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Abstract

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A Welfare Analysis of the Commonwealth Seniors Health Card*

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The Commonwealth Seniors Health Card (CSHC) is a key element of a suite of benefits for Australia's 'self-funded retirees'. Its main component is a pharmaceutical concession, which is analysed as a form of public health insurance. The utility gain through risk-pooling is found to be negligible under conservative assumptions. The deadweight loss through moral hazard may be considerable. Finally, the CSHC may be seen as an inequitable transfer, because CSHC holders are a particularly wealthy population.

I Introduction

As structural ageing affects the population of almost all developed countries (OECD, 2007), the fiscal sustainability of publicly funded retirement income systems is being questioned (Holzmann *et al.*, 2005; Blake & Mayhew, 2006; Whiteford & Whitehouse, 2006; Australian Government, 2007a). Australia's response has included the provision of financial support for people who save for their retirement. This includes preferential taxation treatment for retirement savings as well as direct benefits to 'self-funded retirees'.¹ Paradoxically,

this increasing support implies that these people are not entirely self-funded. The effects of these policies warrant evaluation, as do their costs.

The Commonwealth Seniors Health Card (CSHC) is one of the main components of this policy suite. It provides a price concession for pharmaceuticals, which can be seen as a public health insurance policy. It also provides eligibility for other non-cash benefits as well as cash benefits, conditional on residency requirements. The aim of this article is to evaluate the welfare effects of the CSHC, focusing on the pharmaceutical concession. I estimate the welfare gain associated with risk reduction and the welfare loss associated with moral hazard.² Equity is considered by evaluating

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JEL classifications: H42, H51, I38, H31

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¹ The term 'self-funded retiree', now commonplace in Australian policy discourse, has no formal definition. However, in typical usage, it excludes anyone who receives

any pension income. (See for example Commonwealth of Australia, 1999; Department of the Parliamentary Library, 2001). This population is the subject of the analysis in this article.

² The term 'moral hazard' is widely used in the literature on insurance. It often refers to the increased propensity to take risks, resulting from the incentives provided by insurance. In the health economics literature, however, the term is commonly used in a different sense. It often refers to the increased health care consumption resulting from the reduced marginal price of health care characterised by health insurance (see for example Folland *et al.*, 2007: 166). This is the sense in which the term is used here.

the relative income and wealth of recipients. Consideration is also given to the altruistic externalities associated with health care and the applicability of the chosen approach to public health insurance more broadly.

The remainder of the article is organised as follows. Section II provides a detailed description of the CSHC. It considers changes to its eligibility rules and the increasingly generous set of benefits to which holders are entitled. It also provides a profile of CSHC holders, whose distinguishing characteristic is wealth. Sections III and IV estimate the welfare effects of risk reduction and moral hazard, respectively. Section III finds the welfare gain through risk reduction to be negligible under very conservative assumptions and quite general specifications of the utility function. Even without the pharmaceutical concession, consumers are already covered against high levels of pharmaceutical expenditure, so it is not surprising that the additional reduction in risk provided by the CSHC is negligible. Section IV estimates the welfare loss due to moral hazard. The deadweight loss is found to be substantial, even if a small price elasticity of demand for pharmaceuticals is assumed. The sensitivity of the estimates to the assumed parameters is considered in detail. The assumptions underlying the deadweight loss calculations are of particular importance in analysing health care and health insurance and these are discussed in Section V. Section VI concludes.

II The Commonwealth Seniors Health Card

The CSHC was introduced in July 1994. Its original purpose was to provide pharmaceuticals at a concessional price to people of age pension age who met the pension income eligibility test, but who did not meet other eligibility conditions. The majority of such people did not meet the assets test or residency requirements. In April 1997 there were only 37 844 CSHC holders (Table 1) (Standing Committee on Family and Community Affairs, 1997). The concessional price for pharmaceuticals listed on the Pharmaceutical Benefits Scheme (PBS) was \$2.60 per prescription at the time. Other people eligible for the concession include pensioners and low income earners. Consumers who were ineligible for the pension paid \$16.00 per prescription. For both general and concessional consumers, the price is reduced after a consumer exceeds a given annual out-pocket expenditure in a calendar year, as shall be discussed subsequently.

In January 1999, there was a fundamental change in the role of the CSHC. The CSHC

TABLE 1
Number of CSHC Holders

April 1997	37 844
June 2001	226 140
June 2003	282 691
June 2004*	287 326
June 2005	300 165
June 2006	310 633
June 2007*	318 278

* It is presumed that these are at June as for the other years, though this is not stated in the original source.

Source: Standing Committee on Family and Community Affairs (1997) and FaCS/FaCSIA Annual Reports in various years.

income eligibility threshold was no longer linked to that of the age pension eligibility threshold. It was almost doubled to \$40 000 per annum for singles and \$67 000 for couples. Officially, the 1999 CSHC policy change was designed to 'encourage people to save for their own retirement' (Costello, 1998: 5). The threshold was increased again nominally in July 2000 and more substantially in July 2001, to \$50 000 for singles and \$80 000 for couples (Australian Government, 2007b: Section 4.10.7.50). Immediately before the last of these threshold increases (June 2001), there were 226 140 CSHC holders (Department of Family and Community Services, 2003a). Two years after the last increase (June 2003) there were 282 691 CSHC holders (Table 1) (Department of Family and Community Services, 2003b). The exact number of people who took-up the card as a result of the income threshold reforms is unknown.³ Recall that the 37 844 CSHC holders in 1997 were all below the age pension income eligibility threshold. If this number was to stay constant over time, then perhaps

³ As will be shown below, the income distribution of CSHC holders is available at one point in time, using the Household Expenditure Survey (HES) of 2003–2004. These data could be used to estimate the proportion of recipients whose income falls between the old and new thresholds. However, this may be misleading because of the application of CSHC income eligibility rules. Applicants meet the CSHC income eligibility test if their income in the previous financial year was below the threshold. However, applicants can also meet the income test on the basis of an estimate of income in the current financial year, if they can demonstrate a change in circumstances since the end of the previous financial year.

87 per cent of CSHC holders in 2003 had become eligible due to the increase in the threshold.⁴ This is a very rough approximation, but it suggests that most CSHC holders may have become eligible due to the reforms.

Prior to September 2001, the PBS concession was the only benefit of the CSHC. Since then, there has been a number of additional cash benefits introduced which are linked to CSHC eligibility. From September 2001, CSHC holders who meet residency requirement are also eligible for the Telephone Allowance. This is a cash benefit initially worth \$72 per year (paid quarterly) for people who have a telephone connected in their name or their partner's name. This has increased incrementally to \$85.60 by December 2006. Age pensioners are also eligible for the Telephone Allowance.

From December 2004, CSHC holders who meet residency requirements are entitled to the Seniors Concession Allowance, a cash benefit initially worth \$200 per year (paid in two instalments). This has increased incrementally to \$214 by December 2006. Age pensioners are not eligible for this benefit. However, age pensioners are eligible for the Utilities Allowance and various concessions from State and Territory governments for services such as property and water rates, energy bills, public transport and motor vehicle registration, many of which are not available to CSHC holders. Indeed the Seniors Concession Allowance was introduced because of such concessions.

In turn, the Seniors Concession Allowance has provided eligibility for two 'one-off' payments. In June 2007, a payment of \$500 was made to Seniors Concession Allowees as well as to age pensioners. In June 2006, a one-off payment of \$102.80 was made to Seniors Concession Allowees. The same payment was made to age pensioners. Notably, however, age pensioners who were members of a couple (not separated due to illness) only received half of this amount each, while coupled Seniors Concession Allowees each received the full amount. Non-concession card holders were not eligible for these payments. It is also notable that a similar payment (worth \$300) was made in 2001 to age pensioners, but not to CSHC holders.

⁴ This estimate becomes 86 per cent if it is assumed that this number increased in proportion with the age pension age population (taking into account the increase in the age eligibility threshold for women from 60.5 to 62 years between 1997 and 2003).

CSHC holders might also be more likely to be bulk-billed⁵ for GP services than non-concessional patients. In February 2004, the Commonwealth Government introduced financial incentives for GPs to bulk-bill concession card holders and children aged less than 16. However, there does not seem to be any available data that quantifies the extent to which CSHC holders are actually bulk-billed.

From March 2004, CSHC holders are entitled to concessional coverage under the extended Medicare Safety Net. Under this scheme, 80 per cent of non-hospital out-of-pocket medical expenses are reimbursed by the government after such expenditure exceeds a given threshold. In 2007, this threshold is \$519.50 per year for concession card holders, and \$1039 for non-concession card holders. Thus the additional concessional coverage is worth a maximum of $80\% \times (\$1039 - \$519.50) = \$415.60$ per year per recipient. Data on the distribution of annual out-of-pocket medical expenses of CSHC holders are not available, and so the average value of this concession to CSHC holders is unknown. However, the average annual out-of-pocket expenditure by CSHC holders is estimated to be \$257 in 2003–2004, and the proportion exceeding \$519.50 is no more than 11 per cent.⁶ Furthermore, both concession card holders and general patients are also eligible for the (original) Medicare Safety Net. Under this scheme, 100 per cent of the Medicare Schedule Fee is reimbursed for patients whose 'gap' fees exceed an annual threshold. The gap is the difference between the

⁵ Bulk-billing is a billing system which includes no charge for the patient.

⁶ Author's calculations from the 2003–2004 ABS Household Expenditure Survey Expanded Confidentialised Unit Record File. Expenditure in this dataset is recorded on a household basis. Household expenditure is assumed to be equally distributed between household members. Respondents are asked to recall expenditure on medical services over the previous three months. The distribution of annual expenditure cannot be derived from these data. The variance of expenditure is likely to be greater for a short recall period than a long recall period. However, an upper bound of the proportion of people exceeding the threshold can be derived by assuming that the 3-month recall period is representative of the full year for each household. Under this assumption, 11.0 per cent of CSHC holders exceeded the \$519.50 threshold. Thus a maximum of 11.0 per cent of CSHC receive any benefit from the Medicare Safety Net. Similarly, no more than 8 per cent exceed the \$1039 threshold, hence benefiting from the maximum value of the concession.

TABLE 2
Summary of non-PBS CSHC Benefits per card Holder in 2007

	Single	Coupled (per person)
Telephone allowance	\$86.20	\$43.10
Seniors concession allowance	\$214.00	\$214.00
One-off Payment	\$500.00	\$500.00
Additional bulk billing	Value unknown	Value unknown
Medicare safety net (concessional threshold)	Value unknown*	Value unknown*
Total	\$800.20	\$757.10

* The value is estimated to be no greater than \$45.72, but could be considerably less than this. Due to the lack of confidence in this estimate, it has been excluded from the calculations that follow.

Medicare Schedule Fee and the amount reimbursed by Medicare. The gap is equal to 15 per cent of the Schedule Fee, although practitioners are free to charge in excess of the Schedule Fee. In 2007, the threshold for this scheme is \$358.90. Without access to relevant data, the interaction between the original and extended Medicare Safety Nets is difficult to gauge. Nevertheless, it is clear that the average value of this scheme to CSHC holders (in excess of its value to non-concessional patients) is likely to be small. An upper bound is calculated as the maximum benefit multiplied by the maximum proportion of beneficiaries, which equals $\$415.60 \times 11\% = \45.72 . The actual value may be considerably smaller than this.

Table 2 summarises the non-PBS benefits received by each CSHC card holder in 2007. The total is \$800.20 for singles and \$757.10 for each member of a couple plus the unmeasured values of additional bulk billing and the concessional threshold in the Medicare Safety Net. Older people without concession cards are not eligible for any of these benefits. Age pensioners are eligible for all of these benefits except for the Seniors Concession Allowance.

The 2003–2004 Household Expenditure Survey is perhaps the only nationally representative dataset available which explicitly identifies CSHC holders. Table 3 shows summary statistics for CSHC holders, with comparisons to non-CSHC holders of age pension age and to younger people (including children). Approximately 10 per cent of older people were CSHC holders. On average, CSHC holders were one year younger than non-CSHC holders of age pension age and a slightly larger percentage (2 per cent) was male. Their average equivalised current disposable income was considerably higher (\$102 per week) than that of non-CSHC holders of age pension age, but

considerably lower (\$78) than that of younger people. CSHC holders are located throughout the income distribution, although relatively few are in the top quintile. In comparison, non-CSHC holders of age pension age are concentrated in the bottom half of the distribution. While CSHC holders appear to fare poorly relative to younger people on these income measures, it is noted that cash income is not a good metric for comparisons of living standards between older people and younger people. This is due to the exclusion of imputed rental income from owner occupied housing, which greatly benefits older people relative to younger people (see Yates, 1991; Saunders & Siminski, 2005). This is reflected in the last row of Table 3, which shows that 88 per cent of CSHC holders live in an owner-occupied dwelling without a mortgage, compared with 77 per cent of non-CSHC holders of age pension age and just 23 per cent of younger people.

The distinguishing characteristic of CSHC holders is wealth. Their net wealth per capita was \$623 898, almost twice that of other older people and almost four times that of younger people. CSHC holders are highly concentrated at the top of the wealth distribution. The majority (59 per cent) of CSHC holders are in the top decile of the wealth distribution, while only 6.5 per cent are in the bottom 60 per cent of the distribution.

III The Welfare Gain of Risk Pooling

Health insurance provides protection against the financial consequences of adverse health shocks. It also protects against welfare loss due to poor health to the extent that lower prices for health care translate into higher health care consumption. In this section, I abstract from the effects of such behavioural responses to price, since they are

TABLE 3
Descriptive Statistics from HES 2003–2004

	CSHC holders	Non-CSHC holders of age pension age	Younger people*
Number of people	264 438	2 312 571	17 011 496
Sex (% female)	56.1	57.8	49.0
Mean age	71.7	72.9	34.9
Mean equivalised income (\$/week)	493.07	390.75	570.81
Percentage in each decile of equivalised income			
First decile (low)	17.5	18.4	8.8
Second decile	6.2	27.3	7.8
Third decile	8.4	19.7	8.9
Fourth decile	12.3	10.1	9.9
Fifth decile	12.8	8.2	10.2
Sixth decile	10.5	5.1	10.6
Seventh decile	8.2	3.2	11.0
Eighth decile	11.3	1.9	11.0
Ninth decile	5.7	2.7	11.0
Tenth decile (high)	7.0	3.4	10.9
Total	100.0	100.0	100.0
Owner occupied dwelling (outright) (%)	88.0	77.1	22.9
Mean net wealth per capita (\$ '000s)	623.9	325.8	161.2
Percentage in each decile of net personal wealth			
First decile (low)	0.7	4.7	10.9
Second decile	0.5	5.8	10.8
Third decile	0.6	4.5	10.9
Fourth decile	2.4	3.7	11.0
Fifth decile	0.8	7.4	10.5
Sixth decile	1.6	6.9	10.6
Seventh decile	9.0	12.0	9.7
Eighth decile	7.7	15.6	9.4
Ninth decile	17.7	20.7	8.4
Tenth decile (high)	59.1	18.8	7.7
Total	100.0	100.0	100.0

Equivalised income is person-weighted current disposable income, equivalised using the 'modified-OECD' equivalence scale. The equivalence scale adjusts for differences in need due to household composition. Person-weighting ensures that all people (including children) are included in the summary statistics. The method assumes pooling of income within households. The net wealth statistics assume that wealth is shared equally amongst all members within households. * All people (including children) who are below age pension age (males < 65 years and females < 63 years).

analysed in detail in the next section. Let I denote income. Let x and y denote pharmaceutical and non-pharmaceutical consumption respectively. Let p denote the price of pharmaceuticals, while the price of y is normalised to 1. Income is equal to total consumption, so that $I = px + y$. Consider a health state dependent utility function of the following form:

$$U = U_1(y) + U_2(h). \quad (1)$$

Where h is health. In this model, health contributes to utility independently of (non-pharmaceutical) consumption. The model does not allow for the

possibility that the marginal utility of consumption varies with health status. It is shown in Appendix 1 that a more general specification, which allows the marginal utility of consumption to decrease with sickness, would result in an even smaller utility gain due to risk pooling. However, the more restrictive specification is used in the body of the text as it is analytically tractable.

Let h , in turn, be a function of pharmaceutical consumption (x) and the exogenous pre-treatment health status (θ), over which there is uncertainty. Pharmaceutical consumption is a function of θ and I . It does not contribute directly to utility.

Assume that U_1 is the constant relative risk aversion (CRRA) function. The functional form of U_2 remains unspecified:

$$U = \frac{y^{1-\rho}}{1-\rho} + U_2(h) = \frac{(I - px)^{1-\rho}}{1-\rho} + U_2(h) \quad (2)$$

where ρ is the Arrow-Pratt relative risk aversion parameter. The CRRA utility function assumes that risk aversion is negatively proportional to wealth (or consumption) (Pratt, 1964). Many available estimates of ρ are in respect to utility as a function of wealth and so are not relevant here (see Hartley *et al.*, 2006 for a review of such estimates; and Meyer & Meyer, 2005 for a formal discussion of the relationship between CRRA utility functions of wealth and consumption). Estimates of ρ in respect to utility as a function of consumption include 4.1 in a study based on hypothetical gambles over permanent changes to income (Barsky *et al.*, 1997). That study also found very little variation in this estimate by income quintile, supporting the assumption of CRRA for consumption. There have been several other studies which exploit savings responses to interest rates to measure the intertemporal elasticity of consumption, which in turn is the inverse of ρ . These estimates for ρ include 2.5 (Engen, 1993; cited by Engen & Gruber, 2001) and between 2 and 5 (Skinner, 1985). The consistency of these estimates justify the 'long line of simulation literature' described by Finkelstein and McKnight (2005) which takes ρ to be 3. In the present study, I follow Finkelstein and McKnight (2005, 2008) by assuming that ρ is equal to 3, and testing sensitivity to values of 1 and 5. It is acknowledged that all of the estimates for ρ reviewed above are with respect to the USA. To the author's knowledge, corresponding estimates do not exist for Australia.

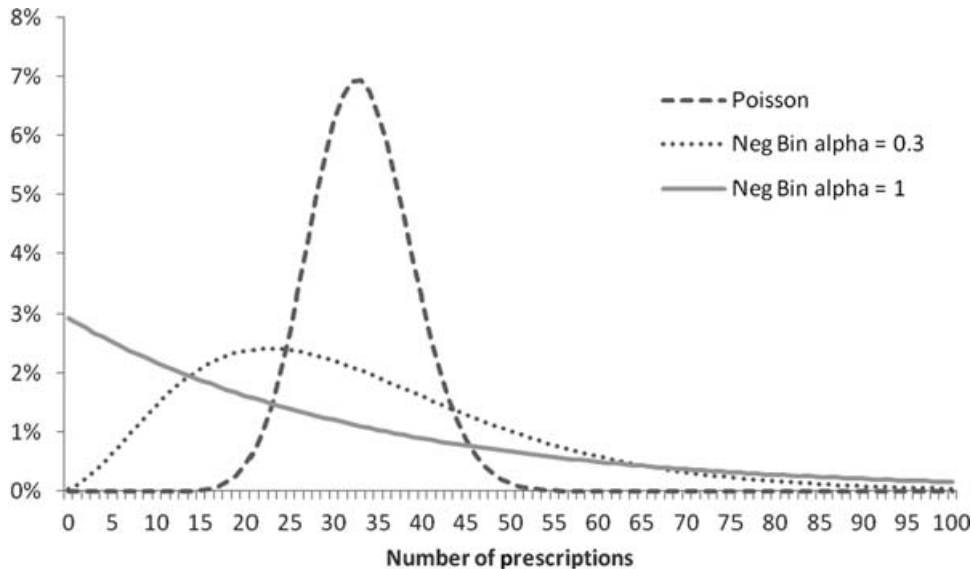
To implement this approach, it is necessary to estimate the extent of uncertainty over pre-treatment health status or at least over the resulting pharmaceutical consumption. While x is a random variable, it may not be completely random. In particular, health status is likely to be serially correlated. Several approaches have been used in related studies to address this issue. In the RAND Health Insurance Experiment, participants were asked to predict future health care consumption. Manning and Marquis (1996) compared these responses to actual consumption, thus measuring the extent to which it was predicted. Finkelstein and McKnight (2008) modelled the distribution of health care consumption before and after the introduction of the Medicare scheme in the USA.

The data to implement such approaches for the CSHC are not available. In fact, the annual distribution of pharmaceutical expenditure is not readily available for even one point in time for the population of interest.⁷ However, this is not a major limitation. The approach taken here is to make conservative assumptions over the distribution of out of pocket pharmaceutical expenditure and the extent of uncertainty over future consumption. Despite these assumptions, the utility value of the CSHC due to risk-pooling is found to be negligible. Pharmaceutical consumption is assumed to be completely random, regardless of prior health status or other observable characteristics. This approach will overestimate the uncertainty over pharmaceutical consumption (and hence the utility value of risk pooling). Following Siminski (2008a), the annual number of PBS pharmaceutical prescriptions consumed is assumed to follow an overdispersed count data process, with a mean of 33.1. The extent of overdispersion is unknown, but is parameterised through a Negative Binomial process (see Cameron & Trivedi, 1998: equation (3.26) for the density function). Figure 1 shows three such distributions. The first is the Poisson distribution, which is a special case of the Negative Binomial with the overdispersion parameter (α) equal to zero. This is also almost identical to a Normal distribution. The other distributions are Negative Binomial with α set to 0.3, and 1 respectively. When $\alpha=1$, the variance of the Negative Binomial is 34 times larger than that of the Poisson.

Assume the distribution of the number of prescriptions purchased is the same under general and concessional price schedules (the welfare effect of responses to price are the subject of the next section). Each of the probability distributions of prescription counts in Figure 1 corresponds with a distribution of pharmaceutical expenditure under general and concessional price schedules, respectively. For a given person, the probability distribution of non-pharmaceutical consumption is

⁷ HES 2003–2004 includes self-reported household expenditure on prescription medication in a 2-week period. The distribution of this amount is unlikely to be a useful proxy for the shape of the annual distribution for at least two reasons. The variance of expenditure in 2-week recall period is likely to be much greater than that of annual expenditure. Second, not all prescription medications are listed on the PBS. Patients would pay the full cost of any such medications, thereby increasing the variance further.

FIGURE 1
Possible Distributions for Annual Number of PBS Drug Purchases



a function only of PBS concession status. An illustration of these distributions under both sets of prices is shown in Figure 2 for a single person. In this example, the negative binomial distribution is assumed to have α equal to 0.3. The discontinuity in the distribution under 'general prices' occurs at the point where the safety net is invoked. In the distribution under 'concession prices', expenditure is capped at a maximum of \$274.40 per year, after which all subsequent prescriptions are free to the consumer. In the model being developed here, the effect of the CSHC is to replace the 'general price' probability distribution of non-pharmaceutical consumption with the corresponding 'concession price' distribution.

For couples, safety net eligibility is based on combined pharmaceutical consumption. The probability distributions of their non-pharmaceutical consumption thus differ from those in Figure 2 and they are not shown. The results that follow differentiate between single and coupled CSHC holders. It is assumed that each member of a couple independently faces the same probability distribution of prescription counts and that income is shared within the household. The main findings are unchanged under alternate assumptions (for

example perfectly correlated pharmaceutical consumption and/or no income pooling by couples).

The expected utility (with a CSHC card) is:

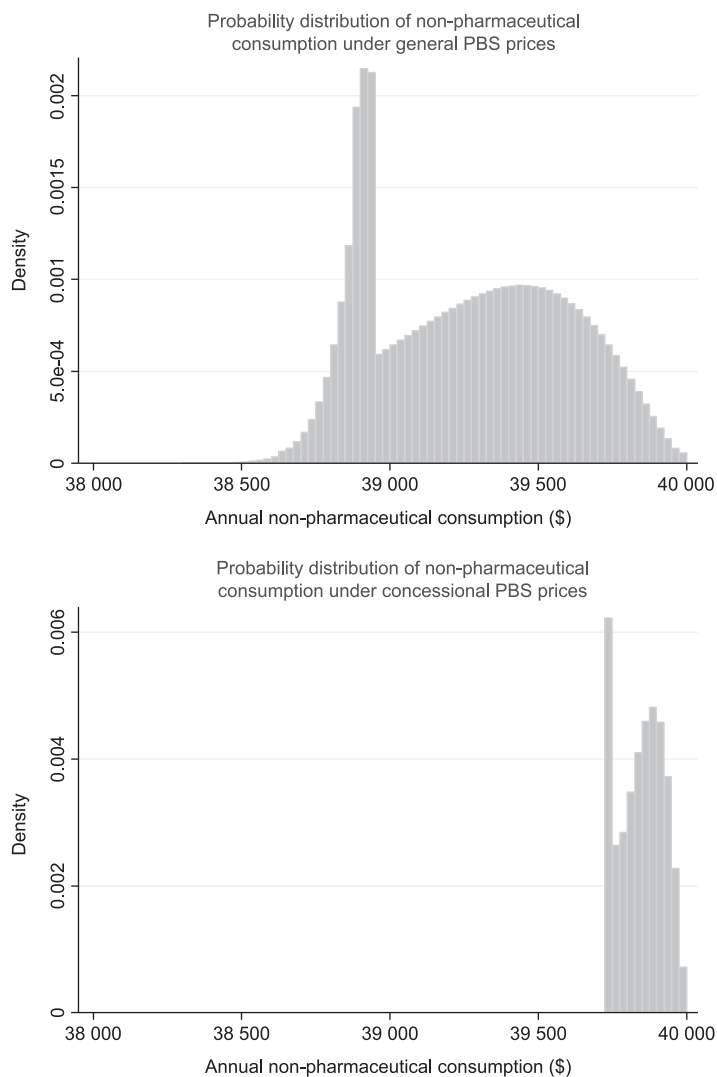
$$E(U^c) = \int U_1(y)f_1(y)dy + \int U_2(h)g(\theta)d\theta \quad (3)$$

where y is non-pharmaceutical consumption, f_1 is the probability density function depicted in the first panel of Figure 2 (or the corresponding density under different assumptions about dispersion), g is an unspecified probability density of pre-treatment health states (θ). The expected utility without a concession card is given by:

$$E(U^s) = \int U_1(y)f_2(y)dy + \int U_2(h)g(\theta)d\theta \quad (4)$$

where, f_2 is the probability density function depicted in the second panel of Figure 2 (or the corresponding distribution under different assumptions about dispersion). The second integral is identical to that of $E(U^c)$ since no response to price in pharmaceutical consumption has been assumed in this section. A rational consumer is indifferent between possessing a CSHC or receiving a cash payment M when the utility of each situation is equal:

FIGURE 2
 Probability Distributions for Annual Non-pharmaceutical Consumption by PBS Concession Status – Singles (\$'000)
 (Annual Income = \$40 000; $\alpha = 0.3$)



$$\int U_1(y + M)f_2(y)dy + \int U_2(h)g(\theta)d\theta = \int U_1(y_i)f_1(y_i)dy_i + \int U_2(h)g(\theta)d\theta. \quad (5)$$

Which implies that:

$$\int U_1(y + M)f_2(y)dy = \int U_1(y)f_1(y)dy. \quad (6)$$

With $\rho = 3$, this becomes:

$$\int -\frac{(y_i + M)^{-2}}{2}f_2(y)dy = \int -\frac{y^{-2}f_1(y)}{2}dy. \quad (7)$$

TABLE 4
Utility Value of CSHC Due to Risk Reduction (% of Actuarially Fair Premium)

ρ	α		
	0 (Poisson)	0.3	1
Singles			
1	0.0	0.2	0.5
3	0.1	0.6	1.4
5	0.2	1.1	2.4
Couples			
1	0.0	0.0	0.8
3	0.0	0.1	1.0
5	0.0	0.1	1.3

Notes: This table shows the estimated contribution of the CSHC to utility through risk avoidance, expressed as a percentage of the actuarially fair premium. It shows various estimates for singles and couples under different assumptions of α (the extent of overdispersion in the assumed negative binomial distribution of annual pharmaceutical counts) and ρ (the Arrow-Pratt relative risk aversion parameter). It is assumed that future pharmaceutical consumption is completely unknown as discussed in the text.

With $\rho = 3$ and $\alpha = 0.3$, M is evaluated to be \$582.85 for singles. The actuarially fair insurance premium is the difference in expected pharmaceutical expenditure (under concessional and general prices) = $E(xp^s) - E(xp^c) = \$579.19$. Thus the contribution to utility associated with risk reduction is worth \$3.66 per year, or 0.6 per cent of the actuarially fair premium. For couples, M is estimated to be \$887.93 (or \$443.96 per person). This is lower for couples because they are more likely than singles to reach the safety net threshold under general prices. The contribution to utility through risk reduction is also smaller for couples at just 0.1 per cent of the actuarially fair premium. This is mainly because couples effectively self-insure against risk, by pooling their combined income.⁸ Table 4 shows the results under various assumed values for α and ρ . Even under assumptions of high dispersion of the PBS consumption

⁸ If it is assumed that couples do not pool income, the value of the concession through risk reduction increases to 0.5 per cent of the actuarially fair premium. If it is assumed that pharmaceutical consumption is perfectly correlated within couples, the value is 0.2 per cent of the actuarially fair premium, regardless if income is assumed to be pooled.

distribution ($\alpha = 1$), high risk aversion ($\rho = 5$) and completely random future health status, the value of the CHSC to risk reduction is equal to only 2.4 per cent of the actuarially fair premium value of the card for singles, and 1.3 per cent for couples. The actual value is likely to be less than 1 per cent and is hence negligible.

IV Moral Hazard and Deadweight Loss

In this section, I consider the deadweight loss (DWL) associated with the PBS component of the CSHC. DWL is the difference between the social cost of the CSHC and the minimum cash amount that rational recipients would be willing to receive instead of the CSHC. The key assumptions underlying these calculations are discussed in detail in the following section and should be considered when interpreting these results.

The key parameter which influences the results is the price elasticity of demand for pharmaceuticals. Exploiting the CSHC policy change as a natural experiment, Siminski (2008a) estimated the price elasticity to be -0.1 for this population. This value is adopted here, with sensitivity tested to other values.

For this exercise, it is assumed that there is no uncertainty, since uncertainty was addressed in the previous section. In this model, consumers know their own health status with certainty for the immediate accounting period (a calendar year). For this health status and a given price, there is a unique quantity of pharmaceuticals consumed, which maximises the utility of a given consumer. This consumer's utility function depends on pharmaceutical consumption and non-pharmaceutical consumption. In summary, the approach taken is to derive the Hicksian compensating variation (HCV) for such a consumer under a number of different scenarios (Hicks, 1943; Hausman, 1981). The difference between the cost to government and the HCV is the DWL component of government expenditure.

Consider a demand function for pharmaceuticals for person i . Let the quantity demanded and price of pharmaceuticals be denoted x_i and p , respectively. Let y_i be the quantity demanded of the composite of all other goods. The price of y_i is normalised to 1 and is fixed. Income is denoted I_i . Assume that the demand function exhibits constant price and income elasticities. Under these assumptions, the Marshallian demand function for pharmaceuticals can be written as:

$$x_i = c_i p^{\alpha_i} I_i^{\delta_i} \quad (8)$$

where α_i and δ_i are the own-price and income elasticities of demand for pharmaceuticals, c_i is individual specific and varies with health status and preferences for pharmaceutical versus non pharmaceutical consumption, but these are assumed fixed for the accounting period and are known with certainty.

Consider the following indirect utility function:

$$V_i(p, I_i) = \frac{-c_i p^{\alpha_i+1}}{\alpha_i + 1} + \frac{I_i^{1-\delta_i}}{1-\delta_i}. \quad (9)$$

This utility function corresponds to the demand function given in (8). For a given utility u_i , the corresponding expenditure function is derived by solving (9) for I , which is now denoted $e_i(p, u_i)$:

$$e_i(p, u_i) = \left[(1 - \delta_i) \left(u_i + \frac{c_i p^{\alpha_i+1}}{\alpha_i + 1} \right) \right]^{\left(\frac{1}{1-\delta_i} \right)}. \quad (10)$$

This is the minimum expenditure required to achieve utility u_i , given the price p .

Consider the consequences of the abolition of the CSHC, which would change p from p_0 to p_1 . The compensation in income which would result in no change in utility given the price change is the Hicksian compensating variation:

$$\begin{aligned} \text{HCV} &= e_i(p_1, u_i) - e_i(p_0, u_i) \\ &= \left[(1 - \delta_i) \left(u_i + \frac{c_i p_1^{\alpha_i+1}}{\alpha_i + 1} \right) \right]^{\left(\frac{1}{1-\delta_i} \right)} \\ &\quad - \left[(1 - \delta_i) \left(u_i + \frac{c_i p_0^{\alpha_i+1}}{\alpha_i + 1} \right) \right]^{\left(\frac{1}{1-\delta_i} \right)}. \end{aligned} \quad (11)$$

Figure 3 shows the nominal price schedules for general and concessional consumers. For CHSC holders in 2007, the first 56 PBS medications cost \$4.90 each. Additional prescriptions are free. For non-concession card holders, the first 43 prescriptions cost an estimated average of \$24.56 each.⁹ Additional prescriptions cost \$4.90 each.

The zero price after 56 prescriptions for concession card holders is a complication for the analysis. Demand is undefined for a zero price in the constant elasticity demand function. However, it is noted that the full cost of obtaining a prescription

is not truly zero. There are non-monetary (time) costs associated with obtaining the medications, as well as (time and possible monetary) costs associated with seeing a GP to obtain a prescription. This unmeasured cost might be small for several reasons. GP care is free for most Australians, especially older people (for around 85 per cent of people aged 65 and over) (Department of Health and Ageing, 2005). For most medications, GPs can prescribe several courses (up to six) at one time. They can also prescribe as many different types of medication at one time as deemed appropriate. Furthermore, many people will have needed to see their GP in any case, for reasons other than to obtain the prescription. Nevertheless, it is difficult to estimate the net value of these costs. For the purpose of the illustration, this unmeasured cost is assumed to be \$1 per prescription. This is applied throughout the analysis, regardless of the cash price. Sensitivity of the results is shown for alternative assumptions of \$0.50 and \$5.

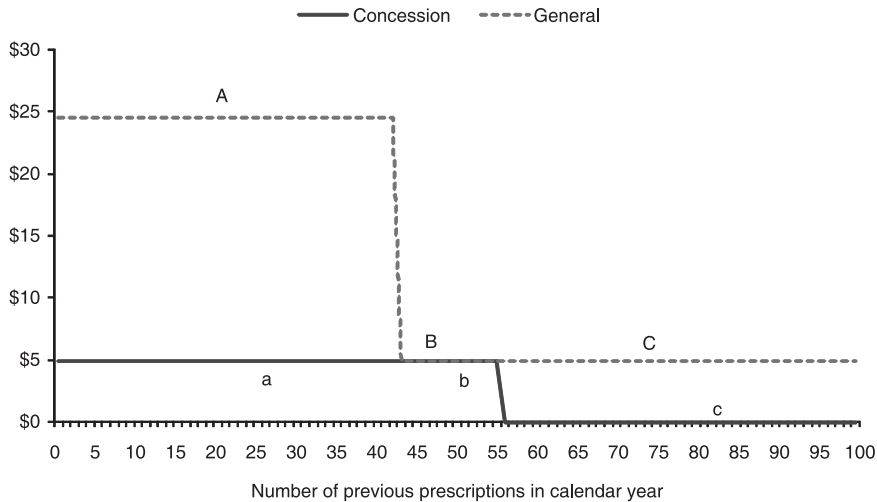
Consider a CSHC holder with $\alpha = -0.1$, $\delta = 2$, $I = \$40\,000$ and consumption of 30 units of pharmaceuticals ($x_0 = 30$). Substituting these values into (8), c is equal to 2.2×10^{-8} . Evaluating Equation (9) at these values results in a utility value of -2.5×10^{-5} . If the concession was removed (if p is increased to p_1), what would be the compensation required to maintain utility at the same level? Substituting into Equation (11), the compensating variation is evaluated to be \$547. This consumer would be indifferent between a health concession card and a cash benefit of \$547.

Now consider the cost to government of the CSHC subsidy. At $p = \$25.56$, $x = 25.91$ (from Equation (8)), which is the component of consumption *not* induced by the CSHC. For each of these 25.91 prescriptions, the cost to government is equal to the difference between the concessional and general PBS prices, which is $\$24.56 - \$4.90 = \$19.66$. An additional $30 - 25.91 = 4.09$ prescriptions were induced by the price change (moral hazard). In the absence of the CSHC, these would not have been consumed at all. For these 4.09 prescriptions, the unit cost to government is greater than for each of the original 25.91. It is equal to the full government contribution of these drugs. For concession card holders this is estimated to be \$32.¹⁰ In total, the cost to government of the

⁹ The notional general co-payment amount was \$30.70 in 2007. However, some listed drugs have a lower price. The ratio of average out-of-pocket price to the listed co-payment price for CSHC holders was estimated by Siminski (2008a) and is applied here.

¹⁰ This is equal to the total government contribution to PBS expenditure for concession card holders divided by the number of prescriptions. Corresponding data are not available for the subset of CSHC cardholders.

FIGURE 3
Nonlinear Concessional and General Price Schedules, 2007



CSHC for this consumer is equal to $25.91 \times (\$24.56 - \$4.90) + 4.09 \times 32 = \640 . The DWL is the difference between HCV and government cost = \$94, or 15 per cent of its cost.

The above example is a special case in a more general situation, characterised by a nonlinear price schedule (Figure 3). The quantity demanded in the example above is to the left of the discontinuities in both price schedules ($x_0 < 43$). This quantity and the associated marginal price are labelled as 'a' in Figure 3. Quantity demanded and the marginal price in the counterfactual (general PBS prices) is labelled 'A'. 'A' is also the left of the discontinuities whenever $x_0 < 43$, since the marginal price in the general schedule is greater than or equal to the concession price at all levels of consumption. Let 'Scenario 1' refer to the situation where $x_0 < 43$.

In Scenario 2, x_0 is between the price discontinuities in the two price schedules ($43 < x_0 < 56$ prescriptions in the year, labelled 'b'). To calculate the corresponding HCV, it is necessary to calculate utility under the counterfactual, which is the general price schedule. To do so, one must confront the issues posed by the nonlinear price schedule. The optimal consumption level in the counterfactual (x_1) might also lie between the discontinuities (denoted 'B'). However, the consumer may derive higher utility from a lower level of pharmaceutical

consumption, $x < 43$, given the higher price of each of the first 43 prescriptions.

Nonlinear price schedules pose considerable difficulties for the analysis of health care demand (Keeler *et al.*, 1977). However, under the assumptions outlined above, the consumer knows their health status for the accounting period with certainty. This consumer can thus choose an optimal level of consumption for the entire year at the beginning of the period. If they choose a point to the left of the discontinuity ($x_1 < 43$), the associated utility and HCV can be calculated using the same techniques as Scenario 1, with price equal to \$25.46.

If the optimum consumption level is to the right of the discontinuity ($x_1 > 43$) they will face an 'effective price' of \$5.90 per prescription. This 'effective price' is relevant to every prescription considered for purchase during the year, since the consumer knows with certainty that an additional prescription purchase will result in an additional expenditure of only \$5.90 for the year. The actual expenditure on pharmaceuticals, however, is greater than this, since the cost of pharmaceuticals is \$25.46–\$5.90 higher for the first 43 prescriptions. The effect of this on consumption and utility is a pure income effect, equal to a reduction in income equal to $(\$25.46 - \$5.90) \times 43$ prescriptions = \$845. Therefore, if the consumer chooses a consumption level greater than 43 prescriptions in

TABLE 5
HCV (\$ Per Person Per Year) and DWL (% of Government Cost) by Consumption Level and Assumed Price Loading

	x_0			Average across all x_0 s, negative binomial distribution: mean = 33.1, overdispersion =					
	30	50	80	0	0.3	1	0	0.3	1
HCV (\$ per person per year)				Singles			Couples		
Price loading									
\$0.50	544	845	893	601	537	458	814	815	734
\$1	547	845	908	604	547	467	861	842	755
\$5	561	845	934	619	559	479	881	863	775
DWL (% of government cost)									
Price loading									
\$0.50	15.4	7.3	39.3	15.2	21.1	27.4	36.9	33.0	33.5
\$1	14.6	7.3	33.6	14.4	17.7	22.9	27.4	26.1	27.2
\$5	10.7	7.3	19.7	10.5	11.8	14.4	14.5	14.4	15.3

Notes: HCV is (Hicksian) compensating variation. DWL is deadweight loss.

the counterfactual, the HCV is exactly equal to \$845. To summarise, pharmaceutical consumption in the counterfactual will be to the left of the price discontinuity ($x_1 < 43$ prescriptions) if the associated utility is greater than consumption above the discontinuity. In other words, if $V(25.46, 40\,000) > V(5.9, 40\,000-845)$. The cost to government and DWL are calculated using the same methods as Scenario 1.

To illustrate, take a consumer with the same parameters as in the first example, with the exception that he consumes 50 units of pharmaceuticals ($x_0 = 50$). From (8), c is equal to 3.7×10^{-8} . In the counterfactual, utility is higher if the consumer purchases more than 43 prescriptions, as $V(5.9, 40\,000-845) = -2.57 \times 10^{-5} > V(25.46, 40\,000) = -2.58 \times 10^{-5}$. The optimal $x_1 = 47.9$. HCV is evaluated to be \$845. The cost to government of the CSHC for this consumer is equal to $43 \times (\$24.56 - \$4.90) + 2.1 \times 32 = \913 . The DWL is \$67, or just 7 per cent of its cost to government.

This is a much smaller DWL than in Scenario 1. This is because the 'effective price' for concession cardholders is the same as that of non-card holders. The DWL is driven solely through an income effect. However, if x_0 is slightly lower (48 units), a much larger DWL is calculated. In this case, the optimum consumption in the counterfactual is to the left of the price discontinuity ($x < 43$). It is in fact 41.5 prescriptions. The associated DWL is \$143, or 14 per cent of the cost to government. It is driven by both income and price effects.

In Scenario 3, $x_0 > 56$ (denoted 'c' in Figure 3). Consider a consumer with the same parameters as in the first two scenarios, with the exception that he consumes 80 units of pharmaceuticals ($x_0 = 80$). Since $x_0 > 56$, the nominal marginal price is assumed to be \$1 per prescription as discussed above. To account for the income effect associated with paying \$5.90 for each of the first 56 prescriptions, income is effectively reduced by $(\$5.90 - \$1) \times 56 = \$274.40$. From (8), $c = 5.1 \times 10^{-8}$. In the counterfactual, utility is maximised with $x_1 = 65.1$ prescriptions. HCV is evaluated to be \$908. The cost to government of the CSHC for this consumer is equal to \$1367. The DWL is \$459, or 34 per cent of its cost to government. If the assumed additional price of pharmaceuticals is increased to \$5, the DWL falls to 20 per cent of the government cost. If it is assumed to be 50 c, the DWL increases to 39 per cent. Regardless of the choice of this parameter, the DWL is highest in Scenario 3.

The left panel of Table 5 summarises the results for the three illustrative consumption levels and the assumed price loading per prescription (α and δ are fixed at -0.1 and 2 , respectively). The value of the card to the recipient clearly depends on the consumption level, with high consumers benefiting more than low consumers. DWL also varies considerably at the different levels of consumption, being highest for high consumers and lowest for those who consume 50 prescriptions. The estimated HCV is not particularly sensitive to the assumed

TABLE 6
HCV (\$ Per Person Per Year) and DWL (% of Government Cost) by Price Elasticity of Demand for Pharmaceuticals

	x_0			Average across all x_0 s, negative binomial distribution: mean = 33.1, overdispersion =					
	30	50	80	0	0.3	1	0	0.3	1
HCV (\$ per person per year)				Singles			Couples		
Price elasticity									
0	599	845	948	659	583	497	892	880	795
-0.1	547	845	908	604	547	467	861	842	755
-0.3	458	769	481	506	424	356	364	558	554
DWL (% of government cost)									
Price elasticity									
0	-1.5	7.3	7.5	-1.2	1.9	3.5	3.5	3.2	3.0
-0.1	14.6	7.3	33.6	14.4	17.7	22.9	27.4	26.1	27.2
-0.3	36.5	36.0	78.2	36.4	48.3	55.3	79.9	66.5	62.5

Notes: HCV is (Hicksian) compensating variation. DWL is deadweight loss.

price loading due to unobserved costs. However, the estimated DWL is sensitive to the price loading, particularly at the top of the distribution (where pharmaceuticals are nominally free).

The middle and right panels of Table 5 shows the average HCV and DWL across the assumed distributions of consumption for singles and couples, respectively. As before, the assumed value of the overdispersion parameter is 0.3, and consumption is assumed to be uncorrelated between members of couples. The preferred estimate for the average HCV of the PBS component of the CSHC is \$547 for singles and \$842 for couples (\$421 per coupled person). As in the previous exercise, above, this estimate for coupled people is lower than for singles because couples are more likely to reach the safety net threshold under general prices than singles. The estimates are neither particularly sensitive to the assumed overdispersion, nor to the assumed price loading. The DWL percentages in the middle and right panels are the percentage of total government expenditure that is DWL (rather than the average of DWL percentages across the distribution). In the preferred estimate for singles, the DWL is equal 17.7 per cent of government expenditure, but this is sensitive to the assumed overdispersion and price loading. The estimated DWL percentage is higher for couples than for singles, at 26.1 per cent in the preferred model. For couples, the DWL estimate is much less sensitive to the assumed overdispersion, but remains sensitive to the price loading.

Table 6 shows the sensitivity of results to the price elasticity of demand for pharmaceuticals (δ is fixed at 2 and the price loading is \$1). The value of the card to the recipient does not vary greatly with price elasticity. The estimated cost to government of the card varies far more with this parameter. Thus the share of government expenditure that is DWL also varies considerably.

Table 7 shows the sensitivity of results to the income elasticity of demand for pharmaceuticals (α is fixed at -0.1 and the price loading is \$1). Neither the HCV nor the DWL is sensitive to income elasticity.

The results are also insensitive to the assumed income of the consumer. For example, the HCV varies by just \$2 between $I = \$30\,000$ and $I = \$50\,000$ for singles. The corresponding variation in DWL is 0.4 per cent.

The above analysis has assumed a constant elasticity demand function. This appears to be the only specification flexible enough to impose the same price elasticity for both of the discrete price changes that characterise the nonlinear price schedules under consideration. As an example, consider a log linear demand function, commonly used in studies of health care utilisation:

$$\ln x = a + \beta_1 p + \beta_2 I. \quad (12)$$

Consider the discrete price change from \$5.90 per prescription to \$25.56 per prescription. For the (arc) price elasticity to equal -0.1 in this demand function, β_1 must equal -0.0064.

TABLE 7
HCV (\$ Per Person Per Year) and DWL (% of Government Cost) by Income Elasticity of Demand for Pharmaceuticals

	x_0			Average across all x_0 s, negative binomial distribution: mean = 33.1, overdispersion =					
	30	50	80	0	0.3	1	0	0.3	1
HCV (\$ per person per year)				Singles			Couples		
Income elasticity									
0.5	541	845	918	597	543	467	864	844	756
2	547	845	908	604	547	467	861	842	755
5	558	845	890	618	554	469	854	839	752
DWL (% of government cost)									
Income elasticity									
0.5	15.5	2.0	30.9	15.3	17.0	21.5	26.1	24.9	26.1
2	14.6	7.3	33.6	14.4	17.7	22.9	27.4	26.1	27.2
5	12.8	16.1	38.3	12.4	18.7	25.2	30.0	28.4	29.4

Notes: HCV is (Hicksian) compensating variation. DWL is deadweight loss.

However, to impose the same price elasticity for a change from \$1 to \$5.90, β_1 must be much larger (-0.0290). Thus it is impossible to implement the above approach with a log linear demand function that is consistent across all consumption levels.¹¹

To summarise, the average HCV of the PBS concession for CSHC holders is estimated to be \$547 for singles and \$842 for couples. This estimate is not greatly sensitive to variations in any of the assumed parameters. The deadweight loss of the concession is estimated to equal 17.7 per cent of the cost to government for singles and 26.6 per cent for couples. The DWL estimate is sensitive to the assumed price elasticity of demand, the assumed price loading and, for singles, the assumed overdispersion in the distribution of consumption. Regardless of the assumed parameters, the DWL percentage is greater for couples than for singles, which reflects their higher likelihood of surpassing the concession safety net threshold. The concession provides no insurance value through risk pooling. However, there is likely to be considerable variation between individuals

¹¹ If, however, each price change is considered in isolation with different log-linear demand functions, corresponding estimates can be generated. This produces similar estimates of HCV (3–4 per cent higher than the preferred approach at all consumption levels) and slightly smaller estimates of DWL (12–25 per cent smaller). Nevertheless, the validity of such an approach is questionable.

around the average value of the concession. This variation is primarily due to differences in PBS consumption levels, which reflect preferences over pharmaceutical versus non-pharmaceutical consumption. These, in turn, will be partially a function of health status.

V Interpreting 'Deadweight Loss'

The deadweight loss estimated in the previous section results directly from consumers' responsiveness to pharmaceutical prices. Whether the higher consumption associated with lower prices can be interpreted to reduce welfare rests on several assumptions, which can be problematic in the analysis of health care in general (see Rice, 1998 for a detailed critical introduction to these issues). Perhaps some of these assumptions are more likely to hold for the CSHC population than for other population groups who are more responsive to price. Nevertheless, it is unlikely that all of these assumptions hold for all CSHC holders, and the effect of this on welfare is difficult to quantify. Thus the estimated welfare loss associated with moral hazard must be considered in light of the unmeasured consequences of possible violations of the assumptions that are listed below.

The first set of assumptions concerns revealed preferences. Traditional demand theory assumes that consumers will respond to a price change in a way which maximises their individual wellbeing. This requires that consumers be perfectly informed of the health consequences of changing

the quantity of their pharmaceutical consumption. They must also be able to weigh up the effect of any such health consequences against the utility from consumption of other commodities. Finally, behaviour is assumed to be motivated by personal wellbeing, rather than a broader concern over the consequences of ones actions on others (see especially Sen, 1973 for a discussion of this last point).

Even if consumers are well-informed, rational and self-interested, a reduction in pharmaceutical consumption may translate into higher consumption of other forms of health care which are also subsidised by government. This may result in more expensive treatment, such as emergency hospital treatment, for instance (see Newhouse, 2006 for a review of evidence to this effect; and especially Tamblyn *et al.*, 2001 in relation to pharmaceutical subsidies for older people).

Finally, the deadweight loss calculations do not account for the altruistic externalities that characterise health care markets (Thurow, 1974; Hall, 2001). Altruistic externalities are associated with what Tobin (1970) calls 'specific egalitarianism'. People are generally less willing to tolerate inequality of access to health care than to other commodities. Thus the health (and health care) of a given person may enter the utility functions of others. However, this may be a minor issue in the case of the CSHC. CSHC holders have been found to be quite unresponsive to a pharmaceutical price change. The card may have little if any effect on their health. Thus externalities associated with their health status are likely to be small. Similarly, the utility gain from the altruism of subsidising the consumption of this wealthy population may be smaller than that gained through supporting poorer groups.

VI Conclusion

This article has analysed the welfare implications of the Commonwealth Seniors Health Card, focusing on the pharmaceutical concession which the card provides. Its main feature is a pair of models which estimate the welfare gain of risk pooling and the welfare loss of moral hazard, respectively. I find that the welfare gain through risk reduction is negligible, whereas the welfare loss through moral hazard may be substantial. The deadweight loss of the concession is estimated to equal 18 per cent of the cost to government incurred on singles and 26 per cent for couples. This is despite a relatively small estimated price elasticity of demand for pharmaceuticals for this population (-0.1). While the deadweight loss

estimates are sensitive to the assumed parameters, most estimates exceed 10 per cent for singles and 15 per cent for couples.

These results must be considered in the context of the assumptions discussed in section V, which demonstrates the difficulties involved in analysing the welfare implications of health care programs. Some of these assumptions will unquestionably be violated to some extent and it has not been possible to quantify the implications of these violations. However, the extent of these violations may be less severe given the wealth of the CSHC population and their apparently small price elasticity of demand. These assumptions deserve even more consideration in analyses of health care programs that cover populations that are poorer or more responsive to price.

If it is accepted that the deadweight loss of the CSHC pharmaceutical concession represents welfare loss, a cash transfer may be a more efficient use of resources. On the other hand, the concession has greater value for people with higher PBS consumption. To the extent that higher PBS consumption reflects poorer health, the concession is perhaps more equitable than the equivalent cash transfer. However, CSHC holders are a particularly wealthy population and so the CSHC may be regarded as an inequitable transfer. If so, social welfare may be improved by redirecting resources towards programs that are more efficient and/or more equitable than the CSHC.

Finally, it is noted that the CSHC may elicit behavioural responses in the realms of saving and labour supply, which are additional considerations for analyses of its welfare implications. Indeed, the CSHC is intended to encourage people to save for retirement. Whether the card has had such an effect has not been established, although Siminski (2008b) suggests that while the CSHC creates incentives for some people to save for retirement, it may have the opposite effect on others.

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Appendix

Section III estimates the welfare gain of the CSHC due to risk pooling. It uses a health state-dependent utility function which does not allow the marginal utility of consumption to vary with health status. There is some evidence that the marginal utility of consumption decreases with sickness (increases with health) (e.g. Viscusi & Evans, 1990; Finkelstein *et al.*, 2008). This is not a limitation to the analysis if pharmaceutical consumption completely restores full health, but this is unrealistic. This appendix outlines the implications of relaxing this assumption. Specifically, I show that the value of risk-avoidance is even smaller if the marginal utility of consumption decreases with sickness.

Equation (6) in the body of the text states that a consumer is indifferent between a cash transfer of M and a pharmaceutical concession. Here, the analysis is simplified by assuming only two health states, good and bad, which have probabilities of g and b , respectively. The bad health state elicits consumption of x pharmaceuticals at a price of p . The good health state requires no pharmaceutical consumption. The nonlinear price concession of the CSHC is replaced by a pure subsidy that is equal to $(1-r) \times 100\%$ of general out of pocket expenditure (r is the rate of co-insurance). Finally, the marginal utility of consumption in the bad health state is equal to γ times the marginal utility of consumption in the good state. Thus marginal utility of consumption is lower in poor health when $\gamma < 1$. With these modifications, an equation that is equivalent to Equation (6) is:

$$gU_1(I+M) + b\gamma U_1(I-px+M) = gU_1(I) + b\gamma U_1(I-rpx). \quad (A1)$$

Let the utility of non-pharmaceutical consumption be a CRRA function, where ρ can take any value.

$$g \frac{(I+M)^{1-\rho}}{1-\rho} + b\gamma \frac{(I-px+M)^{1-\rho}}{1-\rho} = g \frac{I^{1-\rho}}{1-\rho} + b\gamma \frac{(I-rpx)^{1-\rho}}{1-\rho}. \quad (A2)$$

It will be shown that $dM/d\gamma > 0$ in general. This implies that a lower marginal utility of consumption in poor health results in a lower cash equivalent value of the subsidy. Furthermore, the

expected government expenditure on the subsidy is equal to $b(1-r)x$ regardless of γ . It follows that the welfare gain of the subsidy due to risk reduction is also lower under the assumption of lower marginal utility of consumption in poor health. To find $dM/d\gamma$, Equation (A2) is implicitly differentiated:

$$g(I+M)^{-\rho} \frac{dM}{d\gamma} + b \left[\frac{(I-px+M)^{1-\rho}}{1-\rho} + \gamma(I-px+M)^{-\rho} \frac{dM}{d\gamma} \right] = b \frac{(I-rpx)^{1-\rho}}{1-\rho}. \quad (A3)$$

Make $dM/d\gamma$ the subject:

$$\frac{dM}{d\gamma} = \frac{(1-\rho)^{-1}b[(I-rpx)^{1-\rho} - (I-px+M)^{1-\rho}]}{g(I+M)^{-\rho} + b\gamma(I-px+M)^{-\rho}}. \quad (A4)$$

Note that g, I, M, b, γ are all ≥ 0 . Also, $I > px$ as long as pharmaceutical consumption does not exceed income. Therefore the denominator of Equation (A4) is positive, and $dM/d\gamma$ has the same sign as:

$$(1-\rho)^{-1}[(I-rpx)^{1-\rho} - (I-px+M)^{1-\rho}] \quad (A5)$$

when $\rho > 1$, $(1-\rho)^{-1} < 0$ and when $\rho < 1$, $(1-\rho)^{-1} > 0$. The second term of Equation (A5) is negative when:

$$(I-rpx)^{1-\rho} < (I-px+M)^{1-\rho}. \quad (A6)$$

When $\rho > 1$, Equation (A6) implies: $(I-rpx) < (I-px+M)$ which simplifies to: $M < px(1-r)$. Similarly, the second term of Equation (A5) is positive when $\rho < 1$ and $M < px(1-r)$. Therefore, from Equation (A5), $dM/d\gamma > 0$ if $M < px(1-r)$ regardless of the value of ρ . To see if this inequality holds, consider the expected utility in the left hand side of Equation (A1). If the transfer (M) is equal to $px(1-r)$, expected utility is:

$$gU(I+px[1-r]) + b\gamma U(I-rpx) \quad (A7)$$

but this is greater than the right hand side of Equation (A1), since $px > 0$ and $r < 1$. Therefore, for the equality in (A1) to hold, the transfer (M) must be smaller, so that $M < px(1-r)$ must hold in general. Therefore, $dM/d\gamma > 0$.