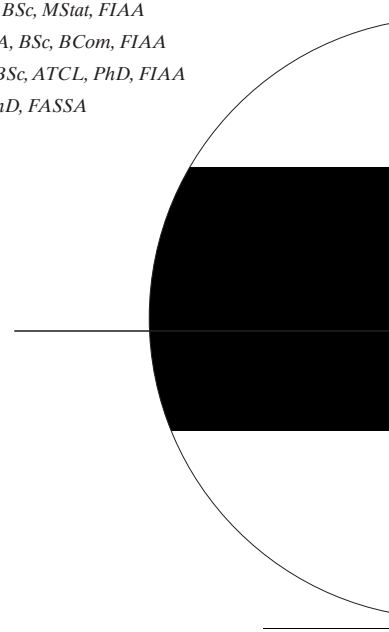
australian actuarial journal

2010
VOLUME 16
issue 1

Institute of Actuaries of Australia



ISSN 1442-3065

The Australian Actuarial Journal is published by
The Institute of Actuaries of Australia
Level 7 Challis House
4 Martin Place Sydney NSW 2000 Australia
Telephone: +61 (0) 2 9233 3466

www.actuaries.asn.au

For subscription information and guidelines for authors please see inside of back cover.

australian
actuarial journal

Contents

2010 VOLUME 16
issue 1

Feature Articles

Feature Articles

2010 VOLUME 16
issue 1

australian **actuarial** journal | 2010 Volume 16 Issue 1 | pp. 1– 64

"Someone Else's Problem" The Failure of the Guarantee Security Life Insurance Company

S Ferris *

*Contact: Shauna Ferris, Senior Lecturer, Actuarial Studies Department, Macquarie University, Sydney, Australia. Email: shauna.ferris@mq.edu.au.

Introduction

From time to time, a financial institution becomes insolvent. This should not be surprising: in a capitalist system, strong and efficient companies will survive and prosper, while weak and inefficient companies will wither and die.

The failure of a financial institution does not always cause serious social consequences. Often, when an insurer deteriorates, the prudential regulator can arrange an orderly exit from the market – for example by encouraging a stronger company to take over the failing company. Although shareholders may suffer, policyholders are protected.

However, from time to time, a financial institution collapses with enormous losses, causing serious dislocation of the financial system.

Now theoretically, this should not occur.

No doubt there will always be incompetent, irresponsible, and/or corrupt businessmen who will happily gamble with other people's money. But theoretically, we should have systems in place to limit the damage which can be caused by such people. There should be standards for sound corporate governance within the company. And we have legislators, regulators, auditors, actuaries, lawyers, custodians, financial advisors, and rating agencies which should help to improve security for the public.

But these systems ultimately rely upon the vigilance, intelligence, and integrity of the people involved – and hence will be fallible.

In order to prevent future failures, it is helpful to analyse the causes for some notable past failures.

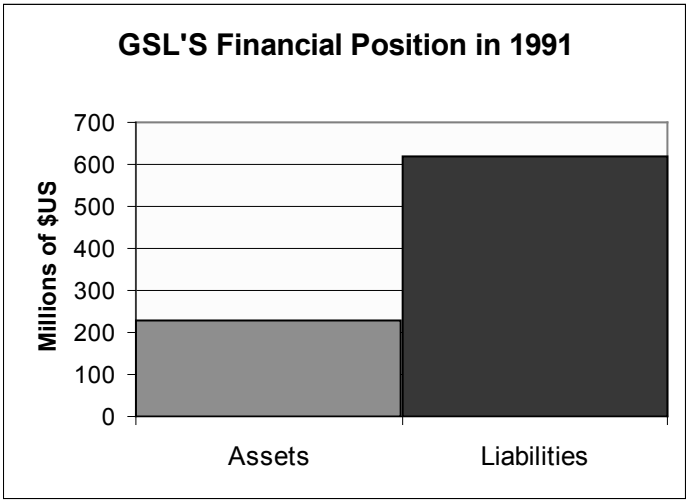
In the following case study, we examine one conspicuous example of regulatory failure: the collapse of the Guarantee Security Life Insurance Company (GSL) in 1991.

The Guarantee Security Life Insurance Company

During the 1980s, Guarantee Security Life was one of the largest life insurers in Florida. In August 1991, the Florida Department of Insurance declared the company insolvent and placed it in the hands of a receiver.

At that time, the insurer had 56,000 policyholders, mostly elderly, low-income people who had invested their meagre life savings with a company which purportedly offered high returns with "guaranteed security".

The receiver estimated that GSL's policy liabilities amounted to $620 million – but unfortunately the company's assets were worth only $230 million. The shortfall was about $390 million, ie. a deficit amounting to 63% of the liabilities.[1] At the time, this was one of the largest insolvencies in the history of the US life insurance industry.[2]



You might wonder: *What went wrong? How could an insurance company possibly end up with a deficit equal to 63% of their liabilities? Aren't there prudential regulations in place to protect policyholders?*

1 Statement of the Receiver, Michael Heekin, to the United States Senate Permanent Subcommittee on Investigations, Hearings April 29, 1992

2 The National Organisation of Life and Health Insurance Guaranty Associations publishes annual reports on the costs of insolvencies, as measured by the claims made against the state guaranty associations.

Who was a responsible for such a fiasco?

Apparently, no one was responsible. In the testimony provided during subsequent investigations, everyone blamed everyone else, while providing lengthy justifications for their own behaviour.

No doubt the owners and executives of the company were primarily responsible.

However, they could not have lost so much money without the assistance of many professionals – investment bankers, auditors, lawyers, reinsurers, and bank custodians – who helped them to circumvent the rules which were designed to protect the policyholders. According to the Florida Insurance Commissioner:

> *"Guarantee Security was almost from the beginning a massive fraud, aided and abetted by blue-ribbon brokers and licensed professionals motivated by their own self interest. The fraud of Guarantee was a carefully-orchestrated bank robbery, but the thieves disguised themselves with the help of accountants, brokers and lawyers rather than wearing silk-stocking masks. They operated like early 20th century robber barons, cloaking their thievery in the guise of a sound business organisation. We regulators were deceived…."*[3]

Not everyone agreed with this opinion.

The accountants, brokers, and lawyers all claimed to be innocent of any wrong-doing. As they pointed out, their actions were *technically* legal – or at least, their actions fell within a grey area which might arguably be considered legal if you were inclined to adopt a flexible perspective. The laws had loopholes; the regulations were unclear; the accounting standards were subject to interpretation.

While all this was going on, where was the public's watchdog, the state regulator?

3 Testimony by Florida Treasurer and Insurance Commissioner Tom Gallagher to the United States Senate Permanent Subcommittee on Investigations, Hearings April 29, 1992

The Florida Department of Insurance later claimed that they had been deceived by GSL. But they, too, played a part in the downfall of GSL. There were numerous warning signs of disaster, which any competent regulator should have noticed. Indeed, there is evidence to suggest that the Department was well aware of problems at GSL; but little effective action was taken. Perhaps, if the Department had been more vigilant – if it had enforced its own solvency standards properly - then GSL would have been closed down much earlier, before thousands of policyholders poured their money into an already-insolvent company.

The story of GSL is not just an isolated incident. Similar problems have been observed in other studies of insurance insolvencies. Apparently, for many people in the insurance industry, protecting the policyholders is "Someone Else's Problem".

Stages in the Downfall of GSL

This paper outlines the following stages in the demise of GSL.

- Section 1 examines the ownership and management objectives of the insurer.
- Section 2 of this paper outlines GSL's phenomenally successful growth strategy, which gave the insurance company control of almost a billion dollars of policyholders' money.
- Section 3 describes GSL's ill-fated investment strategy, and the effects of the insurer's involvement with the notorious Michael Milken.
- Rapid growth, underpricing, and high-risk investment strategies will inevitably lead to capital shortages. Section 4 outlines the ingenious methods used by GSL to disguise solvency problems and allay the regulator's fears.
- Section 5 describes the enormous financial benefits flowing to the owners of GSL prior to the collapse of the company.
- Section 6 describes the aftermath of GSL's collapse – the effect on the policyholders and other stakeholders.

Section 1: Sanford and Blackburn Buy GSL

According to the International Association of Insurance Supervisors, it is essential for insurance regulators to make sure that the owners, board members, and senior managers of an insurer are fit and proper to fulfil their roles – ie. they must possess integrity, competency, experience and qualifications.[4]

So who were the owners of GSL?

Mark Sanford was "*a workaholic financier*", who believed in his own genius – particularly his skills in investment. In order to demonstrate his abilities, he simply needed access to large sums of other people's money.

William Blackburn has been described as a "*gregarious marketing man*". He knew how to sell.

In the 1970s, both of them worked as brokers for a small securities firm in Kentucky. Together, they set up the Blackburn-Sanford Holding Company, which later changed its name to Transmark USA, Inc.[5]

Initially the company was a brokerage, but later it moved into mutual funds and venture capital. Apparently, in the early years, the company was not very successful.[6]

In January 1984, Transmark bought the Guarantee Security Life Insurance Company, which was "*a small, modestly profitable insurance company*" with assets of almost $100 million.[7] The purchase price was $6.8 million, and the funding was apparently provided "*on a very leveraged basis*".[8]

4 Insurance Core Principles and Methodology, International Association of Insurance Supervisors, 2003, available on www.iaisweb.org

5 For simplicity we will refer to this company as Transmark at all times, even though the name was not changed until 1987.

6 *Trouble followed investor to Tampa* by Robert Trigaux, St Petersberg Times, 8 March 1992 page 11

7 *A Nest of Vipers* by Abraham J Briloff, Submission to the Senate Permanent Subcommittee on Investigations (p217 of Hearings April 29-30)

8 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations (p139 and page 334 of Hearings, April 29-30)

According to the testimony at the US Senate investigation into GSL's collapse, neither Sanford nor Blackburn had any experience in managing an insurance company.[9]

So why did they buy an insurer?

At the Congressional inquiry into the collapse of GSL, Blackburn explained his motivation:

> *"I didn't really want to be in the insurance business. There were essentially two reasons for doing it. The first and foremost reason was that Mark Sanford and I for some years had been in the money management business. We were seeking new money to manage. We took notice that insurance companies had what we considered to be relatively low-quality management of their assets, underperforming assets, and we thought that if we could buy an insurance company two things would happen. One is we could gain the management of the assets of the insurance company, thereby gaining a client, and two is that we thought we could value-add to that company by making a higher rate of return on its investable assets".*[10]

Since Blackburn and Sanford lacked knowledge of the insurance industry, it would be desirable for them to hire competent and experienced people to run the company. At the time of purchase, GSL did have some experienced insurance people on staff. But almost immediately after buying the company, Blackburn decided to replace the president of the company – apparently he was "*totally uncooperative*" with the new owners.[11]

In early 1984, Blackburn became the CEO of GSL. Sanford became chairman of the board and took over management of the investments. Sanford's brother Robert became Vice-President. Sanford's wife was also on the payroll. Melanie Ratcliff (who later married Blackburn) was

9 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations, (p139 of Hearings, April 29-30)

10 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations, p141 of Hearings, April 29-30

11 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations, p141 of Hearings, April 29-30

appointed as the head of marketing[12]. So a small close-knit group of people had ownership and control of the company.

How could people like Sanford and Blackburn obtain a license from the regulator?

The Florida Insurance Commissioner later testified that

> *"Inexperienced people were able to obtain a state license to sell insurance because there was no known reason to deny them."*[13]

Insurance licensing procedures vary from state to state. Unfortunately, it seems that during the 1980s Florida developed a reputation for lax standards. According to one newspaper report published after the collapse of GSL:

> *"As long as they put up the money to capitalize the company, and are not convicted felons, we'll give them a certificate of authority," says one Insurance Department staff member in Tallahassee.*

The staffer, who asked not to be identified, says "*you can tell from the applicants' business plans that they have no idea what they're getting into*".[14]

Section 2: Going For Growth

The New Marketing Strategy

As noted above, Sanford and Blackburn were keen to exercise their investment skills by obtaining control of as much money as possible.

Once under new management, GSL immediately took steps to increase its assets, by adopting an aggressive marketing strategy.

12 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations, p335 of Hearings, April 29-30
13 Testimony of Tom Gallagher to the Senate Permanent Subcommittee on Investigations, Hearings p45
14 *Florida Insurers: Why they failed* by Keith Donner, Miami Review, 29 January 1993, page 10

Initially, GSL did this by selling single-premium annuities and single-premium whole-life policies. These policies provide large up-front payments to the insurer, thus maximising the amount of assets available for investment.

Blackburn described GSL's marketing strategy:

> *"The market for sale of annuities at that time was very competitive. We knew that we could not sell the company's products based on the size of the company or a long track record. We were not rated by AM Best. Our marketing policy was based on three elements:*
>
> *a) paying good interest rates to policyholders;*
>
> *b) paying good commissions; and*
>
> *c) providing high quality service to the agents.*
>
> *Our idea was to market to the agents and not to consumers."*[15]

Since GSL offered higher commission than most other companies, perhaps it is not surprising that the number of agents selling GSL products skyrocketed over the next few years. They soon had a network of over 16000 agents working in 42 states.[16]

GSL seems to have targeted low-income, unsophisticated investors.[17] Most of the annuity policies were for relatively small amounts, $5,000 or $10,000, and often represented the life savings of the policyholders.[18]

The policies generally offered above-average crediting rates. These high rates were guaranteed for an initial period such as one year.

Based on subsequent testimony to the US Senate Subcommittee, it seems that some agents might have inadvertently given clients the impression that the high rates were likely to continue indefinitely.

15 Testimony of William H Blackburn to the Senate Permanent Subcommittee on Investigations (p336 of Hearings, April 29-30)

16 *Third Interim Report on United States government efforts to combat fraud and abuse in the insurance industry: enhancing solvency, regulation, and disclosure requirements- a case study of Guarantee Security Life Insurance Company,* prepared by the Permanent Subcommittee on Investigations of the Committee on Government Affairs, United States Senate, 1993, page 7

17 Statement of Tom Gallagher, Commissioner of Insurance, State of Florida, at Hearings p 27

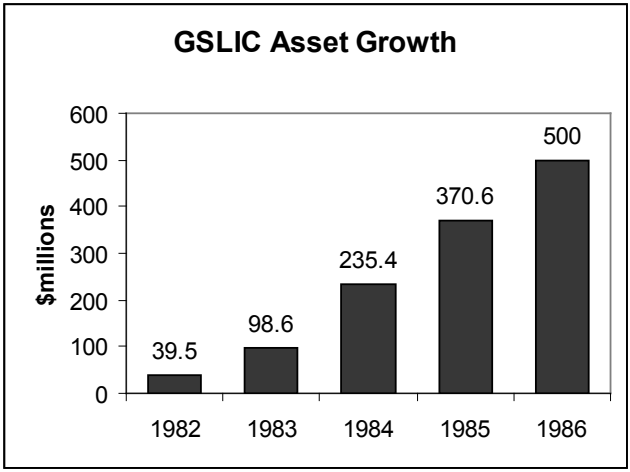
18 Statement of W. Michael Heekin, Deputy Receiver, Guarantee Security Life Insurance Company, Jacksonville Florida, before the United States Senate Permanent Subcommittee on Investigations, April 29, 1992 (Page 179 of Hearings, April 29-30)

The high rates were attributed to the wonderful investment skills of Mark Sanford. However, the policyholders were often disappointed – GSL's crediting rates dropped sharply over the next few years.

Some policyholders might have considered surrendering their policies – but it would have been expensive to do this. Many of the policies had high surrender penalties (15% to 20%), which meant that customers were effectively "locked in".[19]

GSL's Rapid Growth

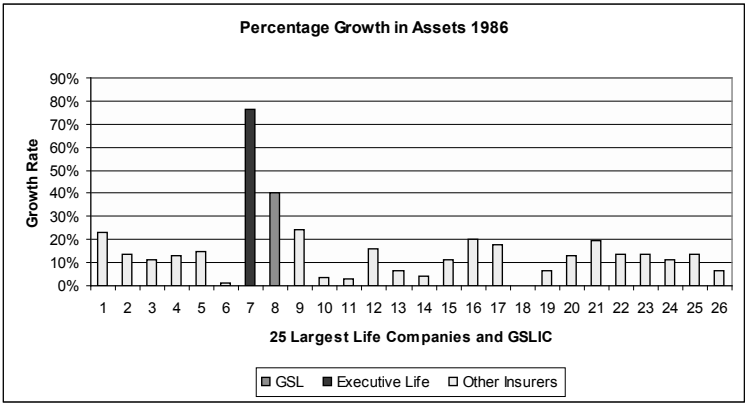
Between 1983 and 1986, GSL was remarkably successful in increasing assets – they grew from roughly $100 million in assets to more than $500 million.



The company boasted about its rapid growth. GSL's marketing brochures pointed out that they were growing much faster than all the other big, established life offices. GSL regarded this rapid growth as a sure sign of success.[20]

19 Statement of W. Michael Heekin, Deputy Receiver, Guarantee Security Life Insurance Company, Jacksonville Florida, before the United States Senate Permanent Subcommittee on Investigations, April 29. 1992 (Page 180 of Hearings, April 29-30)

20 Some of the marketing brochures are reproduced in the submissions to the Senate Permanent Subcommittee on Investigations (Hearings p 353-354 and 466)



Of course, rapid growth is nothing to boast about when the growth arises from unsound pricing and high commission rates. Numerous studies of the insurance industry have shown that rapid growth is often a precursor to insolvency.[21] In fact, an insurance company named Baldwin-United, which had followed a business strategy very similar to GSL's, had collapsed with enormous losses in 1983. This rapid growth should have been a warning sign to the regulator.

It is interesting to note that the only large insurer which had stronger asset growth than GSL was Executive Life (California) – another company which specialised in high-interest-rate, high-commission annuity products. Executive Life became insolvent just a few months before GSL, in April 1991.

Assumption Reinsurance

As crediting rates fell in later years, it became more difficult for GSL to sell to individual policyholders. GSL eventually found an even better way to grow – essentially switching from retail sales to wholesale. They started to buy blocks of business from other life insurers – a practice known as "assumption reinsurance".

21 *AM Best Publishes 27-Year Life/Health Insolvency Study*, Best's Insurance News, 30 December 2004

Assumption reinsurance was a significant factor in the growth of GSL between 1987 and 1989. GSL "assumed" 30,000 annuity contracts with a total value of about $280 million[22].

Australians may not be familiar with the term "assumption reinsurance". In assumption reinsurance, the original insurer is released from all liability as soon as the reinsurance deal is finalised. The liability is transferred to the reinsurer. The policyholder must rely on the reinsurer to pay his claim[23]. In Australia, we would call this arrangement a portfolio transfer.

Clearly, in some cases, assumption reinsurance can be detrimental to policyholders – particularly when the original insurer is financially strong and the acquiring company is financially weak. If the reinsurer goes broke, the policyholder is likely to suffer a loss.

In most assumption reinsurance deals, the policyholder had no choice. His policy could be transferred from one company to another, without his knowledge or consent.

As an example, consider the testimony provided by one unhappy GSL policyholder, Mr Eliades. In 1981 he decided to invest $30,000 with the American Health and Life Insurance Company of Baltimore, which had an A+ rating from AM Best. In 1987, his policy was transferred to GSL, as part of an assumption reinsurance deal.

He was not given any option to switch, he was simply notified that it was "a done deal". A few years later Mr Eliades lost his job, and he desperately needed to withdraw his savings – but when he contacted GSL, he found that the insurer had been seized by the regulator and all surrender payments were frozen. This was the first he had heard of any trouble with the company.[24]

Mr Eliades complained that:

22 According to the Third Interim Report (p8), GSL bought a block of business worth $200 million from American Health and Life Insurance Company of Baltimore, Maryland; and other blocks of business from the Capitol Life Insurance Company and the Kanawha Insurance Company (policies issued by Northwestern Security Life Insurance Company).

23 This process is known as "novation".

24 Testimony of George Eliades to the United States Senate Permanent Subcommittee on Investigations (Hearing p 15)

> *"I find it appalling that I could invest my money in an A-rated company only to have that investment shunted off a few years later to a relatively new, unrated company without my consent".*

Was this legal? Apparently, yes. In fact it was an "accepted practice" in the US insurance industry in the 1980s. The rules varied from one state to the next, but most states permitted the transfer of policies without the prior permission of the policyholder.

After GSL collapsed, the Florida Insurance Commissioner called the assumption reinsurance deals "*a blatant breach of fundamental contract rights*".[25] The Insurance Commissioner took four of the ceding insurers to court, demanding that they accept liability for the annuities which had been transferred to GSL. Unfortunately, the law was not entirely clear in this regard, and the original insurers fought the claim[26].

Apparently, these insurers believed that they had no particular responsibility to protect their own policyholders: it was perfectly reasonable to transfer their policies to another insurer, without considering the financial condition of that insurer.

One of the lawyers involved in managing GSL after the collapse commented that

> *"Litigation has been undertaken by the receiver against a couple of companies that engaged in reinsurance transactions with Guarantee Security before it went down. The response by those companies has been that reinsurance transactions are a way of life in the industry and the guaranty associations exist to take care of the losses that result."* [27]

25 *Florida Regulator files $60 million class action suit vs. four insurers: Gallagher charges breach of policyholders' rights,* Business Wire, 22 June 1992

26 Legal opinions on assumption reinsurance were provided to the Senate Permanent Subcommittee on Investigations of the Committee on Governmental Affairs, United States Senate, March 1993, see pages 447-457. See also *Reinsurance and Assumption Agreements: How does the Novation Take Place?* By Robert M. Hall, 2001, available at www.robertmhall.com/articles/Reins_AssumpArt.htm

27 Rehabilitation Fallout, Harper, Ewald, Petty, and Veed, Record of the Society of Actuaries, 1993 Vol 19 No 4B

After a great deal of litigation, the Insurance Commissioner was eventually successful in obtaining a settlement from the original insurers, covering some of GSL's assumed liabilities.[28]

Assumption Reinsurance Reforms

Assumption reinsurance was obviously a flaw in the regulatory structure. GSL was by no means the only example – several other small weak insurers had used assumption reinsurance transactions to boost their cash flow, shortly before becoming insolvent.

Assumption reinsurance clearly created significant risks for the policyholders, which led to a call for stricter controls. However, for many years the life insurance industry opposed any reforms to the legislation. Assumption reinsurance was very convenient for the insurers – it allowed them to sell off unprofitable lines of business easily. Such deals could be very profitable, especially if you could find a buyer like GSL – ie. one which was willing to offer quite generous terms in order to gain control of additional assets.

Despite the objections of the life insurance industry associations, a US Senate Committee eventually decided that legislative reform was really necessary. The insurance guarantee funds (and taxpayers) were bearing excessive costs, as a result of covering losses associated with assumption reinsurance.[29] In 1993, the National Association of Insurance Commissioners developed an Assumption Reinsurance Model Act, which significantly improved protection for policyholders (in those states which adopted it) [30] [31] [32].

28 *Final Judgement and Orders in Case No 92-2631* in the Circuit Court of the 2nd Judicial Circuit in and for Leone County Florida dated April 26, 1995

29 The Senate Committee on Commerce, Science, and Transportation held hearings on assumption reinsurance on May 26, 1994, and heard submissions from the ACLI and two State Insurance Commissioners.

30 *Reinsurance and Assumption Agreements: How does the Novation Take Place?* by Robert M. Hall, on website at www.roberthall.com/articles/Reins_assumpArt.htm

31 Note that in the USA, insurance legislation is state-based. The National Association of Insurance Commissioners can recommend legislation, but each state makes its own decision (after consultation with insurers operating in that state). Apparently many states were slow to adopt the Model Act for assumption reinsurance

32 In Australia portfolio transfers, takeovers and mergers require approval from APRA. How effective is this in protecting policyholders? The Palmer Report on the collapse of HIH has some interesting comments on the approval process in relation to the HIH takeover of FAI, which did not turn out well.

Section 3: GSL's Investment Strategy

As we have seen, GSL was very successful in obtaining control of large sums of money. Over the period from 1984 to 1989, assets grew from about $100 million to almost a billion dollars.[33]

But how should that money be invested?

GSL's marketing strategy depended on paying above-average crediting rates. And of course you cannot pay above-average crediting rates unless you are earning above-average returns on your investments. And of course you cannot earn above-average investment returns unless you are willing to take a few risks. So GSL invested a lot of money in "high yield" bonds – more commonly known as "junk bonds". At one stage GSL had more than 90% of its assets invested in junk bonds.

Now with the benefit of hindsight, it is clear that this was not a good idea. But in the 1980s, high yield bonds were very popular with many investors. The rapid growth of the junk bond market can be attributed to one man, Michael Milken[34], who worked for Drexel Burnham Lambert.

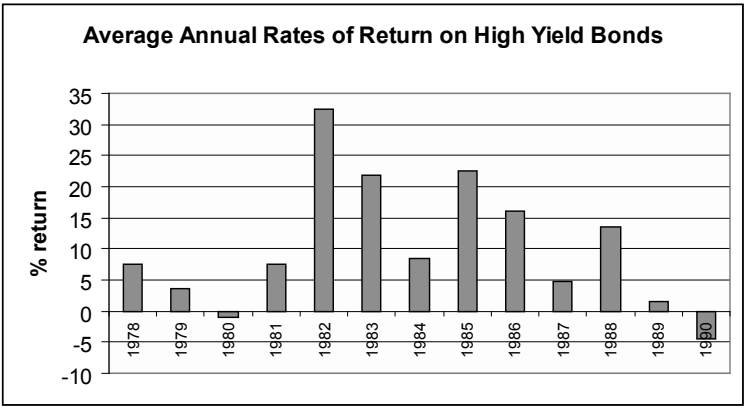
Milken recommended investment in a diversified portfolio of high yield bonds. Although some bonds would undoubtedly default, these losses would theoretically be offset by high returns on other bonds, providing an attractive return overall. Milken began marketing high yield securities to Drexel's clients. He found that several insurance companies and savings and loan companies were very interested in any investments which offered above average returns.

Within a few years, Milken had a coterie of investors who would buy almost anything he recommended. And why not? During the mid-1980s, they were making excellent returns, as shown in the graph below.[35]

33 *A Nest of Vipers* by Abraham J. Briloff, Hearings p216ff.

34 The development of the junk bond market has been examined in many many books and articles, which often disagree. Some people regard Milken as a brilliant financial innovator who has been cruelly persecuted; others regard him as an unscrupulous villain who should have spent a lot longer in jail.

35 *Revisiting the High Yield Bond Market* by Edward I Altman, Financial Management, Summer 1992, p78-92



Junk bonds were risky. But junk bonds sold by Milken seldom defaulted, because Milken usually came to the rescue. Milken used his dominance of the junk bond market to trade favours. Suppose that one of his junk bond issuers was about to default. He would persuade his other "regular investors" to rescue the defaulter, by refinancing the debt. [36]

So Milken was the key player in maintaining confidence in the junk bond market.[37] This confidence was shaken in September 1988, when Milken and his employer were charged with violating a number of securities laws. They were accused of market manipulation and insider trading. [38]

During 1989, this faith was shaken even further: there were a few high-profile defaults on junk bonds. There was increasing concern about the riskiness of such investments.

In 1989, the government passed a law[39] to force savings and loans to reduce their holdings in junk bond investments. The forced sales pushed prices even lower. Over the next few months, the junk bond market collapsed. Many of Milken's most faithful customers were the hardest hit

36 *Den of Thieves* by James B Stewart, Simon and Schuster (Pocket Book edition), 1992, p 298
37 *Devil Take the Hindmost* by Edward Chancellor, Plume, 2000. This book provides a useful summary of the junk bond boom and bust.
38 *Public Confession: Milken Pleads Guilty to Six Felony Counts and Issues an Apology* by Laurie P Cohen, Wall Street Journal, 25 April 1990, Page 1
39 *The Financial Institutions Reform, Recovery and Enforcement Act (FIRREA).*

– including two life insurance companies, Executive Life and GSL.

The receiver of GSL described the impact of the junk bond crash on the insurer.

- Since the company was suffering losses on its junk bonds, it cut the bonus rates paid to policyholders;
- This led to a wave of surrenders, leading to payouts of $30 million per month;
- In order to make those payments, GSL sold off its better quality, liquid assets;
- So that the remaining assets were of poor quality and/or in default.
- The valuation of these assets was also doubtful – many of them were illiquid securities which had been bought via private placements, so there was no objective market price available.[40]

After GSL collapsed, the receivers found that many of the junk bonds were worth much less than the value shown in the accounts[41]. The receiver's expert estimated that the bonds were over-valued by at least $100 million[42].

Regulatory Restrictions on Junk Bonds

Why was GSL allowed to invest so much money in such high-risk investments?

When GSL began to invest in junk bonds, there were no restrictions on such investments. Insurers were allowed to invest in low-grade bonds without restriction, as long as they set aside specified reserves to cover potential losses.

40 Statement of W. Michael Heekin, Deputy Receiver Guarantee Security Life Insurance Company to the United States Senate Permanent Subcommittee on Investigations, April 29, 1992

41 The annual accounts were audited and you might wonder about the valuation of these junk bonds. The auditors added a note to the 1989 accounts: *"…a substantial portion of the Company's investment portfolio is comprised of high-yield securities. The values of the Company's investments in such securities have been determined in good faith by the Company. We have reviewed the procedures used by the Company in estimating the value of such securities and have inspected underlying documentation and, in the circumstances, we believe the procedures are reasonable and the documentation appropriate. However those estimated values may differ significantly from the values that would have been used, had an independent market quotation for such securities existed."*

42 *Insurance: $400 million collapse brings plenty of blame* by David Poppe, Miami Review, 9 April 1993, p A8

However, as the amount of money invested in junk bonds increased sharply during the 1980s, some regulators became concerned about the risk.

In 1986 the New York Department of Insurance decided to limit junk bond investments to just 20% of the insurer's assets[43]. There was strong opposition to this move – especially from Drexel (which was marketing junk bonds) and Executive Life (an insurance company which had more than 60% of its assets invested in junk bonds). These companies argued that junk bonds provided a wonderful investment opportunity: the policyholders would benefit from higher returns available from junk bonds; and the risks were acceptable. In some states – such as California – these lobbyists successful blocked laws designed to limit junk bond investments.

By 1987, the Florida regulators decided that it was time to set some limits. The Florida Department of Insurance (FDI) recommended that insurers should be required to hold no more than 20% of their assets in junk bonds. The new law was passed, effective from 1 January 1988.

However, GSL was not happy about these restrictions. They lobbied hard, and eventually persuaded the legislators to include a grandfathering provision: they would be allowed to reduce their junk bonds slowly, over time.

Even with this provision, GSL felt that the new rules were unreasonable. During the next year, GSL sought (and received) a "Special Consent", which allowed them to maintain higher levels of investment in junk bonds. [44] Both the FDI and the Florida legislature agreed to special rules for GSL.[45]

Why did GSL get special treatment? At the Congressional enquiry, the Florida Insurance Commissioner admitted the regulators had erred.

43 Note the New York regulators are generally considered to be strict regulators, and often take the lead in tightening regulations.

44 Letter from Department of Insurance to Guarantee Security Life Insurance Company, dated 24 January 1989, included in Hearings p 391-392

45 Statement of John G. Heimann, Chairman of Global Financial institutions, Merrill Lynch & Co Inc, submission to the Senate Subcommittee on Investigations (Hearings p322)

> *"Not a single other Florida-based insurer held a high-risk portfolio that approached the size of Guarantee Security's. Its junk bond portfolio totalled, at one time, as much as 90 percent of its reported assets. It stood out like a sore thumb. But the junk bonds produced an alluring income. I think it's fair to say that our department's regulatory staff was as blinded by the junk bond dazzle as the rest of the nation's financial industry."*[46]

The market for junk bonds began to tumble in 1989 and 1990, and this led directly to GSL's collapse. Later, when everyone was trying to allocate blame, the FDI was held responsible:

> *"The principal cause of GSLIC's downfall was deliberate, regulatory acquiescence in the size of GSLIC's junk bond holdings."*[47]

Was it just an honest mistake?

GSL lost a lot of money by investing in junk bonds. But maybe this was simply the result of poor judgement by the investment manager – maybe Mark Sanford just made some honest mistakes?

The Florida Department of Insurance certainly believed that there were more sinister forces at work.

During the investigations into Michael Milken's activities, the SEC had become concerned about some special deals Milken offered to favoured investors. If a fund manager agreed to buy the junk bonds which Milken was selling, then they would be given the opportunity to buy certain "equity sweeteners" for their own personal account. These securities were low-priced options to buy equities, which allowed buyers the opportunity to make large profits with very little risk. [48]

46 Testimony of Tom Gallagher, Commissioner of Insurance, State of Florida, to the Permanent Subcommittee on Investigations, (Hearings p44).
47 Supplemental Testimony of John G. Heimann, Chairman, Global Financial Institutions, Merrill Lynch and Co Inc, (Hearings p 688)
48 *Den of Thieves* by James B Stewart, p 259 and p 553-554

It is certainly possible that these special deals improperly influenced the investment decisions made by those fund managers.

However, according to Milken, there was nothing wrong with these deals. He pointed out that these securities were not given away, they were sold at a fair price. The buyers were just very fortunate to make such large profits by selling these securities later. Some people might think that the securities had been sold at bargain basement prices – but these were unlisted securities, and the fair value was a matter of opinion. Who could really say whether the prices were fair?

Sanford and Blackburn were recipients of some of these equity sweeteners. For example, in 1989 Sanford bought certain junk bonds for GSL's portfolio, but kept the associated equity warrants for himself. He paid $15,000 for the warrants and sold them in 1991 for $13 million.[49]

According to a statement of claim made against Transmark in 1993, Sanford and Blackburn "*obtained these securities as an illicit inducement for causing Transmark and its subsidiaries to purchase high-risk Junk Bonds ….This practice of equity stripping potentially impacted the nature of the investment decisions made for and on behalf of Transmark and its subsidiaries and the nature, quality, safety and return on the investment portfolios.*"[50]

Sanford and/or Blackburn were involved in at least 16 separate equity-stripping deals, and the total value of the securities would have been many millions of dollars.[51]

49 *Before the crash, few saw trouble* by Robert Trigaux, St Petersberg Times, 2 February 1992, p 11

50 *RTC Complaint. Resolution Trust Corporation in its Corporate Capacity and as receiver for Centrust Federal Savings Bank and Imperial Federal savings, Plaintiff v. Transmark USA INC, a Kentucky Corporation; Mark C, Sanford; Robert C. Sanford,; Margena Burnett; William B. Blackburn; Melanie Blackburn; Merrill Lynch and Co Inc A Delaware corporation; Merrill Lynch Pierce Fenner and Smith Incorporated, a Delaware corporation,, D/B/A Merrill Lynch Capital Markets; Merrill Lynch Government Securities Inc A Delaware Corporation; And Richard Allerton; Defendants.* Case No 93-112 CIV-J-20 In the United States District Court for the Middle District of Florida, Jacksonville Division, Filed April 199, 1993 (available from Lexis-Nexis)

51 Details of these deals are given in the RTC Complaint (ibid).

The Regulatory Response to the Equity Stripping

By 1989, the Florida Department of Insurance probably knew (or should have known) about these equity-stripping deals. After all, they were well aware of GSL's junk bond holdings, and in 1989 the news about Milken's indictment for fraud was all over the front pages of newspapers across the country. Furthermore, in 1989 and 1990, unhappy Transmark bond-holders filed two suits suit accusing both Sanford and Blackburn of equity stripping[52].

After the collapse, the FDI sued Michael Milken and his brother Lowell for $225 million, alleging that they "*reaped millions of dollars in ill-gotten gains and profits*" as result of GSL's participation in their junk bond deals.[53] [54] The FDI also attempted to sue Drexel, without success (Drexel was already out of business).

Repercussions of the Association with Milken

Ironically, GSL's association with Milken probably led to its downfall. When Milken was under investigation by the Securities and Exchange Commission (SEC), he was offered a reduced sentence if he would cooperate, by providing useful information about other wrong-doers. According to press reports, Milken revealed details of some of GSL's more dubious financial transactions (described in more detail below) – and the subsequent SEC investigations prompted the regulator to put GSL into receivership.[55]

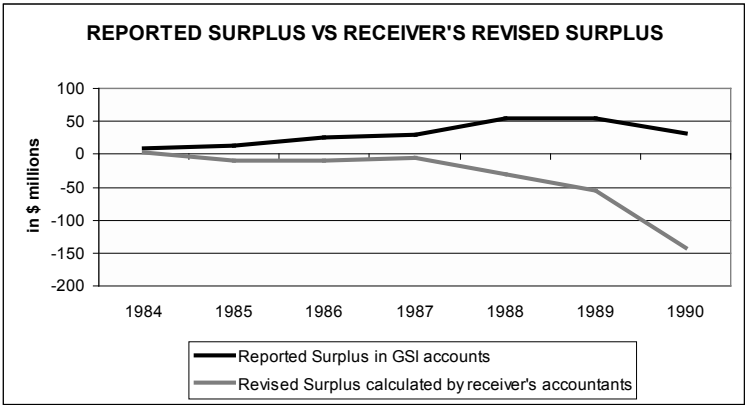
Section 4: A Shortage of Capital

According to the evidence which was later collected by the US Senate enquiry, GSL was probably technically insolvent at all times after 1984. But the State regulator did not take over the company until 1991.

52 CSL Investment v. Transmark USA Inc, et al, MD Fla., C.A. No 89-986-Civ.-J-16 (J.A. 200-233)
53 *State of Florida Department of Insurance as Receiver of Guarantee Security Life Insurance Co v. Michael R. Milken and Lowell J. Milken*, United States District Court, Case No 92-243-CIV-J-14 March 1992
54 *Fla Insurance Dept Sues Milken for 225 Mln Dollars,* Reuters News, 5 March 1992
55 *Milken implicated Merrill Lynch*, The New Yorker Says, Reuters, 28 February 1993.

From 1984 to 1991, the company manipulated its accounts in order to circumvent the solvency requirements and disguise its own financial problems.

After the collapse of GSL, the receiver called in forensic accountants to determine the true financial position of the company. They produced the following data. The top line represents the surplus as reported in GSL's accounts. The lower line represents the surplus calculated by the receiver's accountants after adjusting for certain questionable transactions (ie. end-of-year swaps and investments in affiliates, as described below). This does not make any adjustment for over-valuation of the junk bond assets, so in fact the true deficit in 1990 was even greater.



What caused GSL's solvency problems, and how were these problems concealed from the regulator?

Solvency Problems

In the United States, life insurance companies are required to set aside reserves to cover liabilities to policyholders. The reserves must be calculated using specified assumptions set by the regulator. The assumptions are conservative, to ensure that there is a high probability that the insurer will be able to pay future claims.

GSL was charging low premiums and paying high commissions. The cash inflow was simply insufficient to provide the required reserves for new business. The more policies they sold, the worse the problem would become – and during the mid-1980s GSL was expanding rapidly.

Based on statutory accounting standards, the company was likely to be insolvent by the end of 1984.

So what could be done to solve this problem? GSL adopted a four-pronged approach:

- Surplus Relief reinsurance;
- End-of-year swap transactions;
- Issuing junk bonds; and
- Affiliate transactions.

Surplus Relief Reinsurance

During the 1980s, fast-growing life insurers often used "surplus relief reinsurance" to manage capital problems.

The term "surplus relief reinsurance" covers a wide range of different arrangements. Some of these arrangements pass risk from the insurer to the reinsurer. Hence, the insurer need not retain any reserves to cover the risk. Under the circumstances, the regulator would normally allow the insurer to claim a "reserve credit" to reduce his statutory reserve requirements.

However, some types of surplus relief reinsurance were just financial reinsurance. Although the contract might be structured so that it *appeared* that the liability had been transferred to the reinsurer, the contract would include some mechanism which ensured that some (or all) of the losses were passed back to the original insurer. A variety of different mechanisms might be used to transfer the risk back from the

reinsurer to the direct insurer, eg. profit shares, early termination clauses, variable interest charges, etc. The contracts were often quite complex, so that it was difficult for outside parties to determine the amount of risk transfer.

As long as the surplus relief reinsurance contract was structured to *look like* a traditional co-insurance contract, the life insurance company could claim "reserve credits".[56]

In other words, in many cases, surplus relief reinsurance was simply an accounting trick, designed to improve the reported solvency of the companies, without actually providing any improvement in security for the policyholders.

By the end of 1984, GSL had unusually high levels of surplus relief reinsurance. These contracts were often organised shortly before the end of the financial year, and they were described as "innovative". During the Congressional investigation into the collapse of GSL, William Blackburn admitted that these contracts did not really provide much protection to the policyholders.

> *Senator: Those companies on reinsurance don't have any obligation if the company goes bankrupt?*
>
> *Blackburn: There is some obligation, but no one seems to know what that obligation really is.*
>
> *Senator: What do you think you're buying when you pay the premium for that?*
>
> *Blackburn: You are buying surplus that counts for statutory accounting.*
>
> *...*
>
> *Senator: If you're trying to protect your policyholders, why don't you make sure you get the right kind of reinsurance? Isn't that your duty as president of the company?*

56 A description of some typical surplus relief contracts, and industry attitudes to these contracts, is given in *Reinsurance*, Moderator Denis W. Loring, Participants John Tiller, Michael Winn, Gordon Dowsley, Record of the Society of Actuaries, Vol 9 No 3, 1983 p 905-931; and *Reinsurance*, Moderator Jay A. Novick, Participants Melville J. Young, David M. Holland, and Robert P. Johnson, Record of the Society of Actuaries, 1983, Vol 9 No 1-2, page 589-626; See also

Blackburn: The duty of the president of the company is to follow industry practice and my advice from the experts – and the regulators. I mean, this is the entrenched system of allowing small companies to exist.

Senator: Were you at all concerned about the policyholders?

Blackburn: No, I wasn't.

Senator: You didn't think it was part of your duty?

Blackburn: I wasn't concerned about the policyholders with regard to the reserving because statutory accounting is overly conservative. Surplus relief seems to balance out that over-conservatism, and that's what industry practice has been.

The surplus relief reinsurance arrangement allowed GSL to able to report that technically, it was meeting statutory solvency requirements at the end of 1984.

The Florida Department of Insurance was well aware that GSL was using surplus relief deals to maintain statutory solvency, because the company provided this information on statutory returns. The regulatory early-warning system (IRIS) would raise a red-flag on any insurer which had surplus relief reinsurance above 20%: GSL's ratio was 44%[57].

In evidence to the Senate investigation, GSL's auditors defended the use of surplus relief reinsurance to meet solvency requirements. They pointed out that this was quite a common practice in the life insurance industry: the auditor testified that he was aware of several other Florida companies which had used similar transactions to improve their reported solvency.[58] He claimed that the state regulators were well aware of such arrangements, and they had no objections at all. He said that the statutory rules were often "*overly restrictive*" and therefore "*surplus relief may be permitted by state insurance departments to mitigate the effects of these statutory conventions*".[59]

57 The National Association of Insurance Commissioners has an early warning system called IRIS, which automatically flags any unusual features in company statutory returns. In relation to GSL's 31 December 1984 returns, the IRIS system reported six "unusual values", including unusually large amounts of surplus relief reinsurance. (Hearings p 388-389)

58 Testimony of Donald F Withers, Partner, Coopers and Lybrand, to the Permanent Subcommittee on Investigations, Hearings, p 66

59 Testimony of Baily to the Permanent Subcommittee on Investigations, at Hearings

Reforms to statutory solvency regulation

Over time, regulators became more and more concerned about the misuse of surplus relief reinsurance. As a result, the laws were gradually tightened. As usual, New York state regulators led the way, passing new rules early in 1985. A few months later the National Association of Insurance Commissioners also issued a model regulation to restrict the use of surplus reinsurance.[60]

However, by the time the new rules were introduced, the GSL management had found other ways of dealing with their solvency problems.

The MSVR and end-of-year swap transactions

GSL's solvency problems were exacerbated by its own investment strategies.

Junk bonds are risky – and of course insurance regulators were well aware of this risk and took precautions to protect policyholders. Life offices were required to set aside reserves, known as the Mandatory Securities Valuation Reserve (MSVR), to cover the potential losses from falls in asset values.

To determine the MSVR for each company, bonds were graded according to the risk of default.

- Government bonds were considered to be perfectly safe, and therefore it was not necessary to set up any MSVR for government bonds.
- Corporate bonds from AAA rated issuers were considered to be fairly safe, and hence only a small reserve was required, say 1% of the value of the bonds.
- BBB rated bonds required a reserve of 2%.
- Junk bonds were in the highest-risk category: the MSVR for junk bonds was set at 20% of the value of the bonds.[61]

60 For development of tighter regulations, see *Capital Management: The Big Picture* in Record of the Society of Actuaries, 1987 Vol 13 No 2

61 *Insurance Regulation: Shortcomings in Statutory Asset Reserving Methods for Life Insurers*, Report by the Government Accounting Office, June 1994

Sanford and Blackburn took over GSL in 1984, and immediately began investing in junk bonds. However, they did not have enough capital to set up the required MSVR. So technically, they were in breach of the statutory solvency standards by the end of 1984.

However, they found a way to solve this problem. The Florida regulator would calculate the MSVR based on the assets held at the end of each year (31 December). So just before the end of the year, GSL simply "sold" their junk bonds to Merrill Lynch for about $155 million. A few days later, they bought them back, for approximately the same amount. [There was a small adjustment in the buy-back price of some of the bonds – this provided a fee to Merrill Lynch for services provided.]

As a result, GSL's 1984 end-of-year accounts did not show any junk bond holdings – it simply showed $155 million as a sum receivable from Merrill Lynch (it was never paid in cash, of course, it was all a paper transaction).

Under the Florida law, it is not necessary to set aside any MSVR for assets held in cash or as receivables from brokers. As a result of this transaction, GSL's MSVR was significantly reduced. Hence the company was able to meet the minimum solvency standards for 1984.

Similar deals were done in 1985, 1986, and 1988 – but since GSL's junk bond portfolio was growing, it was necessary to increase the amount in subsequent years:

1985 $255 million
1986 $292 million
1987 nil[62]
1988 $205 million.

After 1984, the system was refined a bit, to make it a bit less obvious in the accounts. The junk bonds were not traded for cash – they were traded for Treasury Bonds. It was normal for most life offices to have Treasury Bonds on their balance sheets, so this would attract less

62 Note that no such deals were done in 1987; at the time, the Florida legislature was imposing restrictions on new junk bond purchases, so GSL would not have been able to buy back the bonds on January 1. So in 1987, GSL had to find other ways of raising capital (as noted below, in 1987 the parent company Transmark issued its own junk bonds and then provided capital to GSL).

attention than a large cash amount "due from brokers".

How did the President of GSL justify the end-of-year swaps?

At the US Senate enquiry into the collapse of GSL, William Blackburn was quizzed about these year-end transactions. According to his testimony, Blackburn believed that the statutory solvency rules were too strict; hence it was quite acceptable to find ways of getting around the rules. Normally, this would be done by using surplus relief reinsurance; however this was expensive, since the reinsurers would charge a hefty fee for their services. Blackburn decided that the end-of-year swap deals were just a more efficient way of achieving the same outcome.

> *"The year-end transactions, by reducing the mandatory securities valuation reserve, and increasing the surplus of the company, put GSL in a position where it did not have to acquire additional surplus relief reinsurance, and thereby it saved the amount of the premium."*[63]

Blackburn and other GSL executives also argued that these trades were entirely legal; the transactions were properly recorded in the accounts; and the regulator was well aware of the trades and had no objection.

In order for this strategy to be effective, GSL required the co-operation of the brokers Merrill Lynch, the auditors Coopers & Lybrand, and the Florida Department of Insurance. Let's look at each of these in turn.

Why would Merrill Lynch agree to do the end-of-year swaps?

Merrill Lynch's fee for providing this service was relatively low – why would the investment bank put its reputation at risk by doing this sort of deal?

63 Statement of William B Blackburn, to the Permanent Subcommittee on Investigations, Hearings p 338

According to subsequent testimony to the Senate, Merrill Lynch agreed to do this for competitive reasons. Drexel Burnham Lambert dominated the junk bond market, but Merrill Lynch was desperately trying to increase its own market share. GSL was Drexel's client, and it had a junk bond portfolio worth hundreds of millions of dollars – so Merrill Lynch decided to be helpful to GSL, in the expectation that this would help them obtain some of GSL's business in the future.[64]

The Senate subcommittee which looked into this matter also expressed some curiosity about an unusual investment opportunity. Richard Allerton was a vice-president at Merrill Lynch, and he was primarily responsible for the GSL account. Allerton bought some warrants from Mark Sanford[65]. It turned out to be an excellent investment – the purchase price was about $100,000 and Mr Allerton made a profit of about $300,000 when the warrants were later sold. However, during his Senate testimony, Mr Allerton explained that there was nothing at all untoward about this deal – he might easily have lost money on the investment.[66] So it was definitely not an inducement for him to do the end-of-year swaps.

The Florida Department of Insurance later sued Merrill Lynch, arguing that the investment bankers knew (or should have known) that GSL was using these year-end transactions to conceal its solvency problems; hence Merrill Lynch had acted improperly by agreeing to these trades.

Merrill Lynch admitted that it had been a bit concerned at first – apparently there had been some newspaper reports about some savings and loans which were using similar end-of-year transactions to fiddle their balance sheets, which made them wonder about GSL's motivations for these transactions.[67]

64 Testimony of Samuel Hunter, Former Head of Equity and Debt Trading Worldwide, Merrill Lynch, Pierce, Fenner and Smith, to the Permanent Subcommittee on Investigations, at Hearings p 118

65 Technically, Sanford sold them to the Merrill Lynch trading desk and Allerton bought them from the trading desk – but the transactions occurred simultaneously. (Hearings p 111)

66 This issue was also raised in the Resolution Trust Companies complaint against Transmark (ibid), ie. the RTC alleged that Allerton benefited by receiving one or more bargain-priced investment opportunities from Sanford.

67 GSL was not the only insurer to think of using end-of-year swaps to reduce capital requirements. Executive Life certainly considered this approach, and SEC investigation found similar trades were done with Reliance.

So to make sure everything was above-board, they asked GSL for some assurances. William Blackburn wrote back and promised them that "*all positions and transactions will be fairly presented to all federal and state tax authorities*". [68] In subsequent testimony, Merrill Lynch executives claimed that they relied on GSL's representations.[69] Thereby Merrill Lynch absolved themselves of any responsibility.

Furthermore, Merrill Lynch argued that:

- it was quite common for clients to sell securities just before year end, to make tax losses, so they had no reason to be suspicious; and
- it is quite legal to buy and sell securities;
- if the trades resulted in a misleading presentation of GSL's solvency, that was not their responsibility. It was up to GSL and their accountants to work out the correct accounting treatment. If this was incorrect, it was certainly not Merrill Lynch's fault; and
- Merrill Lynch had no fiduciary responsibility to GSL's policyholders.

Furthermore, Merrill Lynch claimed that these transactions were *not* hidden from the Florida Department of Insurance. On the contrary, they claimed that the regulators were well aware of the year-end trades. Merrill Lynch offered quite a lot of evidence to support this claim (discussed in more detail below).

The Securities and Exchange Commission was unimpressed. They found that Merrill Lynch had violated the record-keeping requirements of the Exchange Act by recording these trades as genuine trades, when they were really just sham transactions. Merrill Lynch refused to admit that it had done anything wrong, but agreed to accept a public censure for its conduct, and promised to improve record-keeping in the future.[70]

The SEC also reached a settlement with Merrill Lynch's employee, Richard Allerton. He was charged with improper record-keeping, and was banned from the securities industry for a year.[71]

68 The letter is reproduced on page 413 of the Hearings of the Senate Subcommittee
69 Statement of John G. Heimann, Chairman, Global Financial Institutions, Merrill Lynch, Before the Senate Permanent Subcommittee on Investigations, April 30, 1992(Hearings Page 308)
70 *Merrill Settles with SEC over Insurance Trades* by John M Doyle, Associated Press, 22 December 1993
71 *Former Merrill Brokers Settle SEC Charges*, Associated Press, 28 August 1995

The FDI decided to sue Merrill Lynch for its role in concealing GSL's financial weakness. The dispute dragged on until July 1995. In the end, Merrill agreed to settle the claim by paying $45 million. They denied any wrong-doing and issued a statement to point out that "*the settlement should not be construed as an admission of guilt*". They claimed that they settled because it was cheaper to settle than to pay the legal costs involved in going to trial.[72]

Why would Cooper's & Lybrand agree to GSL's accounting treatment of the end-of-year swaps?

According to the Florida Department of Insurance, GSL's accounts were misleading, because they did not properly record these end-of-year trades. They sued Cooper's & Lybrand for their role in preparing these misleading accounts.

This leads to the question: what is the correct accounting treatment of such trades?

Before answering this question, it is important to realise that there were two separate sets of accounts for insurers:

- Financial Statement Accounts prepared for shareholders – which must be prepared under Generally Accepted Accounting Principles (GAAP)
- Statutory Accounts for the regulator – which must be prepared under Statutory Accounting Principles (SAP)

Under GAAP, there was no doubt about the correct treatment of the swap transactions. If a sale of securities is followed by a repurchase of the same securities within a short period of time, then it is called a "wash sale". The sale is not recognised for accounting purposes. So under GAAP, the financial accounts should show that GSL was the owner of the junk bonds at year-end.

72 *Florida gets $100 million in Insurer Failure* by Glenn Collins, The New York Times, page 2, 17 July 1995

In 1984, the auditors, Coopers & Lybrand, gave this opinion to Mark Sanford. Sanford was not very happy about this. In fact he immediately sacked the auditors.

However, a few months later (apparently after some fruitless discussions with some other auditing firms), Sanford decided to rehire Coopers & Lybrand. This time, he hired them to do the statutory accounts, not the financial accounts. After some discussion, Coopers & Lybrand were willing to be more flexible: they agreed that the statutory accounts should treat the swaps as genuine transactions. Hence the end-of-year accounts could show nil holdings of junk bonds.

Since the statutory accounts are used to assess a company's regulatory solvency, this meant that GSL would be considered solvent.

Were the accounts in line with accounting standards?

According to the testimony by the Coopers & Lybrand auditors, SAP accounting is not as clear-cut as GAAP accounting[73]. Under GAAP accounting standards, accounts must show "substance over form" – that is the accounts should show the true financial *impact* of any transactions. But the auditors argued that statutory accounting is different – the focus is on the *legal form* of the transaction, not the substance. Under statutory accounting standards, it is merely necessary to comply with the technical rules – if this has a misleading result, it does not matter. Experts testified that:

> *"Statutory accounting practices are often acceptable in the insurance industry because their legal form falls within the boundaries set by insurance regulations or the accounting prescribed in the instructions for the annual statement form, even when the substance of the transaction differs."*[74]

73 Statement by John T Bailey, CPA, to the United States Senate Permanent Subcommittee on Investigations, April 30, 1992 (Hearings p 249ff)

74 Statement by John T Baily, CPA, , to the United States Senate Permanent Subcommittee on Investigations, April 30, 1992 (Hearings p 249ff)

Initially, the auditors weren't sure what to do about the end-of-year trades. So they consulted an in-house expert, who had previously been the chief examiner for the California Department of Insurance[75]. The following file note records the outcome of that consultation,

> *"I spoke with Christie Armstrong (Insurance Partner – C&L, San Francisco) regarding the desire by Guarantee Security to place a rather significant portion of its bond portfolio into due from brokers at the end of 1984 in order to reduce the maximum component of the MSVR and, therefore, include a greater portion of their realised gains and surplus. Christie indicated that he thought from a technical standpoint it might work but felt it may raise some eyebrows by the Regulators. He suggested that it may be advantageous to attach a letter to the annual statement upon filing with the State as well as with the AM Best Company."*[76]

Donald Withers, who was the C&L partner who dealt with GSL, passed on this opinion to Mark Sanford. He suggested that GSL should discuss this with the Florida Department of Insurance, and warned him that the regulator might have its own opinions about the correct accounting treatment. He wrote:

> *"We can give no assurance that insurance regulators will not attempt to recharacterise the above transactions in a manner that they feel more appropriate."*

According to C&L, Mark Sanford told them the state regulators knew all about these deals and they had no objections. The auditors took Sanford's word for this.

During the Senate investigation, the C&L auditors were asked why they did not inform the state regulators about these transactions. They said that they did not think it was necessary, because they believed that the FDI already knew (see below for comments on this).

75 Testimony of Donald F Withers, Partner, Coopers and Lybran, to the Permanent Subcommittee on Investigations, (Hearings p 60ff)

76 A file note in the GSL file, on Coopers and Lybrand Letterhead, dated 10 December 1984, presented in evidence to the Senate Subcommittee, Hearings P 412

Consequences for the auditors

After GSL was placed in receivership, Coopers & Lybrand denied all wrong-doing. Nevertheless, the Department of Insurance sued them for compensation, accusing them of professional misconduct. In the end, the accountants would not admit to any wrong-doing, but they did agree to pay $50 million to Florida.[77]

Donald Withers, the auditor responsible for GSL's accounts, was also reprimanded by the Securities and Exchange Commission, for "*failing to maintain an appropriate professional attitude of scepticism*", and suspended for five years. Withers accepted the ruling without admitting to any wrong-doing. [78]

The Custodial Bank

When assessing the validity of the end-of-year transactions, the auditors relied on statements provided by GSL's custodial bank. At year-end in 1986, the bank was asked to provide a list of the assets held by the bank as custodians for GSL.

This was a bit tricky, since the bank did not actually hold the Treasury securities which GSL claimed to possess at year-end. However, the bank staff were helpful – when a GSL officer contacted them, they typed up a list of the securities which GSL claimed to own, and provided this incorrect information to the auditors.

Reforms to Statutory Accounting Principles

In 1995, the National Association of Insurance Commissions issued a discussion paper proposing reforms of statutory account principles. Among other measures, they suggested that when the same securities are sold and re-purchased within 30 days, the sale should not be recognised for statutory accounting purposes. [79]

77 *Coopers Agrees to Pay Fla. $50 Million*, The Insurance Accountant, 31 July 1995, Page 1
78 *In the Matter of Donald F. Withers*, CPA, Admin. Proc. File No 3-8450, Securities and Exchange Commission. August 17 1994
79 *Codification targets Window Dressing*, The Insurance Regulator, 9 October 1995, page 3

The Florida Department of Insurance

After GSL collapsed, the FDI claimed that they had been fooled by GSL's accounting tricks. The Commissioner stated that

> *"We regulators were deceived. We believed the company's officers and their attorneys; we believed the financial reports; we believed the accountants' audits and the custodian bank's confirmations. These reports and statements are supposed to disclose the company's financial condition; instead, in the case of Guarantee Security Life, they hid it."*[80]

However, this seems rather disingenuous. There are a number of reasons to suspect that the regulators knew (or should have known) about the surplus relief deals and the end-of-year swap deals.

- Firstly, GSL was required to submit quarterly returns to the FDI, showing all investment transactions. The end-of-year swap deals were clearly shown on the quarterly returns.
- Secondly, there are internal memos from FDI staff which refer to the end-of-year swaps.
- Thirdly, it is quite clear that the Department knew that GSL had very high levels of junk bond investments. After all, in 1987, 1988, and 1989 they had specifically lobbied the state legislature to allow GSL to maintain high levels of junk bonds.
- Fourthly, even if the swap deals had not been disclosed, consistency checks should have been obvious that something was wrong. The annual accounts showed a huge investment in Treasury bonds at year end – but also recorded a negligible amount of interest income received from government bonds.
- Fifthly, the Department conducted audits of GSL every three years. There is evidence to suggest that questions were raised about the end-of-year swap transactions during the 1987 audit. In fact, it appears that the first draft of the Department's audit report raised this as a matter of concern. However, after discussions between GSL and the Department, it seems that these comments were eliminated from the

80 Statement by Florida Treasurer Tom Gallagher, to the Permanent Subcommittee on Investigations, Hearings, page 172

final draft of the triennial review.

- Finally, in April 1989 a Florida newspaper published a front-page story which disclosed and criticised these year-end deals.[81] So it was on the public record.

Raising New Capital – the Transmark Issues

As noted above, GSL did not do any end-of-year swaps in 1987. The company found another source of capital. In the 1980's, this was not too difficult – especially if Michael Milken was helping you. In 1986 and 1987, Drexal Burnham helped Transmark (GSL's parent company) raise $150 million by selling notes and preferred stock.

The buyers were financial institutions with close links to Milken – such as Columbia Savings and Loan, Imperial Savings and Loan, and Centrust.[82] According to lawsuits filed later, Milken had a very strong influence on the investment decisions of these S&Ls.

Unfortunately, as the junk bond market collapsed, and GSL sank into insolvency, the Transmark securities became worthless (indeed, some would argue that they were probably worthless from the date they were issued).

Some of the savings and loans which bought these securities subsequently filed lawsuits alleging that Transmark had knowingly issued false and misleading information about its finances.[83] In particular, they complained that Transmark's subsidiary, GSL, had been mis-stating its capital and solvency reserves.[84]

81 *Insurer's dramatic growth raises questions* by Paul Thiel, Florida Times-Union, April 23, 1989

82 *Junky Juggling Act – A look at the deals preceding an insurer's collapse* by Abaham J Briloff, Barron's, 6 April 1992

83 *US Agency Suit Alleges Merrill Helped to Hide Insurer's Losses*, The Asian Wall Street Journal, 8 February 1993, page 14

84 Columbia Savings and Loan settled the claim against Transmark, but the terms of the settlement were sealed by the court. Third Interim Report page 11.

Repercussions

Many of the S&Ls which lost money by buying Transmark bonds subsequently became insolvent. Since the S&Ls were insured under the Federal Deposit Insurance Scheme, the government stepped in and took over responsibility for paying out the S&L's insured depositors. So in the end, the American taxpayer bore most of the losses arising from the collapse of Transmark. [85] [86]

Transactions with Affiliates

Historically, affiliate investments have been a common cause of solvency problems for insurers. Regulators are well aware of this fact, and therefore they impose limits on such investments. If an insurer invests too much in an affiliate company, then the excess amount above the specified limit cannot be counted as an admitted asset for solvency purposes.

This created a problem for GSL, because by 1988 GSL was making significant investments in affiliated companies. They lent money to various other companies owned by Transmark (an airline, the printing business, and the retail clothing businesses). Under Florida law, these loans could not be counted as admitted assets for solvency purposes.

However, Robert Sanford found a creative way around this problem. (Robert Sanford was the brother of Mark Sanford and the chief financial officer of Transmark).[87]

How did he do it?

85 Columbia Savings and Loan sued Transmark and reached a settlement, but the details are unknown (sealed by the court). Third Interim Report, (ibid), p11

86 The S&Ls also sued Coopers & Lybrand for their part in this transaction. C&L settled for $4.5 million, without admitting that they had done anything wrong. *Auditor to pay $4.5 million* by John Finotti, Florida Times Union, 15 May 1993

87 *In the Matter of Robert C Sanford*, Admin Proc File No 3-8451, Securities and Exchange Act of 1934 Release No 34542, August 18,1994 (1994 SEC Lexis 2558)

The affiliate restructures

If Transmark owned the retail clothing business, then any investment by GSL in this business would count as an investment in a related company, which could not be admitted for solvency purposes.

Luckily, Transmark was able to obtain excellent legal advice from the Wall Street law firm of Shereff, Friedman, Hoffman and Goodman. Transmark set up a complex legal structure, using a separate holding company and a "straw man", which allowed Transmark to retain *control* over the retail business, without being the official owner of the company. Hence technically, under Florida law, the retail business was no longer an affiliated company.

Hence, GSL's investment in the retail company could be counted as admitted asset for solvency purposes.

This decision was certainly debatable. But GSL's own internal legal team had a long talk with the auditors, and convinced them that it was all perfectly legal.[88]

This manoeuvre added about $20 million to Transmark's statutory surplus in 1988.

In 1989, Transmark restructured its other affiliate investments, the Airline Group and the Printing Group, in the same way.[89]

The round-robin transactions

At the end of 1989, GSL's owners had to become even more creative. During 1989, the junk bond market was crashing, making it even more difficult for GSL to maintain its solvency. GSL needed an injection of capital – but unfortunately Transmark had no capital readily available.

However, an ingenious round-robin scheme was concocted – by using a little sleight-of-hand, GSL could provide its own capital injection.

88 Statement of Donald F Withers, member of Coopers & Lybrand. To the Permanent Subcommittee on Investigations, Hearings p 298-299

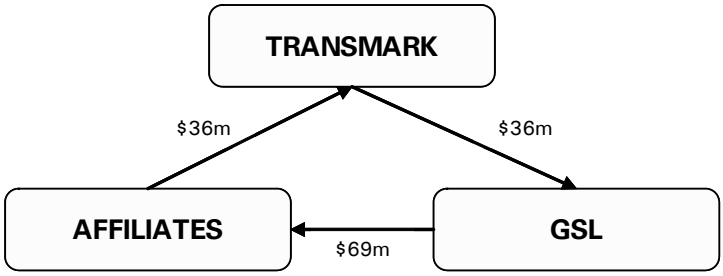
89 After doubts were raised about the legality of these restructures, the affiliates were re-structured again, shortly before GSL was placed into receivership.

Step 1: GSL loaned $69 million to some of the affiliate companies controlled by Transmark.

Step 2: The affiliate companies paid $36 million to Transmark.

Step 3: Transmark then paid $36 million to GSL as a "capital injection".

These transactions all occurred on the same day.[90] It was a simple round-robin. GSL's loans to the affiliates were simply funnelled back to become its own capital injection.



As a result of these transactions, GSL increased its (reported) surplus substantially. The balance sheet assets included both $69 million (in loans) and a $36 million infusion of capital.

No doubt the Florida Department of Insurance was delighted to see such an improvement in the solvency of the company.[91]

However, there was one flaw. The loans to the affiliates were shown as assets on GSL's balance sheet, at face value. But the affiliates themselves had aggregate deficits of $35 million. It was rather unlikely that these loans would ever be repaid.

The situation only deteriorated during the next year. By the end of 1990, GSL's balance sheet showed that investments in affiliated companies were worth $150 million. But the aggregate deficits in these companies amounted to $40 million, so it was highly unlikely that GSL would ever receive that $150 million.

90 Testimony of Heekin, to the Permanent Subcommittee on Investigations, Hearings p41
91 This joy was probably short-lived, since GSL paid Transmark a dividend of $27 million in 1990.

When the SEC investigated this matter later, they criticised the C&L auditor, Mr Withers, for going along with Transmark's proposal. He knew that these were round-robin transactions; he knew that the purpose of the transactions was to improve the reported level of solvency; he knew that the transactions were "*devoid of economic substance*" – yet he still signed off the accounts. He simply relied on a legal opinion on the interpretation of the law – and this legal opinion was provided by Transmark's own in-house lawyers.[92]

Consequences for the legal firm

After the collapse of GSL, the Florida Department of Insurance filed a suit against the legal firm which had helped Transmark devise this plan. They alleged that the law firm was "*the architect of a recapitalisation plan that fraudulently concealed GSL's financial condition from the Department*".[93]

The law firm denied any wrong-doing, on the following basis:

- The law firm had advised the parent company Transmark, not GSL;
- The law firm had no involvement in preparing GSL's statutory returns to the FDI, and therefore could not be held responsible if this information was misleading;
- Furthermore, the restructurings had been disclosed to the FDI, which had encouraged GSL to go ahead with these transactions. So it was unreasonable for the Department to claim that they had been deceived.[94]

While denying any wrong-doing, the law firm agreed to settle the claim by paying $5 million (this amount was covered by their professional indemnity insurance).[95]

92 In the Matter of DONALD F. WITHERS, C.P.A. Admin. Proc. File No. 3-8450, Securities and Exchange Commission Securities Exchange Act of 1934, Release No. 34537; Accounting and Auditing Enforcement, Release No. 582 *1994 SEC LEXIS 2513*, August 17, 1994

93 Shereff, Friedman (defendants) Motion to Strike as Sham. Hearings p 512

94 Affidavit of Andrew J. Levinson, presented in the case of *the State of Florida Department of Insurance, as Receiver of Guarantee Security Life Insurance Company v. Merrill Lynch Pierce Fenner & Smith Incorporated at al*, in the Circuit Court Duval County Florida, included at Hearings page 525

95 *$100 million settlement over defunct insurer*, Business Insurance, 1 April 1996, page 20

Section 5: Financial Benefits To GSL's Owners

We have already seen that GSL's owners, Sanford and Blackburn, made quite a lot of money over the years, by various means.

At the time of the collapse, the 38-year-old Sanford owned a million dollar beachfront home, a powerboat, two Lamborghinis, a Rolls Royce, two Corvette, and a Jaguar. He also owned his own small island in the Bahamas (only 363 acres). He printed his own silver coins to be used as currency on the island – his own face was printed on one side, and his bikini-clad wife on the reverse.[96]

How did Sanford and Blackburn make so much money, when their company was teetering on the verge of insolvency?

- As noted above, they earned millions and millions of dollars from the "equity sweeteners" provided by Michael Milken.
- It appears that they received about $50 million from Transmark's capital raisings in 1986/87.
- According to GSL's receiver, Sanford, Blackburn and associates looted GSL of about $80 million dollars by a variety of other means.

> *"[They] executed self-dealing management agreements, paid themselves fees as investment advisors to the insurance company, paid themselves excessive compensation, unwarranted bonuses, improper dividends, and other devices which produced millions of dollars they should never have received."*[97]

As an example, GSL paid a dividend of $27 million to Transmark in 1990, not long before the company was placed in receivership. The regulator had no objections to this payment –

96 One of these coins was presented in evidence at the Senate Hearings.
97 Statement by Florida Insurance Commissioner Tom Gallagher, the Permanent Subcommittee on Investigations, Hearings page 171

after all, according to the company's own statutory returns, there was plenty of surplus available.

Although Blackburn left GSL in 1988, he did not go away empty-handed. He bought one of GSL's subsidiaries, a small life insurer called Atlantic General. Atlantic General was not a particularly successful insurer – in fact, over the next four years it never sold a single policy. Luckily, it did have one source of funds: in 1988 GSL bought a reinsurance policy from Atlantic General, and transferred $20 million in reserves over to the small insurer as a reinsurance premium. Most of this money was quickly dissipated in a number of dubious investments.

Atlantic General was declared insolvent in December 1991. The Florida Department of Insurance filed charges against Blackburn and his associates, alleging that they had "*caused Atlantic General to enter into numerous contracts with other companies controlled by Blackburn for the purpose of depleting Atlantic's assets and enriching themselves*."[98]

Repercussions for Sanford and Blackburn

The receiver of GSL did attempt to recover some money from Sanford and Blackburn and their associates. Unfortunately, by the time GSL collapsed, many of the assets were held offshore, making it difficult for the receiver to obtain restitution.

At this point, the receiver had some difficult decisions to make. No doubt the receiver wanted to pursue and punish those who were responsible for the collapse of GSL. However, there were some other factors to be taken into account – such as the minimisation of losses.

GSL had a huge deficit. Luckily there were laws to protect the policyholder from losses – the state guarantee funds would be responsible for covering those losses. The state guarantee funds would raise this money by imposing levies on all the other insurers. Naturally,

98 *Gallagher sues former Atlantic directors & officers for self-dealing and corporate waste*, Business Wire, 2 September 1992. *State Sues officers of failed insurance company* by Mark Albright, St Petersberg Times, 3 September 1992, page 1E. *State of Florida Department of Insurance, as Receiver of Atlantic General Life Insurance Company, Appellant, v. William B. Blackburn, Pamela Jeanne Turbow Rush, Susan Lynn Boswell, Tower Investment Group, Inc., Gulf Coast Aircraft Charter Inc, Blackburn and Company and Bay Harbour Investments Inc., Appellees*, Case No. 92-04449, Court of Appeal of Florida, Second District, 633 So. 2d 521; 1994 Fla. App. Lexis 1962, filed March 9, 1994

in order to minimise this cost, the other insurers were keen to ensure that the receivers recovered the maximum possible amount of money.

So in the end, the FDI decided to negotiate with Sanford and Blackburn.

After protracted court battles, Blackburn agreed to settle for about $8 million[99].

Sanford agreed to hand over cash, securities, and property worth about $20 million. The settlement included his island in the Bahamas, which the Florida Department of Insurance later sold for more than $6 million.

Transmark agreed to plead guilty to one count of mail fraud. Mail fraud by an individual may be punished by a jail term of up to 20 years, but of course a company cannot go to jail. Transmark agreed to pay $2.1 million and some property, along with 80% of any tax refunds it received.[100]

In return for these financial settlements, the federal prosecutors agreed that they would not pursue criminal charges against Sanford, Sanford's wife, or Sanford's brother.[101] All three were barred for life from working in the insurance industry.

The Florida Insurance Commissioner announced that:

> *"This settlement is another victory for the 56,000 policyholders of GSLIC. We will not allow insurance companies to be mismanaged or looted, leaving policyholders to foot the bill."*[102]

Compare the amount of money taken out of Transmark and GSL to the amount paid by Sanford and Blackburn under the settlement agreement. It seems possible that Sanford and Blackburn might have

99 *South Dakota insurer takes over Guarantee* by John Dunbar, The Florida Times-Union, 18 October 1997, page C-9

100 Apparently, since Transmark had been overstating its profits for several years, it was entitled to a tax refund.

101 *The Long Road Back*, Marilyn Ostermiller, Best's Review, 1 February 1998, Vol 98, No 10, page 44

102 *Key figure in GSLIC Collapse settles for $15 million*, PR Newswire, 30 March 1996

had a few dollars left over, even after settling these claims.

Section 6: The Aftermath

After GSL collapsed, the receiver had the difficulty task of salvaging the remains and making the fairest possible arrangements for the policyholders. The story of this process is beyond the scope of this paper, but apparently this was done with considerable expertise under quite challenging circumstances. .[103] [104]

A special run-off company was created to manage the assets and liabilities until all the legal issues could be sorted out.

Instead of conducting a "fire-sale" of the assets, the junk bond portfolio was handed over to an expert fund manager. As the junk bond market recovered somewhat over the next few years, the outcomes were better than expected.

As a result of various lawsuits, the receivers managed to recover $100 million - $50 million from Coopers and Lybrand; $45 million from Merrill Lynch; $5 million from the legal firm of Shereff, Friedman, Hoffman and Goodman. Sanford paid about $20 million; Transmark paid about $2 million. Some money was recovered from insurers who had sold policies to GSL under assumption reinsurance deals.

However, these recoveries were partially offset by approximately $27 million in legal costs.[105]

In 1997, the remaining GSL policyholders were transferred to another insurer, Midland National Life.

103 As part of the winding up, the receivers also obtained control of a couple of nude dance clubs which had been owned by an associate of Sanford's. The FDI became responsible for the sound financial management of the establishments known as *The Dollhouse* and *Pure Platinum*. Apparently, the Department's employees did an excellent job, since they were subsequently given an award for their diligent and conscientious efforts on behalf of Florida's taxpayers. *Liquidator finds job weird, rewarding*, John Dunbar, The Florida Times-Union, 21 November 1996, page B-1

104 *The Long Road Back*, Marilyn Ostermiller, Best's Review, 1 February 1998, Vol 98, No 10, page 44; *Rehabilitation Fallout*, Robert E. Ewald, Charles W. Petty, Richard A. Veed, Record of the Society of Actuaries, 1993 Vol 19 No 4B, p 2669-2688

105 *Law Firms Contest Settlement* by John Dunbar, Florida Times-Union, 11 July 1997, page B-4

The winding-up process was regarded as a success. When GSL first collapsed, the deficit was estimated at $390 million. Ultimately the cost to the state guarantee funds was "only" about $180 million.

According to the Florida Commissioner of Insurance:

> *A primary lesson that can be drawn from our experience with Guarantee Security is this: Fortunately for consumers, the regulatory system in place in Florida, the home state of this company, worked.*
>
> *Policyholders now drawing annuities from Guarantee Security are being paid 100% on the dollar. All but a handful of consumers who are due future monies from Guarantee Security will be paid…*
>
> *Yes, the Florida regulatory system designed to protect consumers worked.*[106]

It is not clear if the other insurers – the ones who paid out $180 million to cover GSL's losses – agreed with this view.

Section 7: Relevance for Australia

The GSL fiasco happened a long time ago, far far away, in a country which has a completely different approach to prudential regulation. Does this story have any relevance for Australian actuaries?

From time to time, in the past, some Australian financial institutions have adopted business strategies which were, at least in some respects, quite similar GSL's – often with quite disastrous consequences for their customers[107]. No doubt most readers are already quite familiar with the events leading to the insolvency of FAI and HIH. The appendix gives two more examples from the not-so-distant past:

- the Goldfields Medical Fund – a health fund which was placed under administration in 2002; and

106 Statement by Florida Treasurer, Tom Gallagher Hearings page 165

107 Older readers will no doubt remember various painful incidents from the 1980s, such as the Pyramid Building Society, the WA Teachers Credit Union, The State Bank of Victoria, etc. Those who are too young to remember the 1980s might read *Bold Riders* by Trevor Sykes.

- Commercial Nominees of Australia – a superannuation fund trustee which went into liquidation in May 2001

After the death of any major financial institution, legislators conduct an autopsy of the corpse, in order to identify any weakness in legislation or supervision. Loopholes are closed, risk management controls are improved, and supervisory authorities are given greater powers. For example, as a result of improved supervision post-HIH, APRA managed to substantially reduce the number of financial institutions which were "*operating outside acceptable boundaries for prudent risk management*" (there were 131 such financial institutions operating during 2003-2006, but APRA persuaded most of them either to improve or to exit the system). [108] So we have good reason to believe that the post-HIH reforms have substantially reduced the risk of another major insolvency.

However, it would be optimistic to assume that new problems will not arise in the future.

On the one hand, GSL might be regarded as the story of failure – the failure of the prudential system. On the other hand, if we look at the story from another point of view, GSL is an amazing success story. The financial services industry is a business, and the aim is to maximise profits. Shareholders, company executives, agents, reinsurers, bond traders, merchant banks, auditors, and lawyers: they are all essentially in business to make money. All of those who were involved in the downfall of GSL acted perfectly rationally, in order to achieve this objective – and indeed they showed a remarkable amount of initiative and ingenuity in doing so.

For an entrepreneurial person like Mark Sanford, the regulatory system is simply another obstacle which must be overcome. No doubt Australia has many people who are just as entrepreneurial as Sanford.

108 John F Laker, Chairman of APRA, APRA-*Issues on the Radar*, Speech on 9 August 2006 to the Australian Institute of Company Directors, available on the website at www.apra.gov.au. 131 financial institutions were classified as needing Mandated Improvement, and 37 were classified as requiring Restructure, under the PAIRS rating system.

Any financial system must find a balance between the need to protect consumers, and the need to have a profitable financial services industry. GSL demonstrates the way imbalances can creep into the system, to the detriment of policyholders. Insurance failures like GSL are not simply caused by one "bad seed' company – they arise because of the improper management of the conflicts of interest which permeate the whole financial system.

a) Influencing the legislation

The prudential system starts with effective legislation. The GSL story shows how serious problems can arise when financial institutions have too much influence over the decisions made by politicians. As we have seen:

- Drexel was making huge profits by selling junk bonds to life insurance companies like GSL. Drexel and GSL were successful in lobbying legislators to allow excessive levels of investment in junk bonds, despite the risks. The junk bond losses were the primary cause of GSL's collapse (and several other life insurers and savings and loans as well).
- Life insurers could profit by selling portfolios of unprofitable business to financially weak insurers on favourable terms. The life insurance industry lobbied against stricter controls on assumption reinsurance. As a result insolvent insurers like GSL were able to obtain control of hundreds of millions of dollars of policyholders money.

Of course, politicians must always weigh up the costs and benefits of any legislation. It is important to provide security for policyholders, but it is also important to have a competitive, efficient, flexible financial system. Financial institutions naturally have a right to present their views on such issues. The problems arise when the system gets out of balance, when the interests of the general public are not given enough weight.

Many people believe that the seeds of the Global Financial Crisis were sown many years ago, when the US law-makers succumbed to the special pleading of some financial institutions: eg. when they decided Fannie Mae's capital requirements need not be strengthened; when they decided that Credit Default Swaps need not be regulated; when they

decided that the Glass-Steagall Act was no longer relevant to current conditions[109]. They were persuaded by lobbyists who had a strong financial interest in the outcomes, who were willing to spend a great deal of money to influence the legislation. Of course these lobbyists were not setting out to create a catastrophe – they just wanted to take on more risk with less capital, so that they could make higher profits.

Perhaps as Australians we have greater confidence in the judgement of our own politicians: surely our politicians would never allow their judgement to be swayed by campaign contributions or lobbying (?)

In response, let me point out that GSL operated in 42 states[110]. No doubt most of those states had strict legislation and vigilant insurance supervisors. Nevertheless, this did not protect their citizens. In the USA, each insurer is supervised in its home state, and GSL decided to set up their head office in Florida, which had a decidedly "pro-business" attitude to the insurance industry.[111]

Companies like GSL tend to gravitate towards the jurisdiction which has the most lenient regulation. With the globalisation of financial markets, we have seen that weaknesses in prudential regulation in one country can have devastating effects on citizens in many other countries.[112]

b) Undermining the accounting system

The regulatory system cannot work without reliable financial information. GSL was successful in concealing its insolvency for many years – and they did so by exploiting weaknesses in accounting standards and by creating a strong conflict of interest for auditors.

Accounting is not a simple task which can be done mechanically, using a set of rigid rules which covers every possible transaction and the valuation of every asset – it always requires a considerable amount of

109 See, for example, *The Political Origins of the Financial Crisis: The Domestic and International Politics of Fannie Mae and Freddie Mac* by Helen Thompson, The Political Quarterly, Vol 80, No 1, January-March 2009

110 Third Interim Report, page 7

111 GSL was certainly not the only Florida insurer to fail during this era.

112 For example, the poorly-regulated Icelandic banks took billions of dollars of deposits in England, Germany, and Holland in the last few years before they collapsed.

judgement. If auditors have a financial incentive to do so, they are more likely to exercise this judgement in favour of their clients (and, of course, this applies to actuarial valuations as well).

Sanford created a conflict of interest for his auditors. He sacked them when they would not comply with his wishes. He rehired them when they agreed to be more co-operative – even though they clearly had concerns about the appropriate treatment of the end-of-year transactions. The accounting rules had grey areas which required judgement, and they exercised their judgement to please their client.

Regulators can tackle auditing defects by making more and more proscriptive accounting standards, by insisting on rotation of auditors, etc. This alleviates the problem, but it is unlikely to eliminate it.[113]. Accounting inevitably has "grey areas", there is no correct answer. Therefore, in many cases, "stretching of the boundaries" will not lead to any sanctions. Who can determine whether an optimistic asset valuation was a negligent decision motivated by the desire to keep a customer, or simply poor judgement? No one. And poor judgement is not a crime.

Australian auditing rules have been tightened in recent years, but ASIC still has concerns about conflicts of interest[114]. Tony Schiffman, the national chairman of accounting and advisory practice BDO, has recently pointed out that some major auditing firms were giving large discounts on their audit fees to win business, and then trying to sell other services at a higher margin – a strategy which clearly threatens auditor independence[115].

The simplest way to deal with a conflict of interest is to eliminate the conflict – or at least reduce the size of the conflict. A post-Enron study has suggested that American auditing standards declined during the 1990s for two reasons: accounting firms were increasing relying on revenue from consulting services provided to audit clients, so they had greater financial incentives to be "helpful"; and the Private Securities

113 If it was possible to do so, then financial services could be provided by computers.

114 ASIC Targets independence of auditors, analysts by John Kehoe, Australian Financial Review , 13 October 2009

115 *Claims of Undercutting on audit work* by Mark Fenton-Jones, Australian Financial Review, 6 November 2009, page 47

Fraud Litigation Act made it more difficult to sue auditors.[116] Regulators realised that stricter rules would not solve the problem – they also had to change the financial incentives, eg. by limiting the ability of auditors to provide consulting services to their audit clients.

Conflicts of interest can be reduced if significant financial penalties are applied to accountants and auditors who are too willing to adopt aggressive accounting standards. GSL's auditors were sued, and ended up paying $50 million to the Florida Department of Insurance. At the time of writing, we are awaiting the outcome of lawsuits against HIH's auditors[117].

c) Applying Goodhart's Law

Capital requirements have a key role in encouraging prudent risk management. Theoretically, companies which are financially weak should not be able to take on additional risk. But risk based capital requirements depend on the accurate measurement of risk. And according to Goodhart's Law, this is never going to be easy.

Charles Goodhart was an economist who worked for the Bank of England, advising on monetary policy. The BoE economists used historical data to build economic models. Then they would use the model to determine economic policy, eg. to control inflation. But it did not work. The market simply adapted to the government's policy. Goodhart realised that "*If ever the Government decides to rely on any particular statistical relationship as a basis for policy, then, as soon as it did that, that relationship would fall apart*." [118]

Danielsson has suggested the prudential regulator's corollary to Goodhart's law*: "A risk model breaks down when used for regulatory purposes.*" [119]

116 John C Coffee Jr, *What Caused Enron? A capsule social and economic history of the 1990s*: Cornell Law Review, January 2004, 89 Cornell Review 269
117 *Mystery partner delays HIH deal* by Elisabeth Sexton, Sydney Morning Herald, 6 November 2009
118 Charles Goodhart quoted in a BBC documentary, *A Fable from the Age of Science,* 1992.
119 *The Emperor Has No Clothes: Limits to Risk Modelling* by Jon Danielson, Journal of Banking and Finance, 2002

As soon as regulators use specified risk measures to set minimum capital requirements, financial institutions adapt. In some cases, they will actually reduce the level of risk and/or find additional capital to cover existing risks. But in many cases, they find new ways to take risks – risks which are not accurately measured by the regulator's model.

And there are a great many very clever people – lawyers and investment bankers and reinsurers – who are more than willingly assist them in doing so. These "alternative solutions" are often actively promoted and hence become widespread (even quasi-acceptable in the industry). This is not surprising - it can be very profitable to help insurers find a way around the rules[120]. And given the complexity of the financial system, it is almost inevitable that there will be some loopholes.

In many cases, this simply means moving the risks off the balance sheet. This was the method adopted by GSL – the surplus relief policies and the end-of-year swap transactions were just rudimentary versions of the more sophisticated financial reinsurance deals later used by FAI and HIH and Independent Insurance and AIG. Similar types of financial reinsurance deals have been used for at least 40 years[121]. The banking industry has used similar methods which appear to move risk off the balance sheet without actually doing so, eg. securitisation deals which have buyback options.

Regulators have attempted to deal with this problem by requiring more detailed disclosure. It remains to be seen if this will be a successful strategy. It is perhaps worth noting that the UK regulators recommended the same approach – ie. improved disclosure – in 1990[122]. It has not been wholly successful in preventing the misuse of financial reinsurance (eg. Equitable Life, Independent Insurance).

120 Indeed some would argue that this is the raison d'être for some investment banks. See *Infectious Greed* by Frank Portnoy, for examples of regulatory arbitrage.

121 Financial reinsurance deals were used by Vehicle and General in the last 1960s, before the insurer collapsed in 1971 (described in *Lloyd's of London* by Godfrey Hodgson, Allen Lane, 1984). In Australia, financial reinsurance deals disguised solvency problems at Regal and Occidental, life insurers which were placed under judicial management in 1990. It appears that some reinsurers were actively marketing such contracts to life insurers at the time.

122 *Financial Reinsurance* by R.C. Wilkinson, D.H.Craigend, and A.H. Silverman, Journal of the Institute of Actuaries, 1993 (volume 120) page 311-380, includes a description of the regulatory approach to financial reinsurance in the UK

Of course, financial window-dressing usually requires assistance from a counterparty – eg. GSL required the assistance of Merrill Lynch (for end-of-year swaps) and reinsurers (for surplus relief deals). The evidence suggests GSL had no difficulty in finding a counterparty – obviously the counterparties expected to make a profit from such deals. But they didn't - Merrill Lynch was sued by the FDI and paid over $45 million.

This raises the issue of legal risk for the counterparties. Should they bear any legal liability if an insurer uses such deals to conceal insolvency, and subsequently collapses with large losses? Under what circumstances, if any, should they be held liable? Can they avoid any liability by claiming that they did not know that the financial reinsurance deals would be used to distort financial statements?

At the time of writing, the HIH liquidator is suing four reinsurers who were involved in financial reinsurance deals with FAI or HIH [123]. If he is successful, this may be helpful in deterring such deals in the future. Each counter-party will weigh up the potential costs and the potential benefits of participating in such deals. If the prudential regulation system is to be effective, the costs must outweigh the benefits.

d) Affiliate investments

Investment in affiliates is often a significant cause of problems for life insurers, general insurers, and banks. For example, a Best's study of insurance company insolvencies between 1987 and 1997 found that affiliate problems were the main cause of the insolvency in 18% of all cases[124].

Problems arise because

a) the insurer might be tempted to assist an affiliate which is in financial difficulties, by making loans on favourable terms, buying or selling assets on favourable terms, making reinsurance deals on favourable terms, etc.;

123 *Mystery Partner delays HIH deal* by Elisabeth Sexton, Sydney Morning Herald, 6 November 2009
124 *Insolvencies Charted*, Best's Review, June 1999

b) The value of investments in affiliates is often difficult to determine, since transactions may not be done on an arm's length basis; and

c) The insurer can use transactions with affiliates to do end-of-year window dressing of accounts, shuffling money back and forth between companies.

GSL clearly used affiliate transactions to conceal insolvency, and to siphon money out of the company for the benefit of GSL's owners (ie. by reinsurance deals with Atlantic General).

Of course Australian actuaries already familiar with this problem – the Royal Commission into HIH and FAI revealed a web of cross-guarantees between related companies which effectively disguised the true financial status of the companies in the group. [125]

e) Regulators

The Florida Department of Insurance did a very poor job in supervising GSL. Even though they were well aware of serious problems at GSL, they took little effective action to rectify the situation. There is even some evidence to suggest that the FDI knew that GSL was using various accounting tricks to disguise its solvency problems – and they closed their eyes to this deception.

Regulators naturally need to exercise their judgement when dealing with weak financial institutions. Is there a reasonable probability that, given time, the company will be able to trade out of its difficulties? Or is the situation only likely to deteriorate further?

A number of studies have suggested that regulators are often too lenient towards the weak financial institutions, in both insurance and banking supervision, and in many different countries. American studies show that "*the strategy of most state insurance departments for dealing with potential insolvencies has been to delay recognising insolvency for as*

125 In particular see the sections on netting off of assets, pledged assets, and incorrect reporting of related body assets in the HIH Royal Commission Report

long as possible."[126.127]

This has certainly been a problem in Australia in the past. For example, the Palmer report into APRA's supervision of HIH reported deficiencies in the supervision of both FAI and HIH.[128] *(S5.6.3)* In some cases, the regulators did not have enough power to take action. In some cases, insurers (especially FAI) were able to delay intervention by dragging out legal proceedings, appeals and reviews.

Regulators were also subjected to "behind the scenes" pressures, and had difficulties in balancing conflicting objectives. For example, in relation to FAI, the regulator was quite concerned about the flow-on effects of closing down such a large insurer, and possible political repercussions. The regulators tended to accepted assurances from the management – the management would downplay the problems and/or assure that regulator that the problems were under control. (In relation to FAI, regulators delayed in taking action because they were "*encouraged by the co-operative attitude of the CEO*" (Rodney Adler)).[129]

In Australia, both APRA and ASIC have been criticised many times, for delays in taking effective action - examples include CNAL (described in the appendix), and more recently (for ASIC) Westpoint, Fincorp, Firepower, Opes Prime, and Storm Financial.

After each major collapse, the regulators tend to become more vigilant; they receive extra funding and hire more staff. But this vigilance may be eroded over time – especially during boom times when insolvencies are infrequent. The industry might "push back" against a zealous regulator.

126 *Insurance Regulation: State Handling of Troubled Property/Casualty Insurance Companies*, Government Accounting Office Report, May 1991; *Insurer Failures: Regulators fail to Respond in Timely and Forceful Manner to Four Large Life Insurer Failures*, Government Accounting Office Report to the Senate Subcommittee on Oversight and Investigations Committee on Energy and Commerce, House of Representatives, September 9, 1992

127 Ron Wyman, at Hearings, House of Representatives, Committee of Energy and Commerce, Subcommittee on Energy and Commerce, May 22,1991, page 3

128 Palmer Report Section 5.6.3

129 Palmer Report Section 10.2.3

As an example, consider the US banking system. The government introduced Prompt Corrective Action (PCA) requirements, so that regulators would be *required* to take action when a bank fell below acceptable standards. But the FDIC has recently reported that PCA requirements have not eliminated the problem of regulatory forbearance. When they examined the supervision of banks that had failed in 2008/2009, they found that in most cases the regulator had indeed identified problems in a timely fashion – but did not take forceful corrective action[130]. Often the regulators trusted the bank's management, who provides assurances that were working to resolve the problem.

Conclusion

GSL collapsed because the system of prudential regulation was flawed. Many people had strong incentives – financial or otherwise – to disregard the interests of the policyholders. The owners of the company, the legislators, the industry associations, the auditors, the investment bankers, the lawyers, and the prudential supervisors, all made decisions which contributed to the failure of the prudential system. They all decided, in one way or another, that looking after the policyholders was someone else's responsibility.

130 *FDIC raps its own knuckles over lending* by Alison Vekshin, Australian Financial Review, 20 October 2009

Acknowledgements

The author would like to thank Rade Musulin, who very kindly provided encouragement and helpful advice on several aspects of this paper. Thanks are also due to the anonymous peer reviewers.

APPENDIX: Australian example 1: Goldfields Medical Fund[131]

In 1999, Goldfields Medical Fund (GMF) was a small health fund based in Kalgoorlie, Western Australia.

However, over the next two years membership shot up dramatically. The number of people insured by the fund jumped from less than 18,000 to more than 82,000[132]. In June 1999, GMF was the 31st largest fund – two years later, it was ranked number 13. [133]

How did they achieve such spectacular growth? By "*ridiculously low prices*" and the aggressive use of agents. [134.135]

GMF paid commission of up to 5% for signing up new members. [136] Apparently this commission was not always disclosed to members. The PHI Ombudsman later expressed concerned that clients might not have understood that the brokers were not providing independent advice – for example, customers probably did not realise that the brokers would not recommend any of the big funds, which did not pay commission.[137]

The PHI Ombudsman also noted that anyone could set himself up as a broker – there were no training requirements and no need for any knowledge at all about the health insurance industry. "*Joe Bloggs in theory could set up shop*".[138]

GMF also had a corporate marketing department. It appears that some customers were given substantial premium discounts (ie. 50%) for signing up.[139]

131 The fund changed its name from Goldfields Medical Fund to GMF Health in January 2000. *Is GMF being sold out?* By Lee-Anne Petchell, Kalgoorlie Miner, 29 June 2002
132 PHIAC statistics from 1999 and 2001 annual reports, available on PHIAC website www.phiac.gov.au
133 Another fund, IOR, followed quite a similar growth strategy. It was placed under administration in July 2002. *Broker-backed health fund in financial strife*, Herald Sun, June 2002
134 *Fee Increase Justified - GMF*, Kalgoorlie Miner, 6 February 2002.
135 *Customers hit as agents gain*, Herald Sun, 8 April 2002.
136 *Customers Hit Again as Agents Gain* by Andrew Probyn, Herald-Sun, 8 April 2002.
137 *Clamp on Small Health Fund Brokers*, Daily Telegraph, 25 March 2002.
138 *Clamp on Small Health Fund Brokers*, Daily Telegraph, 25 March 2002.
139 *Merged health Board to review all policies*, Kalgoorlie Miner, 7 February 2003

In June 2001, Choice magazine nominated Goldfields as a top fund for hospital cover in every State, based on competitive prices and the level of benefits.[140]

Phenomenal growth, combined with unsustainable premium rates, soon caused financial difficulties for GMF. In June 1999, GMH had reserves equal to 15 months of contributions. By the end of 2001, reserves were less than 2 months contributions.[141]

The regulator, PHIAC, had been observing the activities of the fund for some time, with increasing concern. In December 2001, PHIAC appointed an administrator, on the following grounds:

a) *Information provided to PHIAC by GMF's actuary and by GMF raised serious concerns about the reported level of claims, decreasing reserves, liquidity, the carrying value of assets and whether or not the management of the business of GMF was in conflict with the actuary's recommendations to preserve the financial stability of GMF;*

b) *PHIAC's review of financial information provided by GMF led PHIAC to suspect that GMF's reserves may, or may in the near future, become insufficient to satisfy the capital adequacy requirements under the Act;*

c) *PHIAC had been informed that GMF had lost several key executive staff including the Chief Executive Officer, the accountant and an experienced senior manager;*

d) *PHIAC suspected that GMF may not have experienced internal managers to effectively manage the operations of the Fund in the interests of contributors.*[142]

It took quite a while for the administrator to sort out the problems. Apparently, "*proper accounting records and procedures were almost non-existent*", there were "*financial discrepancies*", and "*a lack of*

140 *GMF Health proves top choice for Australians*, The Kalgoorlie Miner, 16 June 2002.
141 *Is GMF being sold out?* by Lee-Anne Petchell, Kalgoorlie Miner, 29 June 2002.
142 Federal Court of Australia. *Hedge, as Administrator of Goldfields Medical Fund Inc* [2002] FCA 1303

internal controls and fraud prevention strategies".[143.144] The administrator reported that the fund had inadequate management and corporate governance.

Soon after his appointment, the administrator changed the investment mix of the fund, which he described as "*inappropriate*". For example, the administrator called in a $500,000 loan to the Goldfields Credit Union (a subordinated debt). This loan had enabled the Credit Union to grow and open a new branch. The chairman of GMF was also chairman of the Credit Union at the time the loan was made. The administrator agreed that the loan provided an excellent rate of return, but he believed that "*it should not have been provided under the National Health Act*"[145].

The administrator also noted that GMF had invested money in a number of "community initiatives" which were inappropriate under the National Health Act.[146]

After the collapse, there was some criticism of the fund's Board of Directors. How did they allow the fund to get into such difficulties? The Chairman defended the board, claiming that the board was not given adequate information by the CEO.[147]

Over the next year, the administrator increased premiums sharply[148], closed branches and sacked staff. Eventually, the fund merged with Healthguard.

The Australian Competition and Consumer Commission also became involved. Apparently, GMF had attracted new members by promising them that their premium rates would not increase for at least

143 *Is GMF being sold out?* by Lee-Anne Petchell, Kalgoorlie Miner, 29 June 2002
144 *Health fund woes date back 12 months, Kalgoorlie Miner* by Lee-Anne Petchell, 23 January 2002
145 *Credit Union Asked to Repay GMF loan*, Kalgoorlie Miner, 16 April 2002
146 For example, GMF apparently donated $150,000 for a new skatepark in Kalgoorlie. *GMF Focus to be national, not local*, Kalgoorlie miner. 28 December 2001
147 *Is GMF being Sold out?* Kalgoorlie Miner, 29 June 2002
148 On 1 April 2002, premiums increased by 40.54% on average. Premium increases were even higher in some states. *Rules Loom Over Brokers*, Herald Sun 9 April 2002. Even after such a large increase, Goldfields' premiums were still described a "competitive". *GMF premiums on the rise*, Kalgoorlie Miner, 27 February 2002. GMF members face big increase in premiums, Kalgoorlie Miner, 5 March 2002. The contribution increases caused an ACCC investigation, since GMF had apparently promised its members that there would be no rate increases for 12 months. Hundreds of angry members complained to the PHI Ombudsman *ACCC to investigate GMF Health*; Kalgoorlie Miner. 26 July 2002, GMF Under Fire for breaking Rates Deal, Kalgoorlie Miner, 27 July 2002

a year. Hundreds of members complained when the administrator was forced to increase the premiums.[149]

According to the Minister for Health,

> *"The council [PHIAC] identified a number of breaches of the National Health Act, and what would appear to be breaches of the Corporations Act. However, as Goldfields was an incorporated association, the directors could not be held liable under the Corporations Act."*[150]

For non-profit associations like GMF, the maximum penalty was a $500 fine for office bearers who breached their duties[151]. The Minister pointed out that weaknesses in the then-current legislation hampered the ability of PHIAC to protect the interests of members of such funds, creating a greater risk of improper use of funds and ultimately failure of the fund.

Note that GMF was certainly not the only health fund to have problems in recent years (readers might care to look up IOR and the Teachers Union Health Fund).

149 *GMF under Fire for breaking rates deal* by Robert Newton, Kalgoorlie Miner, 27 July 2002

150 *Explanatory memorandum*, Private Health Insurance Legislation Amendment Bill 2008, circulated by the authority of the Minister for Health and Ageing, the Honourable Nicola Roxon MP, House of Representative 2008

151 *DPP to look into failed health fund by Mark Mallabone*, The West Australian, 18 September 2002.

APPENDIX: Australian Example 2: Commercial Nominees of Australia Ltd.

Commercial Nominees was set up in 1993.

In 1999 the SIS legislation was changed. As a result, many small superannuation funds were required to appoint an APRA-approved trustee to manage the fund[152]. Sensing a business opportunity, CNAL sought approval from APRA to act as an Approved Trustee.

This approval was essential for CNAL's business strategy: many retirees were looking for a safe place to invest their superannuation savings, and they naturally assumed that any trustee which was approved by APRA would be quite safe.

> *"We chose an APRA fund structure because the use of an APRA Authorised Trustee company would ensure our legal and regulatory obligations would be met. In addition the ongoing operation of the fund would continue to be supervised by APRA giving us a sense of security."*[153]

Over the next three years, CNAL became the trustee for about 475 small APRA funds.

Many of the investors had invested with CNAL on the advice of financial advisors from Saxby Bridge Financial Planning. Saxby Bridge attracted the attention of ASIC because it often recommended investments which were "tax effective", such as tea-tree oil. These investments often resulted in severe losses for the investors. Apparently Saxby Bridge's advisors were paid high commissions for recommending such risky investments. Mr Brayisch, the principal and director of Saxby Bridge, also had a financial interest in some of the investments he recommended, which created a serious conflict of interest. [154.155]

152 Note for non-Australian readers. Prior to October 1999, all funds with less than 5 people were called "excluded funds". The prudential rules for excluded funds were more lenient than the rules for larger funds. This led to some abuses, and the rules were tightened. Small funds which met certain standards were allowed to become small self-managed funds (SMSFs); others were required to have an APRA-approved trustee and these were called Small APRA funds (SAFs)

153 Chapter 4 of the Report of the Senate Select Committee on Superannuation and Financial Services, Prudential Supervision and Consumer Protection Second Report, 30 August 2001

154 *ASIC cancels Saxby Bridge,* ABS licences by Anne Lampe, Sydney Morning Herald, 2 November 2001

155 *Licence Restored to Saxby Bridge* by Anne Lampe, Sydney Morning Herald, 5 June 2003

In October 2001, ASIC revoked Saxby Bridge's licence. In 2003 the Administrative Appeals Tribunal overturned the ban, asserting that ASIC had been too severe. In 2007 Jeffrey Braysich resigned as a director of Saxby Bridge in 2007, shortly after being convicted of 27 counts of market rigging. His wife took his place as director. [156]

As well as collecting small superannuation funds from individuals, CNAL also collected superannuation funds on a wholesale basis. CNAL became the trustee of an eligible rollover fund (ERF) [157]. This allowed CNAL to obtain control of a very large number of small accounts. In many cases the owners of the accounts would have had no idea that their money had been transferred from their original superannuation fund to CNAL's ERF.

By 2001, CNAL was responsible for looking after about $300 million.

CNAL invested the superannuation fund in a variety of investments, including an Enhanced Cash Management Trust (ECMT) and an Enhanced Equity Fund. CNAL was trustee of both of these investment vehicles.

Most of the investors in the ECMT believed that they were investing in a standard cash management trust – ie. that their money would be held in low risk cash-type assets such as money in the bank. However, this was quite wrong. The ECMT was investing in a range of rather risky investments, such as a mushroom farm. Many of the investments were tax-driven schemes. The ECMT invested in some other unit trusts run by CNAL, including the Enhanced Equity Fund. The ECMT was also leveraged – liabilities included a secured bank loan of more than $12 million.

Furthermore, the many of these investments were not at arm's length. Loans were made to former directors of CNAL and to related party trusts. It appears that "*CNAL used superannuation money to prop*

156 *Market Riggers Back in Business* by Rebecca Urban, The Australian, 8 October 2009.

157 Note for non-Australian readers. ERFs are special funds which were designed to solve the small accounts problem. Some superannuation funds do not wish to hold small accounts, because the administration costs may exceed the amount which can be charged against the balance of the account. Hence the law allows these funds to roll over the accounts to an ERF, and this may be done automatically, with or without the member's consent.

up investments made previously".

This investment strategy failed. According to the evidence presented to the subsequent Senate inquiry, virtually 100% of the loans were in default. By April 2001, the value of the ECMF assets was written down to nil. The other trusts administered by CNAL also had substantial losses.

In February 2001, APRA revoked CNAL's license as an approved trustee and appointed an acting trustee for the small APRA funds. The company was placed into liquidation in May 2001.

The wind up was complicated by poor record keeping and administration. It appears that CNAL did not always follow the instructions of their clients in a timely fashion. Sometimes a client's money was invested in the ECMF, even though the client has asked for the money to be invested elsewhere.

During the subsequent Parliamentary hearings, both APRA and ASIC were criticised by investors. APRA had become aware of serious problems at CNAL in March 2000 – but they allowed the fund to continue operating (and accepting new funds) until February 2001. APRA apparently hoped that, given time, the directors of CNAL would be able to fix the problems; and they did not want to cause a run on the funds by taking action publicly.

APRA explained that it was only responsible for supervising the superannuation funds. The superannuation funds invested their money into CNAL's ECMT and EEF, but it was not APRA's responsibility to supervise those trusts. ASIC explained that it was not their responsibility either, because the ECMT was set up as an excluded offer fund which did not come under the Managed Investments Act.[158]

In the end, the Minister exercised his discretion to provide compensation to CNAL's investors, up to 90% of their losses – the total cost to the taxpayer was about $30 million.

158 Evidence by Mr Knott (ASIC) to the Senate Committee on 12 June 2001

The APRA-appointed inspector to the funds found that there was evidence of fraud and dishonest conduct. [159]APRA referred two matters relating to directors of CNAL to the Director for Public Prosecutions. Since the directors were reportedly living in Central America at this time, it was probably difficult for the DPP to take effective action.[160]

159 Senator Campbell, Questions without Notice, Hansard, 18 June 2002
160 Senator Coonan, Answer to Questions Without Notice, Senate Hansard, 26 August 2002

The Christmas Effect – Seasonal Variation in Disability Income Claim Incidence and Termination Rates

D Service *

Abstract

The published results of analyses of experience under disability income policies rarely provide detailed analysis at yearly intervals. They normally aggregate the results of three or four years. Hence, consideration of seasonal effects has not previously been examined. However, the Institute of Actuaries of Australia has made available the raw data which underlies the published investigations made by the Institute into the experience of disability income business over the period 1980 to 2001.

This raw data is sufficiently fine-grained to allow analysis of the experience by monthly intervals. As a result a detailed examination of the seasonality of claims incidence and termination has been undertaken.

The results of that investigation show material seasonal variation in both claim incidence and termination which is remarkably consistent in all twenty two years of data.

The disclosure of this significant seasonal variation must add yet another piece of data in support of the proposition that disability claim experience is much more influenced by "state of mind" than "state of body". It is not so much about ability to work – it is, rather, about the desire to work!

Keywords: *Disability Insurance, Claim Seasonality*

*Contact: David Service FIAA, Grad Cert(Higher Ed.)School of Finance, Actuarial Studies and Applied Statistics, Australian National University.
Email: david.service@anu.edu.au

1 Introduction

The published results of analyses of experience under disability income policies rarely provide detailed analysis at yearly intervals. They normally aggregate the results of three or four years. Hence, consideration of seasonal effects has not previously been examined. However, the Institute of Actuaries of Australia has made available the raw data which underlies the published investigations made by the Institute into the experience of disability income business over the period 1980 to 2001.

This raw data is sufficiently fine-grained to allow analysis of the experience by monthly intervals. As a result a detailed examination of the seasonality of claims incidence and termination has been undertaken. The results of that investigation and some discussion as to the probable reasons for those results are set out in this paper.

The paper is set out in seven sections as follows

1. Introduction	This introduction
2. Approach	The general approach to the examination of the issue
3. Incidence	The results for claim incidence
4. Terminations	The results for claim termination
5. 'State of Body' or 'State of Mind'	A discussion of the importance of non-physiological issues in disability
6. Why Is It So?	An exploration of the possible reasons for the observed results
7. Conclusions	The conclusions from the analyses

The willingness of the Institute to provide this data is gratefully acknowledged. Without it, this research would not have been possible.

Thanks are due to Professor Michael Martin for his valuable assistance with the statistical analysis.

A summary of the key items of data is in Appendix A.

2 Approach

For each month of the twenty two years the actual vs expected ratio for both incidence and terminations has been calculated. Expected claims and claim terminations have been derived using IAD8993 rates undifferentiated by smoking status. Then for each calendar year the ratio of A/E for each month to A/E for the whole year has been calculated. The pattern of these final ratios has been analysed to ascertain the extent of any seasonality. This approach removes the trend evident in experience from year to year and enables the seasonal effect to be isolated.

The allocation of new claims to month has been determined using the date of the end of the deferment period. For terminations month is the date of recovery. In neither case is the date of notification relevant. Given the material delay between events happening to individual policies and the submission of data to the Institute it is unlikely that incorrect data has been submitted due to the closeness of data submission to the actual events. Over the twenty two years the companies submitting data has varied. Nevertheless the pattern is very consistent over the whole period. Internal consistency checks are carried out on the data and while there are untraced errors in the data there is no evidence to suggest that the conclusions drawn have been distorted by data errors.

The raw data for exposure for claim incidence is based on in force at year begin and at year end. While date of entry is known for new business and allowed for in the calculation of exposure for new policies, the dates of exit are not known. It has been assumed that exits are uniformly distributed over the year. For claim terminations the exposure in respect to open claims can be calculated accurately from the individual claim records.

It must also be remembered that the data is the industry aggregate and therefore contains different companies and their respective claims practices.

The conclusions which are presented later in this paper are derived from the statistical development of a model of seasonality which is also informed by a visual examination of the pattern of these monthly ratios.

This model of the observed seasonal factors has been subjected to the usual goodness of fit tests.

3 Incidence

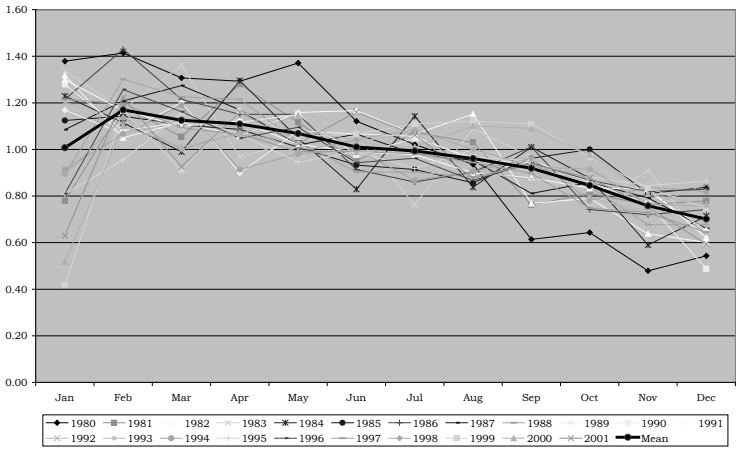
The results show significant evidence of a material seasonality of claim incidence. For each of the 22 years of data the seasonal pattern is very strong. Table 1 shows the final ratios for males and Graph 1 provides a visual representation. The results for females are considered in subsequent paragraphs.

Table 1: Males – Seasonal Incidence Patterns

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	1.38	1.41	1.31	1.29	1.37	1.12	1.02	0.94	0.61	0.64	0.48	0.54
1981	0.78	1.18	1.06	1.28	1.12	0.95	1.07	1.03	0.76	0.81	0.76	0.78
1982	1.32	1.05	1.12	1.06	1.16	1.17	1.07	1.15	0.77	0.79	0.64	0.60
1983	1.34	1.17	1.36	0.97	1.04	1.06	0.76	1.09	0.97	0.75	0.91	0.60
1984	1.23	1.11	0.99	1.30	1.05	0.83	1.14	0.84	1.01	0.88	0.59	0.71
1985	1.12	1.14	1.11	1.09	1.01	0.93	0.91	0.86	0.96	1.00	0.81	0.84
1986	1.22	1.43	1.22	1.15	1.15	0.91	0.86	0.90	1.01	0.74	0.72	0.74
1987	1.09	1.21	1.27	1.17	1.02	1.07	0.98	0.95	0.81	0.86	0.79	0.66
1988	0.89	1.30	1.23	1.22	1.03	0.90	0.90	0.88	0.94	0.84	0.68	0.68
1989	1.17	1.07	1.20	0.90	1.08	1.07	1.06	0.96	0.94	0.87	0.82	0.65
1990	1.28	1.08	1.12	1.12	1.15	0.98	1.05	0.97	0.95	0.86	0.77	0.49
1991	1.30	1.17	1.10	1.12	1.02	0.99	0.98	0.90	0.88	0.83	0.83	0.62
1992	0.64	1.18	1.12	1.10	1.00	1.03	1.07	0.90	0.87	0.93	0.76	0.85
1993	1.20	1.11	1.12	1.10	1.08	1.04	0.98	0.96	0.96	0.80	0.72	0.64
1994	0.91	1.07	1.19	0.91	0.98	1.00	0.87	0.91	0.96	0.78	0.84	0.82
1995	0.81	0.96	1.16	1.06	0.95	0.99	0.92	1.00	0.91	0.88	0.85	0.86
1996	0.81	1.26	1.16	1.05	1.10	0.94	0.96	0.87	0.94	0.87	0.82	0.83

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	1.22	1.20	1.09	1.07	0.99	0.99	0.98	0.94	0.90	0.75	0.73	0.65
1998	0.89	1.14	1.00	1.07	0.99	1.04	1.09	1.00	0.93	0.92	0.77	0.76
1999	0.42	1.17	0.91	1.17	1.06	1.07	1.11	1.12	1.11	0.97	0.84	0.75
2000	0.52	1.10	1.01	1.07	1.15	0.99	1.01	1.10	1.09	0.98	0.81	0.76
2001	0.63	1.22	0.93	1.16	1.03	1.16	1.06	0.88	0.94	0.88	0.75	0.59
Mean	1.01	1.17	1.13	1.11	1.07	1.01	0.99	0.96	0.92	0.85	0.76	0.70
Std Dev	0.29	0.11	0.12	0.11	0.09	0.08	0.09	0.09	0.11	0.09	0.10	0.11
Co Var.	0.29	0.10	0.10	0.10	0.09	0.08	0.09	0.09	0.12	0.10	0.13	0.15

Graph 1: Males - Seasonal Incidence Patterns



(1) The heavy line is the mean of all years.

(2) This graph shows the results for each of the years 1980 to 2001. The intention is to provide a visual picture of the overall pattern of the 22 years.

The visual pattern shows a significant consistency across all years. The coefficient of variation is quite low except for the month of January. And in most cases each year lies within plus or minus one standard deviation.

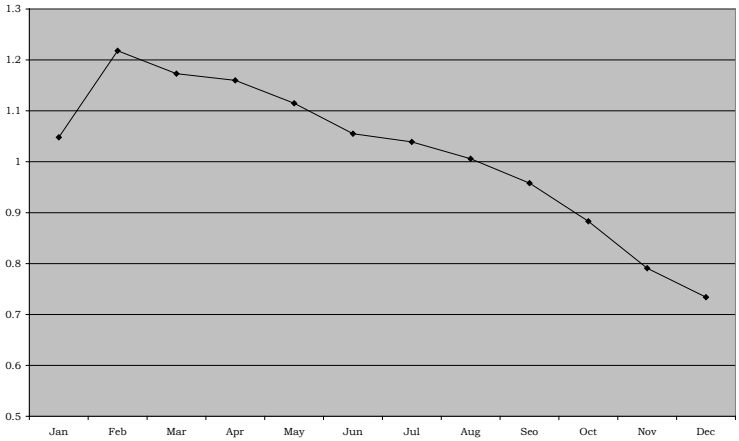
A model of the seasonal variation has been fitted using linear regression and the parameters and resulting seasonal ratios are shown in Table 2. The seasonal ratios are the ratio of Actual/Expected for the particular month to Actual/Expected for the full year. The table also indicates which months are significantly different, at the 95% level, from 1.0 which would indicate no seasonality.

Table 2: Incidence Seasonal Model Parameters

Month	Month Delta	Seasonal Ratio	Significantly Different from 1.0 at 95% level
Intercept	0.734		
Jan	0.314	1.048	NO
Feb	0.484	1.218	**YES**
Mar	0.439	1.173	**YES**
Apr	0.426	1.160	**YES**
May	0.381	1.115	NO
Jun	0.321	1.055	NO
Jul	0.305	1.039	NO
Aug	0.272	1.006	NO
Sep	0.224	0.958	NO
Oct	0.149	0.883	NO
Nov	0.057	0.791	**YES**
Dec	0.000	0.734	**YES**

The model exhibits adequate goodness of fit with a p-value < 0.0001 and an adjusted R^2 of 0.543 with 252 degrees of freedom. Graph 2 shows the fitted model ratios.

Graph 2: Incidence Seasonal Ratios



There is clear evidence of a statistically significant seasonal pattern.

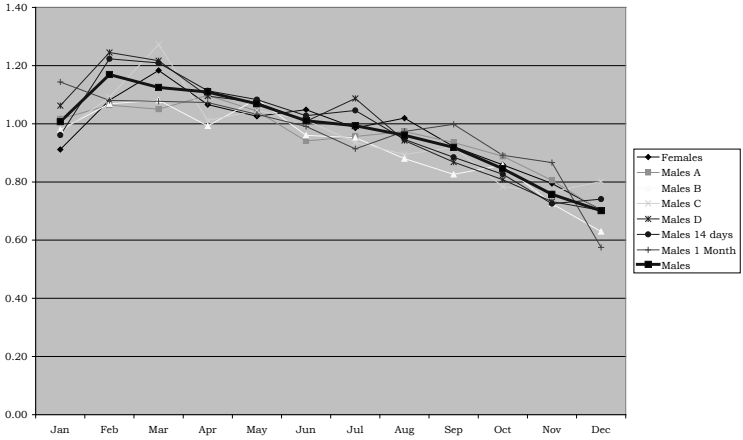
This model of the seasonal ratios will be used as the pattern for discussion. Incidence rates peak in February and then decline almost uniformly over the remainder of the year, reaching their low point in December. There is no increase during the winter months, although the otherwise uniform rate of decrease does show a slight slowing in winter. This is, of course, contrary to the usual pattern of illness. It should be noted that the vast majority of the data in all years is represented by deferment periods of 2 weeks and 1 month. The proportions in these two deferment periods range between 55% and 85%. The lower value only occurs in the period up to 1985. Consequently the elapsed time between the disablement incident and the recognition of a new claim at the end of the deferment period is short. Hence, there is little room for distortion by lengthy time delays between disablement and claim incidence.

This data is for all males without distinction by any other characteristics. The impact of the other major characteristics – gender, occupation, deferment - is illustrated in Table 3 which shows the mean and coefficient of variation for these other major characteristics.

Table 3: Seasonal Variation by Characteristic

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Females	Mean	0.91	1.08	1.18	1.07	1.03	1.05	0.99	1.02	0.92	0.86	0.79	0.70
	C o V	0.36	0.27	0.28	0.21	0.22	0.13	0.15	0.20	0.28	0.22	0.27	0.25
Males A	Mean	1.02	1.06	1.05	1.10	1.04	0.94	0.96	0.97	0.94	0.89	0.81	0.70
	C o V	0.29	0.18	0.17	0.17	0.17	0.14	0.15	0.12	0.17	0.18	0.20	0.19
Males B	Mean	0.98	1.07	1.08	0.99	1.09	0.96	0.95	0.88	0.83	0.86	0.73	0.63
	C o V	0.49	0.46	0.62	0.39	0.46	0.40	0.50	0.47	0.40	0.41	0.37	0.49
Males C	Mean	0.97	1.09	1.27	1.01	1.05	1.01	0.94	0.89	0.92	0.78	0.77	0.80
	C o V	0.42	0.26	0.67	0.27	0.29	0.24	0.34	0.28	0.25	0.24	0.32	0.65
Males D	Mean	1.06	1.25	1.22	1.10	1.07	1.01	1.09	0.94	0.87	0.81	0.73	0.70
	C o V	0.37	0.15	0.25	0.18	0.19	0.20	0.26	0.15	0.19	0.31	0.19	0.27
Males	Mean	0.96	1.22	1.21	1.11	1.08	1.03	1.05	0.95	0.88	0.83	0.73	0.74
14 days	C o V	0.43	0.12	0.17	0.11	0.15	0.14	0.14	0.12	0.17	0.13	0.20	0.19
Males	Mean	1.14	1.08	1.08	1.07	1.03	0.99	0.91	0.97	1.00	0.89	0.87	0.58
1 month	C o V	0.21	0.21	0.23	0.11	0.13	0.09	0.22	0.14	0.15	0.11	0.13	0.46

Graph 3: Seasonal Variation by Characteristic



While the coefficients of variation grow larger as the volume of data diminishes in each group, the general pattern shows no sign of being materially disrupted. All groupings show the same basic trend. Higher incidence rates in the early part of the year followed by a definite decline to the lowest point in December. The flattest pattern occurs for males, occupation class A, but even there the seasonal variation can clearly be seen, particularly in the December quarter.

4 Terminations

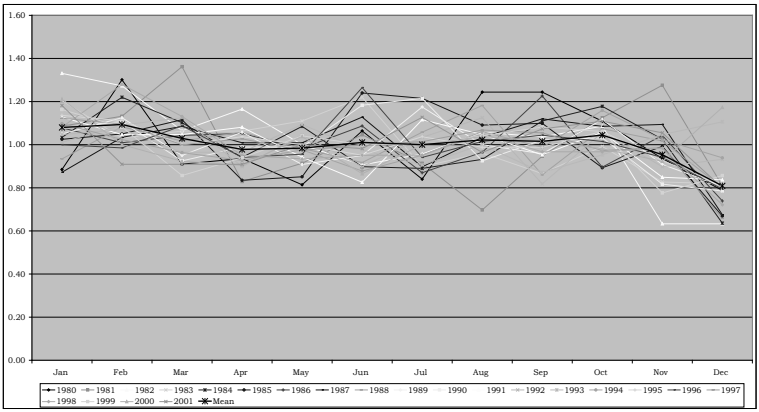
The results for terminations are not as clear as for incidence. Table 4 shows the observed ratios for males and Graph 4 provides a visual representation.

Table 4: Males – Seasonal Termination Patterns

1980	0.89	1.30	0.91	0.94	0.81	1.06	0.84	1.24	1.24	1.11	0.94	0.79
1981	1.09	1.13	1.36	0.83	0.91	1.05	0.91	0.70	0.95	1.13	1.28	0.81
1982	1.33	1.27	1.07	1.17	1.00	0.91	0.96	1.06	1.04	1.09	0.63	0.63
1983	1.21	1.03	1.06	1.06	1.11	1.22	0.90	0.96	0.87	0.99	0.83	0.82
1984	1.03	1.22	1.10	0.94	1.09	0.90	0.89	0.93	1.11	1.18	1.03	0.64
1985	1.03	1.05	1.12	0.84	0.85	1.24	1.22	1.09	1.10	0.89	0.99	0.67
1986	1.08	1.01	1.04	1.05	0.98	1.09	0.87	0.97	1.23	0.90	1.04	0.74
1987	0.87	1.03	1.09	1.01	1.01	1.13	0.90	1.03	1.12	1.09	1.09	0.68
1988	0.93	1.08	1.02	1.06	0.98	0.92	1.06	1.18	0.86	1.07	1.02	0.80
1989	1.05	1.13	0.95	1.06	0.91	0.95	1.18	1.00	0.96	1.12	0.91	0.81
1990	1.08	1.11	0.93	0.99	0.99	1.18	1.22	0.93	1.02	1.03	0.82	0.79
1991	1.13	1.05	1.05	1.08	0.94	0.83	1.12	1.05	0.95	1.06	0.85	0.84
1992	1.01	1.09	1.13	0.90	1.05	0.90	1.03	1.13	0.82	1.06	0.90	0.93
1993	1.05	1.07	0.97	0.97	1.09	0.98	0.91	1.00	0.87	0.95	1.05	1.11
1994	1.10	1.02	0.96	0.93	0.98	0.88	0.95	1.06	0.99	1.16	1.02	0.94
1995	1.14	1.11	1.00	1.04	1.00	0.95	1.04	0.99	0.99	1.06	0.93	0.82
1996	1.00	0.99	1.09	0.94	0.96	1.27	0.94	1.02	1.04	1.02	0.94	0.79
1997	1.12	1.10	1.00	1.03	0.97	1.00	1.01	1.07	1.06	0.97	0.99	0.66
1998	1.08	1.28	1.13	0.95	0.93	0.95	0.95	1.05	0.97	0.97	0.98	0.72

1999	1.16	1.08	0.86	0.94	1.04	1.00	1.00	1.04	1.08	1.06	0.78	0.86
2000	1.21	1.00	0.92	0.90	1.04	0.87	1.00	1.04	1.02	0.98	0.92	1.17
2001	1.18	0.91	0.91	0.91	1.00	0.98	1.13	0.96	1.07	1.11	1.06	0.80
Mean	1.08	1.09	1.03	0.98	0.98	1.01	1.00	1.02	1.02	1.04	0.95	0.81
StdDev	0.11	0.10	0.11	0.08	0.07	0.13	0.11	0.11	0.11	0.08	0.13	0.14
Co Var	0.10	0.09	0.11	0.09	0.07	0.13	0.11	0.10	0.11	0.07	0.14	0.17

Graph 4: Males - Seasonal Termination Patterns



(1) The heavy line is the mean.

(2) This graph shows the results for each of the years 1980 to 2001. The intention is to provide a visual picture of the overall pattern of the 22 years.

The pattern shows a significant amount of noise. There is, however, some indication that the months of November and December have significantly lower seasonal ratios. In interpreting these results it must be remembered that lower terminations are bad news for insurance companies.

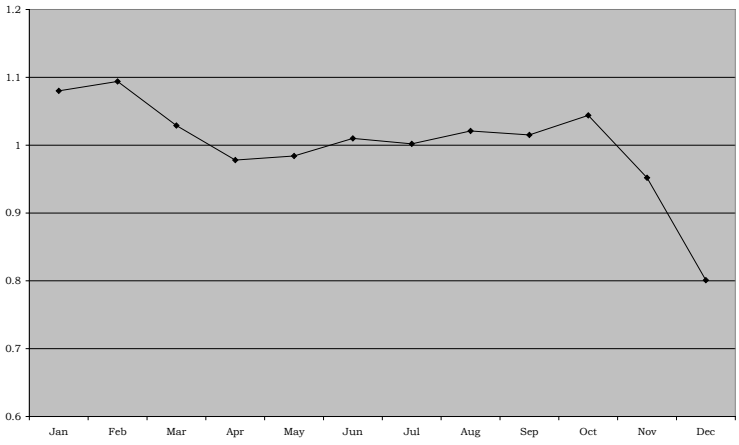
A model of the seasonal variation has been fitted using linear regression and the parameters and resulting seasonal ratios are shown in Table 5. The table also indicates which months are significantly different, at the 95% level, from a value of 1.0 which would indicate no seasonality.

Table 5: Termination Seasonal Model Parameters

Month	Month Delta	Seasonal Ratio	Significantly Different from 1.0 at 95% level
Intercept	0.801		
Jan	0.279	1.080	NO
Feb	0.293	1.094	NO
Mar	0.228	1.029	NO
Apr	0.177	0.978	NO
May	0.183	0.984	NO
Jun	0.209	1.010	NO
Jul	0.201	1.002	NO
Aug	0.220	1.021	NO
Sep	0.214	1.015	NO
Oct	0.243	1.044	NO
Nov	0.151	0.952	NO
Dec	0.000	0.801	**YES**

The model exhibits excellent goodness of fit with a p-value < 0.0001 and an adjusted R2 of 0.283 with 252 degrees of freedom. Graph 5 shows this model.

Graph 5: Terminations Seasonal Model Ratios



While there is some suggestion of a seasonal pattern only the December ratio is statistically significant. The variations in other months do not, on this analysis, constitute evidence of seasonality. The low points in November and December are not made up by corresponding increases in terminations in January and February. There is no decrease in terminations during the winter months but rather a small increase. This contradicts the expected pattern of health during winter.

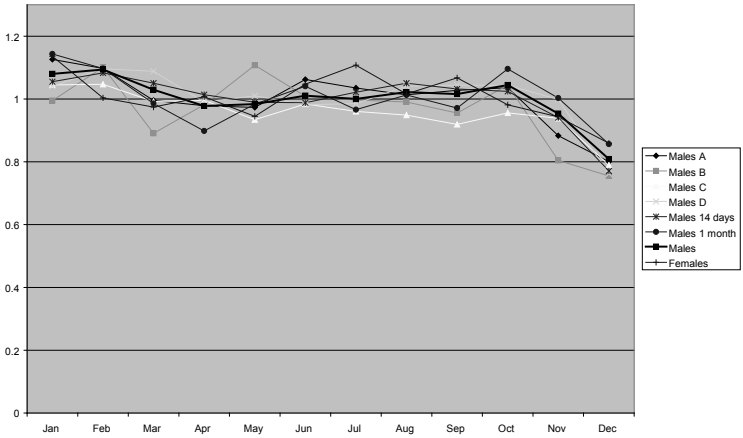
Claim terminations exclude benefit expiry and less than 2% of terminations are caused by death. There is little room, therefore, for distortion from these reasons for claim termination.

This data is for all males without distinction by any other characteristics. The impact of the other major characteristics – gender, occupation, deferment – is illustrated in Table 6 which shows the mean and coefficient of variation for these other major characteristics.

Table 6: Seasonal Variation by Characteristic

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Females	Mean	1.14	1.00	0.97	1.01	0.94	1.05	1.11	1.02	1.07	0.98	0.94	0.86
	CoV	0.22	0.30	0.23	0.19	0.25	0.22	0.20	0.24	0.21	0.25	0.32	0.27
Males A	Mean	1.13	1.10	1.00	0.98	0.97	1.06	1.04	1.01	1.03	1.04	0.88	0.80
	CoV	0.18	0.14	0.14	0.14	0.14	0.20	0.15	0.15	0.16	0.11	0.23	0.23
Males B	Mean	0.99	1.10	0.89	0.98	1.11	1.01	1.00	0.99	0.96	1.04	0.80	0.76
	CoV	0.45	0.40	0.43	0.28	0.54	0.80	0.49	0.45	0.51	0.48	0.39	0.41
Males C	Mean	1.05	1.05	0.99	1.00	0.93	0.98	0.96	0.95	0.92	0.96	0.94	0.79
	CoV	0.27	0.27	0.29	0.32	0.26	0.29	0.25	0.34	0.30	0.29	0.30	0.33
Males D	Mean	1.04	1.10	1.09	0.99	1.01	0.98	0.99	1.04	1.04	1.04	1.00	0.76
	CoV	0.13	0.21	0.14	0.16	0.22	0.15	0.18	0.27	0.17	0.17	0.19	0.27
Males	Mean	1.05	1.08	1.05	1.01	0.99	0.99	1.02	1.05	1.03	1.02	0.94	0.77
14 days	CoV	0.12	0.15	0.14	0.11	0.11	0.14	0.10	0.14	0.10	0.10	0.15	0.20
Males	Mean	1.14	1.10	0.99	0.90	0.98	1.04	0.97	1.01	0.97	1.10	1.00	0.86
1 month	CoV	0.19	0.14	0.18	0.23	0.13	0.18	0.20	0.23	0.14	0.13	0.25	0.27

Graph 6: Seasonal Variation by Characteristic



While the coefficients of variation grow larger as the volume of data diminishes in each group, the general pattern shows no sign of being materially disrupted. All groupings show the same basic trend. Flat termination rates in the early part of the year followed by a definite decline in December.

5 'State of Body' or 'State of Mind'

Before discussing the possible reasons for the significant seasonal variation it is essential to understand the extent to which claims under disability income insurance are due to physiological issues or to motivation to work – "state of body" or "state of mind".

This discussion is not an attempt to suggest that many disability claims are fraudulent, although certainly some are. The skills of claim assessors will see that most fraudulent claims are rejected. It is rather to recognise that all definitions of disability for insurance purposes centre around the ability to work. While the physiological issues are an important element, it is clear that other issues are involved. At the most obvious level some physiological issues will render insureds unable to work in some occupations while they will have little or no impact in others. A broken leg is almost certainly disabling for a roofer but quite

possibly not for an actuary.

One commentator has noted that disability insurance is not insurance against the risk of becoming disabled. It is, rather, insurance against the risk that, having become disabled, the claimant decides not to work. (Service 1986). In a similar vein Swiss Re described it as "Employability insurance" (1975).

Although Watson does not address this issue in his famous Manchester Unity investigation one can see the first glimmer of the idea that disability experience is influenced by factors other than the physiological. In noting that some IOOF lodges reduced the amount of sickness benefit after longer periods of claim, he commented "Excessive reductions of benefit may conceivably tend to diminish the rates of sickness by forcing members off the funds." (1903, p55).

He does however, directly write on the subject later (1931, p22). "Since the unmarried woman is apparently not subject to a greater risk of becoming incapacitated for work than a man of corresponding age, it is difficult to understand why, when sickness comes, the woman's average period of incapacity .. should be nearly half as long again as that of a man. I suggest as a probable explanation that the reason is not physical but economic"

In discussing this subjective element in disability claims, Service notes *"A study which showed that less than 5% of those recovering from disability returned to work on a Friday also illustrated the point."* (1983, p480).

Lixin Cai supports the general proposition that disability claims are impacted by more than just the claimant's health condition.

> *" .. demographic and economic factors are important in determining disability benefit participation and disability is not only determined by health conditions per se."* - (2004, p26).

While all these comments make good sense there is, unfortunately little "hard" data supporting the proposition. However, the results of this analysis of seasonal variation may legitimately be regarded as providing some "harder" data in support.

Further research is currently underway to collect all the evidence which is relevant to this hypothesis.

6 Why Is It So?

Bearing in mind the discussion in Section 5 we might postulate that a relevant name for this seasonal pattern is the "Christmas Effect". As the calendar year draws to a close and the Christmas (and in Australia, the summer) holidays approach, those whose actual physiological condition allow, do not claim on their disability insurance. To do so would be to suffer a reduction in income, a potential battery of medical tests to prove their claim and a fear of intrusive insurance company claim assessors interfering in their Christmas holidays. The Christmas rush in many businesses means that overtime or extra work may be available. Once January has passed all these issues drop away and claim season is upon us. The declining value of the seasonal ratio from February to April, when statistical significance ceases, supports this assertion.

For those already on claim, whose actual physiological condition would allow recovery and return to work, appear not do so. To take that step would be to forego the Christmas holidays and to exchange that period of celebration, fun and relaxation for work. Even though an increase in income would result it is possible that the claimants have rearranged their affairs to cope with the reduced income during the disability claim and are prepared to continue with that until the holiday season is finished. It must also be recognised that many employers will not be attracted to having a previously disabled worker returning just as the hassle of ensuring sufficient staff over the holiday period is in full swing.

It is interesting to compare the seasonal pattern for incidence and claim termination. Both show a similar pattern but the physiological reasons appear contrary. Lower incidence implies lower disability, lower claims termination implies worse continuing disability. It is tempting to once again remember the discussion of section 5 and suggest that much disability behaviour may have less relation to physiology than seems logical.

It might be argued that part of the seasonal variation in December is due to the lower number of working days in that month. While this is true, the assignment of new claims or claim terminations to a particular month is driven by the date on which the deferment period ended, or the date of recovery, not the date of reporting. Hence the number of working days should have no material impact.

Some have suggested that the cause of lower terminations in December is due to holiday taking by claims assessors. While this is entirely possible, there is a 20% reduction in relative terminations in that month. If the taking of holidays is the cause, the impact is very significant.

The effect of economic conditions on both claim incidence and termination is widely held although sparsely demonstrated. Service and Ferris (2001) showed "credible evidence … that disability experience is materially affected by economic conditions". Since disability income insurance is always related to the ability to work the most important economic indicator will be employment. It is, therefore, possible to argue that the seasonal effects are driven more by the availability of employment during the year rather than other issues.

In order to test this hypothesis the ANZ Job Advertisements series has been used as an indicator of the availability of employment opportunities. While the majority of disability income business is likely sold to the self employed this series is taken as a reliable indicator. Since it has monthly data over a long time period it provides data at the time intervals needed.

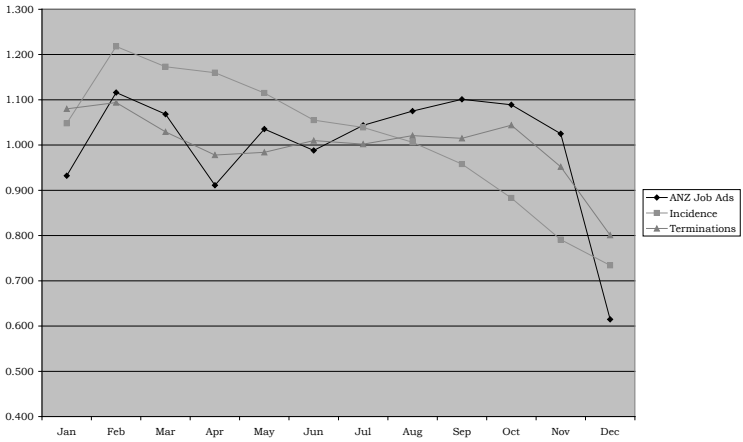
In a manner analogous to the derivation of the seasonal ratios for claims the ratio of twelve times the number of job advertisements in each month to the total job advertisements for the relevant year has been calculated. This result gives a cogent measure of the extent to which job advertisements vary by month during the year and produces a number which has the same scale as the claim seasonal model ratios.

The results are shown in Table 7 and Graph 7.

Table 7: Comparison of Seasonality in Job Advertisements and Disability Claims

	ANZ Job Ads	Claim Incidence	Claim Termination
Jan	0.932	1.048	1.080
Feb	1.116	1.218	1.094
Mar	1.068	1.173	1.029
Apr	0.911	1.160	0.978
May	1.035	1.115	0.984
Jun	0.988	1.055	1.010
Jul	1.044	1.039	1.002
Aug	1.075	1.006	1.021
Sep	1.101	0.958	1.015
Oct	1.089	0.883	1.044
Nov	1.025	0.791	0.952
Dec	0.615	0.734	0.801

Graph 7: Comparison of Seasonality in Job Advertisements and Disability Claims



If the behaviour of claimants is driven, at least in part, by economic conditions, particularly employment, then when employment is readily available claim incidence would drop and claim termination would increase and conversely when employment is relatively scarce. However the comparison of the seasonal claim factors with the seasonality of job advertisements shows a contradiction.

For claim terminations the expected relationship does hold. As job advertisements decrease so do the claim terminations. In fact the correlation between the two series is 0.81. On the other hand the expected relationship with claim incidence shows the complete opposite. As job advertisements decline so do new claims. Although the correlation is lower at 0.47 the spatial relationship is clear from the graph.

Perhaps the relationship between employment and claim incidence is more complex than a simple linear one. It is just possible that when job advertisements are high this is a sign of increased stress in the workplace as too few workers cope with too much business. Such a situation could legitimately lead to greater claim incidence. The evidence in respect to such a hypothesis would include claim incidence by claim cause. Further research is in progress to collate and analyse such data.

7 Conclusions

It is clear that material seasonal variation in claim incidence is evident. For claim termination there is significant evidence of a material decline in terminations in December. The seasonal variation is contrary to what would be expected from the usual seasonal health variations i.e. worse health in winter.

While the data in respect to the relationship between employment and claim incidence is not entirely clear it does support a direct link in respect to claim terminations. As job advertisements increase so do claim terminations.

For companies examining their experience on a regular basis such a seasonal pattern must be included if the signals from the experience are to be properly interpreted. While the limited volume of data in

an individual company will lead to a lot of noise, the general pattern should be remembered when asserting, for example, that "the December quarter has shown an improvement in incidence experience" or "a deterioration in claim termination experience".

The results must raise questions about the behaviour of claims management. If their diligence is unchanged why do they allow more existing claims to continue in December than every other month?

The disclosure of this significant seasonal variation must add yet another piece of data in support of the proposition that disability claim experience is much more influenced by "state of mind" than "state of body". It is not so much about ability to work it is, rather, about the desire to work!

Bibliography

Cai L. (2004) *An Analysis of Durations on the Disability Support Pension (DSP) Program*, Melbourne Institute Working Paper 8/04

Service D.A. (1983) *Disability Valuation – Some Observations*, Institute of Actuaries of Australia Transactions

Service D.A. (1986) *An Occupational Loading – You've Got to be Joking*, National Assessment Officers Conference

Service D.A. & Ferris. K (2001) *Disability Experience & Economic Conditions*, Institute of Actuaries of Australia, Convention

Swiss Re (1975) *Disability Handbook*, Swiss Reinsurance Company, Zurich

Watson A.W. (1903) *Sickness and Mortality Experience of the I.O.O.F. Manchester Unity during the five years 1893-1897*, Manchester Unity, Manchester

Watson A.W. (1931) *The Analysis of a Sickness Experience*, Journal of the Institute of Actuaries Vol 62 p12-43

Appendix A - Key Data

Year Ending 31 Dec.	InForce Records	New Claims	Claims Terminated (1)
1979	24,294		
1980	32,740	639	628
1981	30,877	584	589
1982	38,265	864	826
1983	42,493	968	940
1984	43,183	880	883
1985	51,137	1,095	1,075
1986	98,733	1,374	1,432
1987	118,632	2,980	2,963
1988	123,741	3,022	3,167
1989	148,764	3,223	3,221
1990	213,773	3,656	3,454
1991	243,008	5,341	5,447
1992	265,554	5,876	5,693
1993	289,547	6,614	6,609
1994	338,091	7,705	7,378
1995	303,963	7,829	6,993
1996	318,143	7,748	6,709
1997	340,258	8,092	7,265
1998	343,932	7,177	5,948
1999	386,518	6,950	5,269
2000	426,681	7,654	6,176
2001	407,376	7,393	7,038

(1) Excluding Benefit Expiry

Ruin probabilities for a risk model with two classes of risk processes

*X Wu**

Abstract

In this paper a risk model with two classes of business is considered, in which claim number processes are modeled by two independent Erlang(2) processes, aiming to calculate probabilities of ruin caused by a claim from a certain class. To do so, integro-differential equations for the ruin probabilities are derived and their Laplace transforms are then obtained. At the end of this paper, numerical results for the ruin probabilities are calculated for individual claim sizes with exponential and Gamma distributions.

Keywords: *Erlang risk process; Integro-differential equations; Laplace transforms*

*Contact: Xueyuan Wu, University of Melbourne Tel.: +61-3-83447939; Fax: +61-3-83446899. Email: xueyuanw@unimelb.edu.au.

1 Introduction

During the last two decades, Erlang processes have been frequently employed by authors to model the number of claims received by an insurance company. Works in respect of Erlang(2) processes can be found in Dickson (1998), Dickson and Hipp (1998, 2001), Cheng and Tang (2003), Sun and Yang (2004) and Tsai and Sun (2004). Meanwhile, Li and Garrido (2004a) and Li and Dickson (2006) considered risk models with Erlang(n) processes. Moreover, the generalized Erlang(n) processes are explored by Albrecher et al.(2005), Dickson and Drekic (2004), Gerber and Shiu (2003, 2005), and Li and Garrido (2004b).

Erlang processes also participated in modeling insurance business with multiple classes of claims. Yuen et al. (2002) derived a system of integro-differential equations for the survival probabilities for a risk model with two classes of business in which $\{N_1(t); t \geq 0\}$ is a Poisson process and $\{N_2(t); t \geq 0\}$ is an Erlang(2) process. Li and Garrido (2005) further explored the survival probabilities for a more general model where $N_1(t)$ is a Poisson process and $N_2(t)$ is a generalized Erlang(2) process. For the same model, Li and Lu (2005) considered the expected discounted penalty functions at ruin, given that ruin is caused by a claim of a certain class *j*.

This paper is devoted to studying a risk model which is constructed from two independent Erlang(2) risk processes. The generalized Erlang(2) processes are avoided in this paper because of the tediousness of mathematical derivations, but not theoretical difficulties. Definitions and notation related to the model are introduced in the next section. Ultimate probabilities of ruin due to a claim from a certain class are defined and remain the centre of interest thereafter. Similar ruin probabilities are defined in Li and Lu (2005). In Section 3, a system of integro-differential equations for the ruin probabilities is developed, and their Laplace transforms are derived in Section 4. Considering the large number of equations and expressions, key results are presented in a matrix form. At the end of this paper, numerical examples of the ruin

probabilities are provided with claim sizes following exponential and Gamma distributions.

2 The Model

We consider a continuous time risk model with two classes of business in an insurance company that has two streams of individual claims, denoted by $X_i, i=1,2,\ldots$ and $Y_j, j=1,2,\ldots$, respectively. We assume that individual claim amounts X_i's are independent and identically distributed (i.i.d.) and have a common distribution function (d.f.) F_X, a probability density function (p.d.f.) f_x and a survival function (s.f.) $\bar{F}_X := 1-F_X$. Similarly, claim amounts Y_j's are i.i.d. following the common d.f. F_Y, d.f. f_Y and s.f. $\bar{F}_Y := 1-F_Y$. Let $E[X_1]=\mu_X$, and $E[Y_1]=\mu_Y$. In addition, let $\{X_i\}_{i\geq 1}$ and $\{Y_j\}_{j\geq 1}$ be mutually independent from each other.

Renewal processes $\{N_1(t); t\geq 0\}$ and $\{N_2(t); t\geq 0\}$ are employed, respectively, to denote the number of claims that occur up to time t in the first and second class. Both $N_1(t)$ and $N_2(t)$ have i.i.d. inter-arrival times. Let $V_{1i}=L_{i1}^{(1)}+L_{i2}^{(1)}$ be the i th inter-arrival time of $N_1(t)$. Assume that $\{L_{i1}^{(1)}\}_{i\geq 1}$ and $\{L_{i2}^{(1)}\}_{i\geq 1}$ are independent of each other and are both i.i.d. exponentially distributed with parameter $\lambda_1>0$. Then $\{V_{1i}\}_{i\geq 1}$ follows an Erlang(2) distribution. Similarly, for $N_2(t)$, the inter-arrival times are sums of two independent r.v.'s, ie., $V_{2i}=L_{i1}^{(2)}+L_{i2}^{(2)}$, where $\{L_{i1}^{(2)}\}_{i\geq 1}, \{L_{i2}^{(2)}\}_{i\geq 1}$ are i.i.d. exponential r.v.'s with parameter $\lambda_2>0$. These two claim number processes are presumed to be independent of each other and are independent from all the claim size random variables as well. Then we are able to define the following surplus process consisting of these two classes of business,

$$S(t)=u+ct-\sum_{i=1}^{N_1(t)}X_i-\sum_{j=1}^{N_2(t)}Y_j, \qquad t>0, \tag{2.1}$$

where $S(t)$ is the amount of surplus of the company at time t and $S(0) = u$. As usual, $u\geq 0$ is the initial surplus, and $c>0$ is the rate of premium received by the company. The positive safety loading condition for (2.1) is

$$c > \frac{\lambda_1}{2}\mu_X + \frac{\lambda_2}{2}\mu_Y,$$

and the safety loading factor θ satisfies

$$\frac{1}{1+\theta} = \frac{1}{2c}(\lambda_1\mu_X + \lambda_2\mu_Y).$$

Notice that due to the independence between the two classes of business, θ is the overall safety loading factor for the combined business, which is not necessarily the safety loading factor for each class.

For the risk model (2.1), we define $T := \inf\{t > 0 : S(t) < 0\}(\infty \text{ otherwise})$ to be the time of ruin, and $\psi(u) := \Pr\{T < \infty \mid S(0) = u\}$ to be the ultimate ruin probability. Then $\phi(u) := 1 - \psi(u)$ is the ultimate survival probability. Further, we let J be the cause-of-ruin random variable. If the ruin is caused by a claim from class j, j = 1,2 , then $J = j$. Thus the ruin probability $\psi(u)$ can be decomposed as $\psi(u) = \psi_1(u) + \psi_2(u)$, where

$$\psi_j(u) := \mathrm{P}\{T < \infty, J = j \mid S(0) = u\}, \quad u \geq 0, \quad j = 1,2,$$

is the ruin probability due to a claim from class j.

3 Integro-differential equations for ruin probabilities

In this section we will derive a system of integro-differential equations for the ultimate ruin probabilities for the surplus process (2.1) defined in section 2, where both $\{N_1(t); t \geq 0\}$ and $\{N_2(t); t \geq 0\}$ are Erlang(2) processes. Note that as remarked by Zhu and Yang (2009), the differentiability of the ultimate ruin probabilities is not guaranteed. A counter example can be constructed by just letting the claim size distributions to be discontinuous (see page 168 of Rolski et al. (1998)). Therefore, to make sure that the ruin probabilities are differentiable, we need to assume that all claim size distributions are absolutely continuous within the rest of this paper.

Li and Garrido (2005) commented that because of the Erlang(2) distributed claim inter-arrival times from the second class in their model, the ruin probability is no longer time-homogeneous. So for the

probability of ultimate ruin, they assumed that a claim from the second class occurs exactly at time 0. It results in the consideration of a type of bivariate ruin probabilities. For the same reason, the ultimate ruin probabilities, $\psi(u)$ and $\psi_j(u), j=1,2$, defined above are not time-homogeneous either. We assume that $\psi(u)$ is the ultimate ruin probability for two new lines of business that both commence exactly at time 0. Then we define a ruin probability, denoted by $\psi(u,\tau_1,\tau_2)$, to be a multivariate function of the current surplus u, the length of time τ_1, elapsed since the time of a claim from the first class of business, and the length of time τ_2, elapsed since the time of a claim from the second class. Not surprisingly, we say $\psi(u,\tau_1,\tau_2)=\psi_1(u,\tau_1,\tau_2)+\psi_2(u,\tau_1,\tau_2)$, where ψ_j is the probability of ruin if the claim that causes ruin is from class j, j = 1, 2. Naturally we are interested in the ruin probabilities at the time of the realization of $L_{11}^{(1)}$ and $L_{11}^{(2)}$, which are distinguished by the following four situations due to the lack of memory of $L_{11}^{(1)}$ and $L_{11}^{(2)}$. For j = 1, 2:

- when $L_{11}^{(1)}>\tau_1$ and $L_{11}^{(2)}>\tau_2$, $\gamma_{j0}(u):=\psi_j(u,\tau_1,\tau_2)=\psi_j(u,0,0)=\psi_j(u)$;
- when $L_{11}^{(1)}<\tau_1$ and $L_{11}^{(2)}>\tau_2$, $\gamma_{j1}(u):=\psi_j(u,\tau_1,\tau_2)=\psi_j(u,L_{11}^{(1)},0)$;
- when $L_{11}^{(1)}>\tau_1$ and $L_{11}^{(2)}<\tau_2$, $\gamma_{j2}(u):=\psi_j(u,\tau_1,\tau_2)=\psi_j(u,0,L_{11}^{(2)})$;
- when $L_{11}^{(1)}<\tau_1$ and $L_{11}^{(2)}<\tau_2$, $\gamma_{j3}(u):=\psi_j(u,\tau_1,\tau_2)=\psi_j(u,L_{11}^{(1)},L_{11}^{(2)})$.

Then $\psi(u)=\gamma_{10}(u)+\gamma_{20}(u)$. Using the total probability formula we have

$$\begin{aligned}\psi_j(u,\tau_1,\tau_2)&=\gamma_{j0}(u)\mathrm{P}\{L_{11}^{(1)}>\tau_1,L_{11}^{(2)}>\tau_2\}+\gamma_{j1}(u)\mathrm{P}\{L_{11}^{(1)}<\tau_1,L_{11}^{(2)}>\tau_2\}\\&\quad+\gamma_{j2}(u)\mathrm{P}\{L_{11}^{(1)}>\tau_1,L_{11}^{(2)}<\tau_2\}+\gamma_{j3}(u)\mathrm{P}\{L_{11}^{(1)}<\tau_1,L_{11}^{(2)}<\tau_2\}\\&=e^{-\lambda_1\tau_1}e^{-\lambda_2\tau_2}\gamma_{j0}(u)+\left(1-e^{-\lambda_1\tau_1}\right)e^{-\lambda_2\tau_2}\gamma_{j1}(u)\\&\quad+e^{-\lambda_1\tau_1}\left(1-e^{-\lambda_2\tau_2}\right)\gamma_{j2}(u)+\left(1-e^{-\lambda_1\tau_1}\right)\left(1-e^{-\lambda_2\tau_2}\right)\gamma_{j3}(u),\quad j=1,2.\end{aligned}$$

In the following we will derive integro-differential equations for the ultimate ruin probabilities $\gamma_{ji}(u)$, j = 1, 2, i = 0, 1, 2, 3. We let

$\mathbf{\Gamma}_j(u)=\left(\gamma_{j0}(u),\gamma_{j1}(u),\gamma_{j2}(u),\gamma_{j3}(u)\right)^{\mathrm{T}}$ to be a 4×1 vector, and $\frac{d}{du}\mathbf{\Gamma}_j(u)$

$=\left(\frac{d}{du}\gamma_{j0}(u),\frac{d}{du}\gamma_{j1}(u),\ \frac{d}{du}\gamma_{j2}(u),\frac{d}{du}\gamma_{j3}(u)\right)^{\mathrm{T}}$, j = 1, 2. Assuming an

integral of a matrix consists of integrals of elements in the integrand matrix, then we have the following result.

Theorem 1 The ruin probability vector $\mathbf{\Gamma}_j(u), j=1,2$ for risk model (2.1) satisfies the following integro-differential equation:

$$c\frac{d}{du}\mathbf{\Gamma}_j(u) = \mathbf{A}\mathbf{\Gamma}_j(u) - \int_0^u [\mathbf{g}_1(x)+\mathbf{g}_2(x)]\mathbf{\Gamma}_j(u-x)dx - \bar{\mathbf{G}}_j(u)\mathbf{1}, \tag{3.1}$$

where

$$\mathbf{A} = (a_{ij}) = \begin{pmatrix} \lambda & -\lambda_1 & -\lambda_2 & 0 \\ 0 & \lambda & 0 & -\lambda_2 \\ 0 & 0 & \lambda & -\lambda_1 \\ 0 & 0 & 0 & \lambda \end{pmatrix},$$

$$\mathbf{g}_1(x) = \begin{pmatrix} 0 & 0 & 0 & 0 \\ \lambda_1 f_X(x) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_1 f_X(x) & 0 \end{pmatrix},$$

$$\mathbf{g}_2(x) = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ \lambda_2 f_Y(x) & 0 & 0 & 0 \\ 0 & \lambda_2 f_Y(x) & 0 & 0 \end{pmatrix},$$

$\lambda = \lambda_1 + \lambda_2$, $\mathbf{G}_j(u) = \int_0^u \mathbf{g}_j(x)dx, \bar{\mathbf{G}}_j(u) = \int_u^\infty \mathbf{g}_j(x)dx$, and $\mathbf{1} = (1,1,1,1)^{\mathrm{T}}$.

Proof. Let W be the minimum of $L_{11}^{(1)}$ and $L_{11}^{(2)}$. Note that similar random variables were defined by Yuen et al. (2002) and Li and Garrido (2005) to study the ultimate ruin probabilities for their models. We can work out the following probabilities

$$\Pr\{W = L_{11}^{(1)}\} = \Pr\{L_{11}^{(1)} < L_{11}^{(2)}\} = \frac{\lambda_1}{\lambda},$$

$$\Pr\{W = L_{11}^{(2)}\} = \Pr\{L_{11}^{(1)} > L_{11}^{(2)}\} = \frac{\lambda_2}{\lambda},$$

$$\Pr\{W > t \,|\, W = L_{11}^{(1)}\} = \Pr\{W > t \,|\, W = L_{11}^{(2)}\} = e^{-\lambda t}.$$

Obviously, the two conditional distributions are exponential with parameter λ. We first consider $J = 1$. Using these probabilities and conditioning on the values of W in the surplus process $S(t)$, we can write the following equation:

$$\gamma_{10}(u) = \int_0^\infty \Pr\{W = t, W = L_{11}^{(1)}\}\gamma_{11}(u+ct)dt$$

$$+ \int_0^\infty \Pr\{W = t, W = L_{11}^{(2)}\}\gamma_{12}(u+ct)dt$$

$$= \lambda_1 \int_0^\infty e^{-\lambda t}\gamma_{11}(u+ct)dt + \lambda_2 \int_0^\infty e^{-\lambda t}\gamma_{12}(u+ct)dt. \qquad (3.2)$$

Let $W_1 = \min(L_{12}^{(1)}, L_{11}^{(2)})$. By similar arguments, we have that

$$\gamma_{11}(u) = \int_0^\infty \Pr\{W_1 = t, W_1 = L_{12}^{(1)}\}[\int_0^{u+ct} \gamma_{10}(u+ct-x)f_X(x)dx$$

$$+\overline{F}_X(u+ct)]dt + \int_0^\infty \Pr\{W_1 = t, W_1 = L_{11}^{(2)}\}\gamma_{13}(u+ct)dt$$

$$= \lambda_1 \int_0^\infty e^{-\lambda t}[\int_0^{u+ct} \gamma_{10}(u+ct-x)f_X(x)dx + \overline{F}_X(u+ct)]dt$$

$$+\lambda_2 \int_0^\infty e^{-\lambda t}\gamma_{13}(u+ct)dt. \qquad (3.3)$$

Parallel to (3.2) and (3.3), one can write the following equations for $\gamma_{12}(u)$ and $\gamma_{13}(u)$:

$$\gamma_{12}(u) = \lambda_2 \int_0^\infty e^{-\lambda t} \int_0^{u+ct} \gamma_{10}(u+ct-y)f_Y(y)dydt$$

$$+\lambda_1 \int_0^\infty e^{-\lambda t}\gamma_{13}(u+ct)dt, \qquad (3.4)$$

and

$$\gamma_{13}(u) = \lambda_1 \int_0^\infty e^{-\lambda t}[\int_0^{u+ct} \gamma_{12}(u+ct-x)f_X(x)dx + \overline{F}_X(u+ct)]dt$$

$$+\lambda_2 \int_0^\infty e^{-\lambda t} \int_0^{u+ct} \gamma_{11}(u+ct-y)f_Y(y)dydt. \qquad (3.5)$$

Notice that in (3.4) and (3.5), a claim from the second class, say Y_1, cannot cause ruin when we evaluate the probabilities for $J = 1$. Letting $s = u + ct$, equations (3.2) - (3.5) can be rewritten as

$$c\gamma_{10}(u) = \lambda_1 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}\gamma_{11}(s)ds + \lambda_2 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}\gamma_{12}(s)ds,$$

$$c\gamma_{11}(u) = \lambda_1 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}[\int_0^s \gamma_{10}(s-x)f_X(x)dx + \overline{F}_X(s)]ds$$

$$+\lambda_2 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}\gamma_{13}(s)ds,$$

$$c\gamma_{12}(u) = \lambda_2 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\} \int_0^s \gamma_{10}(s-y)f_Y(y)dyds$$

$$+\lambda_1 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}\gamma_{13}(s)ds,$$

and

$$c\gamma_{13}(u) = \lambda_1 \int_u^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\}[\int_0^s \gamma_{12}(s-x)f_X(x)dx + \overline{F}_X(s)]ds$$

$$+\lambda_2 \int_0^\infty \exp\left\{-\frac{\lambda(s-u)}{c}\right\} \int_0^s \gamma_{11}(s-y)f_Y(y)dyds.$$

Differentiating the above equations with respect to u yields the following system of integro-differential equations:

$$c\frac{d}{du}\gamma_{10}(u) = \lambda\gamma_{10}(u) - \lambda_1\gamma_{11}(u) - \lambda_2\gamma_{12}(u),$$

$$c\frac{d}{du}\gamma_{11}(u) = -\lambda_1 \int_0^u \gamma_{10}(u-x)f_X(x)dx - \lambda_1\overline{F}_X(u) + \lambda\gamma_{11}(u) - \lambda_2\gamma_{13}(u),$$

$$c\frac{d}{du}\gamma_{12}(u) = -\lambda_2 \int_0^u \gamma_{10}(u-y)f_Y(y)dy + \lambda\gamma_{12}(u) - \lambda_1\gamma_{13}(u),$$

$$c\frac{d}{du}\gamma_{13}(u) = -\lambda_2 \int_0^u \gamma_{11}(u-y)f_Y(y)dy - \lambda_1 \int_0^u \gamma_{12}(u-x)f_X(x)dx$$

$$-\lambda_1\overline{F}_X(u) + \lambda\gamma_{13}(u),$$

or in a matrix form,

$$c\frac{d}{du}\mathbf{\Gamma}_1(u) = \mathbf{A}\mathbf{\Gamma}_1(u) - \int_0^u [\mathbf{g}_1(x) + \mathbf{g}_2(x)]\mathbf{\Gamma}_1(u-x)dx - \overline{\mathbf{G}}_1(u)\mathbf{1}. \qquad (3.6)$$

The integro-differential equation for $\Gamma_2(u)$ can be derived similarly.

To end this section, we derive a relation between the initial values $\gamma_{ji}(0)$, $i=0,1,2,3$, which has a similar form to equation (11) in Li and Garrido (2005). After integrating both sides of equation (3.1) from 0 to u, we obtain

$$\begin{aligned} c[\boldsymbol{\Gamma}_j(u)-\boldsymbol{\Gamma}_j(0)] &= \int_0^u \mathbf{A}\boldsymbol{\Gamma}_j(s)ds - \int_0^u\int_0^s [\mathbf{g}_1(x)+\mathbf{g}_2(x)]\boldsymbol{\Gamma}_j(s-x)dxds \\ &\quad - \int_0^u\int_s^\infty \mathbf{g}_j(x)\mathbf{1}dxds \\ &= \int_0^u \mathbf{A}\boldsymbol{\Gamma}_j(s)ds - \int_0^u \left[\mathbf{G}_1(s)+\mathbf{G}_2(s)\right]\boldsymbol{\Gamma}_j(u-s)ds - \int_0^\infty x\mathbf{g}_j(x)\mathbf{1}dx \\ &= \int_0^u \mathbf{C}\boldsymbol{\Gamma}_j(s)ds + \int_0^u [\bar{\mathbf{G}}_1(s)+\bar{\mathbf{G}}_2(s)]\boldsymbol{\Gamma}_j(u-s)ds - \int_0^\infty x\mathbf{g}_j(x)\mathbf{1}dx, \end{aligned}$$

where

$$\mathbf{C} = \begin{pmatrix} \lambda & -\lambda_1 & -\lambda_2 & 0 \\ -\lambda_1 & \lambda & 0 & -\lambda_2 \\ -\lambda_2 & 0 & \lambda & -\lambda_1 \\ 0 & -\lambda_2 & -\lambda_1 & \lambda \end{pmatrix}.$$

It is straightforward to show

$$\int_0^\infty x\mathbf{g}_1(x)\mathbf{1}dx = \begin{pmatrix} 0 \\ \lambda_1\mu_X \\ 0 \\ \lambda_1\mu_X \end{pmatrix}, \qquad \int_0^\infty x\mathbf{g}_2(x)\mathbf{1}dx = \begin{pmatrix} 0 \\ 0 \\ \lambda_2\mu_Y \\ \lambda_2\mu_Y \end{pmatrix}.$$

By the Monotone Convergence Theorem and the fact that $\boldsymbol{\Gamma}_j(\infty)=0$ $=(0,0,0,0)^{\mathrm{T}}$, $j=1,2$, from the above equation, as $u\to\infty$, we have

$$\boldsymbol{\Gamma}_j(0) = -\frac{1}{c}\int_0^\infty \mathbf{C}\boldsymbol{\Gamma}_j(s)ds + \frac{1}{c}\int_0^\infty x\mathbf{g}_j(x)\mathbf{1}dx, \qquad j=1,2.$$

Since one can easily verify that $\frac{1}{4}\mathbf{1}^{\mathrm{T}}\mathbf{C}=\mathbf{0}^{\mathrm{T}}$, we obtain the following results for $\boldsymbol{\Gamma}_1(0)$ and $\boldsymbol{\Gamma}_2(0)$:

$$\frac{1}{4}\mathbf{1}^{\mathrm{T}}\boldsymbol{\Gamma}_1(0) = \frac{1}{4c}\mathbf{1}^{\mathrm{T}}\int_0^\infty x\mathbf{g}_1(x)\mathbf{1}dx = \frac{1}{2c}\lambda_1\mu_X,$$

$$\frac{1}{4}\mathbf{1}^{\mathrm{T}}\boldsymbol{\Gamma}_2(0)=\frac{1}{4c}\mathbf{1}^{\mathrm{T}}\int_0^\infty x\mathbf{g}_2(x)\mathbf{1}dx=\frac{1}{2c}\lambda_2\mu_Y,$$

$$\frac{1}{4}\mathbf{1}^{\mathrm{T}}[\boldsymbol{\Gamma}_1(0)+\boldsymbol{\Gamma}_2(0)]=\frac{1}{1+\theta}, \tag{3.7}$$

where θ is the safety loading factor defined in section 2. Results in (3.7) are used in the derivation of Laplace transforms of the ruin probabilities $\gamma_{ji}(u), i=0,1,2,3, j=1,2$, in section 4.

4 Laplace transforms of the ruin probabilities

Having obtained the integro-differential equations for the ultimate ruin probabilities $\gamma_{ji}(u)(i=0,1,2,3, j=1,2)$ of model (2.1), in the following we will derive the Laplace transforms for the ruin probabilities and consider the inversion of these Laplace transforms for some particular claim size distributions.

Firstly, we define the following Laplace transforms:

$$\hat{\gamma}_{ji}(s)=\int_0^\infty e^{-su}\gamma_{ji}(u)du, \qquad j=1,2, \quad i=0,1,2,3,$$

$$\hat{f}_X(s)=\int_0^\infty e^{-sx}f_X(x)dx, \qquad \hat{f}_Y(s)=\int_0^\infty e^{-sy}f_Y(y)dy,$$

and $\hat{\boldsymbol{\Gamma}}_j(s)=\left(\hat{\gamma}_{j0}(s),\hat{\gamma}_{j1}(s),\hat{\gamma}_{j2}(s),\hat{\gamma}_{j3}(s)\right)^{\mathrm{T}}, j=1,2$.

Using standard properties of Laplace transforms, we obtain from the integro-differential equation (3.1) that

$$\begin{aligned} c[s\hat{\boldsymbol{\Gamma}}_j(s)-\boldsymbol{\Gamma}_j(0)]=&\mathbf{A}\hat{\boldsymbol{\Gamma}}_j(s)-[\hat{\mathbf{g}}_1(s)+\hat{\mathbf{g}}_2(s)]\hat{\boldsymbol{\Gamma}}_j(s)\\ &-\hat{\bar{\mathbf{G}}}_j(s)\mathbf{1}, \quad j=1,2, \end{aligned} \tag{4.1}$$

where

$$\hat{\mathbf{g}}_1(s)+\hat{\mathbf{g}}_2(s)=\begin{pmatrix} 0 & 0 & 0 & 0\\ \lambda_1\hat{f}_X(s) & 0 & 0 & 0\\ \lambda_2\hat{f}_Y(s) & 0 & 0 & 0\\ 0 & \lambda_2\hat{f}_Y(s) & \lambda_1\hat{f}_X(s) & 0 \end{pmatrix},$$

$$\hat{\tilde{\mathbf{G}}}_1(s)\mathbf{1} = \frac{\lambda_1}{s}\begin{pmatrix} 0 \\ 1-\hat{f}_X(s) \\ 0 \\ 1-\hat{f}_X(s) \end{pmatrix}, \quad \hat{\tilde{\mathbf{G}}}_2(s)\mathbf{1} = \frac{\lambda_2}{s}\begin{pmatrix} 0 \\ 0 \\ 1-\hat{f}_Y(s) \\ 1-\hat{f}_Y(s) \end{pmatrix}.$$

As a result, equation (4.1) is rewritten as,

$$\left[s\mathbf{I} - \frac{1}{c}\left(\mathbf{A} - \hat{\mathbf{g}}_1(s) - \hat{\mathbf{g}}_2(s)\right)\right]\hat{\boldsymbol{\Gamma}}_j(s) = \boldsymbol{\Gamma}_j(0) - \frac{1}{c}\hat{\tilde{\mathbf{G}}}_j(s)\mathbf{1}, \quad j = 1,2, \tag{4.2}$$

where I = diag(1, 1, 1, 1). Let $\mathbf{D}(s) = cs\mathbf{I} - \mathbf{A} + \hat{\mathbf{g}}_1(s) + \hat{\mathbf{g}}_2(s)$, which has the form

$$\begin{pmatrix} cs-\lambda & \lambda_1 & \lambda_2 & 0 \\ \lambda_1\hat{f}_X(s) & cs-\lambda & 0 & \lambda_2 \\ \lambda_2\hat{f}_Y(s) & 0 & cs-\lambda & \lambda_1 \\ 0 & \lambda_2\hat{f}_Y(s) & \lambda_1\hat{f}_X(s) & cs-\lambda \end{pmatrix}.$$

If the inverse of $\mathbf{D}(s)$ exists, ie., $\det(\mathbf{D}(s)) \neq 0$, then equation (4.2) is solvable. So one will be interested to know the solutions of equation $\det(\mathbf{D}(s)) = 0$, where the determinant of $\mathbf{D}(s)$ is:

$$det(\mathbf{D}(s)) = \left[(cs-\lambda)^2 - \lambda_1^2\hat{f}_X(s) - \lambda_2^2\hat{f}_Y(s)\right]^2 - 4\lambda_1^2\lambda_2^2\hat{f}_X(s)\hat{f}_Y(s).$$

It is shown in the following theorem that the equation $\det(\mathbf{D}(s)) = 0$ has only three positive real roots.

Theorem 2 The equation

$$[(cs-\lambda)^2 - \lambda_1^2\hat{f}_X(s) - \lambda_2^2\hat{f}_Y(s)]^2 - 4\lambda_1^2\lambda_2^2\hat{f}_X(s)\hat{f}_Y(s) = 0 \tag{4.3}$$

has exactly three positive real solutions, say, ρ_1, ρ_2 and ρ_3.

Proof. For our convenience, we rewrite equation (4.3) as $\alpha^2(s) = \beta(s)$, where $\alpha(s) = (cs-\lambda)^2 - \lambda_1^2\hat{f}_X(s) - \lambda_2^2\hat{f}_Y(s)$, $\beta(s) = 4\lambda_1^2\lambda_2^2\hat{f}_X(s)\hat{f}_Y(s)$.

The first step is to show equation $\alpha(s)=0$ has only two positive real roots. We need to prove that the equation

$$\alpha'(s)=2c^2s-2c\lambda-\lambda_1^2\hat{f}_X'(s)-\lambda_2^2\hat{f}_Y'(s)=0 \tag{4.4}$$

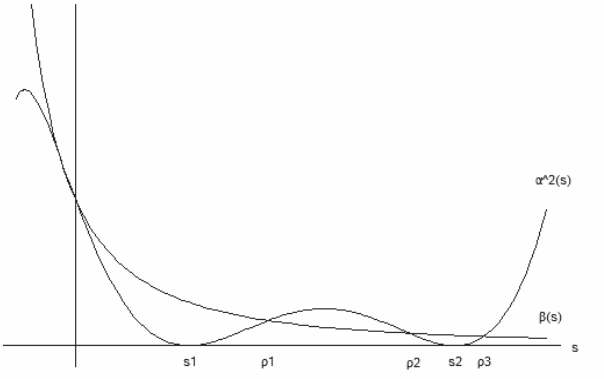
has only one positive real root, say, s_0. This is because the function $2c^2s$ is a strictly increasing function taking values between 0 and ∞. The function $2c\lambda+\lambda_1^2\hat{f}_X'(s)+\lambda_2^2\hat{f}_Y'(s)$ is also strictly increasing from $2c\lambda-\lambda_1^2\mu_X-\lambda_2^2\mu_Y(>0)$ to $2c\lambda$. Therefore equation (4.4) has only one positive real root. In addition, $\alpha'(0)=\lambda_1^2\mu_X+\lambda_2^2\mu_Y-2c\lambda<0$ and $\alpha'(\infty)=\infty$, so one can see that $\alpha'(s)<0$ for $s\in[0,s_0)$ and $\alpha'(s)>0$ for $s\in(s_0,\infty)$. It means that $\alpha(s)$ decreases for $s\in[0,s_0)$ and is increasing for $s\in(s_0,\infty)$. Moreover, the facts that $\alpha(0)=\lambda^2-\lambda_1^2-\lambda_2^2=2\lambda_1\lambda_2>0$ and $\alpha(\frac{\lambda}{c})=-\lambda_1^2\hat{f}_X(\frac{\lambda}{c})-\lambda_2^2\hat{f}_Y(\frac{\lambda}{c})<0$ show that equation $\alpha(s)=0$ has only two positive real roots, say, s_1 and s_2, satisfying $s_1<s_0\le\frac{\lambda}{c}<s_2$, as $\alpha'(\frac{\lambda}{c})\ge 0$.

Next we will examine the equation $\alpha^2(s)=\beta(s)$. Clearly, the function $\beta(s)$ is a non-negative decreasing function for all $s\in(0,\infty)$, $\alpha^2(s)$ is non-negative for all *s*, and the two positive real numbers s_1 and s_2 satisfy $\alpha^2(s)=0$. It is not hard to find that the function $\alpha^2(s)$ is decreasing over intervals $[0,s_1)$ and $[s_0,s_2)$, and is increasing over $[s_1,s_0)$ and $[s_2,\infty)$. We then show the following facts which will lead to three positive roots for the equation $\alpha^2(s)=\beta(s)$. The first fact is $\alpha^2(0)=4\lambda_1^2\lambda_2^2=\beta(0)$. The second one is $\frac{d}{ds}[\alpha^2(s)]|_{s=0}<\beta'(0)$, which is because

$$\begin{aligned}
&\frac{d}{ds}[\alpha^2(s)]|_{s=0}-\beta'(0)\\
&=4\lambda_1\lambda_2(\lambda_1^2\mu_X+\lambda_2^2\mu_Y-2c\lambda)+4\lambda_1^2\lambda_2^2(\mu_X+\mu_Y)\\
&=4\lambda_1\lambda_2[(\lambda_1+\lambda_2)(\lambda_1\mu_X+\lambda_2\mu_Y)-2c(\lambda_1+\lambda_2)]\\
&<4\lambda_1\lambda_2[(\lambda_1+\lambda_2)(\lambda_1\mu_X+\lambda_2\mu_Y)-(\lambda_1\mu_X+\lambda_2\mu_Y)(\lambda_1+\lambda_2)]=0.
\end{aligned}$$

Thirdly, $\alpha^2(\frac{\lambda}{c})>\beta(\frac{\lambda}{c})$. The proof is straightforward. These three facts, as a whole, show that the equation $\alpha^2(s)=\beta(s)$ has only three positive real roots, say, ρ_1, ρ_2 and ρ_3, satisfying $0<s_1<\rho_1<\frac{\lambda}{c}<\rho_2<s_2<\rho_3<\infty$ (see Figure 1 below).

Figure 1: An example figure for $\alpha^2(s)$ and $\beta(s)$



From Theorem 2 we know when $s \neq \rho_i, i = 1,2,3$, the inverse of $\mathbf{D}(s)$ exists satisfying $\mathbf{D}^{-1}(s) = [det(\mathbf{D}(s))]^{-1}\mathbf{D}^*(s)$, where $\mathbf{D}^*(s)$ has the form:

$$\begin{pmatrix} (cs-\lambda)\alpha(s) & -\lambda_1\xi_1(s) & -\lambda_2\xi_2(s) & 2\lambda_1\lambda_2(cs-\lambda) \\ -\lambda_1\hat{f}_X(s)\xi_1(s) & (cs-\lambda)\alpha(s) & 2\lambda_1\lambda_2(cs-\lambda)\hat{f}_X(s) & -\lambda_2\xi_2(s) \\ -\lambda_2\hat{f}_Y(s)\xi_2(s) & 2\lambda_1\lambda_2(cs-\lambda)\hat{f}_Y(s) & (cs-\lambda)\alpha(s) & -\lambda_1\xi_1(s) \\ 2\lambda_1\lambda_2(cs-\lambda)\hat{f}_X(s)\hat{f}_Y(s) & -\lambda_2\hat{f}_Y(s)\xi_2(s) & -\lambda_1\hat{f}_X(s)\xi_1(s) & (cs-\lambda)\alpha(s) \end{pmatrix}$$

in which $\xi_1(s) = \alpha(s) + 2\lambda_2^2\hat{f}_Y(s)$, and $\xi_2(s) = \alpha(s) + 2\lambda_1^2\hat{f}_X(s)$. Therefore, solving equation (4.2) yields

$$\hat{\mathbf{\Gamma}}_j(s) = c\mathbf{D}^{-1}(s)\mathbf{\Gamma}_j(0) - \mathbf{D}^{-1}(s)\hat{\bar{\mathbf{G}}}_j(s)\mathbf{1}, \qquad j = 1,2. \tag{4.5}$$

For j = 1, 2, $\mathbf{\Gamma}_j(0)$ is determined as follows. Since $\hat{\gamma}_{ji}(s), i = 0,1,2,3$ are all finite for all $s > 0$, Theorem 2 implies that at $s = \rho_k$ $(k = 1,2,3)$, $c\mathbf{D}^*(s)\mathbf{\Gamma}_j(0) - \mathbf{D}^*(s)\hat{\bar{\mathbf{G}}}_j(s)\mathbf{1} = 0$. Further, since the rank of matrix $\mathbf{D}^*(\rho_k)(k = 1,2,3)$ equals 1, then using the second row vector of $\mathbf{D}^*(\rho_k)$, denoted by $\mathbf{d}_2^*(\rho_k)$, we can write the following equations

$$c\mathbf{d}_2^*(\rho_k)\mathbf{\Gamma}_j(0) - \mathbf{d}_2^*(\rho_k)\hat{\bar{\mathbf{G}}}_j(\rho_k)\mathbf{1} = 0, \qquad k = 1,2,3. \tag{4.6}$$

These three equations together with (3.7) could be written in a matrix form as follows:

$$\mathbf{E}\boldsymbol{\Gamma}_j(0) = \mathbf{e}_j, \tag{4.7}$$

where

$$\mathbf{E} = \left(\frac{1}{4}\mathbf{1}, \mathbf{d}_2^*(\rho_1)^{\mathrm{T}}, \mathbf{d}_2^*(\rho_2)^{\mathrm{T}}, \mathbf{d}_2^*(\rho_3)^{\mathrm{T}}\right)^{\mathrm{T}},$$

$$\mathbf{e}_1 = \left(\frac{1}{2c}\lambda_1\mu_X, \mathbf{d}_2^*(\rho_1)\hat{\tilde{\mathbf{G}}}_1(\rho_1)\mathbf{1}, \mathbf{d}_2^*(\rho_2)\hat{\tilde{\mathbf{G}}}_1(\rho_2)\mathbf{1}, \mathbf{d}_2^*(\rho_3)\hat{\tilde{\mathbf{G}}}_1(\rho_3)\mathbf{1}\right)^{\mathrm{T}},$$

$$\mathbf{e}_2 = \left(\frac{1}{2c}\lambda_2\mu_Y, \mathbf{d}_2^*(\rho_1)\hat{\tilde{\mathbf{G}}}_2(\rho_1)\mathbf{1}, \mathbf{d}_2^*(\rho_2)\hat{\tilde{\mathbf{G}}}_2(\rho_2)\mathbf{1}, \mathbf{d}_2^*(\rho_3)\hat{\tilde{\mathbf{G}}}_2(\rho_3)\mathbf{1}\right)^{\mathrm{T}}.$$

Solving (4.7) gives

$$\boldsymbol{\Gamma}_j(0) = \mathbf{E}^{-1}\mathbf{e}_j, \qquad j = 1,2, \tag{4.8}$$

where $\mathbf{E}^{-1}$ is the inverse of E. Using results (4.5) and (4.8), the ultimate ruin probabilities can be obtained by inverting their Laplace transforms. In particular, $\psi_1(u) = \gamma_{10}(u)$, $\psi_2(u) = \gamma_{20}(u)$, and $\psi(u) = \psi_1(u) + \psi_2(u)$.

5 Numerical Examples

In this section, we examine an insurance business having two classes of individual claims, which follow exponential and Gamma distributions, respectively. Given the exact distribution information, using the derived formulae in Section 4 we are able to obtain numerical expressions for the ruin probabilities of interest. The computation involved is conducted by the software *Mathematica.*

Example 1: In this example, we assume both X_1 and Y_1 follow different exponential distributions, ie. $f_X(x) = \exp\{-x\}$, $f_Y(y) = 0.5\exp\{-0.5y\}$.

So $\hat{f}_X(s) = (1+s)^{-1}$, $\hat{f}_Y(s) = (1+2s)^{-1}$, $\mu_X = 1$, and $\mu_Y = 2$. Let $\lambda_1 = 1, \lambda_2 = 0.5, c = 1.1$, then we have $\lambda = 1.5$ and $\theta = 0.1$. From the definition of $\alpha(s)$, we obtain

$$\alpha(s) = (1.1s - 1.5)^2 - \frac{1}{1+s} - \frac{1}{4(1+2s)},$$

and equation (4.3) is

$$[(1.1s - 1.5)^2 - \frac{1}{1+s} - \frac{1}{4(1+2s)}]^2 - \frac{1}{(1+s)(1+2s)} = 0.$$

It has three positive real roots $\rho_1 = 0.98191, \rho_2 = 1.70019$, and $\rho_3 = 2.08155$, giving

$$\alpha(\rho_1) = -0.41260, \quad \alpha(\rho_2) = -0.29011, \quad \alpha(\rho_3) = 0.25070.$$

Substituting the numbers into (4.7) and solving the equations yields:

$$\mathbf{\Gamma}_1(0) = (0.40390, 0.61302, 0.29788, 0.50339)^{\mathrm{T}},$$

$$\mathbf{\Gamma}_2(0) = (0.45373, 0.29946, 0.61872, 0.44627)^{\mathrm{T}}.$$

Substituting them into (4.5) gives

$$\mathbf{\Gamma}_1(s) = \eta^{-1}(s) \begin{pmatrix} 0.40388(0.5+s)(0.57974+s)(0.878+s) \\ 0.61302(0.41155+s)(0.5+s)(0.90495+s) \\ 0.29788(0.51426+s)(0.69374+1.62218s+s^2) \\ 0.50339(0.44702+s)(0.52292+1.4198s+s^2) \end{pmatrix},$$

$$\mathbf{\Gamma}_2(s) = \eta^{-1}(s) \begin{pmatrix} 0.45373(0.48798+s)(0.96494+s)(1+s) \\ 0.29946(0.49096+s)(0.93994+s)(1.56446+s) \\ 0.61872(0.47841+s)(0.80396+s)(1+s) \\ 0.44627(0.50264+s)(0.78571+s)(1.36585+s) \end{pmatrix},$$

where $\eta(s) = (0.07898+s)(0.48942+s)(0.76272+1.7407s+s^2)$. Inverting these Laplace transforms yields $\mathbf{\Gamma}_1(u)$ and $\mathbf{\Gamma}_2(u)$ which give

$$\psi_1(u) = [0.14382\cos(0.07218u) + 0.03877\sin(0.07218u)]e^{-0.87035u}$$
$$-0.00243e^{-0.48942u} + 0.26251e^{-0.07898u},$$

$$\psi_2(u) = [-0.13309\cos(0.07218u) - 0.044\sin(0.07218u)]e^{-0.87035u}$$
$$+0.00258e^{-0.48942u} + 0.58424e^{-0.07898u},$$

$$\psi(u) = \psi_1(u) + \psi_2(u)$$

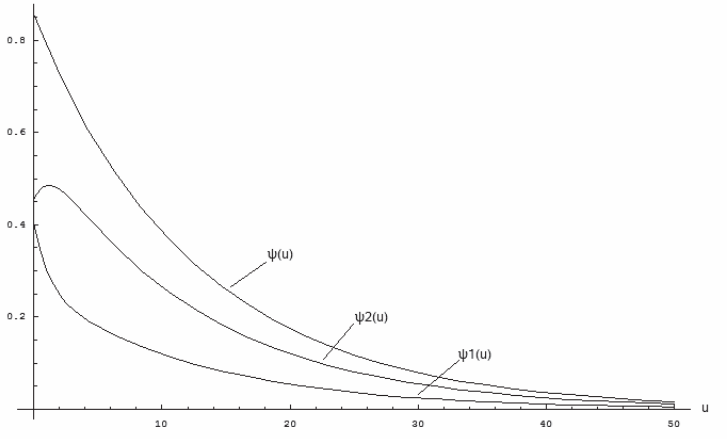
$$= [0.01073\cos(0.07218u) - 0.00523\sin(0.07218u)]e^{-0.87035u}$$

$$+0.00015e^{-0.48942u} + 0.84675e^{-0.07898u},$$

with $\psi_1(0) = 0.40390, \psi_2(0) = 0.45373$, and $\psi(0) = 0.85763$.

Figure 2 shows the total probability of ruin for different values of u, as well as their decomposition into the ruin probabilities due to claims from class one and those from class two. One can see from the graph that $\psi_1(u)$ is a strictly decreasing function of u. It is reducing sharply when u is small (between 0 and 2) and turns to be flatter when u increases. On the contrary, $\psi_2(u)$ is a strictly increasing function when u is small (between 0 and approximately 2) and starts to decrease when u increases. Moreover, $\psi_2(u)$ is always greater than $\psi_1(u)$, which means the second class of business is riskier than the first one within the context of the combined business. Although individual claims received by the company are expected to be less frequent from class two, the higher expected individual claim amount indicates that claims from class two will cause ruin more likely than those from class one.

Figure 2: Decomposition of the ruin probability in Example 1



Example 2: We consider the following claim size distributions: $f_X(x) = 4x\exp\{-2x\}$ and $f_Y(y) = y\exp\{-y\}$, ie., $X_1 \sim \text{Gamma}(2,2)$ and $Y_1 \sim \text{Gamma}(2,1)$. So $\hat{f}_X(s) = 4(2+s)^{-2}$, $\hat{f}_Y(s) = (1+s)^{-2}$, $\mu_X = 1$, and $\mu_Y = 2$. Using $\lambda_1 = 1, \lambda_2 = 0.5$, and $c = 1.1$, the function $\alpha(s)$ has the form

$$\alpha(s) = (1.1s - 1.5)^2 - \frac{4}{(2+s)^2} - \frac{1}{4(1+s)^2},$$

and equation (4.3) becomes

$$[(1.1s - 1.5)^2 - \frac{4}{(2+s)^2} - \frac{1}{4(1+s)^2}]^2 - \frac{4}{(1+s)^2(2+s)^2} = 0.$$

It has three positive real roots $\rho_1 = 0.983376$, $\rho_2 = 1.68756$, and $\rho_3 = 1.974$, which give

$$\alpha(\rho_1) = -0.338, \quad \alpha(\rho_2) = -0.201805, \quad \alpha(\rho_3) = 0.169224.$$

Substituting the numbers into (4.7) and solving the equations yield:

$$\boldsymbol{\Gamma}_1(0) = (0.389174, 0.633569, 0.279393, 0.516046)^{\mathrm{T}},$$

$$\boldsymbol{\Gamma}_2(0) = (0.455215, 0.280531, 0.641064, 0.441372)^{\mathrm{T}}.$$

Substituting them into (4.5) gives

$$\boldsymbol{\Gamma}_1(s) = \eta^{-1}(s)\begin{pmatrix} 0.39(1+s)^2(1.48+s)(2.43+s)(2.74+s)(1.19+2.11s+s^2) \\ 0.63(0.62+s)(1+s)^2(2.42+s)(2.98+s)(1.87+2.73s+s^2) \\ 0.28(1.56+s)(2.45+s)(2.79+s)(1.05+2.04s+s^2)(1.54+2.04s+s^2) \\ 0.52(0.73+s)(1.17+s)(1.60+s)(2.46+s)(3.08+s)(1.04+1.76s+s^2) \end{pmatrix},$$

$$\boldsymbol{\Gamma}_2(s) = \eta^{-1}(s)\begin{pmatrix} 0.46(0.87+s)(1.11+s)(2+s)^2(2.40+s)(2.25+2.97s+s^2) \\ 0.28(0.90+s)(1.08+s)(2.41+s)(2.19+2.94s+s^2)(6.77+4.51s+s^2) \\ 0.64(0.78+s)(1.66+s)(2+s)^2(2.46+s)(1.36+2.31s+s^2) \\ 0.44(1.23+s)(1.63+s)(2.46+s)(0.87+1.83s+s^2)(6.02+4.37s+s^2) \end{pmatrix},$$

where

$$\eta(s) = (0.12+s)(0.88+s)(1.10+s)(1.52+s)(2.44+s)(2.51+s)(1.85+2.62s+s^2).$$

Inverting these Laplace transforms gives:

$$\psi_1(u) = -0.06603e^{-2.50908u} + 0.01657e^{-2.44128u} + 0.02344e^{-1.51647u}$$

$$+[0.15593\cos(0.36491u) - 0.07338\sin(0.36491u)]e^{-1.30987u}$$

$$+0.00906e^{-1.10128u} - 0.01187e^{-0.88265u} + 0.26207e^{-0.1199u},$$

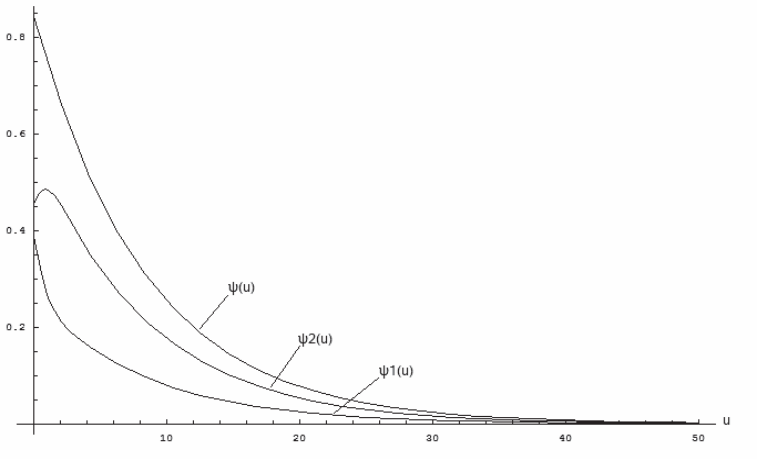
$$\psi_2(u) = 0.05648e^{-2.50908u} - 0.01772e^{-2.44128u} - 0.01961e^{-1.51647u}$$
$$-[0.14889\cos(0.36491u) - 0.05041\sin(0.36491u)]e^{-1.30987u}$$
$$-0.00971e^{-1.10128u} + 0.01281e^{-0.88265u} + 0.58185e^{-0.1199u},$$

$$\psi(u) = -0.00955e^{-2.50908u} - 0.00115e^{-2.44128u} + 0.00383e^{-1.51647u}$$
$$+[0.00704\cos(0.36491u) - 0.02297\sin(0.36491u)]e^{-1.30987u}$$
$$-0.00065e^{-1.10128u} + 0.00093e^{-0.88265u} + 0.84393e^{-0.1199u},$$

with $\psi_1(0) = 0.38917, \psi_2(0) = 0.45522$, and $\psi(0) = 0.84439$.

Similarly, Figure 3 shows the total probability of ruin, $\psi(u)$, for different values of *u*, as well as $\psi_1(u)$ and $\psi_2(u)$. The ruin probability $\psi_1(u)$ is still a strictly decreasing function of *u*, and it decreases rapidly when *u* is small (between 0 and 2). It decreases slower when *u* increases. On the contrary, when *u* is small (between 0 and slightly < 2) $\psi_2(u)$ is a strictly increasing function and starts to decrease when *u* increases. Again, $\psi_2(u)$ is always greater than $\psi_1(u)$, which is expected by the higher expected individual claim amount for the second class of business.

Figure 3: Decomposition of the ruin probability in Example 2



Remark. The author has also worked on a more general risk model that is formed by two generalized Erlang(2) processes. Due to the similar derivations, more tedious forms of results, and the fact that no new techniques are required, the author decides not to include the model within this paper.

Acknowledgments

The author is grateful to the anonymous referees for their constructive comments that helped to improve the paper.

References

Albrecher, H., Claramunt, M.M., Mármol, M. (2005). On the distribution of dividend payments in a Sparre Andersen model with generalized Erlang(*n*) interclaim times. Insurance: Mathematics and Economics, 37, 324-334.

Cheng, Y., Tang, Q. (2003). Moments of the surplus before ruin and the decifit at ruin in the Erlang(2) risk process. North American Actuarial Journal, 7(1), 1-12.

Dickson, D.C.M. (1998). On a class of renewal risk processes. North American Actuarial Journal, 2(3), 60-68.

Dickson, D.C.M., Drekic, S. (2004). The joint distribution of the surplus prior to ruin and the deficit at ruin in some Sparre Andersen models. Insurance: Mathematics and Economics, 34, 97-107.

Dickson, D.C.M., Hipp, C. (1998). Ruin probabilities for Erlang(2) risk processes. Insurance: Mathematics and Economics, 22, 251-262.

Dickson, D.C.M., Hipp, C. (2001). On the time to ruin for Erlang(2) risk processes. Insurance: Mathematics and Economics, 29, 333-344.

Gerber, H.U., Shiu, E.S.W. (2003). Discussion on 'Moments of the surplus before ruin and the deficit at ruin in the Erlang(2) risk process' by Y. Cheng and Q. Tang. North American Actuarial Journal, 7(3), 117-119.

Gerber, H.U., Shiu, E.S.W. (2005). The time value of ruin in a Sparre Andersen model. North American Actuarial Journal, 9(2), 49-69.

Li, S., Dickson, D.C.M. (2006). The maximum surplus before ruin in an Erlang(*n*) risk process and related problems. Insurance: Mathematics and Economics, 38, 529-539.

Li, S., Garrido, J. (2004a). On ruin for Erlang(*n*) risk process. Insurance: Mathematics and Economics, 34, 391-408.

Li, S., Garrido, J. (2004b). On a class of renewal risk models with a constant dividend barrier. Insurance: Mathematics and Economics, 35, 691-701.

Li, S., Garrido, J. (2005). Ruin probabilities for two classes of risk processes. ASTIN Bulletin, 35, 61-77.

Li, S., Lu, Y. (2005). On the expected discounted penalty functions for two classes of risk processes. Insurance: Mathematics and Economics, 36, 179-193.

Rolski, T., Schmidli, H., Schmidt, V., Teugels, J. (1998). *Stochastic processes for insurance and finance*. John Wiley & Sons Ltd, NY, USA.

Sun, L., Yang, H. (2004). On the joint distributions of surplus immediately before ruin and the deficit at ruin for Erlang(2) risk processes. Insurance: Mathematics and Economics, 34, 121-125.

Tsai, C.C., Sun, L. (2004). On the discounted distribution functions for the Erlang(2) risk process. Insurance: Mathematics and Economics, 35, 5-19.

Yuen, K.C., Guo, J.Y., Wu, X. (2002). On a correlated aggregate claims model with Poisson and Erlang risk processes. Insurance: Mathematics and Economics, 31, 205-214.

Zhu, J., Yang, H. (2009). On differentiability of ruin functions under Markov-modulated models. Stochastic Processes and their Applications, 119, 1673-1695.

Mission Statement

The Australian Actuarial Journal is committed to promoting the work of actuaries, researchers and other experts in financial risk assessment, with a particular focus on Australian and Asia-Pacific issues. The focus of the Journal is in publishing contributions on:

- Original research in actuarial science, finance and investment, and related areas.
- Applications of theory that are of interest to practitioners.
- Surveys or reviews of current research that may appear in the literature.
- Significant presentations at the Institute's public forums.

All published papers, other than those that report the Institute's proceedings, are subject to a rigorous process of peer review. Contributions that appear as Feature Articles are assessed by two independent reviewers. Contributions that appear as Notes may be reviewed by members of the Editorial Committee.

The Journal is published in hardcopy edition on a quarterly basis, or at such frequency appropriate to the submission of quality contributions. Papers published in the Journal are also accessible in electronic format from the Institute's website at **www.actuaries.asn.au**.

Contributions from prospective authors are invited in the areas of the Journal's focus. Full authoring guidelines may be downloaded from the Institute's website.

Editorial Policy

The Australian Actuarial Journal publishes papers of interest to actuaries and other experts in financial risk, with a particular focus on Australian, New Zealand and Asian topics. All papers which appear in the Feature Article section of the Journal, with the exception of the annual presidential addresses, are assessed by two independent reviewers. The Notes section of the Journal contains less weighty items, which are reviewed by members of the editorial team.

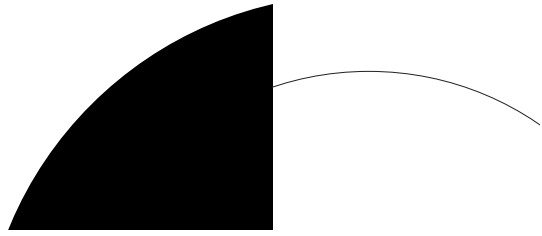
Guidelines for Intending Authors

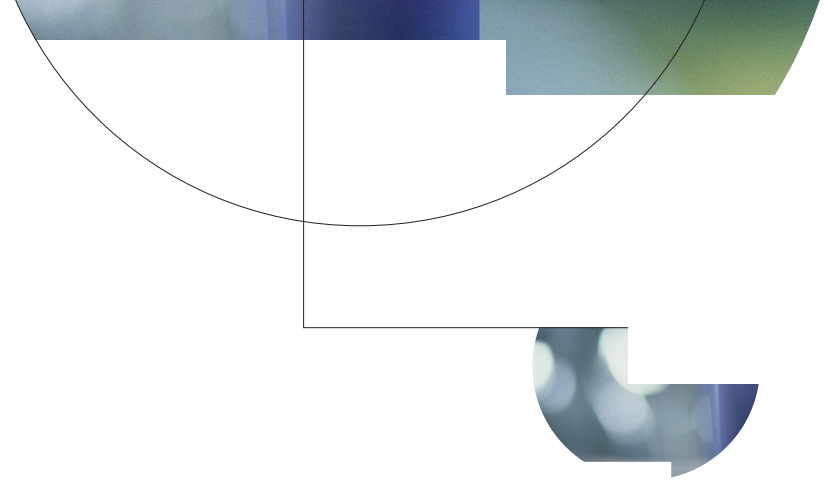
The editor welcomes contributions to the Journal, either as Feature Articles or as Notes. Papers may be practical or theoretical in nature. Full guidelines for authors are available from the Institute of Actuaries of Australia or can be downloaded from the Institute's website www.actuaries.asn.au

Subscriptions

The Australian Actuarial Journal is published bi-annually and is issued to members of the Institute of Actuaries of Australia. Subscription rates for non-members are AUS$100 per year, including postage and handling. For subscription inquiries, contact the:

Membership Coordinator
Institute of Actuaries of Australia
Level 7 Challis House
4 Martin Place Sydney NSW 2000 Australia
Telephone: +61 (0) 2 9233 3466
Email: actuaries@actuaries.asn.au





Contents

Feature Articles