Institute of Actuaries of Australia

On Equalisation by

Risk Based Capitation Reinsurance

Prepared by Walther Neuhaus

Presented to the Institute of Actuaries of Australia
XVth General Insurance Seminar 16-19 October 2005

The Institute of Actuaries of Australia
Level 7 Challis House 4 Martin Place
Sydney NSW Australia 2000
Telephone: +61 2 9233 3466 Facsimile: +61 2 9233 3446
Email: actuaries@actuaries.asn.au Website: www.actuaries.asn.au

Abstract

The paper points out that Risk Based Capitation (RBC) Reinsurance, as proposed by the Department of Health to equalise hospital benefits, has several shortcomings, and how those shortcomings could be eliminated. A theory of optimal equalisation is used to derive an equalisation scheme that properly recognises the form of partial community rating that is mandatory for private health insurers in Australia today. The optimal equalisation scheme is also of the RBC form, the only difference to the current proposal being that Single Equivalent Units (SEU) need to be calculated in a different way.

Keywords: Health insurance, Community Rating, Equalisation, Risk Based Capitation, Reinsurance

1. Introduction

In 2003 the Department of Health announced its plan to introduce Risk Based Capitation (RBC) Reinsurance for private health insurers from 1st July 2005. The implementation date has been postponed, with the change now due to take effect from 1st July 2006.

The calculations of RBC Reinsurance are set out in a paper from the Department (2003), and the considerations leading to RBC Reinsurance are documented in a report by Trowbridge (1999).

This paper points out that RBC Reinsurance as proposed by the Department has shortcomings that could be eliminated. The problem that will be highlighted here is that RBC Reinsurance is steeped in the rate structure that was mandatory a decade ago. The current RBC Reinsurance proposal fails to make allowance for the changes that have been made since 1996, namely:

- The fact that health insurers are free to set premium relativities for four different membership categories, following changes to health laws in 1996.
- The fact that health insurers are obliged to apply premium loadings for late entrants to Lifetime Health Cover, following changes to health laws in 2000.

Notwithstanding the fact that health insurers are free to set different premium relativities for four different membership categories (Single, Couple, Single Parent and Family), most are still applying the relativities that were mandatory prior to 1996. The practice was challenged before the Administrative Decisions Tribunal in Sydney, in the case of Strong v HCF (ADT 2004). The ADT order to dismiss the application is under appeal, with the next hearing set for 17th October 2005. This paper shows that the proposed RBC Reinsurance will make it virtually impossible for health insurers to change their premium relativities significantly from those that were mandatory a decade ago.

In a submission to the Department, the Institute of Actuaries of Australia (1999) pointed out that Lifetime Health Cover (LHC) loadings ought to be recognised. The submission recommended the operation of a separate pool to redistribute the LHC loadings, but did not provide a specific formula to that end. In this paper, a way of recognising the LHC loadings is proposed.

A theory of optimal equalisation has been described by the author (Neuhaus 1995, 1997a&b). The theory is used in this paper to derive an equalisation scheme that properly recognises the specific form of partial community rating that is mandatory for private health insurers in Australia today. Partial community rating means that insurers are free to set premium rate relativities in respect of certain rating variables (read: membership category, insurance product), at the same time as they are obliged to apply specified premium rate relativities in respect of other rating variables (read: entry age, dependant status); the specification of premium rate relativities including a prohibition to differentiate the premium rate according to still other variables (read: attained age, gender etc.).

Section 2 of the paper gives a brief introduction to partial community rating as it is currently mandatory for Australian health insurers.

In Section 3, the author's theory of optimal equalisation is revisited. The optimal equalisation scheme is shown to be of the RBC form, the only difference to the current proposal being that Single Equivalent Units (SEU) need to be calculated in a different way. The term Adapted SEU is introduced. A numerical example is given in Section 4, showing the equalisation transfers that would be generated by optimal scheme on a notional population of NSW.

The transfers that would be generated by the proposed RBC Reinsurance on the same population are then calculated in Section 5. It is shown that RBC Reinsurance discriminates between membership categories. Single parent memberships are charged a higher reinsurance contribution than all other membership categories as payors to the reinsurance pool, and credited a lower subsidy than all other membership categories as payees from the reinsurance pool. Section 6 compares the optimal scheme and RBC Reinsurance with two intermediate schemes, one of which eliminates discrimination between membership categories but fails to recognise LHC loadings, while the other recognises LHC loadings but does not solve the discrimination problem.

In Section 7, the Department's proposal to reflect product mix in the risk relativities underpinning RBC Reinsurance is discussed. This paper argues that product mix is not a variable that qualifies for equalisation, as insurers are free to set different premiums for different products. If product mix is recognised in the way it has been proposed, it will generate a subsidy for "Comprehensive like" products. Such a subsidy can indeed be justified with reference to higher utilisation rates. However, RBC Reinsurance "With product" seems to be a rather blunt instrument to achieve that end. The author's view on some implementation issues is briefly outlined in Section 8.

In writing this paper the author had to choose between the notation that the Department (2003) is using in its paper, and using a notation that was developed in earlier papers by the author. Maybe not surprisingly, the author has opted for his own notation, because it appears to be more conducive to asking the question ***Why*** of equalisation, not just answering the question ***How*** of implementation. Apologies go to the reader for the fact that several symbols (letters) used in this paper are the same as in the Department's paper, with different meanings attached to them. A cross reference table of symbols used is provided at the end of the paper.

Purely as a manner of speaking, this paper will refer to insured persons as payors and payees, as if they were individually charged or credited from the equalisation pool. That is of course not the case, the only payors and payees being health insurers on behalf of their members. The author is aware of the distinction, but has found the payor/payee terminology useful to discuss for which risk groups an equalisation scheme creates a charge for the insurer, and for which groups it creates a subsidy. The ability to source equalisation payments back to individual risk groups ("divisibility") has also been promoted as one of the major advantages of RBC Reinsurance, because it enables health insurers to properly price the effect of reinsurance at an individual level.

2. The rating structure of Australian health insurance

RBC Reinsurance will operate on a state by state basis, including the Northern Territory. Thus there will be seven separate equalisation schemes, all under the administration of PHIAC. Let us denote the insurers in one state of Australia by $i = 1, \ldots, I$. Partial community rating for Australian health insurers involves the following rating variables:

- **Membership category**. There are four defined membership categories: Single, Couple, Single Parent and Family. Let us denote the membership category by $m \in \{1,2,3,4\}$.

- **Insurance product**. There is a wide variety of health insurance products on offer in Australia.

- **Entry age**. Entry age is defined as the age when the insured person started holding health insurance continuously. Let us denote the certified entry age of an insured person by e.

- **Dependant status**. Dependants are normally children under the age of 20 in Single Parent or Family memberships. Let us indicate that an insured person is *not* insured as a dependant, by the indicator variable a (for *a*dult status).

Prior to 1996, the only allowable premium differentiation was by insurance product and by membership category, and the premium relativity between membership categories was prescribed: for a given insurance product the insurer could charge one premium unit (base rate) for a single person, two premium units for all other membership categories. Following the change in 1996 an insurer is free, in principle, to apply a different base rate for each of the four membership categories. For each insurance product p that it offers, therefore, the insurer i may have four different base rates of its own discretion, which we shall denote by $b_{im}^{(p)}$ $(m = 1,2,3,4)$.

Following further changes in 2000, a mandatory lifetime loading is charged to late entrants to health insurance. For every year by which an insured person's entry age exceeds 30, and up to the entry age of 65, an extra 2% loading is added to the base rate.

No additional premium may be charged for dependants, regardless of their number, in Single Parent or Family memberships. Mathematically, the only consistent formulation of this restriction is to say that additional dependants (starting with the first) are covered free of charge, i.e., the mandatory premium rate relativity that applies to a dependant, is always zero.

Therefore, the premium payable by a person in membership category m, who is insured with insurer i and holding insurance product p, will be $b_{im}^{(p)} \cdot r(e,a)$. The base rate $b_{im}^{(p)}$ is at the insurer's discretion, while the mandatory rate relativity r is defined by

$$(1) \qquad r(e,a) = a \cdot \left(1 + 0.02 \cdot \left((e-30)^+ \wedge 35\right)\right).$$

There is actually a small complication because the LHC loading for late entrants applies only to persons who joined health insurance after the expiry of a period of grace in 2000, while no loading applies to those who had joined before. In order to save notation, let us simply assume that all those who had joined health insurance in time to avoid the LHC loading, have joined before the age of 30.

Insurers are not allowed to differentiate their premium by any risk variable, such as the insured's attained age (y) or gender (g). The prohibition is made explicit if one includes those risk variables *pro forma* as arguments to the mandatory rate relativity function r, which then becomes

(2) $\quad r(e,a,y,g) = a \cdot \left(1 + 0.02 \cdot \left((e-30)^{+} \wedge 35\right)\right)$

One could of course include additional risk variables *ad libitum*, as long as they do not affect the premium rate. The reason for this formalistic representation will become clear shortly.

3. A theory of optimal equalisation revisited

Let us assume that every person of the insured population can be characterised by a composite vector $\mathbf{x} = (\mathbf{x}_1, \mathbf{x}_2)$ in such a way that

- The sub-vector $\mathbf{x}_1$ contains sufficient information to determine the mandatory rate relativity for that person, which every insurer must apply. In the context of the previous section, we have $\mathbf{x}_1 = (e,a)$ = (entry age, adult status).

- The sub-vector $\mathbf{x}_2$ consists of relevant risk variables that determine the expected benefits paid to the person, but that the insurer is precluded from using in the rating formula. Again in the context of the previous section, we have $\mathbf{x}_2 = (y,g)$ = (attained age, gender).

The mandatory rate relativity that every insurer must apply to an insured person with characteristic vector $\mathbf{x}$, we denote by $r(\mathbf{x})\ (= r(\mathbf{x}_1))$. Let $\mathbf{X}_1$ denote the range of possible values of $\mathbf{x}_1$, let $\mathbf{X}_2$ denote the range of possible values of $\mathbf{x}_2$, and define $\mathbf{X} = \mathbf{X}_1 \times \mathbf{X}_2$.

As an abbreviation and to avoid tedious repetition, let $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ denote the collective of persons characterised by $\mathbf{x} \in \mathbf{X}$ that are insured by insurer i in membership category m, and are holding insurance product p. Let $\mathbf{C}_{im}^{(p)} = \bigcup_{\mathbf{x} \in \mathbf{X}} \mathbf{C}_{im}^{(p)}(\mathbf{x})$ denote the collective of all persons that are insured by insurer i in membership category m, with insurance product p. Finally, let $\mathbf{C}(\mathbf{x}) = \bigcup_{i,m,p} \mathbf{C}_{im}^{(p)}(\mathbf{x})$ be the collective of insured persons characterised by $\mathbf{x} \in \mathbf{X}$, regardless of where and how they are insured, and let $\mathbf{C} = \bigcup_{\mathbf{x} \in \mathbf{X}} \mathbf{C}(\mathbf{x})$ denote the entire insured population.

For a person in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$, the expected cost of benefits will be denoted by $d_{im}^{(p)}(\mathbf{x})$, the letter d standing for drawing rate. The number of persons in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ will be denoted by $n_{im}^{(p)}(\mathbf{x})$. The number of premium units collected from the collective $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ is $s_{im}^{(p)}(\mathbf{x}) = n_{im}^{(p)}(\mathbf{x}) \cdot r(\mathbf{x})$. No prizes for guessing what the letter s alludes to - we are of course looking at a generalisation of what is commonly known as single equivalent units, or SEU. Let us call them Adapted SEU. Let us denote by $s_{im}^{(p)}$ and s the number of Adapted SEU collected from the collectives $\mathbf{C}_{im}^{(p)}$, respectively $\mathbf{C}$.

The expected cost of benefits per premium unit that will be experienced by insurer i in respect of the collective $\mathbf{C}_{im}^{(p)}$, is $\bar{b}_{im}^{(p)}$ as defined by

(3) $$\bar{b}_{im}^{(p)} \quad = \quad \sum_{\mathbf{x} \in \mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot d_{im}^{(p)}(\mathbf{x}) \Big/ \sum_{\mathbf{x} \in \mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot r(\mathbf{x}).$$

Let us first consider the situation with no equalisation. The expected cost of benefits (pure premium) paid to a person in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ is $d_{im}^{(p)}(\mathbf{x})$. In order to recover the expected cost of benefits paid to the collective $\mathbf{C}_{im}^{(p)}$ while obeying the mandatory rating relativity function, the insurer must charge a person in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ a net risk premium of $\bar{b}_{im}^{(p)} \cdot r(\mathbf{x})$. Thus for a person in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$, the mandatory rate relativity function r engenders an implicit transfer $\bar{t}_{im}^{(p)}(\mathbf{x}) = \bar{b}_{im}^{(p)} \cdot r(\mathbf{x}) - d_{im}^{(p)}(\mathbf{x})$ that is a payable if $\bar{t}_{im}^{(p)}(\mathbf{x}) > 0$, or a receivable if $\bar{t}_{im}^{(p)}(\mathbf{x}) < 0$.

For persons in the collective $\mathbf{C}(\mathbf{x})$ at large, the average implicit transfer is $\bar{t}(\mathbf{x}) = \bar{b} \cdot r(\mathbf{x}) - d(\mathbf{x})$, where we have defined the overall expected cost of benefits per premium unit

$$(4) \qquad \bar{b} \;=\; \sum_{i,m,p}\left(\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot d_{im}^{(p)}(\mathbf{x})\right) \Bigg/ \sum_{i,m,p}\left(\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot r(\mathbf{x})\right),$$

and the overall expected cost of benefits per person in the collective $\mathbf{C}(\mathbf{x})$:

$$(5) \qquad d(\mathbf{x}) \;=\; \sum_{i,m,p} n_{im}^{(p)}(\mathbf{x}) \cdot d_{im}^{(p)}(\mathbf{x}) \Big/ \sum_{i,m,p} n_{im}^{(p)}(\mathbf{x}).$$

According to the definition proposed by Neuhaus (1997a), an "arbitrage opportunity" exists for persons in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ whenever $\bar{t}_{im}^{(p)}(\mathbf{x}) \neq \bar{t}(\mathbf{x})$, i.e., when those persons have the opportunity of changing the implicit transfer they are facing, by the act of switching to another insurer, membership category or insurance product. If $\bar{t}_{im}^{(p)}(\mathbf{x}) > \bar{t}(\mathbf{x})$, persons in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ will be better off somewhere else, while in the opposite case (some) persons in $\mathbf{C}(\mathbf{x}) \setminus \mathbf{C}_{im}^{(p)}(\mathbf{x})$ will be better off in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$.

The purpose of an equalisation scheme is to distribute the transfer that is payable or receivable by an insured person with characteristic vector $\mathbf{x}$, equitably across

- insurers (i),
- membership categories (m),
- insurance products (p),

in such a way as to minimise the arbitrage opportunities that community rating engenders. An equalisation scheme consists of a zero-sum reallocation $\{\bar{b}_{im}^{(p)}\}_{i,m,p} \mapsto \{\tilde{b}_{im}^{(p)}\}_{i,m,p}$ of expected benefit cost per premium unit. Equalisation transforms the implicit transfer faced by a person in $\mathbf{C}_{im}^{(p)}(\mathbf{x})$ from $\bar{t}_{im}^{(p)}(\mathbf{x}) = \bar{b}_{im}^{(p)} \cdot r(\mathbf{x}) - d_{im}^{(p)}(\mathbf{x})$ to $\tilde{t}_{im}^{(p)}(\mathbf{x}) = \tilde{b}_{im}^{(p)} \cdot r(\mathbf{x}) - d_{im}^{(p)}(\mathbf{x})$.

In order to determine the optimal equalisation scheme, Neuhaus (1997a) proposes to minimise the objective function

$$(6) \qquad Q\left(\{\tilde{b}_{im}^{(p)}\}_{i,m,p}\right) = \sum_{i,m,p} \sum_{\mathbf{x}\in\mathbf{X}} s_{im}^{(p)}(\mathbf{x}) \cdot \left(\frac{\left(\tilde{b}_{im}^{(p)} \cdot r(\mathbf{x}) - d_{im}^{(p)}(\mathbf{x})\right) \;-\; \left(\bar{b} \cdot r(\mathbf{x}) - d(\mathbf{x})\right)}{r(\mathbf{x})}\right)^2$$

under the balancing constraint $\sum_{i,m,p} \tilde{b}_{im}^{(p)} \cdot s_{im}^{(p)} = \sum_{i,m,p} \sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot d_{im}^{(p)}(\mathbf{x})$.

Using Lagrange minimisation one can verify that the optimal equalisation under the chosen criterion is given by

$$\text{(7)}\qquad \tilde{b}_{im}^{(p)} \;=\; \bar{b} \;+\; \left(\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot r(\mathbf{x})\right)^{-1} \sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot\left(d_{im}^{(p)}(\mathbf{x})-d(\mathbf{x})\right).$$

[If you're squeamish about the fact that $r(\mathbf{x})=0$ for dependants, set dependants' $r(\mathbf{x})$ to $e>0$ in (6) and make the transition $e\to 0$ in (7)]

Thus the cost per premium unit that is allocated to the collective $\mathbf{C}_{im}^{(p)}$ is the overall average cost per premium unit, plus a weighted average of the difference in benefits enjoyed (or suffered) by persons in $\mathbf{C}_{im}^{(p)}$ compared with the overall collective $\mathbf{C}$.

After equalisation, the expected claim cost for the collective $\mathbf{C}_{im}^{(p)}$ is $\tilde{b}_{im}^{(p)}\cdot\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot r(\mathbf{x})$. Thus the equalisation transfer payable (receivable) by insurer i in respect of the collective $\mathbf{C}_{im}^{(p)}$ is

$$\text{(8)}\qquad \tilde{t}_{im}^{(p)} = s_{im}^{(p)}\cdot\left(\tilde{b}_{im}^{(p)}-\bar{b}_{im}^{(p)}\right)=\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot\left(\bar{b}\cdot r(\mathbf{x})-d(\mathbf{x})\right)= s_{im}^{(p)}\cdot\bar{b}-\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot d(\mathbf{x}).$$

Thus the equalisation transfer in respect of the collective $\mathbf{C}_{im}^{(p)}$ consists of two transactions:

- Paying to the equalisation pool, an amount equal to the number of Adapted SEU collected from persons insured in $\mathbf{C}_{im}^{(p)}$, times the overall average cost per premium unit; and
- Receiving from the equalisation pool, an amount equal to average (capitation) cost adjusted to the risk profile of the persons insured in $\mathbf{C}_{im}^{(p)}$.

This is exactly the recipe of RBC reinsurance. To see that this is really the case, rewrite the right hand side of the transfer (8) in the following form:

$$\text{(9)}\qquad \tilde{t}_{im}^{(p)} = \frac{\left(\dfrac{1}{s}\sum_{\mathbf{x}\in\mathbf{X}} n(\mathbf{x})\cdot\dfrac{d(\mathbf{x})}{d} \;-\; \dfrac{1}{s_{im}^{(p)}}\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot\dfrac{d(\mathbf{x})}{d}\right)}{\dfrac{1}{s}\sum_{\mathbf{x}\in\mathbf{X}} n(\mathbf{x})\cdot\dfrac{d(\mathbf{x})}{d}}\cdot s_{im}^{(p)}\cdot\bar{b} \quad\Leftrightarrow\quad \underbrace{\frac{\left(\bar{r}_s-\bar{r}_f\right)}{\bar{r}_s}\times m_f\times\bar{b}_s}_{\text{Department's notation}}.$$

The expression $\frac{1}{s}\sum_{\mathbf{x}\in\mathbf{X}} n(\mathbf{x})\cdot\frac{d(\mathbf{x})}{d}$ corresponds to what the Department's paper calls the Average Risk for the state ("$\bar{r}_s$"), while $\frac{1}{s_{im}^{(p)}}\sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x})\cdot\frac{d(\mathbf{x})}{d}$ corresponds to the Average Risk of the fund ("$\bar{r}_f$"). The fractions $d(\mathbf{x})/d$ correspond to the Risk Relativities ("r_{is}"). This author prefers to express the equalisation transfer by the formula (8), because it seems to be more transparent than (9).

Actually, a more direct way of deriving equation (7) would be to simply postulate that it is equitable to assign to every person in the collective $\mathbf{C}(\mathbf{x})$ the average transfer $\bar{t}(\mathbf{x}) = \bar{b} \cdot r(\mathbf{x}) - d(\mathbf{x})$, regardless of where or how the person is insured. Adding together all the transfers in a collective $\mathbf{C}_{im}^{(p)}$ on the right hand side of (8), then solving equation (8) for $\tilde{b}_{im}^{(p)}$, one arrives directly at equation (7).

The reader may ask, and justly so, what the point is of defining a complicated notation, just to conclude that the solution is RBC reinsurance. There are actually several reasons for going through this seemingly formalistic rigmarole.

To begin with, the next sections will show that RBC reinsurance as proposed by the Department of Health, differs from the optimal scheme (8). In order to demonstrate why, in the opinion of this author, the scheme (8) is superior, one needs to have stated explicitly what the equalisation scheme is designed to achieve.

Second, the theoretical formulation provides scope for generalisation. The alert reader will have noticed that the capitation costs that are credited to the collective $\mathbf{C}_{im}^{(p)}$ (the terms $d(\mathbf{x})$, to be precise) must be calculated separately for each $\mathbf{x} \in \mathbf{X} = \mathbf{X}_1 \times \mathbf{X}_2$. In theory that means that a different capitation cost $d(\mathbf{x}_1, \mathbf{x}_2)$ is needed for each combination of rating variables $\mathbf{x}_1$ (read: entry age, adult status) and risk variables $\mathbf{x}_2$ (read: attained age, sex). In practice there is nothing to stop one from using the average cost $d(\,\cdot\,, \mathbf{x}_2) = \sum_{\mathbf{x}_1 \in \mathbf{X}_1} n(\mathbf{x}_1, \mathbf{x}_2) \cdot d(\mathbf{x}_1, \mathbf{x}_2) \Big/ \sum_{\mathbf{x}_1 \in \mathbf{X}_1} n(\mathbf{x}_1, \mathbf{x}_2)$ for all $\mathbf{x}_1$, in which case the only differentiation of the capitation cost is by risk variables. On the other hand, one should not disregard the possibility that the rating variables could carry risk information. One could surmise, for instance, that a late entrant represents a higher expected cost than an early entrant of the same age, due to a selection mechanism. Or, one could want to be prepared for the possibility that, after further legislative change, some risk factor will attract a defined penalty or discount in the mandatory rating formula. If one wants to make sure that the equalisation scheme is able to cope with such possibilities, the capitation cost must be capable of differentiation by both risk variables and rating variables.

Finally, the objective function (6) allows one to discuss what equity should mean. Is it really fair to assign to every person in $\mathbf{C}(\mathbf{x})$ the average transfer $\bar{t}(\mathbf{x})$, or should there be some grading of the transfer according to the expected benefits the person is receiving in his or her insurance product? The question will not be pursued in this paper, but the objective function (6) can be easily modified to accommodate other definitions of equity.

4. Numerical calculations of the optimal scheme

To illustrate the calculation of the transfers that would be generated by the optimal equalisation scheme, the author has used data from the PHIAC A Report for NSW, Dec. 2004 (PHIAC, 2004a).

As the numbers of persons covered are split only by membership category and into the old under/over 65 dichotomy in Part 1 of PHIAC A, the author had to construct a notional split by adult status and gender, using a few bold assumptions.

Firstly, it was assumed that all dependants are in the age group 0-19. The number of dependants was calculated by subtracting from the number of persons covered, one (adult) person per contributor for Single Parent memberships, and two (adult) persons per contributor for Family memberships.

Secondly, using Part 3 of PHIAC A, the proportion of females can be calculated to be 48.6% for persons aged 0-19, 51.9% for persons aged 20-64 and 55.1% for persons aged 65 and over. Those proportions were used in all membership categories, to split the number of persons covered in the different age groups into females and males.

The resulting split is shown in the table below.

Table 1. PHIAC A data for NSW December 2004, notionally split into females and males

Membership category	Single		Couple		Single Parent		Family		Total	
Contributors	688 623		317 229		26 929		439 193		1 471 974	
Persons covered	Under 65	65 And Over	Under 65	65 And Over	Under 65	65 And Over	Under 65	65 And Over	Under 65	65 And Over
Number of persons	509 502	179 121	451 756	182 702	73 382	134	1 743 391	5 073	2 778 031	367 030
Notional split										
Adult females	264 591	98 782	234 603	100 757	13 915	73	453 523	2 797	966 632	202 409
Adult males	244 911	80 339	217 153	81 945	12 880	61	419 790	2 276	894 734	164 621
Adults total	509 502	179 121	451 756	182 702	26 795	134	873 313	5 073	1 861 366	367 030
Dependant females	0		0		22 640		422 849		445 490	
Dependant males	0		0		23 947		447 229		471 176	
Dependants total	0		0		46 587		870 078		916 665	
Proportion dependants	0 %		0 %		63 %		50 %			

Further, in order to avoid having to guess the exact age distribution of each sub-population, only three age groups were used to represent dependants, adults under 65, and adults over 65. For the purpose of the calculations it was assumed that:

- All dependants belong to the age group 10-14.
- All adults under the age of 65 belong to the age group 35-39.
- All adults over the age of 65 belong to the age group 65-69.

It was then necessary to make an assumption as to the entry age of the adult groups. To simplify the example, only three entry age intervals were used: 0-30, 35-39 and 60-64. It was assumed that:

- 20% of adults in the age group 35-39 have joined health insurance recently (entry age 35-39), the remaining 80% had joined health insurance before age 30.
- 10% of adults in the age group 65-69 have joined health insurance recently (entry age 60-64), the remaining 90% had joined health insurance before age 30.

Having joined health insurance "before age 30" includes the possibility of having joined after age 30 but before the end of the period of grace. It only means that the person is not charged a LHC loading.

The assumed proportion of late entrants is higher than the actual proportion in NSW, which was 4.3% in December 2004. The assumed proportions are meant to reflect an as yet unknown level of late entrants when the LHC system has reached a steady state. The lower proportion in the higher age group is meant to reflect the more severe penalty for entry at 60-64, compared with entry at 35-39. No allowance was made for adults aged 65-69 who had joined at age 35-39, as that would be looking awfully far into the future.

It is now possible to tabulate the notional population with the degree of disaggregation that the equalisation scheme (8) requires:

Table 2. The notional population - number of persons covered

Product	Membership category	Gender	Attained age	Adult status	Entry age 0-30	…	Entry age 35-39	…	Entry age 60-64	…	Total
Without product	Single	Females	35-39	Adult	211 673	…	52 918	…	n/a	…	264 591
			65-69		88 904	…	-	…	9 878	…	98 782
		Males	35-39	Adult	195 929	…	48 982	…	n/a	…	244 911
			65-69		72 306	…	-	…	8 033	…	80 339
	Couple	Females	35-39	Adult	187 683	…	46 920	…	n/a	…	234 603
			65-69		90 682	…	-	…	10 075	…	100 757
		Males	35-39	Adult	173 723	…	43 430	…	n/a	…	217 153
			65-69		73 751	…	-	…	8 194	…	81 945
	Single Parent	Females	10-14	Dependant	22 640	…	n/a	…	n/a	…	22 640
			35-39	Adult	11 132	…	2 783	…	n/a	…	13 915
			65-69		66	…	-	…	7	…	73
		Males	10-14	Dependant	23 947	…	n/a	…	n/a	…	23 947
			35-39	Adult	10 304	…	2 576	…	n/a	…	12 880
			65-69		55	…	-	…	6	…	61
	Family	Females	10-14	Dependant	422 849	…	n/a	…	n/a	…	422 849
			35-39	Adult	362 819	…	90 704	…	n/a	…	453 523
			65-69		2 518	…	-	…	279	…	2 797
		Males	10-14	Dependant	447 229	…	n/a	…	n/a	…	447 229
			35-39	Adult	335 832	…	83 958	…	n/a	…	419 790
			65-69		2 049	…	-	…	227	…	2 276
All	All	All	All	All	2 736 091	…	372 271	…	36 699	…	3 145 061

To calculate the average charge per person and year split by gender and attained age, the "Without product" risk relativities for NSW from PHIAC Circular 04/15 (PHIAC, 2004b) were used and scaled with an arbitrarily chosen factor of $1000. Table 3 shows the assumed average charge per person.

Table 3. Assumed average charge per person

Product	Membership category	Gender	Attained age	Adult status	Entry age 0-30	…	Entry age 35-39	…	Entry age 60-64	…	Total
Without product	Single	Females	35-39	Adult	881	…	881	…	n/a	…	881
			65-69		2 545	…	2 545	…	2 545	…	2 545
		Males	35-39	Adult	503	…	503	…	n/a	…	503
			65-69		2 685	…	2 685	…	2 685	…	2 685
	Couple	Females	35-39	Adult	881	…	881	…	n/a	…	881
			65-69		2 545	…	2 545	…	2 545	…	2 545
		Males	35-39	Adult	503	…	503	…	n/a	…	503
			65-69		2 685	…	2 685	…	2 685	…	2 685
	Single Parent	Females	10-14	Dependant	114	…	n/a	…	n/a	…	114
			35-39	Adult	881	…	881	…	n/a	…	881
			65-69		2 545	…	2 545	…	2 545	…	2 545
		Males	10-14	Dependant	119	…	n/a	…	n/a	…	119
			35-39	Adult	503	…	503	…	n/a	…	503
			65-69		2 685	…	2 685	…	2 685	…	2 685
	Family	Females	10-14	Dependant	114	…	n/a	…	n/a	…	114
			35-39	Adult	881	…	881	…	n/a	…	881
			65-69		2 545	…	2 545	…	2 545	…	2 545
		Males	10-14	Dependant	119	…	n/a	…	n/a	…	119
			35-39	Adult	503	…	503	…	n/a	…	503
			65-69		2 685	…	2 685	…	2 685	…	2 685
All	All	All	All	All	734	…	699	…	2 608	…	752

The next step is to calculate the mandatory rate relativity that applies to persons in the different classes. To simplify the calculation of the rate relativity according to (2), the midpoint entry age was used in each of the Entry age classes 35-39 and 60-64.

Table 4. Mandatory rate relativity

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
		Males	35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
	Couple	Females	35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
		Males	35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
	Single Parent	Females	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
		Males	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
	Family	Females	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
		Males	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	114 %	…	n/a	…	103 %
			65-69		100 %	…	114 %	…	164 %	…	106 %
			Use Entry age		30	…	37	…	62	…	

The next step is to calculate the number of Adapted SEU, i.e. total premium units collected from persons in the different classes.

Table 5. Adapted SEU

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	211 673	…	60 327	…	n/a	…	272 000
			65-69		88 904	…	-	…	16 200	…	105 104
		Males	35-39	Adult	195 929	…	55 839	…	n/a	…	251 768
			65-69		72 306	…	-	…	13 174	…	85 480
	Couple	Females	35-39	Adult	187 683	…	53 489	…	n/a	…	241 172
			65-69		90 682	…	-	…	16 523	…	107 205
		Males	35-39	Adult	173 723	…	49 510	…	n/a	…	223 233
			65-69		73 751	…	-	…	13 438	…	87 189
	Single Parent	Females	10-14	Dependant	-	…	n/a	…	n/a	…	-
			35-39	Adult	11 132	…	3 173	…	n/a	…	14 305
			65-69		66	…	-	…	11	…	77
		Males	10-14	Dependant	-	…	n/a	…	n/a	…	-
			35-39	Adult	10 304	…	2 937	…	n/a	…	13 241
			65-69		55	…	-	…	10	…	65
	Family	Females	10-14	Dependant	-	…	n/a	…	n/a	…	-
			35-39	Adult	362 819	…	103 403	…	n/a	…	466 222
			65-69		2 518	…	-	…	458	…	2 976
		Males	10-14	Dependant	-	…	n/a	…	n/a	…	-
			35-39	Adult	335 832	…	95 712	…	n/a	…	431 544
			65-69		2 049	…	-	…	372	…	2 421
All	All	All	All	All	1 819 426	…	424 389	…	60 186	…	2 304 001

In order to calculate the average charge per Adapted SEU, we need to first calculate the total expected charge in the State:

Table 6. Total expected charge

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	186 441 578	…	46 610 174	…	n/a	…	233 051 753
			65-69		226 269 570	…	-	…	25 140 498	…	251 410 068
		Males	35-39	Adult	98 473 915	…	24 618 353	…	n/a	…	123 092 269
			65-69		194 105 457	…	-	…	21 564 589	…	215 670 046
	Couple	Females	35-39	Adult	165 311 186	…	41 327 136	…	n/a	…	206 638 322
			65-69		230 794 758	…	-	…	25 641 883	…	256 436 641
		Males	35-39	Adult	87 313 180	…	21 827 918	…	n/a	…	109 141 098
			65-69		197 984 560	…	-	…	21 996 793	…	219 981 353
	Single Parent	Females	10-14	Dependant	2 583 224	…	n/a	…	n/a	…	2 583 224
			35-39	Adult	9 805 066	…	2 451 266	…	n/a	…	12 256 332
			65-69		167 977	…	-	…	17 816	…	185 792
		Males	10-14	Dependant	2 849 693	…	n/a	…	n/a	…	2 849 693
			35-39	Adult	5 178 790	…	1 294 698	…	n/a	…	6 473 488
			65-69		147 648	…	-	…	16 107	…	163 755
	Family	Females	10-14	Dependant	48 247 071	…	n/a	…	n/a	…	48 247 071
			35-39	Adult	319 570 975	…	79 892 083	…	n/a	…	399 463 058
			65-69		6 408 562	…	-	…	710 083	…	7 118 645
		Males	10-14	Dependant	53 220 251	…	n/a	…	n/a	…	53 220 251
			35-39	Adult	168 789 163	…	42 197 291	…	n/a	…	210 986 454
			65-69		5 500 541	…	-	…	609 382	…	6 109 922
All	All	All	All	All	2 009 163 165	…	260 218 920	…	95 697 149	…	2 365 079 233

Table 7 now shows the average charge per Adapted SEU.

Table 7. Average charge per Adapted SEU

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	881	…	773	…	n/a	…	857
			65-69		2 545	…	0	…	1 552	…	2 392
		Males	35-39	Adult	503	…	441	…	n/a	…	489
			65-69		2 685	…	0	…	1 637	…	2 523
	Couple	Females	35-39	Adult	881	…	773	…	n/a	…	857
			65-69		2 545	…	0	…	1 552	…	2 392
		Males	35-39	Adult	503	…	441	…	n/a	…	489
			65-69		2 685	…	0	…	1 637	…	2 523
	Single Parent	Females	10-14	Dependant	0	…	n/a	…	n/a	…	0
			35-39	Adult	881	…	773	…	n/a	…	857
			65-69		2 545	…	0	…	1 552	…	2 398
		Males	10-14	Dependant	0	…	n/a	…	n/a	…	0
			35-39	Adult	503	…	441	…	n/a	…	489
			65-69		2 685	…	0	…	1 637	…	2 526
	Family	Females	10-14	Dependant	0	…	n/a	…	n/a	…	0
			35-39	Adult	881	…	773	…	n/a	…	857
			65-69		2 545	…	0	…	1 552	…	2 392
		Males	10-14	Dependant	0	…	n/a	…	n/a	…	0
			35-39	Adult	503	…	441	…	n/a	…	489
			65-69		2 685	…	0	…	1 637	…	2 523
All	All	All	All	All	1 104	…	613	…	1 590	…	1 027

Thus the overall average charge per Adapted SEU is $\bar{b} = 1\,027$. Having established that number, we are now in a position to calculate the per capita equalisation transfer $\bar{t}(\mathbf{x}) = \bar{b} \cdot r(\mathbf{x}) - d(\mathbf{x})$.

Table 8. Per capita equalisation transfer using Adapted SEU

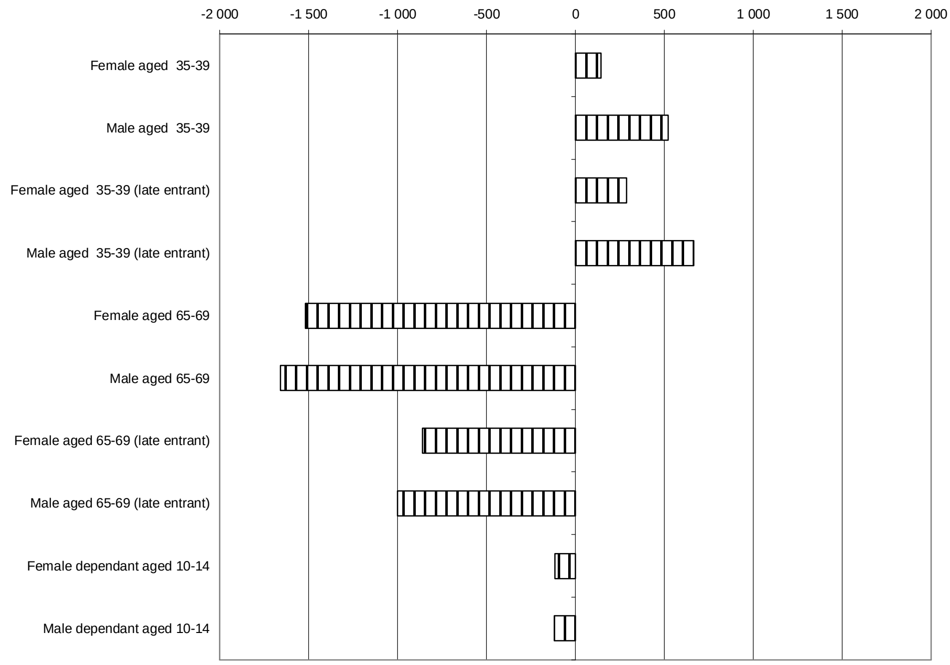
					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	146	…	289	…	n/a	…	174
			65-69		-1 519	…	-	…	-862	…	-1 453
		Males	35-39	Adult	524	…	668	…	n/a	…	553
			65-69		-1 658	…	-	…	-1 001	…	-1 592
	Couple	Females	35-39	Adult	146	…	289	…	n/a	…	174
			65-69		-1 519	…	-	…	-862	…	-1 453
		Males	35-39	Adult	524	…	668	…	n/a	…	553
			65-69		-1 658	…	-	…	-1 001	…	-1 592
	Single Parent	Females	10-14	Dependant	-114	…	n/a	…	n/a	…	-114
			35-39	Adult	146	…	289	…	n/a	…	174
			65-69		-1 519	…	-	…	-862	…	-1 456
		Males	10-14	Dependant	-119	…	n/a	…	n/a	…	-119
			35-39	Adult	524	…	668	…	n/a	…	553
			65-69		-1 658	…	-	…	-1 001	…	-1 593
	Family	Females	10-14	Dependant	-114	…	n/a	…	n/a	…	-114
			35-39	Adult	146	…	289	…	n/a	…	174
			65-69		-1 519	…	-	…	-862	…	-1 453
		Males	10-14	Dependant	-119	…	n/a	…	n/a	…	-119
			35-39	Adult	524	…	668	…	n/a	…	553
			65-69		-1 658	…	-	…	-1 001	…	-1 592
All	All	All	All	All	-52	…	471	…	-924	…	0

Multiplying the per capita equalisation transfer in Table 8 with the coverage numbers in Table 2, one arrives at the total equalisation transfer.

Table 9. Total equalisation transfers using Adapted SEU

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	30 842 768	…	15 315 572	…	n/a	…	46 158 340
			65-69		-135 008 769	…	-	…	-8 511 126	…	-143 519 895
		Males	35-39	Adult	102 649 065	…	32 701 404	…	n/a	…	135 350 469
			65-69		-119 882 661	…	-	…	-8 041 229	…	-127 923 890
	Couple	Females	35-39	Adult	27 347 197	…	13 579 626	…	n/a	…	40 926 823
			65-69		-137 708 823	…	-	…	-8 680 866	…	-146 389 689
		Males	35-39	Adult	91 015 131	…	28 994 773	…	n/a	…	120 009 904
			65-69		-122 278 457	…	-	…	-8 202 394	…	-130 480 851
	Single Parent	Females	10-14	Dependant	-2 583 224	…	n/a	…	n/a	…	-2 583 224
			35-39	Adult	1 622 038	…	805 458	…	n/a	…	2 427 496
			65-69		-100 227	…	-	…	-6 031	…	-106 258
		Males	10-14	Dependant	-2 849 693	…	n/a	…	n/a	…	-2 849 693
			35-39	Adult	5 398 364	…	1 719 791	…	n/a	…	7 118 155
			65-69		-91 189	…	-	…	-6 006	…	-97 196
	Family	Females	10-14	Dependant	-48 247 071	…	n/a	…	n/a	…	-48 247 071
			35-39	Adult	52 866 177	…	26 251 627	…	n/a	…	79 117 804
			65-69		-3 823 811	…	-	…	-240 393	…	-4 064 204
		Males	10-14	Dependant	-53 220 251	…	n/a	…	n/a	…	-53 220 251
			35-39	Adult	175 945 577	…	56 052 110	…	n/a	…	231 997 687
			65-69		-3 397 223	…	-	…	-227 233	…	-3 624 455
All	All	All	All	All	-141 505 083	…	175 420 361	…	-33 915 278	…	0

By studying Table 8 one can convince oneself that the equalisation scheme is equitable, in the sense defined in Section 3. Within the few age groups used for the purpose of this example, its effect can be succinctly summarised by the following graph.



Graph 1. Per capita equalisation transfer using Adapted SEU

There are two aspects worth noting.

Firstly, the amount of charge or subsidy does not depend on the membership category of the person.

Secondly, late entrants who are subject to the LHC loading are charged more if they are net payors, subsidised less if they are net payees. That late entrants should be charged more as payors and subsidised less as payees, is of course a consequence of the fact that they are paying a higher premium on account of being late entrants. This feature of the equalisation scheme fits in nicely with the notion that late entrants impose a burden on the community rated, insured population and as a result should contribute more towards equalisation

Table 9 shows one further aspect that one should note, although is not a feature of the equalisation scheme but of the composition of the insured population: Total equalisation transfers generated for persons insured in Single Parent memberships make up only a very small proportion of the total equalisation transfers generated for other membership categories. The reason is that the number of persons insured in Single Parent memberships (73,516) constitutes only about 2.3% of the total number of persons insured in NSW (3,145,061). Australia-wide the percentage of persons insured in Single Parent memberships is also 2.3%.

5. Numerical calculations in RBC Reinsurance

Risk Based Capitation (RBC) Reinsurance as proposed by the Department, is formally identical to the scheme proposed in Section 3. Using its own notation, the paper by the Department represents the equalisation transfer in a formula equivalent to (9), which in turn is equivalent to (8).

There is, however, an important difference in the way SEU are defined. For the purpose of RBC Reinsurance, "*all single parent memberships will count as 2 single equivalent units (SEU) except for those held with Defence and Navy Health where single parent memberships will count as 1 SEU*".

Let us now put RBC Reinsurance into the framework of Section 2. There it was argued that the mandatory rate relativity for dependants necessarily must be zero, because no additional premium may be charged for dependants, regardless their number. Consequently, the SEU count of RBC Reinsurance implies the following rate relativities for insured persons:

$$(10) \qquad r^*(m,e,a,y,g) = \begin{cases} a \cdot 1 & \text{if } m \neq \text{Single Parent} \\ a \cdot 2 & \text{if } m = \text{Single Parent} \end{cases}$$

Table 10 shows the implied rate relativities on the notional population of Section 4.

Table 10. Rate relativities implied by RBC Reinsurance

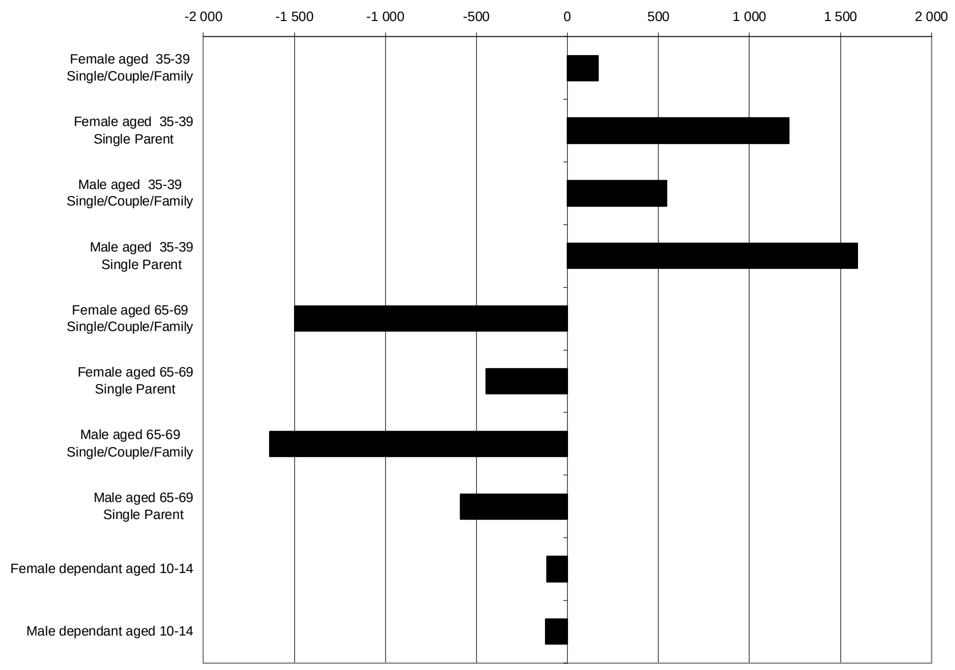
Product	Membership category	Gender	Attained age	Adult status	Entry age 0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %
		Males	35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %
	Couple	Females	35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %
		Males	35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %
	Single Parent	Females	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	200 %	…	200 %	…	n/a	…	200 %
			65-69		200 %	…	200 %	…	200 %	…	200 %
		Males	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	200 %	…	200 %	…	n/a	…	200 %
			65-69		200 %	…	200 %	…	200 %	…	200 %
	Family	Females	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %
		Males	10-14	Dependant	0 %	…	n/a	…	n/a	…	0 %
			35-39	Adult	100 %	…	100 %	…	n/a	…	100 %
			65-69		100 %	…	100 %	…	100 %	…	100 %

Let us now calculate the equalisation transfers that RBC Reinsurance would generate on the notional population. One can perform the same arithmetical steps as in the previous section, therefore not all tables will be displayed here. The average charge per SEU turns out to be $\bar{b}^* = 1049$. We then calculate the per capita equalisation transfer $\bar{t}^*(\mathbf{x}) = \bar{b}^* \cdot r^*(\mathbf{x}) - d(\mathbf{x})$, which is shown in Table 11.

Table 11. Per capita equalisation transfer by RBC Reinsurance

					Entry age						
Product	Membership category	Gender	Attained age	Adult status	0-30	…	35-39	…	60-64	…	Total
Without product	Single	Females	35-39	Adult	168	…	168	…	n/a	…	168
			65-69		-1 496	…	-	…	-1 496	…	-1 496
		Males	35-39	Adult	546	…	546	…	n/a	…	546
			65-69		-1 636	…	-	…	-1 636	…	-1 636
	Couple	Females	35-39	Adult	168	…	168	…	n/a	…	168
			65-69		-1 496	…	-	…	-1 496	…	-1 496
		Males	35-39	Adult	546	…	546	…	n/a	…	546
			65-69		-1 636	…	-	…	-1 636	…	-1 636
	Single Parent	Females	10-14	Dependant	-114	…	n/a	…	n/a	…	-114
			35-39	Adult	1 217	…	1 217	…	n/a	…	1 217
			65-69		-448	…	-	…	-448	…	-448
		Males	10-14	Dependant	-119	…	n/a	…	n/a	…	-119
			35-39	Adult	1 595	…	1 595	…	n/a	…	1 595
			65-69		-587	…	-	…	-587	…	-587
	Family	Females	10-14	Dependant	-114	…	n/a	…	n/a	…	-114
			35-39	Adult	168	…	168	…	n/a	…	168
			65-69		-1 496	…	-	…	-1 496	…	-1 496
		Males	10-14	Dependant	-119	…	n/a	…	n/a	…	-119
			35-39	Adult	546	…	546	…	n/a	…	546
			65-69		-1 636	…	-	…	-1 636	…	-1 636
All	All	All	All	All	-29	…	365	…	-1 559	…	-0

By studying Table 11 one can see that Entry age does not affect the per capita equalisation transfers of RBC Reinsurance, which was to be expected. The remaining transfers of RBC Reinsurance are summarised in the following graph:



Graph 2. Per capita equalisation transfer using RBC Reinsurance

As RBC Reinsurance allocates two SEU to all memberships except Single memberships and Single Parent memberships with Defence and Navy Health, it was to be expected that Single Parent memberships would be worse off under RBC Reinsurance, than under the equalisation scheme of Section 4. The surprising result of this section is how much worse off they will be.

For a net payor (aged 35-39), being a single parent means that a female will be charged 7.3 times the amount that she would be charged in any other membership category. A male single parent in the same age group will be charged 2.9 the amount that he would be charged in other membership categories.

For a net payee (aged 65-69), being a single parent means that a female will attract only 30% of the subsidy that she would attract in any other membership category. For a male in the same age group, the corresponding percentage is 36%.

This author is therefore humbly suggesting the RBC Reinsurance is not equitable.

The inequity is caused by the implied rate relativity (10). In effect, an insurer is deemed to be receiving a contribution at twice the Single rate (i.e., $2\bar{b}^*$) from a single parent; after that, the entire excess of the deemed contribution over the deemed average cost (i.e., $2\bar{b}^* - d(\mathbf{x})$) is "confiscated" to support equalisation. When a Single Parent membership changes into a Family membership that also counts as two SEU under RBC Reinsurance, the reduction in equalisation transfer pays for the extra adult; in the opposite transition, the increase in equalisation transfer consumes the cost saving of an adult leaving the membership.

An argument could be put forward that this is fair, since most insurers are in fact charging Single Parent memberships twice the Single rate. That argument is circular, however, as RBC Reinsurance will make it virtually impossible for insurers to charge Single Parent memberships significantly less than twice the Single rate.

Another argument has been heard, to the extent that insurers continue to charge twice the Single rate for Single Parent memberships because the unadjusted drawing rates of single parents are higher than those of corresponding persons in other membership categories. This author has no way to compare the unadjusted drawing rates in different membership categories. However, if single parents indeed are higher drawers on a per capita basis, the overall benefit cost of insuring a single parent under the proposed RBC Reinsurance could become higher than twice the cost of a corresponding person in other membership categories. This is so because overall benefit cost is the sum of the net equalisation transfer ($2\bar{b}^* - d(\mathbf{x})$) and the unadjusted drawing rate ($d(\mathbf{x}) + \Delta_{\text{Single Parent}}$).

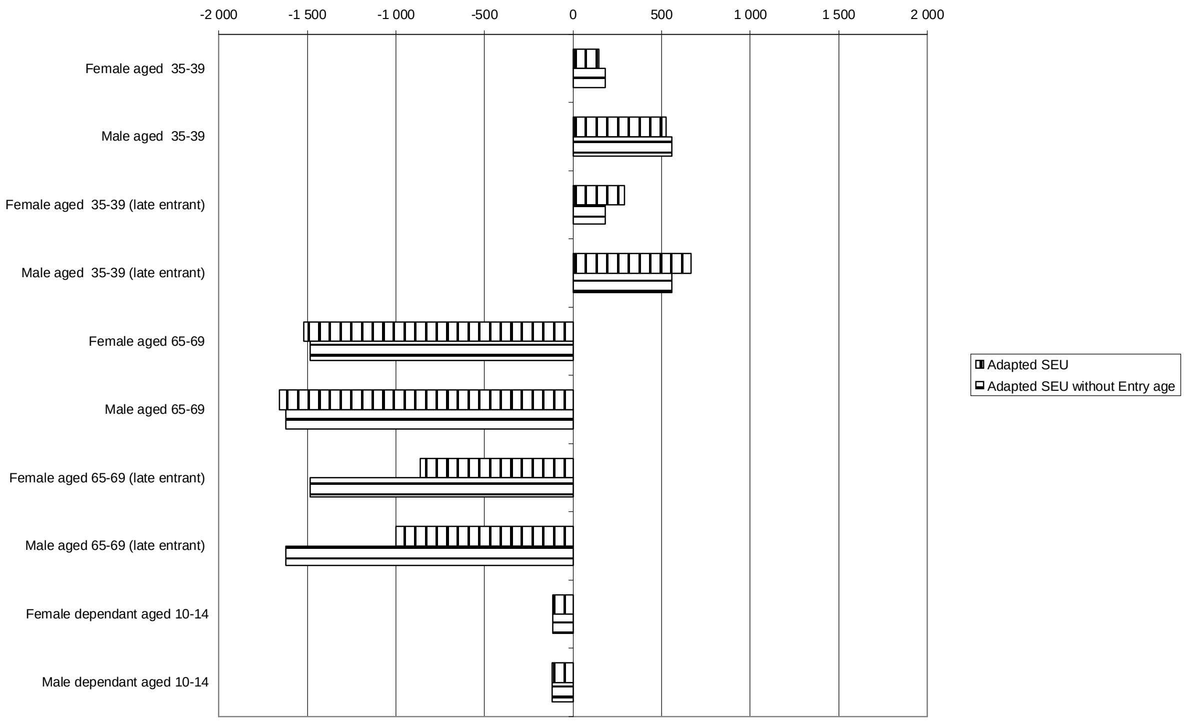
It has also been put to the author that insurers are forced to charge Single Parent memberships twice the Single rate anyway, lest premiums for Family memberships have to be increased. Considering that Single Parent memberships only constitute a small proportion of the insured population, that argument amounts to asking major sacrifice from a minority to provide relatively minor relief to a majority.

6. Comparison of some alternative schemes

In the previous section it was argued that RBC Reinsurance is not equitable. The reason is that RBC Reinsurance implies rate relativities (10) that not adapted to the rate relativities (2) that are mandatory at this time. In this section we will consider several ways of fixing RBC Reinsurance.

One way, using "Adapted SEU", has already been described in Sections 3 and 4. Its operation requires a full two-way split of the insured population by Attained age and Entry age. The necessary calculations, as outlined in Section 4, are voluminous but straightforward. In the opinion of this author, using Adapted SEU would be the theoretically correct way to go.

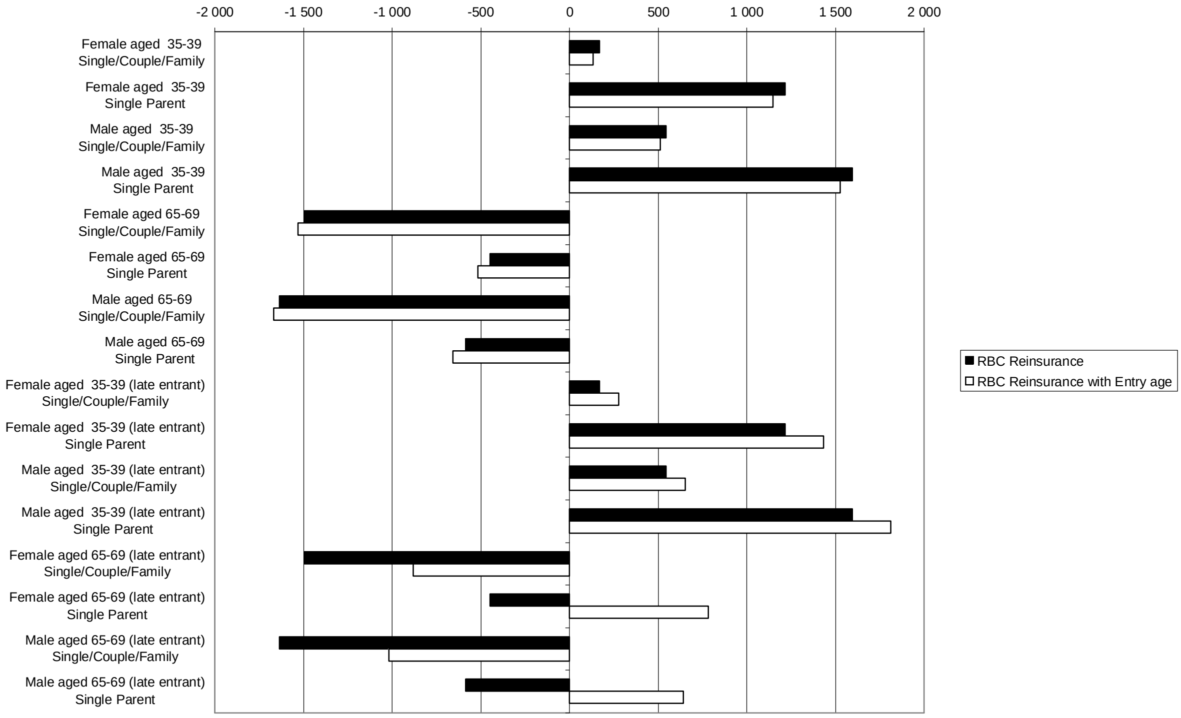
If one only wanted to eliminate the differential treatment of Single Parent memberships, then one could consider using "Adapted SEU without Entry Age". This amounts to counting as one SEU every paying adult irrespective of membership category and entry age, and counting as zero SEU every dependant. The equalisation transfers generated by "Adapted SEU" and "Adapted SEU without Entry Age" are compared in Graph 3.



Graph 3. Per capita equalisation transfer using Adapted SEU with and without Entry age

"Adapted SEU" and "Adapted SEU without Entry age" would generate transfers that are relatively similar for most classes, except for very late entrants who are paying a high LHC loading, and who would be subsidised more under "Adapted SEU without Entry age". Measured by per capita transfers, neither "Adapted SEU" nor "Adapted SEU without Entry age" would discriminate between insured persons on the basis of their membership category. As the proportion of late entrants is low, and the proportion of very late entrants lower still, this author considers "Adapted SEU without Entry age" to be a defendable alternative to RBC Reinsurance, that would be very easy to implement.

Another approach that conceivably someone could propose, is to use "RBC Reinsurance with Entry age" - that is, to retain the rule that Single Parent memberships count as two SEU, but to adjust the SEU with LHC loadings. In the context of Table 10 this would mean that the SEU for an entrant at entry age 35-39 (using the midpoint age of 37) would be adjusted from 100% to 114% for all memberships except Single Parent memberships, where the SEU would be adjusted from 200% to 228%. As far as this author is aware, this is how most health insurers are currently calculating their contribution rates. The equalisation transfers generated by "RBC Reinsurance" and "RBC Reinsurance with Entry Age" are compared in Graph 4 below.



Graph 4. Per capita equalisation transfer using RBC Reinsurance without and with Entry age

For net payors (those aged 35-39), "RBC Reinsurance with Entry age" would lead to a relatively modest skewing of the transfers to the disadvantage of late entrants. The difference between ordinary RBC Reinsurance and "RBC Reinsurance with Entry age" is more pronounced for net payees (those aged 65-69), who are late entrants in addition. A single parent, late entrant aged 65-69 would actually become a net payor under "RBC Reinsurance with Entry age". In the opinion of this author, this illustrates adequately that "RBC Reinsurance with Entry age" is not the way to go.

7. Product Mix

So far in this paper, it has been assumed that equalisation would be based on "Without product" risk relativities. Illustrating the effect of the different equalisation schemes has been intricate enough, without adding in the extra dimension of Product.

However, the paper by the Department (2003) states that "*Product mix will be recognised in the new arrangements by having RR [risk relativities] for products with significantly higher benefits per person but will be reviewed prior to full RBC implementation*". PHIAC Circular 04/15 contains a table of risk relativities that are split into two types of product: "Comprehensive like" and "Other". The risk relativities are shown in the Table 12.

The arithmetic of RBC Reinsurance "With product" works in exactly the same way as "Without product", the only difference being that "With product" employs twice as many risk groups.

The question is: "Is it appropriate to recognise Product Mix in this way?"

Table 12. NSW Risk Relativities for RBC Reinsurance with Product Mix

	Comprehensive like		Other	
Age group	Females	Males	Females	Males
0-4	0,5045	0,5175	0,3384	0,3952
5-9	0,1607	0,1482	0,1028	0,1120
10-14	0,1663	0,1771	0,1067	0,1106
15-19	0,3638	0,2990	0,2431	0,2357
20-24	0,5256	0,4465	0,4165	0,3993
25-29	1,8923	1,1885	0,9096	0,5807
30-34	2,0813	0,9286	1,1049	0,5717
35-39	1,4129	0,7450	0,8223	0,4788
40-44	0,9741	0,8507	0,6230	0,4626
45-49	1,0231	0,8386	0,6740	0,5955
50-54	1,1854	1,1926	0,8780	0,8167
55-59	1,4890	1,5224	1,1589	1,1789
60-64	2,0889	2,2097	1,6992	1,7954
65-69	2,8061	2,9832	2,4333	2,5666
70-74	3,5471	4,1468	3,4245	3,5333
75-79	4,2428	4,4873	4,1821	4,3667
80-84	4,5450	5,2710	4,5709	4,8855
85-89	5,1000	6,2970	5,2448	5,3326
90-94	5,0647	5,8133	5,2494	5,7270
95-100	5,2442	4,8328	3,9595	4,5865

In order to discuss this question, it is instructive to return to the theoretical setting of Section 3. According to Equation (8), the equalisation transfer payable (receivable) by insurer i in respect of the collective $\mathbf{C}_{im}^{(p)}$ - i.e., persons insured in membership category m, holding product p - is

$$(11) \qquad \tilde{t}_{im}^{(p)} = \sum_{\mathbf{x} \in \mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot \left(\bar{b} \cdot r(\mathbf{x}) - d(\mathbf{x}) \right).$$

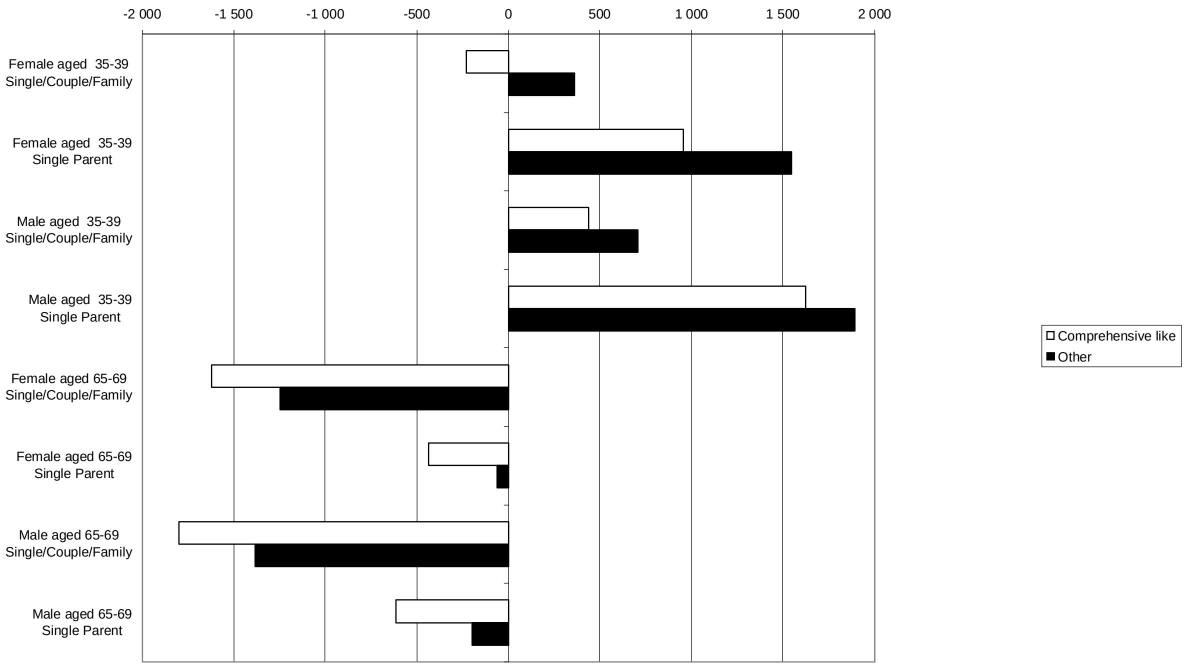
Thus for every insured person characterised by $\mathbf{x}$, the insurer is debited an amount of $\bar{b} \cdot r(\mathbf{x})$ and credited an amount of $d(\mathbf{x})$; the difference becoming the net equalisation transfer.

Under RBC Reinsurance "With product", product will be included in the variable $\mathbf{x}$. Recall that in the framework of Section 3, $\mathbf{x}$ consists of two sub-vectors $\mathbf{x}_1$ and $\mathbf{x}_2$. The sub-vector $\mathbf{x}_1$ comprises the rating variables that force the mandatory premium rate relativity, while $\mathbf{x}_2$ comprises the risk variables that are to be recognised in the equalisation scheme.

Interestingly, the Department is proposing that product be recognised as a risk variable, but not as a rating variable, in RBC Reinsurance "With product". In effect, this means than an insurer will be deemed to be receiving the same premium for Comprehensive like as for Other products, while at the same time being credited for higher benefits for Comprehensive like products.

The calculations of RBC Reinsurance "With product" have been applied to the notional insured population of NSW. In order to split the population further by product, the author has assumed that Comprehensive like products are those described as Non-exclusionary and Non-FED in Part 1 of PHIAC A. Graph 5 displays the per capita equalisation transfers, as they would be on that population.

The graph shows significant differences in the per capita transfers. In the case of a female aged 35-39, a person who would be a net payee when holding Comprehensive like insurance, would turn into a net payor after a switch to Other insurance, and vice versa. Can this be justified in any way?



Graph 5. Per capita equalisation transfer under Reinsurance "With product"

If health insurers were compelled to charge the same premium for a Comprehensive like product as for an Other product, then equalisation of product mix would make perfect sense. It is of course difficult to see who would be buying Other products in a free market, if Comprehensive like products were available for the same premium.

If there existed just two, or any finite number of defined products with a mandatory premium relativity associated with each, then it would still be possible to recognise the difference in premiums in an equalisation scheme. All one would need to do, was to include product not only as a risk variable in $\mathbf{x}_2$, but also as a rating variable in $\mathbf{x}_1$, and to model the rate relativity function $r(\mathbf{x})$. The insurer would then be credited a higher amount $d(\mathbf{x})$ for a Comprehensive like product from the pool, but he would also be charged a higher contribution $\bar{b} \cdot r(\mathbf{x})$ to the pool. If both $d(\mathbf{x})$ and $r(\mathbf{x})$ were modelled correctly, then the resulting equalisation scheme (8) would be equitable in the sense of Section 3.

In reality, every insurer is free to set the premium rates for the different products it is selling. Therefore, product is not a variable that qualifies for equalisation. RBC Reinsurance "With product" appears to be a flawed construction on two accounts:

- Because it equalises the effect of a variable that does not qualify for equalisation; and
- Because the implied rate relativity function $r^*(\mathbf{x})$ is not adapted to the mandatory relativities.

In an attempt to find a justification of RBC Reinsurance "With product", one needs to step outside the framework of Section 3. Within that framework, the only risk factors that qualify for equalisation are those explicitly recognised, and their effect on both benefits and contributions needs to be modelled.

In health insurance, however, it is common that sicker people select higher benefit cover. As a result of self-selection, the excess claim cost of Comprehensive like products is made up of two components:

- Higher benefits per hospital day or episode (the benefit component); and

- higher utilisation rates on account of sicker members (the utilisation component).

Gale (2005) provides an excellent description of the self-selection process. MIRA (1993, 1994) argued that the effect of the utilisation component should be equalised to some extent and proposed ways to achieve this. Their view was rejected by the Industry Commission (1997) and the Trowbridge Report (1999). It appears to have re-entered the stage in the guise of RBC Reinsurance "With product".

Summarily crediting higher risk relativities for all Comprehensive like products in order to compensate the issuing insurers for presumably sicker members, seems to be a rather blunt instrument. Ideally, one should measure and equalise the extent of differential utilisation directly for each insurer. Barring that, great care must be taken so that the excess risk relativities that are credited for Comprehensive like products compensate the insurers only for the effect of higher utilisation rates, not for the (utilisation corrected) cost of providing the higher benefits in the first place.

8. Some thoughts on the implementation of RBC Reinsurance

Coming from a situation where the only split is between insured persons under 65 and insured persons over 65, it seems very ambitious to split the insured population into twenty five-year age intervals, and by gender. The sheer number of risk cells for which risk relativities must be determined (7x40 for RBC Reinsurance "Without product", 7x80 for RBC Reinsurance "With product") will make it very difficult to include other risk or rating variables into the equalisation scheme later. In the opinion of this author, it would have been better to split the insured population into, say five twenty-year age intervals and by gender, and to leave some room for the possible inclusion of other risk variables.

While on the topic of risk groups and risk relativities, the author would like to warn against the danger of insurers or interest groups lobbying for greater recognition (i.e., higher risk relativities) of their "pet" high risk groups. The task of lobbyists is made easier when the insured population is split into so many risk groups that determining the risk relativities requires a great deal of judgement and discretion. The estimator will find herself with a burden of proof in arguing with advocates of the old, the young, the pregnant, the comprehensive likes, comprehensive dislikes, insurers selling a new product with no statistical record, and so forth. A disciplined and evenhanded approach to setting risk relativities will be necessary, to avoid that such pressures open up new areas of over-compensation.

This paper argues that dependants are covered free of charge ($r = 0$). In the opinion of the author, it would make sense to introduce a mandatory, non-zero relativity for each dependant. Even a small relativity (say, 20% per dependant) would induce a natural order between the premium rates charged for couples, single parents and families. A non-zero relativity for dependants would also force insurers to count correctly the dependants they are covering.

9. Summary

This paper has shown how one can derive an equalisation scheme that properly recognises the form of partial community rating that is mandatory for private health insurers in Australia today. The optimal equalisation scheme is of the RBC form, the only difference to the Department's proposal being that Single Equivalent Units (SEU) would be calculated in a different way. The term "Adapted SEU" is introduced. The Adapted SEU in respect of one insured person is defined as

$$r(\text{Entry age, Adult status}) \quad = \quad \begin{cases} 1 + 0.02 \cdot \left((\text{Entry age} - 30)^{+} \wedge 35 \right) & \text{for a contributing adult} \\ 0 & \text{for a dependant} \end{cases} .$$

The notion of equity that underlies the equalisation scheme, is that the net reinsurance transfer assigned to a person of a given age, gender and entry age, should not depend on where that person is insured (i.e., the insurer) or how she is insured (i.e., membership category and product). The author believes that it makes sense to equalise the reinsurance transfer across all those classes, as most persons will visit more than one insurer, membership category and product during a lifespan with health insurance.

In the opinion of the author, RBC Reinsurance as proposed by the Department of Health would be inequitable on two counts: by discriminating against Single Parent memberships, and by failing to recognise Lifetime Health Cover loadings.

Both inequities affect only small minorities in the insured population. As at December 2004, Single Parent memberships constituted 2.3% of the insured population and late entrants to LHC made up 4.3%. That likeness apart, the discrimination against Single Parent memberships appears to be a more serious problem because the minority concerned is treated considerably worse than it would be in an equitable scheme; while, on the other hand, late entrants to LHC are treated somewhat better than they would be in an equitable scheme.

The author also believes that RBC Reinsurance "With product" is a flawed construction. Insurers are free to set premium rates for different products, so that product mix should not be equalised. Notwithstanding, a subsidy for higher benefit products can be justified with reference to the higher utilisation rates of self-selecting, sicker members. Nevertheless, summarily crediting higher risk relativities for all Comprehensive like products seems to be a blunt instrument. Ideally, differential utilisation rates should be measured and equalised directly - if one accepts that it is equitable to do so.

Table 13 gives an indication of how different membership categories would fare under the different equalisation schemes.

Table 13. Equalisation transfer by membership category and equalisation scheme

	Adapted SEU "Without product"		RBC Reinsurance "Without product"		RBC Reinsurance "With product"		
Equalisation transfer	With Entry age	Without Entry age	Without Entry age	With Entry age	Comprehensive	Other	Total
Single	-89 934 976	-92 363 033	-101 089 650	-98 642 400	-97 345 318	21 627 327	-75 717 992
Couple	-115 933 814	-118 823 632	-126 863 841	-123 964 089	-145 262 545	-165 118	-145 427 662
Single Parent	3 909 280	4 068 462	31 966 688	31 655 862	10 884 303	23 860 921	34 745 224
Family	201 959 510	207 118 204	195 986 803	190 950 627	-30 437 426	216 837 856	186 400 430
Total	0	0	0	0	-262 160 986	262 160 986	0

Please note as a caveat, that the numbers calculated in the numerical example are indicative only. While based on actual membership statistics for NSW, the notional population was greatly simplified by the assumption that it comprises only three age groups and three entry age groups. If that had not been done, the tables and graphs would have filled many more pages without providing essentially better information - because it would have been necessary to make up an age distribution for each membership category. Having said that the quantitative results may differ on a full set of data, the qualitative conclusions about the different schemes' properties will remain unchanged.

This author's interest in equalisation schemes started with his involvement in the work leading to the reports by MIRA (1993, 1994). The arguments put forward in this paper are not intended to serve the commercial interest of any specific insurer or group of insurers. As a matter of principle, however, the author believes that a new reinsurance arrangement for private health insurance ought to be attuned to the partial community rating legislation of today. A reinsurance arrangement that is not attuned to the form of community rating it is implemented to support, will easily become the target of continued criticism and require new revisions.

Special thanks go to Alan Brown for his review of this paper and his helpful comments.

Cross reference table of symbols used

Department of Health (2003)	This paper
i	$\mathbf{x}_2$
not used explicitly	$\mathbf{x}_1$
not used explicitly	$\mathbf{x} = (\mathbf{x}_1, \mathbf{x}_2)$
f	(i, m, p)
s	not used
$\bar{c}_{is}$	$d(\mathbf{x})$
$\bar{c}_s$	d
r_{is}	$d(\mathbf{x})/d$, no separate symbol defined
n_{if}	$n_{im}^{(p)}(\mathbf{x})$
not used explicitly	$r(\mathbf{x})$
m_f	$s_{im}^{(p)} = \sum_{\mathbf{x}\in\mathbf{X}} s_{im}^{(p)}(\mathbf{x}) = \sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot r(\mathbf{x})$
m_s	$s = \sum_{i,m,p} s_{im}^{(p)}$
$\bar{r}_f$	$\frac{1}{s_{im}^{(p)}} \sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot \frac{d(\mathbf{x})}{d}$, no separate symbol defined
$\bar{r}_s$	$\frac{1}{s} \sum_{\mathbf{x}\in\mathbf{X}} n(\mathbf{x}) \cdot \frac{d(\mathbf{x})}{d}$, no separate symbol defined
t_f	$\tilde{t}_{im}^{(p)}$
$\bar{b}_s$ (*)	$\bar{b}$
b_s (*)	$\bar{b} \cdot s$, no separate symbol defined
$t_f = \frac{(\bar{r}_s - \bar{r}_f)}{\bar{r}_s} \times m_f \times \bar{b}_s$	$\tilde{t}_{im}^{(p)} = s_{im}^{(p)} \cdot \bar{b} - \sum_{\mathbf{x}\in\mathbf{X}} n_{im}^{(p)}(\mathbf{x}) \cdot d(\mathbf{x})$

(*) There is a slight difference of interpretation, as this paper defines $\bar{b}$ to be the *theoretical* average benefits per premium unit, while the Department proposes to calculate $\bar{b}_s$ as the *actual* benefits paid in the quarter, divided by the number of SEU. The use of actual benefits will result in a (random) scaling of the reinsurance transfer t_f from quarter to quarter; averaged over time, it should give approximately the same result as the use of theoretical benefits.

References

Administrative Decisions Tribunal (2004). Strong v The Hospitals Contribution Fund of Australia Limited [2004] NSWADT 176.

Department of Health and Ageing (2003). Transition Arrangements for Risk Based Capitation (RBC) Reinsurance.

Gale, A.P. (2005). What Price Health? Paper presented to the Institute of Actuaries of Australia 2005 Biennial Convention, 8th to 11th May 2005.

Industry Commission (1997). Private Health Insurance. Report No. 57 of 28th February 1997.

Institute of Actuaries of Australia (1999). Reinsurance Arrangements for the Private Health Insurance Industry. Submission to the Department of Health and Aged Care, dated 5th August 1999.

MIRA (1993). Review of the Private Health Insurance Reinsurance Arrange Arrangements. Report to the Department of Health.

MIRA (1994). The Reinsurance Issue Follow-Up Study. Report to the Department of Human Services and Health.

Neuhaus, W. (1995). Community Rating and Equalisation. *ASTIN Bulletin* 25, No. 2, 95-118.

Neuhaus, W. (1997a). Statutory Rating and Equalisation. In *Birth to Death: Modelling the Risks of Life* (Editors: Bellis et al.). Department of Actuarial Studies, Macquarie University, 1998.

Neuhaus, W. (1997b). An Equalisation Scheme for Unfunded Lifetime Community Rating. Quarterly Journal of the Institute of Actuaries of Australia, December 1997, 2-16.

PHIAC (2004a). PHIAC A Report for New South Wales December 2004.

PHIAC (2004b). Risk Relativities for Risk Based Capitation Reinsurance. Circular No. 04/15.

Trowbridge (1999). Reinsurance Arrangements for the Private Health Insurance Industry. Report to the Department of Health and Aged Care.