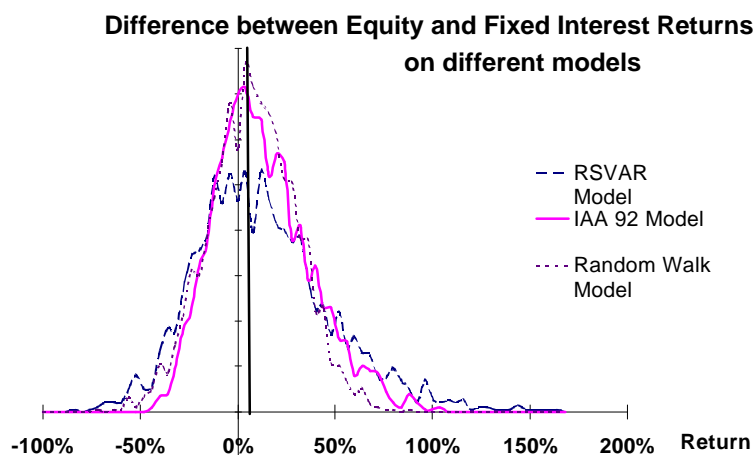
3.21 Figure 1 - Equity returns in the three models:



3.22 Figure 2 - Fixed Interest Returns in the three models



## 3.23 Figure 3 - Difference between equity and Fixed Interest Returns



3.24 We can see from the graphs above that the three models have a number of important differences. First, the random walk model clearly provides much smoother results. This is because it uses a normal distribution without any adaptation.

3.25 Second, for both the equity and fixed interest models, the RSVAR has much fatter tails than the other two models. In the case of the equity model, this effect is only apparent at the tails of the distribution, whereas for the fixed interest model, the whole RSVAR model appears to have a bigger variance.

3.26 The reason for the variance different is quite likely to be the different ways in which parameters have been derived. Fixed interest parameters depend quite substantially on one's view of the market. For both the random walk and the IAA 92 model, data from the 1960s and 1970s has implicitly been

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discarded in the choice of parameters, whereas the RSVAR model uses all available data.

- 3.27 Since both the random walk and the IAA 92 model could be recalibrated if your view of fixed interest markets was for a higher variance, the pattern of returns is probably more important to consider in comparing the two models.
- 3.28 Clearly, the RSVAR model provides a fatter tailed distribution. More of the distribution is quite some distance from the mean than for the other two distributions. This is a function of the regime switching effect of the model. Because periodically this model moves into a state of high variance, there is likely to be a different pattern of returns than with a single state model.
- 3.29 There are two key points to consider here. First, at what point do the fatter tails of the distribution matter? Can we choose a confidence interval at which we get useful information about the distribution, but do not have to worry about the tails of the distribution?
- 3.30 Second, what is the most appropriate way of choosing the parameters? Is it to take the parameters determined through statistical analysis uncritically, or to take those parameters and review them based on the current economic environment.
- 3.31 The tails of the distribution will clearly matter, at least to some extent, for most analysis. However, shown below is the 80% confidence interval for each of the distributions of equities.

RW

IAA92

RSVAR

## Asset liability modelling for Life and General Insurance Companies

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10th percentile	-19%	-12%	-24%
Median return	12%	15%	13%
90th percentile	43%	52%	66%

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- 3.32 There is a difference in median, which is a matter of calibration. There is a more substantial difference in the upper and lower percentiles. This is also partly a matter of calibration, but also a difference in the form of the distribution. The RSVAR has a wider range in both directions, whereas the IAA 92 model has more of a bias towards range above the median, rather than below it. The random walk model is the most symmetrical of the three.
- 3.33 Although this might appear to suggest that the most complex and statistically best fitting model must be used, it also suggests that understanding the bias introduced into any sample by the model used is very important.
- 3.34 If a different set of data had been used to determine the RSVAR model (for example using data points only since 1975, rather than since 1960) it is likely that a different set of parameters would have been derived. It could be argued that only data since 1983 (when Australian markets were substantially opened to foreign investment) should be used for this type of derivation.
- 3.35 Whichever model is used for an asset liability investigation, the key is to understand its limitations. If a simple model is to be used (such as a random walk model) and the main statistic being investigated is a confidence interval such as the return in four out of five years shown above, perhaps the variance of the model should be increased to compensate for the tendency of the model to underestimate this confidence interval.
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- 3.36 This section shows that different models can produce quite different results. However, the parameter fitting of a model should always be a more complex process than taking the best fit from a statistical analysis. A simple model can be used provided the conclusions are not expected to provide precise guidance. The simple model can give an impression of the level of variance and where that variance will come from.
- 3.37 The next two sections provide some examples of these types of investigations.
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#### 4. GENERAL INSURANCE

- 4.1 For general insurance there are two major sources of profit variability. For all types of general insurance company, variation in claims cost can be a major source of variations in profit, but variations in investment conditions often are also a major source of profit variability. Although the fact that investment conditions have a major effect on profit is clear to anyone managing or investing in a general insurance company, the extent of this variation is not always fully recognised. The significance of the asset allocation strategy chosen is not always fully recognised either.
- 4.2 This paper therefore looks at the variability over one year of a general insurance company resulting from variations in asset returns. The return from investing in a general insurance company (ie the total profits earned as a rate on shareholders funds) is compared with the returns from investing in a portfolio of equities. This will assist investors in a general insurance company to understand the contribution that asset returns make to the returns on their investments.
- 4.3 For the investigation of a general insurance company, a simple model has been set up with one line of short tail and one line of long tail business, each contributing half the profit of the company. For the purposes of the paper, the model does not project claims cost variation stochastically, rather the only source of profit variation allowed is variation due to investment return fluctuations.
- 4.4 The purpose of this is to show how dependent a general insurance company's profits can be, on the asset mix backing the shareholders funds,
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## Asset liability modelling for Life and General Insurance Companies

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as well as the asset mix backing the liabilities, in particular the long tail liabilities.

- 4.5 To understand the risks inherent in investing in a general insurance company, the result for the company which is investigated is the return to a shareholder of the equity in the company, assuming that this can be represented by the profits earned in a year. This is investigated both as an item on its own, and also in relation to the return on a portfolio of equities which an investor might choose in preference to the investment in the general insurance company.
- 4.6 In practice, there will be other sources of risks - the claims costs. The variation in claims costs will be somewhat independent of variations in investment returns, so may increase or reduce the variability of profit, depending upon the levels of reinsurance as well as the level of independence from investment return fluctuations.
- 4.7 The balance sheet of this hypothetical company is as follows:

	\$m
Shareholders Funds	100
Unearned premium - short tail	150
Outstanding Claims - short tail	30
Unearned premium - long tail	60
Outstanding Claims - long tail	360
Total liabilities	700

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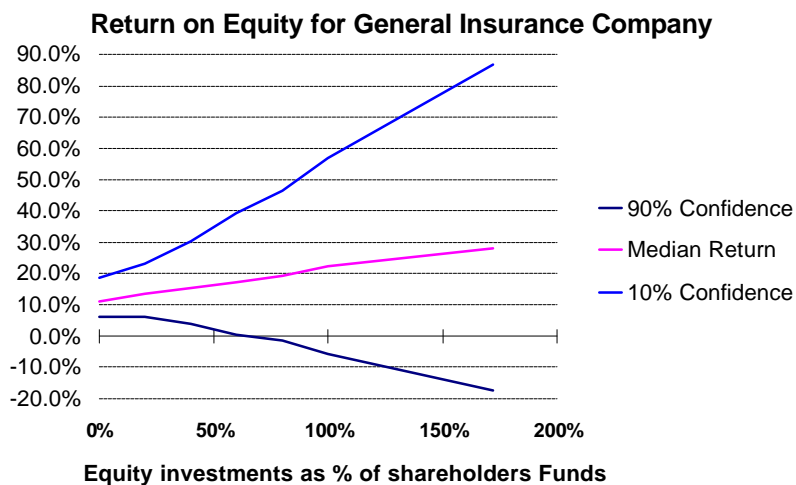
- 4.8 In looking at the return on the equity of the company, the paper considers how both this return and the variation of this return will vary with different asset allocation decisions. The asset allocation decision considered is a gradual increase in the level of equity investment. At the most conservative stage, the shareholders funds can be assumed to be invested in cash, with the assets backing the short tail liabilities and unearned premium on long tail also invested in cash. The assets backing the long tail liabilities are assumed to be invested in fixed interest assets, with a duration exactly matching the liabilities.
- 4.9 The investigation then considers the effect of gradually increasing the proportion of equities invested. First, the equities are gradually increased until the shareholders funds are completely invested in equity assets. Then the assets backing the long tail liabilities are gradually invested in more and more equities, so that these liabilities are not fully matched by equivalent fixed interest assets.
- 4.10 At the initial, low risk end of the investment spectrum, the only investment risk to the company would be that the interest rates assumed in the calculation of premium rates were not achieved. There will be variations in return from cash rate variations, but these will be quite small. (This is generally only a risk for long tail classes of business). As we gradually move up the spectrum of increased levels of equity investment, there would be risks involved in the investments themselves.
- 4.11 As we replaced the assets backing the long tail liabilities with equity investments, there would also be extra risks from the mismatch between the
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## Asset liability modelling for Life and General Insurance Companies

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assumed return on assets (implicit in the valuation of liabilities) of a fixed interest return, and the actual return, which will come from an equity return.

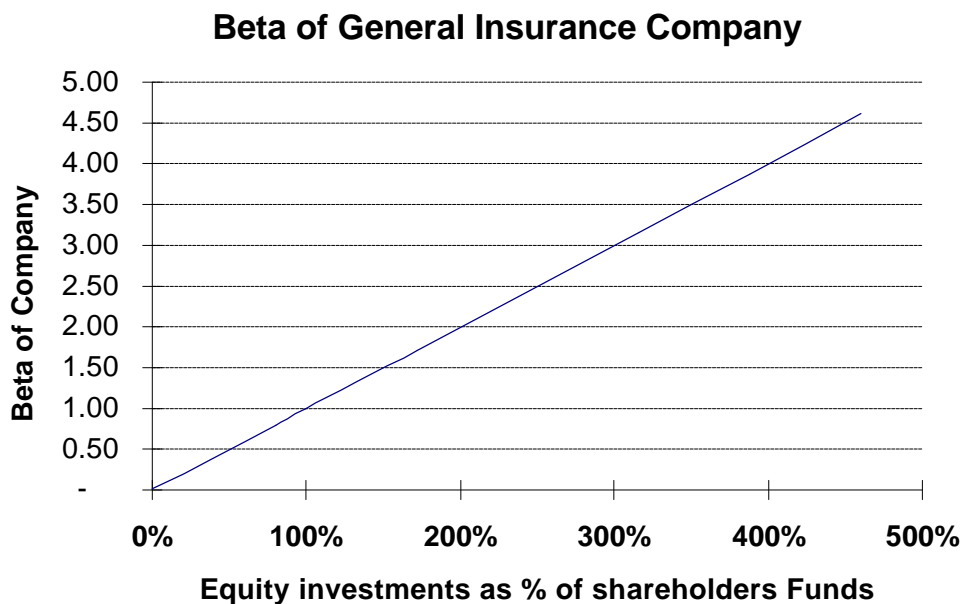
- 4.12 The range shown in all the illustrations below is an 80% confidence interval - in other words the range that profit can be expected to be in four out of five years. This range was chosen as it is close enough to the median to somewhat avoid the issue of the tails of the distribution; to concentrate on the range of returns that can be more confidently modelled by a number of different models.
- 4.13 The graph shows the confidence interval of the return on equity as the equities in the company are increased from 0% (none even in the shareholders fund) to 150% of the shareholders fund (ie backing some of the outstanding claims liabilities).



- 4.14 We can see from this investigation that as the assets backing the liabilities are invested more in equities, and less in assets matching the liabilities, the company's profit behaves more like a direct investment in the share market.
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Another way of looking at this is to look at the beta that we can calculate from these simulated results.

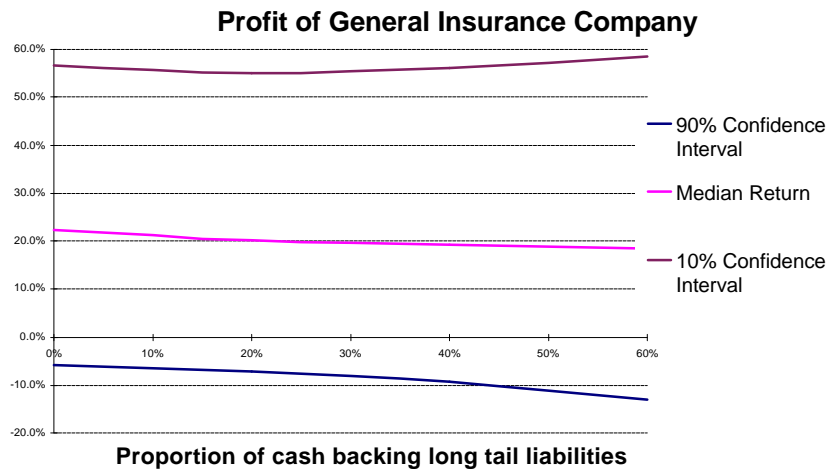
- 4.15 We would expect that the increase in proportion of equities in the company would lead the company to behave more and more like an investment in the share market. The usefulness of this type of analysis lies in the clarity it provides in understanding the likely ranges of these returns.
- 4.16 The second useful analysis that can be done is understanding the effect of mismatching in a duration sense. The graph below shows the effect of having 100% of the shareholders funds invested in equities, and gradually moving from a fully matched position for the long tail liabilities to investing more of the assets backing these liabilities in cash. The graph shows that not only does the median return on the total company decrease (due to the expectation that cash will earn less than fixed interest) but the range of profits expected in four out of five years increases.





## Asset liability modelling for Life and General Insurance Companies

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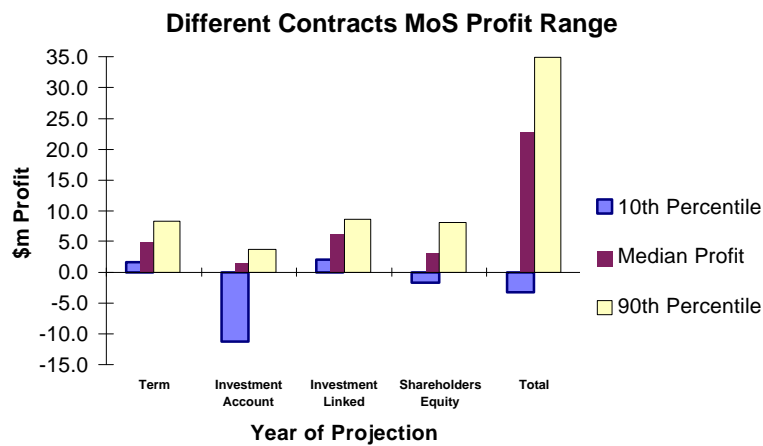


- 4.17 The graph above only shows the risks and rewards for a passive mismatching strategy. The rewards appear to be negative. However, there may be rewards from an active mismatching strategy if the investment management team can add sufficient value from timing the market correctly. However, they will have to overcome the likely risks from the mismatching in order to add value to the portfolio. Management will have to understand the value that the investment team would expect to add from a mismatching strategy before deciding to undertake it.
- 4.18 The usefulness of asset liability modelling lies in the way in which the model can demonstrate the chances of a particular event occurring. The graph showing the fairly small increase in median return compared with a dramatic increase in the range of returns in four out of five years shows how much of a risk the management of the company could be taking for a relatively small increase in expected returns. Directors of a company can then form a better view as to the levels of risk they are taking and whether they are appropriate for the company.
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## 5. LIFE INSURANCE

- 5.1 A major source of variation in profit for a life insurance company is investment return, and the way in which the liabilities and the assets are mismatched. There are, however, other sources of variation in profit, which are gradually increasing as the nature of life insurance changes. These include expense variability (which should be under the company's control so is not investigated here) variation in claims cost, and variations in surrenders.
- 5.2 For the investigation of the life insurance company, we look at a simple model of a life insurance company. It includes three types of business: yearly renewable term, investment linked, and non participating investment account business. Each type of business is calibrated so that they contribute reasonably equally to the company's profits on a margin on services basis, with shareholders funds above margin on services reserves also contributing to the profit of the company.
- 5.3 For all three types of business, as well as the investment returns, the lapses are varied each year, using a simple normal distribution of the lapse rates for each type of business. For the yearly renewable term book of business, the mortality is also varied using a distribution of the loss ratio on the business.
- 5.4 The profits resulting on the company are then modelled to determine their variability. The graph below shows the variability of the profits arising from each part of the company's business, together with the variability of the company's profits as a whole.
-

- 5.5 The graph shows the range of returns that can be expected in four out of five years for each part of the business, and the business as a whole, from a low point to a high point. This range has been chosen as it shows the picture of variability without depending upon accurate modelling of the extremes of the distribution.



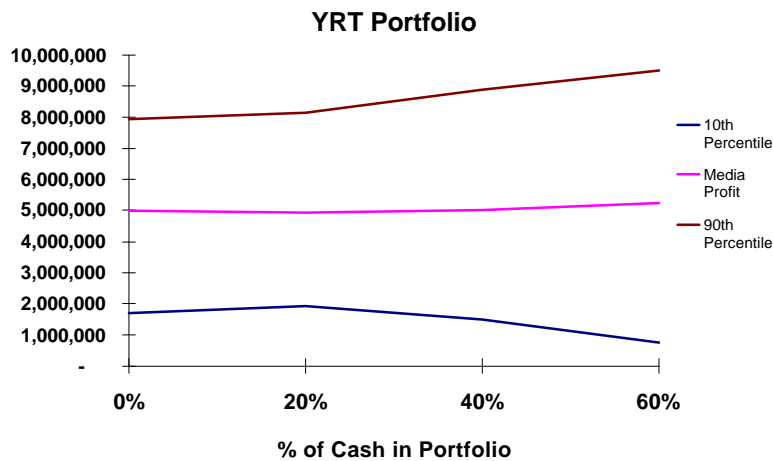
## Term Insurance

- 5.6 The term insurance portfolio was modelled assuming YRT business, with a stochastically varying loss ratio, lapse rate, and asset model. The investments were assumed to be fixed interest approximately the same duration as the liabilities (as the margin on services liabilities are calculated using the fixed interest yields).
- 5.7 The graph below shows the differences in the range depending upon the asset class chosen. This is a little counterintuitive, as one would expect that investing in cash would be the least risky alternative for this contract. However, because the MoS liabilities are discounted at a rate determined by

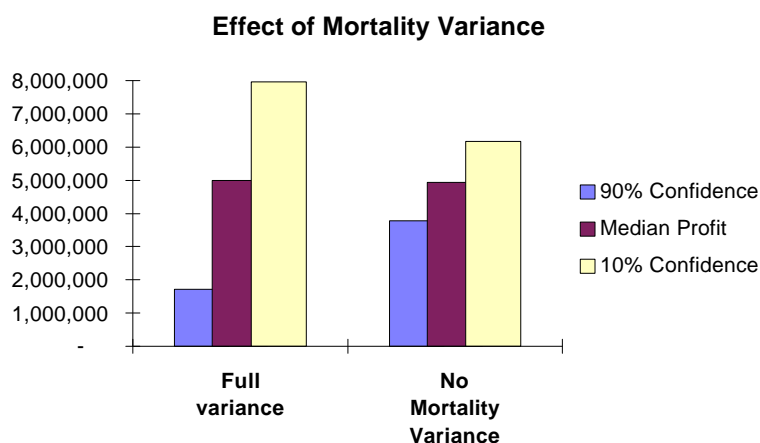
## Asset liability modelling for Life and General Insurance Companies

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the assets, and have a duration of around 10 years, investing in fixed interest is a closer match to the liabilities.

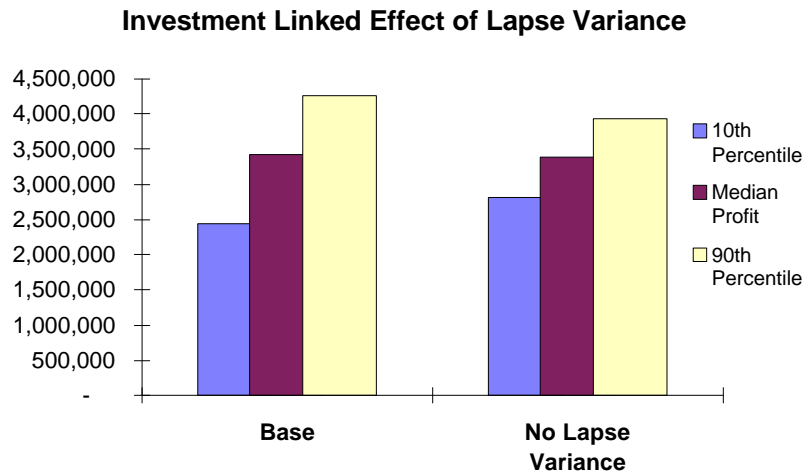


- 5.8 Although one would not expect term policies to depend on the investments, they are dependent on the allocation of investments and the method of determining the future discount rate used to calculate the MoS liabilities.
- 5.9 The other investigation which has been done into term business is looking at the impact of the variability of the loss ratio - ie the likely claims variability. The graph below shows that this has a major impact on the range of profitability of the contract - if claims cost is not variable, there is much less variability in the overall profit.
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## Investment Linked

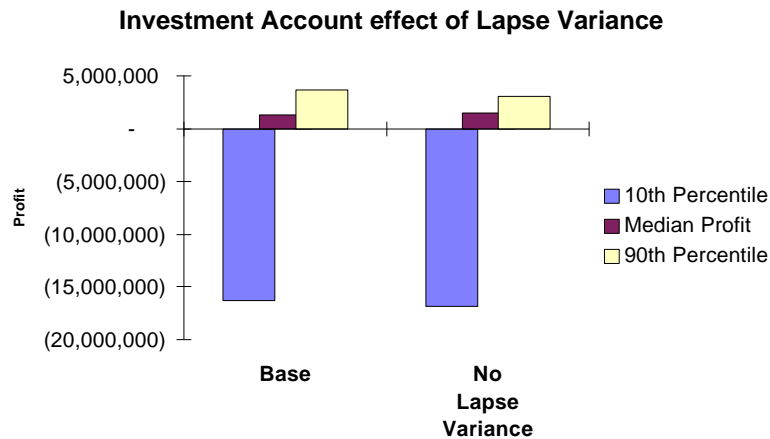
- 5.10 The investment linked contract has been modelled in the same way with the items varying being the surrender rate and the investment earning rate.
- 5.11 From the earlier graph, we can see that the range is quite narrow. This is as we would expect for this type of contract. The life insurance company is not substantially exposed to the investment risk, as all of this risk is passed on to the policyholders. Increased surrenders will change the profit in a year, but not substantially, as this type of contract will not tend to provide a profit or loss to the company on surrender. The impact will be on future rather than current profits.
- 5.12 We can see from the graph below that the difference between the profit range with and without the surrender variation is fairly small, suggesting that most of the profit on this type of contract is within the company's control.



### Investment Account

5.13 The investment account contract is more dependent upon investment returns than either the investment linked contract or the risk contract. This is because the investment return is smoothed, so that although the investment return is eventually passed on to the policyholders, the life insurance company takes most of the risk of the investment return on the policyholders funds as well as their own funds.

5.14 The previous graph shows that the range of profit variation is quite wide. The graph below shows that the profit variation is not particularly reduced by not varying the surrender rates, so that the main contributor to profit variation, as expected, is the variation in investment returns.



### Total Company

- 5.15 By adding up the total returns on each of these parts of the company, and combining them with the returns on the shareholders funds, we can look at the return on the total company, and how it compares with the return on a standard equity investment in the model.
- 5.16 This type of analysis provides useful information as to the likely sources of variation of different product types, and the relative importance of those variations.
- 5.17 The results are not unexpected, but this type of analysis provides much more information about relativities and allows more detailed investigation of the portfolio than the expected results we could otherwise determine.

## 6. CONCLUSION

- 6.1 Asset liability modelling is a useful tool for analysing the economics of a company when varying certain key items. Although the choice of an asset model is difficult, and the calibration of asset models is the subject of considerable research, provided the limitations of the model are understood, valuable management information can be drawn from a model, assisting in the understanding of a company.
- 6.2 When analysing profit for example, the asset liability modelling process does not give precise guidance as to the chance of a loss, or the return which can be expected at least 90% of the time. It will, however, provide useful guidance as to the tradeoff between the range of profit expected and the extra return which can be gained by taking extra risks.
- 6.3 For an insurance company reporting on profits on an annual or more frequent basis, asset liability modelling can provide a better understanding of the likely variance in profit, given key assumptions about asset mix and the level of matching of liabilities being carried out.
- 6.4 This type of modelling is best presented in graphical form, to avoid users of the information taking away an overprecise view of the results of the modelling and the accuracy of the predictions being made as a result of the modelling process.
-



- 6.5 Although much more theoretically accurate modelling is possible, many very useful answers to key questions about a company can be answered with models which are not that complex, provided their limitations are recognised and understood. The economic dynamics of certain aspects of the business can therefore be better understood and managed.
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## 7. ACKNOWLEDGEMENTS

I would like to thank the many people who helped formulate my ideas on this subject and commented on various working drafts. In particular, I would like to thank Colin Brigstock, Scott Collings, Ron Friedman, Maurice Kluge, Eric Ranson, Paul Swinhoe and Terry Towell. As always, any remaining errors are entirely my own responsibility. This paper puts forward my own views on this topic, which do not necessarily coincide with those of my employer.

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**ATTACHMENT A          ASSET MODELS**

This attachment describes the three asset models which have been used in this paper.

**Random Walk Model**

The random walk model consists of five asset classes, each of which is modelled as a normal distribution, with a defined mean and standard deviation. There is also a correlation matrix so that the asset classes are correlated with each other.

The parameters are as follows:

---

Asset Class	Mean	Standard Deviation
Cash	5.9%	1.8%
Australian Fixed Interest	6.5%	4.6%
CPI Bonds	6.5%	4.6%
Direct Property	8.5%	8.5%
Australian Equities	20.0%	24.0%

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**Correlation Matrix**


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	Cash	Fixed Interest	CPI Bonds	Direct Property	Aust Equities
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## Asset liability modelling for Life and General Insurance Companies

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Cash	100%	5%	42%	40%	5%
Fixed Interest		100%	73%	-8%	42%
CPI Bonds			100%	-20%	41%
Direct Property				100%	6%
Aust Equities					100%

---

The mean and standard deviation parameters have been chosen after consideration of the data, but with considerable attention to generally accepted relationships between asset classes.

The correlation parameters are those which emerged from a statistically analysis of the data for a 20 year period (or shorter in the case of CPI bonds).

### **The IAA92 Model**

The IAA 92 model is more complex than the random walk model.

There are a number of different models that make it up.

### **The Asset Model**

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The stochastic asset value model used in the determination of probabilities of ruin and expected losses is based on the method proposed in their 1980 paper by the Maturity Guarantees Working Party of the UK Institute of Actuaries.

The basic time  $Y_t^{cash} = Y_y^{10yr} + \mathbf{m}_c + \mathbf{s}_c \times N(0,1)$  period used throughout is one year. Tax is allowed for in the model by using after tax parameters.

For the shares and property sectors the model projects the dividends received during period  $t$  ( $D_t$ ) and the corresponding prospective yields at the end of period  $t$  ( $Y_t$ ) as follows:

$$\ln(D_t) = \ln(D_{t-1}) + \mathbf{m}_D + \mathbf{s}_D \times N(0,1)$$

$$\ln(Y_t) = \mathbf{a}_y \times [\ln(Y_{t-1}) - \mathbf{m}_y] + \mathbf{m}_y + \mathbf{s}_y \times N(0,1)$$

where  $N(0,1)$  is a unit normal random variable.

For the fixed interest sector only 10 year securities are modelled directly. For these securities the prospective yields at the end of period  $t$  are derived using the same formula as for shares and property but the dividend received during period  $t$  is assumed to be fixed as the coupon on the bond.

The model for prospective cash yields at time  $t$  derives them from the 10 year fixed interest model as follows:



$$CR_1 = \sum_{sectors} A_s \times R_1$$

In order to model the return on fixed interest securities with a term ( $n$ ) between 0 and 10 years the following model for prospective yields at time  $t$  is used:

The next stage in the derivation of total returns for each investment sector is to calculate

prospective prices for period  $t$

$$Y_t^n = Y_t^{10yr} + (\sqrt{n} - \sqrt{10}) \times (Y_t^{10yr} - Y_t^{cash}) / \sqrt{10}$$

$t$  excluding reinvested income ( $P_t$ ). For shares and property these are defined as:

and for  $n$  year fixed interest as:

$$P_t = D_t / Y_t$$

(The formula for fixed interest thus assumes that at the beginning of each year an  $n$  year bond is purchased which is then sold at the end of the year at the price for  $n-1$  year bonds and the proceeds reinvested).

$$P_t = D_t \times a_{n-1} + v^n$$

The model assumes that for a given asset mix the portfolio is remixed back to the original mix at each year end. The composite return used for period  $t$  is thus:

where  $A_s$  is the proportion assumed to be invested in sector 's'.

### The Parameters

The parameters used are as set out in the following table:

	<b>Shares</b>	<b>Property</b>	<b>10 Years Fixed Interest</b>
Dividends			
$m_D$	0.097	0.089	0.102
$s_D$	0.12	0.1176	N/A
Yields			
$m_y$	In 0.051	In 0.055	In 0.111
$s_y$	0.166	0.0735	0.085
$a_y$	0.80	0.50	0.75

In deriving the cash yield from the 10 year fixed interest yields the parameters used are:

= - 0.008

= 0.01802

$m_C$  The price and yield data used in derivation of the autogressive parameters are as follows:

$s_C$

AMP Shares(E) Units (1961-1988) }  
 All Ordinaries price data (1963-1989) } shares  
 All Ordinaries Accumulation data (1973-1989) }  
 AMP Property(P) Units (1961-1988)} property  
 Listed property trusts (1974-1989) }

## Asset liability modelling for Life and General Insurance Companies

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Australian 10 year bond yields (1963-1989) } 10 year fixed interest

For 10 year fixed interest the data prior to 1974 was ignored since there was an apparent break in the data at that point.

Other parameters have been chosen to reflect more current conditions and generally accepted relativities between dividends and yields across the various asset sectors.

The above data was also used to assess whether there is any correlation between asset sectors, in particular the shares and property sectors. From the investigations carried out there did not appear to be any justification for assuming that the sectors are correlated.

The parameters were derived gross of tax and were adjusted to the after tax parameters shown above assuming that the tax environment would be that applying to a superannuation fund taxed at 15%. In carrying out these adjustments allowance was made for depreciation (property) and the effect of deferred tax on capital gains (all sectors).

### **The RSVAR Model**

The RSVAR model is a combination of a simple set of time series models with a regime switch (a combination of two regimes).

The model consists of two states - a fairly normal state, where asset prices tend to increase and volatility is fairly low, and an extreme state, where asset prices tend to decrease, and volatility is very high. Each separate state is defined by a coherent model of the increase in GDP, CPI, the price of shares and the yield on 10 year bonds.

The model is quarterly, with each quarter modelled as a separate time period with its own probability of being in each of the two regimes.

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## Asset liability modelling for Life and General Insurance Companies

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### Regime 1 parameters

Transition probability 15.1% (probability that the regime transits to Regime 2)

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Asset class	Mean	Standard Deviation	A
GDP	1.14%	1.17%	-0.178
Change in CPI%	0.00%	0.55%	-0.332
SPI Price	3.28%	7.06%	0.000
Change in Bond yield	0.22%	4.53%	0.222

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### *Correlation Matrix*

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	GDP	CPI	SPI	Bond yield
GDP	100%	14.8%	0.0%	0.0%
CPI		100%	0.0%	0.0%
SPI			100%	-19.5%
Bond Yield				100%

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### Regime 2 parameters

Transition probability 50.9% (probability that the regime transits to Regime 1)

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Asset liability modelling for Life and General Insurance Companies

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Asset class	Mean	Standard Deviation	A
GDP	0.13%%	1.5%	0.000
Change in CPI%	0.11%	1.6%	-0.449
SPI Price	-4.63%	17.1%	0.000
Change in Bond yield	2.67%	10.0%	0.000

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Asset liability modelling for Life and General Insurance Companies

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*Correlation matrix*

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	GDP	CPI	SPI	Bond yield
GDP	100%	0.0%	-33.7%	0.0%
CPI		100%	0.0%	0.0%
SPI			100%	0.0%
Bond Yield				100%

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Each of the individual asset classes is modelled as an AR(1) process.

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