Making Use of Cantonal Contributions to Health Care Costs in Switzerland

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Abstract (181 words)

The financing of the Swiss health care system is on the verge of one of its largest reforms. The parliament is currently debating how to restructure one fifth of the financing of health insurance. Cantons currently make substantial tax-funded contributions in the form of partial payment for hospital inpatient costs. As the insurer is fully responsible for all outpatient costs, the present system may distort the choice of the site of care. This paper considers and evaluates alternative ways the cantonal funds might be used to improve fairness and efficiency. We do this for the two alternatives currently under consideration in the parliament and introduce a third option, using the cantonal funds to pay a share of insurer's expenses above a high-cost threshold. The high-cost risk sharing alternative is the only win-win-win in relation to the current policy: mitigating the incentive to discriminate against sicker individuals, improving incentives for cost control, and reducing risk of loss for insurers. Our paper adds results from Switzerland to an international literature studying the properties of adding high-cost risk sharing to a risk equalization model.

Key words: Risk equalization, Risk adjustment, Risk sharing, Payment fit

Introduction

Germany, Israel, The Netherlands and Switzerland, among other countries, provide health insurance to their residents through health insurance markets where individuals choose from a set of competing insurers. The Medicare Advantage and Marketplace insurance sectors in the U.S. take a similar approach (see [1]). The fundamental health policy issue faced in all these settings is balancing the goal of financing health insurance equitably against the goal of structuring the insurance market with incentives for efficiency. In all of these countries, part of the solution is to work public subsidies financed by tax revenue into the payment flow. When used carefully, and combined with health insurance market regulation, public funds can improve both the fairness and efficiency of individual health insurance markets. In Switzerland, cantons make substantial tax-funded contributions in the form of partial payment for hospital, but not other, costs. Reforms to the Swiss payment system are currently under discussion to reduce the distortionary effect of the current system. This paper considers and evaluates alternative ways the cantonal funds might be used to improve fairness and efficiency. We do this for the two alternatives currently under consideration in the parliament and introduce a third option with potentially better outcomes. Concerns for fairness and efficiency are shared in all countries. All countries also share a highly skewed distribution of health care costs. Evaluating the performance of alternative payment approaches in the presence of the skewed cost distribution is of interest everywhere (compare [2] [3] [4] [5]).

The critical elements of regulation necessary for a fair and efficient individual health insurance market include mandatory participation and open enrollment, community-rated premiums, specified minimum benefit packages, and risk adjustment of insurer payments, all features present in Switzerland and accepted in this paper as the institutional context for our analysis of the role of public subsidies. Most often, improving <u>fairness</u> with public funds takes the form of paying all (Israel) or part (Germany, The Netherlands, U.S. Medicare) of the premiums for everyone with tax funds, and/or using public funds to reduce the premium for low-income groups (Germany, The Netherlands, Switzerland, U.S. Marketplaces). Improving efficiency with public funds primarily takes the form of protecting health insurers from losses associated with very high-cost cases (U.S. Marketplaces) or paying separately for costs of certain expensive illnesses (Colombia, Israel).

Directing public funds to high-cost cases, the new option for Switzerland we consider here, can improve both the fairness and efficiency of individual health insurance markets. Although all of the countries mentioned above pay health insurers with a form of "risk adjustment" such that plans are paid more for predictably more expensive enrollees, health costs are notoriously difficult to predict, and payments in these formulas fall far short of covering plan costs of those with very high spending, as has been found in Germany, Israel, The Netherlands, the U.S., and elsewhere [1]. Public funds can come into play after the realization of health care costs by reimbursing plans for at least some of the costs for very costly enrollees. The public subsidy for high-cost cases not only protects insurers (particularly smaller insurers) and encourages supply of health insurance, thereby improving efficiency, but also the subsidy protects enrollees with costly illnesses by mitigating the efficiency problem of adverse selection. When plans lose less on very sick people, they have less incentive to discourage their enrollment by underserving those with expensive, chronic illnesses. A fair (and efficient) health insurance market provides access and good care to the sick as well as the healthy.

The Swiss health insurance system is organized according to principles of regulated competition (for a detailed overview, see [6]). Basic health insurance is compulsory for all Swiss residents and provides comprehensive coverage of medical services, medical products, pharmaceuticals and some other health care services. Basic health insurance plans are offered by approximately 50 private insurance companies. However, health plans and health insurers are subject to strict regulation. First, health insurers are obliged to accept all individuals who wish to enroll (open enrollment). Second, insurers may not make profits on basic insurance plans. They are, however, allowed to sell profitable supplementary insurance that are free-market oriented and cover services, e.g., dental services, not part of the basic plan, but may not make financial transfers between basic and supplementary plans. Third, the premiums of basic health plans are community-rated, but may differ among up to three premium regions per canton and must be lower for children (0 – 18) and young adults (19 – 25). As a result of community-rated premiums, a prospective risk equalization scheme based on age, gender, an indicator of a prior hospitalization, and indicators of past prescription drug use mitigates incentives for insurers to practice risk selection. In an additional form of public contribution not analyzed here, cantons subsidize premiums for individuals from low-income households.

For centuries, the cantons have owned and run hospitals and planned their capacity. Today, cantons continue to pay directly at least 55% of the costs of inpatient hospital care. These public funds reduce premiums overall, and may improve the efficiency of the health insurance market by relieving insurers from some of the risk associated with hospitalized individuals who tend to be higher cost. In 2015, the cantons contributed CHF 8.4 billion towards inpatient services, which corresponds to roughly 20% of the expenditures of basic health insurance (see Figure 1). By subsidizing inpatient care but not outpatient care, the present system may distort choices of the site of care, which is inefficient when outpatient care is less costly than inpatient care and the quality of outcome is the same. This point has been made against the current system for years (see [7] for an early critique). As trends in the site of treatment move more to outpatient care, cantons benefit from relieving them of some of their contribution.

At the initiation of the health insurer associations, the Swiss parliament has been debating the best use of the cantonal funds. To increase political feasibility every proposal maintains the magnitude of cantonal contributions equal to the status quo. One health insurer association (Santésuisse) proposes to include changing the form of subsidy to a proportional risk sharing equal across all services, whereby, instead of paying 55% of hospital costs, the cantons would be responsible for roughly 20% of all costs

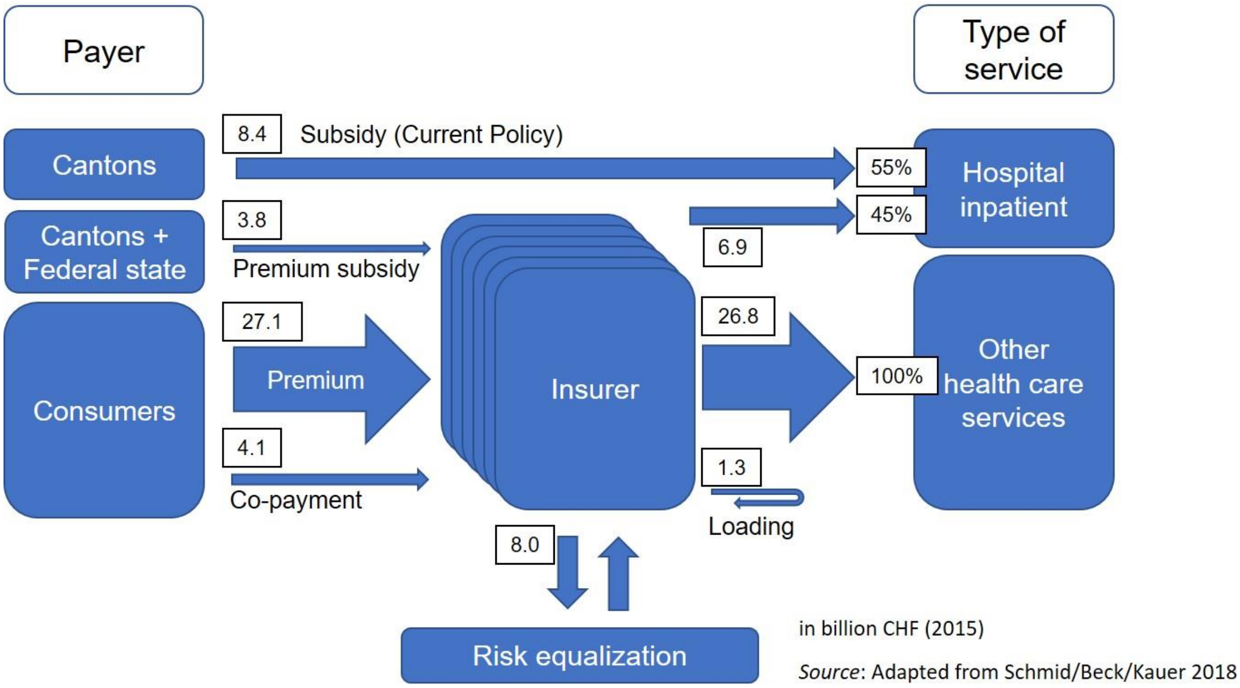

Figure 1: Payment flows in Swiss compulsory health insurance

and pay their funds to the insurers. We refer to this alternative here as Proportional Risk Sharing. The other health insurer association (Curafutura) argues the cantonal funds should be redirected from a subsidy to health care costs as a lump-sum payment into the risk equalization fund, either on a capitated or potentially risk adjusted basis, which we show in the appendix yield the same system-wide results. We refer to these policies as Lump-Sum Subsidies. Finally, recent research in the design of health plan payment has shown the potential benefit of using some funds for reinsurance due to the skewness of the cost distribution (see [2] for the US, [3] for Germany, [4] for these two countries including The Netherlands and [5, 8] for Switzerland). This leads to a third proposal, to use cantonal funds to pay a share of insurer's expenses above a high-cost threshold, whether those high costs are due to other forms of care as well as inpatient care. We refer to this policy as High-Cost Risk Sharing. High-cost risk sharing with copayment in order to maintain efficency incentives of the insurer for outlier costs is only one possibility to implement reinsurance (for a systematic discussion of different concepts, see [9]). We compare each proposed alternative to the current combination of risk equalization and canton hospital-based subsidies, which we refer to as the Current Policy.

The policy alternatives have different implications for incentives related to selection, risk born by insurers, and incentives to contain costs. This paper conducts a preliminary evaluation of the three alternatives in comparison to the Current Policy.

Material and methods

We have access to the full population of the largest Swiss health insurer in compulsory health insurance in 2016 covering about 1.3 million individuals, and corresponding to a national market share of about 16%. We have individual information about gender (52% women), age group (mean age: 51), canton of residence and prior hospitalization (7.9%) and pharmaceutical cost group (PCG) flags, all used in the current Swiss risk adjustment calculation. Children are excluded from risk adjustment, so our study sample consists of roughly 1.0 million adults. Our data include insurer individual-level spending (mean: 3,952 CHF; not including consumer copayments) and the 55% hospital subsidy paid by the canton for hospitalized individuals (mean: 922 CHF; estimated based on the observed insurer payment being 45% of the total). Using pooled data from the entire country our estimates will vary slightly from an official system where age and gender cells are figured at the canton level (though Switzerland runs the same risk adjustment model for the PCGs at the national level). For more information about the empirical application of our version of the Swiss risk equalization model see [5].

The risk-equalization model uses the same risk adjustors across all of our simulations. The estimation of the risk equalization model recognizes differences in insurer obligations across the policy alternatives and estimates regression weights to explain obligations net of any risk sharing. Our risk equalization model can be regarded as being optimized contingent upon the form of cantonal contribution (see Appendix for details). Payments to an insurer equal the predicted value from the risk equalization model plus, depending on the policy alternative, risk sharing or the lump-sum subsidy.

The most common statistic evaluating a risk equalization scheme is the R^2 from a linear regression with insurer spending the dependent variable and the various risk adjustor variables as independent variables. A higher R^2 indicates a mitigation of insurer incentives to discriminate against sicker individuals, which can be regarded as an improvement both in terms of fairness and efficiency. The R^2 measure requires a straightforward modification in the Swiss context. Insurers receive payments from the cantons as well as risk equalization payments and both forms of payment help match revenues to costs.

The fit measure taken from the research literature to deal with combining risk equalization and risk sharing is referred to as payment system fit (PSF), a simple generalization of an R^2 replacing the predicted value from the regression with the payment an insurer would receive for a person and figuring the fit on this basis (see [10] for details and [5, 8] for an application to the Swiss context). Formally, PSF can be defined as:

$$\mathrm{PSF} = 1 - \frac{\sum_{i=1}^{n}(C_i - Z_i)^2}{\sum_{i=1}^{n}(C_i - \bar{C})^2} \, , \tag{1}$$

where C_i and Z_i are insurer costs and revenues (risk equalization plus any risk sharing or lump sum) for individual i, respectively.

Another commonly reported statistic characterizing health plan payment performance is the Cummings prediction measure (CPM) which replaces the squared discrepancies between costs and revenues with linear absolute value before summing. The CPM can be generalized in the same way to take account of risk sharing and becomes in our context:

$$\mathrm{CPM} = 1 - \frac{\sum_{i=1}^{n}|C_i - Z_i|}{\sum_{i=1}^{n}|C_i - \bar{C}|} \tag{2}$$

A higher CPM also indicates a mitigation of plan incentives to discriminate against sicker individuals. The CPM is linear in the discrepancies between payment and costs whereas PSF is quadratic in the discrepancies. The rational for squaring comes from welfare economics where the welfare loss from a pricing error is approximately quadratic in the price gap. Layton et al [10] discuss this in the context of risk equalization evaluation. Van Kleef et al [11] make the observation that payment gaps might be raised to a power between 1 (as in CPM) and 2 (as in PSF). Any power above 1 will put more weight on larger gaps. In addition, the group-level metric for evaluation discussed next is linear in gaps as well, providing a different perspective than the squaring involved in the conventional R^2 statistic evaluating risk equalization models and its generalization, the PSF, applied here. As long as values somewhere in between CPM and PSF capture insurer's incentives to discriminate, the findings support our recommendation.

Evaluations of payment systems also commonly supplement measures of fit at the individual level (such as PSF and CPM) with group-level measures, with the purpose of checking incentives for an insurer to systematically select against specific groups of patients. In the absence of information to group individuals by disease, we check the performance of the four alternatives studied here in terms of how well payments match costs for groups defined as those among the top 1% (and the top 10%) of spending in the previous year. As the payment system falls short of matching payments for these groups, it creates incentives to select against individuals with persistent high levels of spending. Specifically, we report average undercompensation for members of each group g defined as:

$$\text{Undercompensation}_{\text{g}} = \frac{\sum_{i\epsilon g}(Z_i - C_i)}{n_g} \qquad (3)$$

Here, n_g is the number of members of group g.

Another important consideration regarding the performance of a payment system is its effect on incentives for controlling costs. Generally, risk sharing diminishes incentives an insurer has to control costs. We also compare our four alternatives based on their effect on incentives. The research literature contains no consensus about the best way to measure cost-control incentives. Building on some previous literature, including research on incentives in the existing Swiss payment system [8], we apply two measures of incentives, the share of the population affected by risk sharing incentives, and the increase in revenue to an insurer in response to a one CHF increase in spending on each enrollee. Incentives for cost control improve the fewer people affected by risk sharing and the less responsive revenues are to additional spending.

While the PSF, CPM, undercompensation for selected groups, and cost-control incentives evaluate the incentives more from a regulator's perspective, we also consider the unexplained variation in costs the insurer is responsible for, a measure of insurer risk. We prefer unexplained variance in our context to the more common R^2 because the latter cannot be readily compared across alternatives when the insurer is responsible for different costs (see appendix for details).

Results

Simulation results are contained in Table 1. The Current Policy has a PSF of 56.5%, and underpays the top 1% of spenders from the prior year by 26,718 CHF on average. The fit statistic is much higher than the R^2 reported previously for the Swiss system (ranging from 21% to 30%, see [6] Table 16.2). The reason for this is that previous research generally reports R^2 from regressions on health care costs net of subsidies, without recognizing the contribution of cantonal risk sharing to the overall fit of the payments to the costs. When substantial risk sharing is present, as there is in the Current Policy, the payment system fit, reflecting both the risk equalization and risk sharing features is much higher than a simple regression R^2 on costs net of subsidies would indicate.

Policy Alternative	**PSF**	**CPM**	**Under-compensation for 1% top spenders in prior year**	**Under-compensation for 10% top spenders in prior year**	**Relative unexplained Variance**
Current Policy	56.5%	40.7%	-26,718	-5,610	100%
Proportional Risk Sharing	45.8%	36.3%	-25,973	-5,279	125%
Lump-Sum Subsidy	17.6%	21.5%	-31,107	-5,588	190%
High-Cost Risk Sharing					
- with 20% copayment	*78.3%*	40.8%	-13,315	-4,490	50%
- with 10% copayment	*79.3%*	40.8%	-12,024	-4,470	48%

Notes: PSF is payment system fit (equ. 1). CPM is Cummings Prediction Measure (equ. 2). Unexplained variance measures the risk left to the insurer after payments (see Appendix for a formal definition).

Table 1: Fit measures for policy alternatives

The first alternative we consider is Proportional Risk Sharing. The PSF of this alternative is lower than the Current Policy, largely because this new policy subsidizes all costs – low or high - by about 20% while the Current Policy focus its 55% subsidy on the prevailing high inpatient costs. Proportional risk sharing does little to affect underpayment for the previous high-spender groups and increases the risk borne by the individual insurer by 25%.

The Lump-Sum Subsidy policy would eliminate risk sharing. Fit is much reduced, with the PSF driven down to 17.6%. Elimination of any risk sharing exacerbates underpayment of the previous high-spender groups and nearly doubles the remaining risk for the insurer (190%).

High-Cost Risk Sharing is calculated for insurer copayment rates of 10% and 20%. If we set the share of spending the insurer continues to be responsible for above the threshold at 20%, the threshold itself is then CHF 26,900 and only 4.3% of the population is affected by risk sharing in any year. When the insurer copayment falls to 10%, the corresponding threshold increases to CHF 30,100 (holding the volume of subsidies constant) affecting 3.7% of the population. High-Cost Risk Sharing improves PSF very substantially above the Current Policy, moving the metric of fit to 78.3% (and 79.3% respectively). While the linear CPM improves little in comparison to the Current Policy, underpayment for the previous high-spenders is cut in half for the 1% group and cut by over one fifth (or CHF 1,000) for the 10% group. High-Cost Risk Sharing thus reduces selection incentives in comparison to the Current Policy measured at both the individual and group levels. Also relevant is the 50%-point drop in the unexplained variance showing a substantial reduction of the variance insurers must cope with. The improvement in fit is the result of transferring payments to very high-cost cases where almost always the risk equalization formula underpredicts costs. Both the share of population affected by risk sharing (not shown) as well as the fit metrics hardly change if the insurer's copayment is cut in half to 10%.

In terms of incentives for cost control, we begin with a characterization of the Current Policy. Hospital risk sharing in the current policy affects the 11% of the population with a hospitalization each year. These people's hospital claims account for 59% of their total costs of which 55% are subsidized by the canton. A CHF increase in spending for the other 89% of the population has no effect on insurer revenues. Thus, on average, a CHF increase for each enrollee reduces incentives to control costs by .11*.55*.59 ≈ .036 below a fully prospective system.

As noted earlier, a Proportional Risk Sharing system would cover about 20% of all costs, implying that an insurer gets 20 cents back for every extra CHF spent.

The Lump-Sum Subsidy alternative is the most powerful in terms of creating incentives for controlling costs because the insurer is at-risk for all costs. An increase in spending has no effect on insurer revenues.

Policy Alternative	**Increase in Revenue in Response to a 1 CHF Increase in Spending on All Enrollees**
Current Policy	.04
Proportional Risk Sharing	.20
Lump-Sum Subsidy	.00
High-Cost Risk Sharing	.02

Table 2: Incentive measures for policy alternatives

High-Cost Risk Sharing affecting 4.3% of the population and paying 80% of their costs above a threshold which is 40% of their total costs, implies an insurer gets back on average .043*.4 ≈ .017 CHF for each CHF increase in spending. Thus, the High-Cost Risk Sharing policy, because it affects fewer people, would improve cost-control incentives in relation to the Current Policy.

Discussion

Cantonal contributions to health care costs play an important and constructive role in the Swiss health insurance payment system. The tax-financed contributions improve the fairness of the system by promoting the affordability of health insurance. The contributions also mitigate incentives to insurers to discriminate against high-cost cases, improving both fairness and efficiency.

Cantonal funds can be used differently to possibly further promote fairness and efficiency. We consider three alternatives to the Current Policy, all "balanced budget" in the sense of keeping the cantonal contribution set to the same level. Redirecting cantonal funds to the higher-cost cases, as depicted in our High-Cost Risk Sharing alternative appears to be an attractive policy, improving fit at the individual level (higher PSF and constant CPM), the group level (lower undercompensation for previous high spenders) while improving incentives for cost control.

Proportional Risk Sharing falls short or fails to improve fit in relation to the Current Policy, and substantially weakens incentives for cost control. Lump-Sum subsidies would introduce the most radical change to the payment system. The effect of taking cantonal funds out of risk sharing and putting the funds into a lump-sum subsidy shifts health care cost risk onto insurers, enhancing incentives to control costs, but at the expense of a degradation in incentives related to enrolling and serving sicker individuals.

In sum, High-Cost Risk Sharing is the only win-win-win policy alternative to the Current Policy.

We have considered only three specific alternatives to the Current Policy, which of course can be mixed and matched. An example would be a policy moving 25% of cantonal funds to a lump-sum subsidy, and reserving the other 75% of the cantonal funds to pay for high-cost risk sharing at a threshold somewhat higher than the one studied here. Our results imply that the tradeoff between incentives for cost control and incentives for selection made by the regulator should be made by a choice of how much of cantonal contributions will shift to a lump-sum subsidy and how much will be reserved for high-cost risk sharing.

Also within the approach of High-Cost Risk Sharing, there are further alternatives not discussed in this paper. Van Barneveld et al. promote an ex ante High-Risk Sharing [9] to reduce an insurer's incentive for selection; however, this alternative leaves the insurer to cope with high and (individually) unexpected outlier costs. Risk sharing could refer to costs or to outlier residuals after calculating a payment system fit. Schillo et al. show that fit improves for the same funds devoted to risk sharing if the risk sharing is directed to residual underpayments rather than high spending [3].

As a final note, we comment on the alternative policies from the standpoint of the Swiss insurers. Although we do not here conduct a detailed empirical evaluation, higher PSF implies a reduction in unexplained variance. Lower variance in net returns can translate to lower insurer costs. For example, lower variance in returns implies a need for less funds set aside for reserves against an unusually high loss. This advantage may be particularly important for the many small insurers in the Swiss health insurance market.

Conclusion

Previous research on the financing of Swiss health insurance has failed to fully recognize the risk-sharing effect of cantonal contributions. Since the current policy subsidizing only inpatient care creates imbalanced incentives politics is debating about the better use of the cantonal funds. We show that the proposed alternatives result in worse incentives than the current policy, while presenting an alternative with better outcomes. With the same magnitude of cantonal subsidy we identify a rare win- win-win in health policy. That is, consumers are better protected against incentives for risk selection, the regulator achieves greater incentives for cost control, and insurers are better protected against risk of losses.

Our paper adds to the accumulation of findings that risk sharing for very high cost cases can improve the performance of health-care payment systems. Although the institutional situation differs among countries, the goal of reducing incentives for selection in the context of highly skewed health care costs is a universal predicament.

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Appendix to: Making Use of Cantonal Contributions to Health Care Costs in Switzerland

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Formal descriptions of Payment System Fit and R^2

This document provides a formal description of the different fit measures presented in the corresponding article. This requires the following list of variables:

(1)	$i \in \{1,2 \ldots n\}$	Index for n individuals
(2)	$L_i =$	Gross spending for individual *i* excluding copayment
(3)	$L_i = O_i + I_i$	Gross spending for individual *i* for outpatient (O_i) and inpatient care (I_i)
(4)	$S_i =$	Subsidy paid to the insurer for individual *i*
(5)	$l_i = L_i - S_i$	Net spending excluding individual subsidy and copayment
(6)	$\hat{l}_i;\ \hat{L}_i\ =$	Prediction of net and gross spending (respectively) with prospective Risk Adjustment
(7)	$\bar{l};\ \bar{L} =$	Average net and gross spending (respectively), excluding copayment

Given the three policy alternatives, we define beside the Current Policy (with subsidy S_i^{CP}) three different types of subsidies (S_i^{PROP}, S_i^{FS}, S_i^{HCRS}) and $S_i^{R\_ADJ}$ as a close substitute for S_i^{FS} with identical properties:

(8)	$S_i^{CP} = tI_i$	Subsidy under Current Policy: inpatient subsidy depending on inpatient costs (with $(0 < t < 1)$); in our data in 2016: *t* = 55%
(9)	$S_i^{PROP} = qL_i$	Subsidy under Proportional Risk Sharing with $0 < q < 1$. With $\sum_i S_i^{CP} = \sum_i S_i^{PROP}$, i.e. the volume of subsidies kept constant, and *t* = 55%, *q* is mathematically determined by $\frac{\sum_i S_i^{CP}}{\sum_i L_i} = q = 19\%$
(10)	$S_i^{FS} = FS = \frac{\sum_i S_i^{CP}}{n}$	Flat lump sum subsidy; in our data in 2016: 922 CHF pppy
(11)	$RRS_r = \frac{\bar{L}_r}{\bar{L}}$	Relative risk score for risk group *r* ($r \in \{1,2 \ldots R\}$)

(12)	$S_i^{R\_ADJ} = RRS_i \times FS$	Risk adjusted lump sum subsidy with $RRS_i = RRS_{r(i)}$ as the score value from risk group *r* the individual *i* belongs to
(13)	$S_i^{HCRS} = \begin{cases} 0, & if\ L_i \leq T \\ (1-c)(L_i - T), & if\ L_i > T \end{cases}$	High Cost Risk Sharing, given a threshold *T* and a copayment from the insurer c, $(0 < c < 1)$

The underlying constraint is that the total subsidy is constant across alternatives. This reads:

(A.1) $\sum_i S_i^{CP} = \sum_i S_i^{PROP} = \sum_i S_i^{FS} = \sum_i S_i^{R\_ADJ} = \sum_i S_i^{HCRS}$

Risk adjustment

As usual in plan payment with community-rated premiums, risk adjustment plays a crucial role. The risk-adjustment-regression is based on a dependent (left-hand side) variable, the net spending in 2015 inflated by a factor to mimic 2016 data (l_i). The independent variables are the risk indicators from 2015 (age and gender) or 2014 (hospitalization and PCG dummies). Note that the canton has been excluded due to computational reason. The R^2 of the described (concurrent) RA-regression is 31%.

The predicted spending (capitation, $\hat{l}_i$) in 2016 is then calculated with the β-coefficients from the regression multiplied with the risk indicators from 2016 and 2015, respectively. Since risk adjustment is applied prospectively, the zero-sum-condition (always fulfilled in a concurrent context) is only given, when $\hat{l}_i$ is reduced (or increased) by a usually very small constant, the zero-sum-error: $\Delta = \frac{1}{n}\sum_i[l_i - \hat{l}_i]$. Since Δ is minimal in size, affecting the third decimal place only, we neglected it in the formulas. The R^2 of prospective risk adjustment (footed on total variance in gross spending in 2016 as denominator) reads:

(A.2) Prospective Risk Adjustment under Current Policy: R^2: $1 - \frac{\sum_i (l_i - \hat{l}_i)^2}{\sum_i (l_i - \bar{l})^2}$= 22%

Since we vary the subsidies, we must vary Risk Adjustment as well. Whenever the insurer becomes responsible for <u>gross</u> spending (L_i), the predicted capitation the insurer receives is based on gross spending too. The left-hand side variable in the regression is now gross spending in 2015 inflated, due to the prospectivity, by the same factor mentioned above that mimics 2016 data (L_i). The rest of the regression remains the same. The R^2 of this RA-regression reads:

(A.3) Prospective Risk Adjustment based on gross spending: R^2: $1 - \frac{\sum_i (L_i - \hat{L}_i)^2}{\sum_i (L_i - \bar{L})^2}$ = 18%

We use a third RA calculation, when High-Cost Risk Sharing is effective. Risk sharing refers to gross spending and Risk Adjustment is calculated thereafter on gross spending net of subsidies ($l_i^{HCRS} = L_i - S_i^{HCRS}$). Literature proposes a reversed procedure to calculate High-Cost Risk Sharing on the residuals of the Risk Adjustment calculation [1]. While this approach results in higher fits, it calls for iterations in RA calculation and is difficult to explain to policy makers and health plan managers. For these reasons we propose the former straight forward approach. That is, the left-hand side variable of the regression should be reduced by the subsidy. The subsidy needs then to be calculated prospectively with inflated

2015 data (in this case, the virtual ex ante subsidy volume within the RA calculation turns out to be 10% smaller than if calculated with the actual 2016 data), while the true ex post HCS_i remain unchanged, i.e. they are calculated with actual 2016 data.

(A.4) Prospective Risk Adjustment based on spending after HRS: R^2: 1 - $\frac{\sum_i(l_i^{HCRS}-\hat{l}_i^{HCRS})^2}{\sum_i(l_i^{HCRS}-\bar{l}_i^{HCRS})^2}$ = 29%

This figure holds for a threshold of CHF 26,908 resulting from a copayment for the insurer for high risk cases of 20%. The concurrent R^2 is 41%. With a threshold of 30,121 and 10% copayment, prospective (concurrent) R^2 increases to 30% (42%).

Be aware that (A.2) to (A.4) are not directly comparable because the 100% reference, the respective denominator, differs in all three expressions.

Insurer's R^2 and relative unexplained variance (RUV)

The figures provided in (A.2), (A.3), and (A.4) can also be interpreted as the R^2 the insurer is responsible for, since the respective denominators show the variance in insurer's spending.

With Proportional Risk Sharing the insurer's R^2 is equal to (A.3) because the impact of subsidies cancels out: $R^2 = 1 - \frac{\sum_i\left(L_i(1-q)-\hat{L}_i(1-q)\right)^2}{\sum_i\left(L_i(1-q)-\bar{L}(1-q)\right)^2} = 1 - \frac{\sum_i(L_i-\hat{L}_i)^2(1-q)^2}{\sum_i(L_i-\bar{L})^2(1-q)^2} = 1 - \frac{\sum_i(L_i-\hat{L}_i)^2}{\sum_i(L_i-\bar{L})^2} = 18\%$

The same holds true for Lump Sum Subsidies. Here, the subsidy does not cancel out but is subtracted and the remaining expression corresponds to (A.3). This finding holds irrespective of whether the Lump Sum Subsidy is risk-rated or flat.[2]

However, the differences in costs covered by the insurer under different policy alternatives makes the R^2 difficult to compare across alternatives. It is therefore preferable to use unexplained variance (UV) as point of reference. UV can be found as the numerator of the R^2 expression. To compare UV between the different policy alternatives we normalize UV of the current policy $\sum_i(l_i-\hat{l}_i)^2$ (see (A.2)) to 100%. Therefore, the three alternatives are reported in relative terms to the current policy:

Policy Alternative	Relative unexplained variance (RUV)		Relative unexplained standard deviation*
Current Policy	$\frac{\sum_i\left(l_i-\hat{l}_i\right)^2}{\sum_i\left(l_i-\hat{l}_i\right)^2}\cdot 100\% =$	100.0 %	100.0%
Proportional Risk Sharing	$\frac{\sum_i\left(L_i-\hat{L}_i\right)^2(1-q)^2}{\sum_i\left(l_i-\hat{l}_i\right)^2}\cdot 100\% =$	124.7 %	111.7%
Lump Sum Subsidy	$\frac{\sum_i\left(L_i-\hat{L}_i\right)^2}{\sum_i\left(l_i-\hat{l}_i\right)^2}\cdot 100\% =$	189.6 %	137.7%

[2] For further details, see Lump Sum Subsidies and Payment System Fit below.

High-Cost Risk Sharing	$\frac{\sum_i (L_i - S_i^{HCRS} - \hat{l}_i^{HCRS})^2}{\sum_i (l_i - \hat{l}_i)^2} \cdot 100\% =$	50.0 %	70.7%

*Notes: *) Corresponding calculation based on standard deviations (roots of variances)*

Table A.1: Relative unexplained variances for policy alternatives

Payment system fit (PSF)

Payment system without subsidies

The starting point of our PSF analysis for different policy alternatives is a fictitious situation without subsidies ($S_i = 0$ for all individuals). Without subsidies, the insurer becomes responsible for all gross spending (net of copayment) so that PSF and $R^2_{Insurer}$ coincide. Since Risk Adjustment follows (A.3), this results in:

(A.5) PSF = $1 - \frac{\sum_i (L_i - \hat{L}_i)^2}{\sum_i (L_i - \bar{L})^2} = 18\% \quad (= 1 - 82\%)$

We will see that the resulting 18% is an often-applicable point of reference. It fully corresponds for example with insurer's R^2 in (A.3).

Payment system with subsidies for inpatient stay (Current Policy)

Here the corresponding PSF reads:

(A.6) $PSF^{CP} = 1 - \frac{\sum_i (L_i - S_i - \hat{l}_i)^2}{\sum_i (L_i - \bar{L})^2}$ = 57%

The increase in fit compared to (A.5) is evident, since subsidies finance 55% of inpatient spending ex post completely. Given that inpatient costs represent often outlier costs, a high positive impact on fit is what can be expected.

Payment system with proportional subsidies (Proportional Risk Sharing)

Here the subsidy is no longer injected into the system for inpatient services only (as in the Current Policy) but proportionally over all services. The volume of the subsidy needs to remain constant (according to constraint (A.1)). The share of the volume of inpatient subsidies on total spending, *q* = 19%, is then the appropriate correcting factor (see row 9 in the list above). That is, the spending the insurer faces is gross spending (L_i) minus the proportional share financed by subsidies ($-L_i q$).

Also, the predicted capitation is reduced by *q* to prevent overcompensation of the insurer ($-\hat{L}_i q$). This all boils down to:

(A.7) $PSF^{PROP} = 1 - \frac{\sum_i \left(L_i - L_i q - \hat{L}_i (1-q)\right)^2}{\sum_i (L_i - \bar{L})^2} = 1 - \frac{\sum_i (L_i - \hat{L}_i)^2}{\sum_i (L_i - \bar{L})^2} (1-q)^2 = 1 - 82\%(1 - 19\%)^2 = 46\%,$

(when taking (A.5) into account). The denominator remains the same as in all other PSF measures. Therefore, Proportional Risk Sharing reduces fit compared to the Current Policy (A.6) but remains well above the fit without subsidies (A.5).

Payment system with Flat Lump Sum Subsidy

If the subsidy is injected into the system as a flat lump sum per capita irrespective of the individual spending, this amount gets subtracted from individual costs, $(L_i - FS)$, as well as from predicted costs in Risk Adjustment, $(\hat{L}_i - FS)$. Therefore, the lump sum subsidies drop out of the formula:

$(L_i - FS) - (\hat{L}_i - FS) = (L_i - \hat{L}_i)$. And PSF reads:

(A.8) $$PSF^{FS} = 1 - \frac{\sum_i (L_i - \hat{L}_i)^2}{\sum_i (L_i - \bar{L})^2} = 18\%$$

So PSF^{FS} is (with respect to fit) equal to a situation without subsidies (comp. (A.5)).

Payment system with risk rated Lump Sum Subsidy

Differentiating the Lump Sum Subsidy with respect to relative Risk Scores does not alter the outcome: $(L_i - FS \cdot RRS_i) - (\hat{L}_i - FS \cdot RRS_i)$ reduces again to $(L_i - \hat{L}_i)$ and PSF remains the same as (A.8).

Payment system with High-Cost Risk Sharing

High-Cost Risk Sharing alters the left-hand side variable in RA calculation. L_i is substituted by $l_i^{HCRS} = L_i - S_i^{HCRS}$. Spending is financed by risk sharing (S_i^{HCRS}) and predicted capitation net of High-Cost Risk Sharing ($\hat{l}_i^{HCRS}$). And PSF reads:

(A.9) $$PSF^{HCRS} = 1 - \frac{\sum_i \left(L_i - S_i^{HCRS} - \hat{l}_i^{HCRS}\right)^2}{\sum_i (L_i - \bar{L})^2} = 78\%$$

Expression (A.9) is calculated with a threshold of CHF 26’908 and a copayment for the insurer for high risk cases of 20%. With a higher threshold of CHF 30’121 and 10% copayment, PSF^{HCRS} increases to 79%.

References

[1] T. G. McGuire, S. Schillo and R. C. van Kleef, "Two-Sided Reinsurance and Risk Adjustment in Individual Health Insurance: Germany, the Netherlands and the US Marketplaces," *American Journal of Health Economics,* vol. 6, pp. 139-168, 2020.