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COMBINING RISK ADJUSTMENT WITH RISK SHARING IN HEALTH PLAN PAYMENT SYSTEMS: PRIVATE HEALTH INSURANCE IN AUSTRALIA

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Combining Risk Adjustment with Risk Sharing in Health Plan Payment Systems: Private Health Insurance in Australia

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ABSTRACT

Health plan payment systems with community-rated premiums typically include risk adjustment, risk sharing or both to compensate insurers for predictable profits (on young and healthy people) and predictable losses (on the elderly and chronically ill). This paper shows how a payment system based only on risk sharing (like in Australia), is improved by combining risk sharing with risk adjustment. Using Australia's private health insurance market as a case study, we compare and assess the current risk sharing based payment system against alternative systems which combine risk adjustment and risk sharing. Specifically, we develop outcome measures to compare the models in terms of incentives for risk selection and incentives for cost control. We find that a payment system composed of risk adjustment based on simple risk-adjustor variables, supplemented with outlier risk sharing outperforms the current system based solely on risk sharing. Our results show that as more and better data become available, reliance on risk sharing can be reduced whilst the use of risk adjustment can be expanded. In an additional analysis, we show that changes in the payment system affect the redistribution of claims costs across different levels of coverage. We discuss qualitatively additional measures that can be taken to achieve the desired level of redistribution.

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1 Introduction

Regulated health insurance markets typically rely on community-rated premiums to achieve fairness objectives such as affordability of health plans for high-risk people. Despite its positive intended effects on fairness, community rating has an important drawback: it confronts insurers with predictable profits (on the young and healthy) and losses (on the old and chronically ill) on average. This creates incentives for insurers to engage in risk selection, that is, actions to attract profitable and deter unprofitable enrollees (Van de Ven, van Vliet, & van Kleef, 2017).

In practice, payment systems can be composed of risk adjustment, risk sharing or both to redistribute expenditures among insurers to compensate for higher-cost enrollees. By risk adjustment we mean the use of indicators of *expected* health care expenditure (e.g., age, prior diagnoses) to redistribute payments among insurers to match revenues with expected costs. By risk sharing we mean payments to insurers based on the *actual* claims costs of enrollees. Whereas most regulated health insurance markets rely on risk adjustment alone (e.g., Medicare Advantage in the U.S.[1] and the private health insurance scheme in Chile[2]) or a combination of risk adjustment and risk sharing (e.g., the basic health insurance schemes in the Netherlands[3], Germany[4] and Switzerland[5]), the Australian private health insurance scheme exclusively relies on risk sharing.

When it comes to the choice of using risk adjustment, risk sharing or a combination of both, several considerations are important. The appeal of risk adjustment is that - because of its prospective nature - incentives for cost control can be largely preserved. Setting payments in advance means that spending by enrollees reduces revenues to insurers, incentivizing them to control spending (Layton, Ellis, McGuire, & van Kleef, 2018). Risk adjustment, however, can be data intensive, requiring information to construct reliable indicators of expected health care costs, like diagnosis-based adjustors[6] (Iommi, Bergquist, Fiorentini, & Paolucci, 2022).

Compared to risk adjustment, risk sharing can be less data intensive, as it relies on actual claims cost which should be more readily available for purposes of plan payment. Like risk adjustment, risk sharing can reduce selection incentives (Henriquez, Iommi, McGuire, Mentzakis, & Paolucci, 2023; McGuire, Schillo, & van Kleef, 2020; Brammli-Greenberg, Glazer, & Waitzberg, 2019). By compensating insurers for parts of actual claim's costs, it may reduce incentives for cost control[7] (Van Barneveld, Lamers, van Vliet, & van de Ven, 2001).

This paper illustrates how combinations of risk adjustment and risk sharing help balance the trade-off between incentives for risk selection and incentives for cost control. We use the Australian voluntary private health insurance (PHI) market as a case study to design and evaluate alternative

[1] McGuire & Newhouse (2018).
[2] Velasco, Henriquez, & Paolucci (2018).
[3] Van Kleef, Eijkenaar, van Vliet, & van de Ven (2018).
[4] Wasem, Buchner, Lux, & Schillo (2018).
[5] Schmid, Beck, & Kauer (2018).
[6] Diagnosis-based risk adjustors are not incentive free: insurers may provide extra services or "up-code" diagnoses to increase revenues (Geruso & Layton, 2020; Jacobs & Kronick, 2021).
[7] Endogenous risk adjustors reduce incentives for cost control as well. More codes generated by more services increase revenue. See Geruso & McGuire (2016).

payment systems and compare them with the existing risk sharing based system. More specifically, we examine "hybrid" systems that combine risk adjustment and risk sharing. We propose criteria to quantify and assess incentives for risk selection, including: payment system fit, over and under compensation for particular subgroups of low- or high-risk enrollees (Van Kleef, Eijkenaar, & van Vliet, 2020), as well as incentives for cost control.

In an additional analysis, we assess the impact of changes in the payment system on the cost structure (net of risk adjustment/sharing) for the multiple coverage tiers in Australia (Geruso, Layton, McCormack, & Shepard, 2021; Saltzman, 2021; Klein, van Kleef, Henriquez, & Paolucci, 2023).

To our knowledge, our work is the first comprehensive empirically based review of the Australian health plan payment system, assessing its performance, ability to reduce risk selection, and incentives for cost control.

The rest of the paper is organized as follows. Section 2 describes private health insurance in Australia. Section 3 describes the data and methods. Section 4, first, compares the outcomes of the current payment system with the alternative models that combine risk adjustment and risk sharing, and second, shows the effects of the payment system on the redistribution of claims costs across product tiers. Finally, Section 5 presents the conclusion and discusses our main findings.

2 Private Health Insurance in Australia

Private Health Insurance (PHI) in Australia plays an important role in the health system. Since the introduction of Medicare in 1984, which extended coverage to all Australian residents, the health system has been characterized by a public-private mix in terms of funding and provision.

On top of Medicare, individuals may purchase PHI for two types of coverage: duplicative/complementary (i.e., hospital treatment policies); and/or, supplementary, which insures for those services not covered by Medicare (e.g., dental) (i.e., general treatment policies) (Paolucci, Sequeira, Fouda, & Matthews, 2018). PHI is significant in enrollment terms, covering roughly half the population (APRA, 2022). While it does not represent a substantial part of health care funding (approximately 8% of total healthcare spending (AIHW, 2022)), it is an important source of revenue for private hospitals, as around half their funding comes from PHI (AIHW, 2022).

Several regulatory tools typical of competitive individual health insurance markets are present in the Australian PHI. One of the "historic features" (National Health Act 1953) relates to the community-rating principle (McDonald & Duckett, 2017). The principle includes the community rating of premiums (that is, same premium irrespective of individuals characteristics) and open enrolment (inability to refuse coverage based on an individuals' characteristics). To support community rating, the Private Health Insurance Risk Equalization Trust Fund (RETF) was introduced. The objective of the fund is to partially compensate insurers with a more costly demographic profile by redistributing funds away from those insurers covering a less costly group.

The current model of the RETF is based on *actual* claims[8] experience of insurers, and has two components upon which payments are made: an age-based pool (ABP), which shares spending for those above 54 years of age, based on predefined weights, and a high costs claimants pool (HCCP) which applies to a percentage (82%) of excess expenditure over $50,000, after taking into account the ABP (Connelly, Paolucci, Butler, & Collins, 2010). Transfers between insurers and the RETF pool are made every quarter based on the difference between the claims cost for an insurer and the average eligible claims costs in the state.

The regulatory landscape has evolved over time. The decline in participation rates following the introduction of the public Medicare system in the mid 80's led to the implementation of "carrots and sticks" policies through 1997-2000 to reverse this trend, specifically, the Lifetime Health Cover (LHC) – a loading of the premium for each year an individual fails to enroll in PHI after the age of 30-, Medicare Levy Surcharge (MLS) – an levy for those high income earners who do not hold appropriate hospital treatment policies-, and premium rebates – a government funded, means and age tested subsidy on premiums-. More recently, in 2019, further reforms were put in place to improve consumer decision making. These reforms introduced product tiers for hospital treatment policies, where a policy could fall into one of four broad groups: gold, silver, bronze and basic.

3 Data and methods

3.1 Data

We use a rich administrative dataset with information on age, gender, choice of insurance product, and claims costs of Australians with PHI in 2018 and 2019.[9] Insurance products are grouped into four product tiers: basic, bronze, silver, and gold. Claims costs are categorized into three clusters: hospital, medical and prosthesis. Our initial sample contained 14m enrollees. After selecting individuals that were fully enrolled in both years, 8.4m individuals remained in our study sample.

Our payment models generate plan revenues for 2019. The average annual total claims costs (the sum of hospital, medical and prosthesis) for 2019 is $1,325 (SD = 6,374). More than 80% of the working sample has no claims in 2019. The 90th percentile exhibits average claims cost of $1,841, while the 99th percentile individuals have claims costs of more than 10 times that value ($22,917). Males comprise 48.5% of the working sample. Most individuals are 54 years and younger (67.2%). The largest age-gender groups are females aged 35-39 and 45-49, and for males, those aged 45-49.

Given that the payment models generate revenues for 2019, the data from 2018 allow us to identify ex-ante risk types based on prior use. In particular, the available information includes the number of episodes per individual during the 2018 year, which ranges from 0 to 326. Individuals with a

[8] Eligible spending corresponds to Hospital benefits (that is services that require hospitalization), Hospital substitute benefits (e.g., substitute services provided by ancillary providers such as dental treatment, home nursing, physiotherapy), Chronic Disease Management Program benefits (that is treatments aimed at reducing complications and enhancing the prognosis of patients with chronic disease).

[9] Years run from April of year t to March of year t+1. So, for example, the 2018-year period consists of the 12 months between April 2018 and March 2019.

high episode count, most likely reflect daily "episodes" for outpatient treatments or hospital substitution. Those with 4+ episodes comprise 1.8% of the sample.

Gold products (3.3m – 39.8%) and silver products (3.2m – 37.7%) are the most frequently chosen product tiers.

3.2 Methods

In this subsection we present the methods behind the model simulations. First, we describe the rules governing the current health plan payment system in Australia, based on proportional risk sharing that varies by age, supplemented with a high-cost pool. There is no risk adjustment used in the current model. Second, we explain the alternative models being considered which combine risk adjustment and risk sharing. Risk sharing takes the form of high-cost reinsurance. All calculations were performed using R (version 4.0.3).

3.2.1 Rules governing the current health plan payment system in Australia

The current Australian plan payment system includes two risk sharing features: the age-based pool (ABP) and the high-cost claimants pool (HCCP). The payments related to the ABP are determined by the multiplication of annual individual-level total claims costs and the predetermined weights related to the age of the enrollees shown in Table 1. For example, for an individual aged 67 with annual total claims costs of $140,000, the insurer will receive an ABP payment of 60%*$140,000 = $84,000.

Table 1: The percent (%) of total claims costs compensated via the ABP

Age	%
0-54	0%
55-59	15.0%
60-64	42.5%
65-69	60.0%
70-74	70.0%
75-79	76.0%
80-84	78.0%
85+	82.0%

Source: (APRA, 2022).

Payments in the high-cost claimants pool (HCCP) are based on the difference between the total annual claims and the annual ABP payment. We refer to this difference as the 'residual'. When this residual exceeds $50,000, the insurer receives a payment from the HCCP equal to 82% of the residual above $50,000. So, for our 67 year old enrollee, the residual equals $140,000-$84,000 (ABP payment) = $56,000 and, consequently, the HCCP payment equals 82%* ($56,000-$50,000) =

$4,920. So, the total payment for this individual sums up to $88,920 ($84,000 ABP payment plus $4,920 HCCP payments).[10]

The first column of Table 2 summarizes the features of the current system. The payment flows in the Australian health plan payment work as follows. Insurers collect premiums from their enrollees. We assume an enrollee premium based on the population average cost, equal to the average total claims' costs amongst all individuals in the working sample ($1,325). At this point, we treat the data as if all enrollees are in the same product tier (facing the same premium, with the same benefits). Later, we address the issue of the product tier structure (Section 4.2). Next, based on the ABP and HCCP rules, an average (per person) contribution to the pool by the insurers is determined, reflecting the average of the total ABP and HCCP payments. According to our calculations, this equates to $628. The insurers' net premium is captured then by the difference between the population average cost and the average (per person) contribution to pool ($1,325 - $628= $697). To obtain the insurer plan profit/loss (per person) the following formula is required: we compare, at the individual level, the actual claims costs with the insurers payments - which come from the ABP and HCCP pool, and the insurers net premium. This translates into a profit if the insurers payment is above the actual claims costs for an individual, and conversely, to a loss, if the actual claims costs exceed the insurer payments. By construction, the risk sharing in the current system (and in our application) is balanced budget.

3.2.2 Risk adjustment using ordinary least square regressions and reinsurance

The alternative models include risk adjustment in addition to risk sharing. We choose 'risk adjustors' based on data availability, and then estimate payment weights for these risk adjustors using ordinary least squares (OLS) regressions. Table 2 summarizes the main models (including the current system which does not require regression analysis) and their features.

The starting point for risk adjustment will be a model with risk adjustors for age and gender. More specifically, we include 18 risk classes for age (i.e., 0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85+) and combine each of these classes with two classes for gender (i.e., males/females). This provides us with a total of 36 cells, each of which is used as a dummy variable in the OLS regression.

We add to the above a measure of morbidity based on the presence of a prior-year hospital episode. This measure also takes the form of a dummy variable and has the value of 1 if an individual had one or more hospital episodes in the prior year, and 0 otherwise. Observations missing a count of prior hospitalizations were combined with those reporting 0 based on the similarity of 2019 spending.

[10] In practice, ABP- and HCCP-payments are calculated on a quarterly basis. We expect that the annual procedure applied here more or less leads to the same outcomes, as the quarterly calculations are simply a more frequent calculation of the payments, which added, should equate to the annual amounts we calculate.

Table 2: Summary of the main simulated models and features

		Without reinsurance		With reinsurance	
	Current	**Age and gender**	**Age, gender and morbidity based on prior year hospital episodes**	**Age and gender**	**Age, gender and morbidity based on prior year hospital episodes**
Enrollee Premium	Population average cost				
Insurer Net Premium	Population average cost less per person contribution to Pool	Age/gender cell weights from regression on plan costs	Age/gender + prior hospitalization cell weights from regression on plan costs	Age/gender cell weights from regression on plan costs	Age/gender + prior hospitalization cell weights from regression on plan costs
Risk Sharing	Payment from Pool according to annualized ABP and HCCP rules	None		90% of costs over $20k (or $15k) in annual costs per enrollee	90% of costs over $20k (or $15k) in annual costs per enrollee
Plan Profit/Loss Per Person	Insurer Net Premium + Risk Sharing (if present) – Claims Cost				

We combine these models with risk sharing in the form of reinsurance, i.e., compensation of X% of individual-level claims cost above a predefined threshold. Compared to the current risk sharing mechanisms, reinsurance directs risk sharing to higher cost individuals. We examine two threshold values ($20,000 and $15,000) and a cost-sharing rate (X) of 90% above the threshold. The aggressive values for reinsurance were chosen to maintain the very high payment system fit of the current scheme. We estimate these models using a two-step procedure that yields the optimal risk adjustment weights given the presence of reinsurance. Using the $20,000 threshold as an example, first, we pull out of the dependent variable (total claims costs for 2019) the costs subject to reinsurance. In practice, this means that our new dependent variable is total claims costs if their spending is below the threshold of $20,000, and if above, will take the value of $20,000 + 10% of the difference between their total claims costs and the threshold. The virtue of pulling out reinsurance payments from total costs prior to running the risk adjustment regression is that weights reflect costs the plan is at risk for after risk sharing is taken into account (McGuire, Schillo, & van Kleef, 2020).

3.2.3 Evaluation criteria

We evaluate the alternative models according to three criteria. For two of these criteria (payment system fit, under/overcompensations) we follow the standard procedure in the health plan payment literature and treat the data as if all enrollees are in the same product tier (facing the same premium, with the same benefits). More specifically, we assume that all individuals pay the same premium which equals the population average costs. Based on this assumption we calculate the insurer's profit/loss on individual i as the (insurers net premium plus the risk sharing payment for individual i minus [the claims cost for individual i). Later, we address the issue of the product tier structure (Section 4.2).

Payment system fit

As a summary measure for explanatory power we use 'payment system fit' (PSF), a measure analogous to the R-squared (R^2) (see McGuire, Zink, & Rose (2021) for details and related literature). PSF replaces the prediction from the regression model (as would be done to calculate an R^2) with the total payment that an insurer receives (which can be composed of premiums, risk adjustment and/or risk sharing). PSF indicates the share of variance in claims cost explained by the payment model. This is important because we can measure how well a proposed option fits relative to the current system or other alternative. Like an R^2, PSF is based on squared errors, which weigh large errors more than small errors, making it sensitive to variance in expenses and outliers in the data.

Over and under compensations

To assess incentives for risk selection, we calculate the average insurer profit/loss per person for several subgroups based on the following information: age (0-54, 55+), gender (male/female), the number of prior hospital episodes (0, 1, 2, 3, +4). Profits and losses are expressed in dollars per person and indicate the incentives for insurer to select in favor or against a specific subgroup.

Incentives for cost control

We assess incentives for cost control by evaluating the share of total claims costs that are subject to risk sharing in the different alternatives. As more claims costs are shared, incentives for efficiency are reduced. Including age and gender as risk adjustors do not affect cost control incentives, while an indicator for prior hospitalization does affect incentives. We do not assess incentives related to this use-based (i.e., endogenous) risk adjustor.

4 Results

4.1 Outcomes of the current payment system and the alternative models

In this section we compare the current payment system with the alternative models on the basis of the measures of payment system fit, over and under compensation and incentives for cost control. We present the regression coefficients of the main models in the Appendix.

Table 3 compares the current system with the alternative models based on risk adjustment only. Risk adjustment only models have a low payment system fit (5-7%) compared to the current system (76%). Age and gender explain about 5% of the variance in spending. When we add the morbidity variable, payment system fit increases to about 7%.

Over and under compensation measures show the insurer's mean financial result in dollars per person per year by group. The current system overpays for the young and underpays for the old. Males are overpaid as are individuals with no prior hospital episodes. As is known, including a variable as a risk adjustor in an OLS regression leads to the result that the under/overcompensation for the included group is zero. We see this in the age-gender regression and the regression including an indicator for prior hospital episodes. The one-zero prior hospitalization indicator leads to overpayments for those with 1 or 2 hospitalizations and underpayments for those with 3 or more prior hospitalizations. These under- and overcompensations could be removed by including an additional set of dummy variables that explicitly flag these groups.

Based on the share of total claims costs in the system which are affected by the ABP and HCCP rules, our results show that the heavy reliance on risk sharing reduces incentives for cost control in the current system by 47%. As the contrasting models in Table 3 do not include risk sharing (and only risk adjustment), there are full incentives for cost control. As noted earlier, because we ignore any effect of a prior hospitalization on incentives, the only incentive effect is via risk sharing.

Table 3: Outcomes for the current payment system and alternative models that include only risk adjustment

	Current model	Alternative models with risk adjustment based on:	
		Age and gender	Age, gender and morbidity based on prior year hospital episodes
Payment System Fit	76%	5%	7%
Over/Under Compensation			
Age			
0-54	191	0	0
55+	-391	0	0
Gender			
Female	-67	0	0
Male	71	0	0
Prior hospitalization based on episodes			
0	229	349	0
1	-485	-468	1,273
2	-1,085	-1,456	193
3	-1,849	-3,080	-1,484
4+	-4,388	-8,514	-6,950
Incentives for cost control			
Claims costs affected by risk sharing	47%	0%	0%

Table 4 presents models that combine risk adjustment and reinsurance (90% sharing of individual-level claims cost above 20k). Adding reinsurance brings the payment system fit to approximately the level in the current payment model. As noted, the parameters of the reinsurance were selected with the purpose of matching the fit with the current model. Payment system fit in the 70% range is very high by international standards. In Germany, for instance, where the system reflects expenses in the whole population for a comprehensive basic package the R^2 is 26.5%[11]. In the Netherlands, the current value is 34.5%[12]. In a paper on the Swiss health plan payment system, Beck, Kauer, McGuire, & Schmid (2020) find R^2 of 57% for a combination of risk adjustment and risk sharing.

[11] Bundesamt fur Soziale Sicherung (2021).
[12] Zorginstituut Nederland (2020).

Table 4: Outcomes for the current payment system and the alternative models that include both risk adjustment and reinsurance

	Current model	Alternative models with reinsurance (90% sharing of claims costs above 20k) and risk adjustment based on:	
		Age and gender	Age, gender and morbidity based on prior year hospital episodes
Payment System Fit	76%	71%	72%
Over/Under Compensation			
Age			
0-54	191	0	0
55+	-391	0	0
Gender			
Female	-67	0	0
Male	71	0	0
Prior hospitalization based on episodes			
0	229	240	0
1	-485	-415	781
2	-1,085	-1,106	27
3	-1,849	-2,129	-1,032
4+	-4,388	-5,075	-4,000
Incentives for cost control			
Claims costs affected by risk sharing	47%	23%	23%

In sum, Table 4 shows that simple risk adjustors and reinsurance can provide a comparable overall fit to the current system, while cutting in half the share of claims cost subject to risk sharing (23%), thus improving incentives for cost control.

The inclusion of high-cost risk sharing can be expected to have more of an impact on selection incentives for high-cost groups. Compared to the risk adjustment only models, adding reinsurance, which is targeted at those with high costs, decreases under compensation substantially. In the case of the group with 4+ hospital episodes, under compensations reduce from $-8,514 in the model with "risk adjustment based on age and gender and no reinsurance" (see Table 3), to a low of $-4,000 in the model with "risk adjustment based on age, gender and prior year hospital episodes, and reinsurance" (Table 4). Overall, this implies that incentives for insurers to select against high-risk people are reduced with reinsurance. Or in other words: incentives for insurers to meet preferences of high-risk people are improved.

As a sensitivity check, we simulated the reinsurance models with an alternative threshold value of 15k (see the Appendix). With this threshold, a simple demographic risk adjustment combined with reinsurance leads to improvements over the current system, both in terms of reduced incentives for risk selection and preserved incentives for cost control.

4.2 Health plan payment and redistribution of claims costs across product tiers

In the previous subsection, we simulated payment system outcomes in terms of payment system fit, under/overcompensation and percentage of claims shared. These quantitative measures indicate the effects of alternative payment systems on *incentives for insurers*. In the context of voluntary health insurance with multiple products (such as the Australian PHI), payment systems can also affect *incentives for consumers*. The reason is that payment systems can affect the insurers' net costs per product tiers. By 'net costs' we mean claims costs net of risk adjustment/risk sharing.[13] Under the assumption that competition drives equilibrium premiums to the average net costs per product tier, changes in the payment systems can affect premiums and thereby consumer incentives in terms of 1) whether to buy insurance and 2) which plan to buy. Below, we simulate the impact of the current and alternative payment systems on the net claims cost per product tier. Our key observation is that in comparison to the current model, the alternative systems increase the insurers' net cost for basic, bronze, and silver plans while they reduce the net claims cost for gold plans.

Table 5 shows some descriptive information about the frequency, mean premiums, mean claims, mean age, and percentage with prior hospitalization per product tier. Most enrollees in our data have opted for a silver or gold plan. Only 9 percent opted for basic and 13 percent for bronze. Mean premiums are lower for basic products ($1,349) than for gold products ($3,130). Mean claims vary substantially across tiers, from $166 per person per year for basic to $2,193 per person per year for gold. The reason for this variation is two-fold. First, gold plans simply cover more benefits than basic plans. Second, people with high expected claims are likely to select into gold, while those with low expected claims are likely to select into basic. This 'self-selection' is illustrated by the last two columns: mean age ranges from 32 for basic to 49 for gold, and the percentage of people with prior hospital episodes ranges from 6% for basic to 24% for gold.

[13] In the Australian private health insurance market, products are grouped into coverage tiers. Although claims costs and premiums can vary across products within tiers, our analysis here focusses (for simplification) on the average claims cost and premium per tier. The premiums are sourced from Private Health Information statements from the government website and indicative of the mean premium by product tier.

Table 5: Frequency, mean claims, mean age, and percentage with prior hospitalization per product tier

Product Tier	Frequency	Mean premiums	Mean claims	Mean age	% prior year hospital episodes
Basic	9%	1,349	166	32,0	6%
Bronze	13%	1,616	338	31,5	9%
Silver	38%	2,280	1,042	39,3	15%
Gold	40%	3,130	2,193	48,9	24%
Total	100%		1,325	41,4	17%

Although premiums in the current Australian market are higher for gold than for basic, the relative difference (roughly a factor 2) is not as big as the relative difference in mean claims between these products (roughly a factor 13, see Table 5). One reason is the high administrative costs in Australian private insurance compared to international standards (Douven, et al., 2022). Another important reason for this large gap is that premium variation across tiers is mitigated by the current risk sharing based system. In other words, the current system compensates to some extent for the difference in mean claims across tiers. This can be illustrated with the results in Table 6, which presents the mean risk sharing payment per product tier. As shown by the second column, the current system – on average – generates a negative risk sharing payment for basic, bronze, and silver plans and a positive risk sharing payment for gold plans. A negative payment means that plans are net payers to the risk sharing fund while a positive payment means that plans are net receivers. From the insurers' perspective, these risk sharing payments affect the net mean costs per product tier. More specifically, the insurers' mean costs for basic, bronze and silver go up (compared to a situation without risk sharing) while those for gold go down. We come back to this observation in Table 7.

The third and fourth column of Table 6 show the mean risk adjustment/sharing payment per product tier under the alternative systems. Compared to the current system, the mean payment reduces (gets more negative) for basic, bronze and silver and increases (gets more positive) for gold. Apparently, the alternative systems better recognize (and thus better compensate) for the difference in mean claims across tiers. Although the alternative payment systems do not include a direct indicator for product tier, they include indicators (age, gender, and prior hospitalization) that are to some extent correlated with product tiers (see last two columns of Table 5). Consequently, by compensating insurers for cost variation across age, gender and prior hospitalization, the payment system indirectly compensates for some of the cost variation across tiers. Something similar holds for the reinsurance feature: in an additional analysis (not shown here) we found that the percentage of people eligible for reinsurance varies from 0.1% in basic to 0.2% in bronze, 1.3% in silver and 3.1% in gold.

Table 6: Mean risk adjustment/sharing payment per product tier

Product Tier	Current model	RA age/gender & reinsurance	RA age/gender/prior hospital episodes & reinsurance
Basic	-611	-772	-866
Bronze	-587	-734	-786
Silver	-186	-200	-213
Gold	515	614	665
Total	0	0	0

Note: RA stands for risk adjustment.

Table 7 shows the mean claims cost minus the mean risk adjustment/sharing payment per tier. Compared to the current system, the alternative systems increase the insurers' net costs for basic, bronze and silver, and decrease the insurers' costs for gold. Without further measures, this implies that the alternative systems increase equilibrium premiums for basic, bronze and silver, and decrease equilibrium premiums for gold. In the Conclusion and discussion section we will qualitatively discuss the effects of such a change in equilibrium premiums.

Table 7: Mean claims minus mean risk adjustment/sharing payment per product tier

Product Tier	Current model	RA age/gender & reinsurance	RA age/gender/ prior hospital episodes & reinsurance
Basic	777	939	1,032
Bronze	925	1,072	1,124
Silver	1,228	1,242	1,255
Gold	1,679	1,579	1,528
Total	1,325	1,325	1,325

Note: RA stands for risk adjustment.

5 Conclusion and discussion

This paper has shown how a payment system based only on risk sharing improves by combining it with risk adjustment. In our empirical simulations, "hybrid schemes" combining risk adjustment and risk sharing outperform the current risk sharing-only formula across all criteria. At comparable fit, the hybrid schemes provide considerably more incentives for cost control and at the same time reduce incentives for risk selection on the basis of age, gender, and prior hospital episodes. As more and better data become available, reliance on risk sharing can be more targeted and reduced whilst the use of risk adjustment can be expanded.

In a market with multiple products; our results show how changes in the payment system affect the redistribution of claims cost across different levels of coverage. As results show increased mean costs for some plans (basic, bronze, silver) compared to others (gold), overall participation and consumer sorting across tiers might be affected in the absence of further measures. For example,

as premiums of basic/bronze and silver products preferred by younger and healthier individuals increase, participation by these consumers might be reduced, ceteris paribus. If this is considered undesirable, there is a solution: make an explicit policy decision on the intended redistribution across product tiers and design the payment system in such a way that the intended redistribution is preserved. Although it is beyond the scope of this paper to discuss this procedure in detail, there are several ways to achieve a predefined level of redistribution. One intuitive way is to include variables for product tiers in the risk adjustment model together with a set of constraints[14] on the payment weights that ex-ante defines the cost structure across product tiers that the regulator would like to see in the market. This procedure is in the spirit of McGuire, et al., (2013). An alternative solution could be a simple ex-post subsidy among tiers that results in the intended cost structure across tiers. Key to both solutions is that the regulator ex-ante defines an objective regarding the cost structure (or premiums) across product tiers. This involves a normative tradeoff between fairness, participation, and consumer sorting.

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[14] Solely including risk adjusters for product tiers without constraints will derive in perfect compensations for insurers for differences in mean claims across tiers. This would fully equalize costs across tiers, resulting in the same premium for all four tiers.

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7 Appendix

Table A1: Coefficients of the main models

Table A1.1: Current payment model in Australia

Age group	ABP payment	HCCP payment
0–54	0	17.5
55–59	202	37
60–64	797	16
65–69	1,597	6
70–74	2,550	3
75–79	3,523	1
80-84	4,216	1
85+	4,671	0.0165

Table A1.2: Age and gender, and Age, gender and morbidity based on prior year hospital episodes with 20k reinsurance

Risk adjustor	**Payment weights**	
	Risk adjustment based on age and gender	**Risk adjustment based on age, gender and morbidity based on prior year hospital episodes**
Intercept	175.5 ***	42.3 ***
0–4:F	Baseline	Baseline
0–4:M	62.8 ***	18.3
5-9:F	-72.3 ***	-20.5 *
5-9:M	-54.8 ***	-21.6 *
10–14:F	-34.3 ***	30.4 **
10–14:M	-32.2 ***	27.0 **
15-19:F	190.1 ***	181.5 ***
15-19:M	121.9 ***	135.3 ***
20-24:F	325.3 ***	273.0 ***
20-24:M	169.9 ***	170.4 ***
25–29:F	505.9 ***	444.9 ***
25–29:M	122.7 ***	154.2 ***
30–34:F	666.4 ***	544.1 ***
30–34:M	87.7 ***	118.8 ***
35–39:F	592.2 ***	471.3 ***
35–39:M	134.0 ***	142.6 ***
40–44:F	503.8 ***	406.5 ***
40–44:M	219.7 ***	202.5 ***
45–49:F	576.3 ***	470.9 ***
45–49:M	351.3 ***	302.9 ***
50–54:F	731.2 ***	588.9 ***
50–54:M	572.1 ***	474.7 ***
55–59:F	899.4 ***	724.8 ***
55–59:M	880.7 ***	721.5 ***
60–64:F	1,224.9 ***	999.5 ***
60–64:M	1,325.1 ***	1,092.6 ***
65–69:F	1,730.4 ***	1,429.7 ***
65–69:M	1,938.2***	1,611.1 ***

70–74:F	2,320.6 ***	1,936.6 ***
70–74:M	2,649.2 ***	2,225.9 ***
75–79:F	2,921.2 ***	2,469.0 ***
75–79:M	3,294.8 ***	2,788.6 ***
80-84:F	3,343.1 ***	2,863.6 ***
80-84:M	3,831.0 ***	3,278.3***
85+:F	3,586.3 ***	3,122.6 ***
85+:M	4,242.7 ***	3,682.7 ***
Morbidity based on prior year hospital episodes		1,526.2 ***

Note: M = Male, and F = Female.

Table A2: Sensitivity check on the reinsurance threshold

		Alternative models with reinsurance (90% sharing of claims costs above 15k) and risk adjustment based on:	
		Age and gender	**Age, gender and morbidity based on prior year hospital episodes**
Payment System Fit		79	79
Over/Under Compensation			
Age			
	0-54	0	0
	55+	0	0
Gender			
	Female	0	0
	Male	0	0
Prior hospitalization based on episodes			
	0	214	0
	1	-386	680
	2	-996	14
	3	-1,892	-914
	4+	-4,412	-3,453
Incentives for cost control			
	Claims costs affected by risk sharing	30%	30%