Risk-adjusted capitation payments based on expected costs:

Are incentives for cost containment really maintained?

Abstract

An important goal of risk-adjusted capitation payments (RACPs) to community-rated health plans – that may differ in coverage and/or the organization of delivering care – is to reduce incentives for risk selection while maintaining incentives for cost containment. In most schemes, RACPs are "simply" based on the expected costs of enrollees. We show that under this procedure incentives for cost containment will not always be maintained: when identical risk types are concentrated in the same health plans – due to selection, specialization or just coincidence – cost savings can be (partly) captured by the RACPs and leak away from these plans.

JEL classification

I10; I11; D82; G22

Keywords

Health insurance; Capitation payments; Risk adjustment; Cost containment;

1. Introduction

An important goal of risk-adjusted capitation payments (RACPs) to community-rated health plans – that may differ in coverage and/or the organization of care – is to reduce incentives for risk selection while maintaining incentives for cost containment.[1] In most capitation schemes, RACPs are "simply" based on the expected costs of enrollees. From different perspectives this procedure has been criticized. Glazer and McGuire (2000) and Jack (2006) argue that when risk adjusters are only imperfect signals of an individual's risk profile, the RACP for the high risks (i.e. those with the bad signal) should exceed their expected costs while the opposite holds for the low risks (i.e. those with the good signal). Schokkaert et al. (1998) and Schokkaert and Van de Voorde (2004) show that if the risk adjustment formula is not additively separable in the risk adjusters for which the regulator wants a compensation and the risk adjusters for which the regulator does not want a compensation, it is impossible to remove the incentives for risk selection while requiring at the same time that RACPs are equal for identical risk types.

This paper illustrates another shortcoming of basing RACPs on the expected costs of enrollees: when identical risk types are concentrated in the same health plans – e.g. due to selection, specialization or just coincidence – cost savings can be (partly) captured by the RACPs and leak away from these plans. This reduces the plans' incentives for cost containment. Note that this is not the same as the reduction in incentives that results from risk sharing, e.g. outlier risk sharing, proportional risk sharing, risk sharing for high costs and/or high risks. Risk sharing reduces incentives for cost containment since (part of) the actual costs of health plans are compensated

[1] With risk selection we mean actions of consumers and health plans to exploit unpriced risk heterogeneity and break pooling arrangements (Newhouse, 1996).

retrospectively (Van Barneveld et al., 2001). This study does not consider the effects of risk sharing but exclusively focuses on the effects of (prospective) RACPs.

The structure of this paper is as follows. Section 2 starts with an empirical illustration based on administrative data from a Swiss insurer. Section 3 formulates the general conditions under which cost savings will be captured by the RACPs and section 4 provides an overview of real-world situations in which this will happen. Section 5 discusses two measures to prevent RACPs from capturing cost savings. Finally, section 6 summarizes the main conclusions.

2. An empirical example

We assume that incentives for cost containment are *maintained* when in the presence of RACPs health plans have the same incentives for cost containment as in the absence of RACPs. This implies that RACPs must not violate the following condition: *x euro average cost savings in plan B compared to plan A should enable plan B to reduce the premium by x euro compared to plan A.* A simple example shows that this condition can be violated when RACPs are based on expected costs: when low risks (according to the risk adjustment formula) happen to be uniformly with efficient plan B and high risks (according to the risk adjustment formula) happen to be uniformly with inefficient plan A, the RACPs will compensate for the entire cost difference between the two risk types including the cost savings achieved in plan B. As a result, plan B will not be able to offer a lower premium than A, whatever the cost savings are.

Violation of the above-mentioned condition is not just theoretical, to some extent it also occurs in practice. This can be illustrated with empirical data from a Swiss insurer including individual-level information on reimbursed health care costs, deductible choice and age in the year 2003. In that year, Swiss residents – who are obliged to obtain basic health insurance since 1996 – had a mandatory deductible of CHF 230 which could be voluntarily increased to a maximum of CHF 1,500.[2] In the data 17,829 individuals had chosen the highest deductible and 71,864 individuals had chosen no voluntary deductible.[3] Van Kleef et al. (2008) have found that the average cost savings in the high-deductible plan were CHF 750 per person (not including the self-selection effect).[4] Since the data in our illustration are exactly the same as those used by Van Kleef et al. (ibid.), we simply copy their estimation results and refer to their study for the method and its validity.[5] By applying a simplified capitation formula we will show that the voluntary-deductible plan will not be able to reduce its premium by CHF 750 compared to the standard plan.

Let us assume that RACPs are calculated according to formula (1) with C_j as the average costs in risk group j and C as the average costs in the population. The difference in RACPs between risk types reflects the difference in expected costs, which is in principle the case in Switzerland, The Netherlands and Germany, for instance.[6] In this example only two risk types are distinguished: the young (j = Y) and the old (j = O), both representing 50 percent of the population.

(1) $$RACP_j = C_j - C$$

[2] CHF 1 = € 0.61 / $ 0.90, on January 1, 2008.
[3] For a description of the Swiss scheme we refer to Beck (2003) and for a description of the data we refer to Van Kleef et al. (2008).
[4] From the health plan's perspective, cost savings in the deductible plan has two components: increased out-of-pocket expenditures and a moral hazard reduction.
[5] In sum, a four-step estimation procedure was used to estimate the out-of-pocket expenditures and the moral hazard reduction: 1) estimate an expenditure model on the group of insured without a voluntary deductible, 2) predict expenses of the insured with a voluntary deductible by combining their characteristics with the coefficients obtained in the first step, 3) estimate expected out-of-pocket expenditures using the results of the second step, 4) estimate moral hazard reduction due to deductible d as the expected expenses for insured with deductible d minus the medical expenses paid by the insurer and minus their expected out-of-pocket expenditures.
[6] For details about the principles of RACPs to health plans we refer to Van de Ven and Ellis (2000) and for details about the specific capitation schemes in Switzerland, The Netherlands and Germany we refer to Beck et al. (2003), Lamers et al. (2003), Buchner and Wasem (2003), Van de Ven et al. (2003) and Van de Ven et al. (2007).

Table 1 shows how the young and the old are actually distributed over the two health plans. It appears that the share of young having the deductible plan is higher than the share of old having the deductible plan. This may be a result of adverse selection in a way that low-risk individuals (the young) are more likely to choose a deductible than high-risk individuals (the old).

Table 1 Distribution of individuals over health plans and risk types

	Standard plan	Deductible plan	Total
Young	31,162 (35%)	13,624 (15%)	44,786 (50%)
Old	40,702 (45%)	4,205 (5%)	44,907 (50%)
Total	71,864 (80%)	17,829 (20%)	89,693 (100%)

Table 2 shows the average cost savings per risk type in the voluntary-deductible plan compared to the standard plan. Obviously, the average cost savings are higher for the old than for the young. As explained by Van Kleef et al. (2008), this is caused by the fact that the average expected expenses of individuals in the voluntary-deductible plan are higher for the old than for the young. These above-average expenses for the old result in above-average out-of-pocket expenses and above-average moral hazard reduction (holding price-sensitivity constant).

Table 2 Average cost savings in CHF [7]

	Standard plan	Deductible plan
Young	0	642
Old	0	1,096
Mean	0	749

Let us assume that in a situation without deductibles the capitation payment for the young would be $RACP_Y$ and the capitation payment for the old would be $RACP_O$. The main point of this paper is as follows: if RACPs are calculated according to formula (1) the occurrence of the cost savings in table 2 influences the RACP for both the old and the young. Under community-rated premiums, the result is that the average cost savings of CHF 749 cannot fully return in the premium reduction for the voluntary-deductible plan (compared to the standard plan). How does this exactly work? Using tables 1 and 2 it can be calculated that because of these cost savings the average costs in the population decrease with CHF 149 (i.e. (17,829 / 89,693) * CHF 749). This reduction is not the same for the old and the young. For the young the average costs decrease with CHF 195 (i.e. (13,624 / 44,786) * CHF 642) while for the old they decrease with CHF 103 (i.e. (4,205 / 44,907) * CHF 1096). Following formula (1) this implies a change in RACP of CHF -46 ((C_Y-195)-(C-149)) for the young and CHF +46 ((C_O-103)-(C-149)) for the old.

[7] The overall average cost savings are slightly different from the CHF 750 mentioned earlier due to rounding.

Table 3 Effect of cost savings on RACPs in CHF

	Change in RACP
Young	-46
Old	46

From the health plans' perspectives the net effect of cost savings equals the average cost savings minus the change in RACP. For our example the net effects are shown in table 4. Under community-rated premiums per health plan, these net effects allow the deductible plan to reduce its premium by CHF 725 and allow the standard plan to reduce its premium by CHF 6. The resulting premium difference (CHF 719) is lower than the average cost savings of CHF 749. This means that 4 percent of the cost savings in the deductible plan leak away through the RACPs and only 96 percent can actually return in a premium reduction compared to the standard plan.

Table 4 Net effect of cost savings on the average costs and community-rated premiums in CHF

	Standard plan	Deductible plan
Young	46	-596
Old	-46	-1,142
Community-rated premium	-6	-725

Analogous to the procedure used above we calculated that under the actual risk adjuster for age and gender in the Swiss capitation scheme of 2008, 6 percent of the cost savings in the voluntary-deductible plan leak away through the RACPs. Appendix 1 shows the change in RACP for the 26 age/gender-classes due to the cost savings in the voluntary-deductible plan.

3. A general framework

A close look at the empirical example reveals that whether or not cost savings are captured by RACPs and leak away from health plans depends on two parameters: 1) the level of concentration of identical risk types in the same health plans and 2) the relation between cost savings and risk types. Let us transform the empirical illustration into a more general framework: we refer to the inefficient plan as A and to the efficient plan as B (which can be a deductible plan, managed care plan or anything alike). We define h_L as the share of low risks in plan B and h_H as the share of high risks in plan B. Table 5 shows the distribution of risk types over health plans.

Table 5 Distribution of risk types over health plans

	Plan A	Plan B
Low risks	$1 - h_L$	h_L
High risks	$1 - h_H$	h_H

In addition, we define S^B as the overall average cost savings in plan B, S_L^B as the average cost savings for low risks with plan B and S_H^B as the average cost savings for high risks with plan B.

Table 6 Distribution of average cost savings over health plans and risk types

	Plan A	Plan B
Low risks	0	S_L^B
High risks	0	S_H^B
Mean	0	S^B

Appendix 2 shows the premium reduction for plan B in relation to the average cost savings in plan B under different assumptions about the shares of low risks and high risks in plan B and the relation between cost savings and risk type. This exercise reveals five different scenarios, which are summarized in figure 1.

Figure 1 Five relevant scenarios

	Level at which identical risk types are concentrated in the same health plans	**Relation between risk type and cost savings**	**Premium reduction as a percentage *p* of the average cost savings**
I	Full concentration $\mid h_L - h_H \mid = 1$	Any	$p = 0$
II	No concentration $\mid h_L - h_H \mid = 0$	Any	$p = 100$
III	Some concentration $0 < \mid h_L - h_H \mid < 1$	$S_H^B = \frac{h_L}{h_H} S_L^B$	$p = 100$
IV	Some concentration $0 < \mid h_L - h_H \mid < 1$	$S_H^B < \frac{h_L}{h_H} S_L^B$	$0 < p < 100$
V	Some concentration $0 < \mid h_L - h_H \mid < 1$	$S_H^B > \frac{h_L}{h_H} S_L^B$	$p > 100$

The level of *p* in scenarios IV and V depends on the relative size of risk groups L and H. Appendix 3 presents the level of *p* for a situation where L and H have exactly the same size.

3.1 Scenario I

If all the low risks have plan B and all the high risks have plan A (or vice versa), the cost savings S^B cannot at all be incorporated into the premium reduction for plan B. The simple explanation is that payments $RACP_L$ and $RACP_H$ (computed according to formula (1)) capture all cost differences between the two groups, including the cost savings in plan B.

3.2 Scenario II

If the share of low risks having plan A and the share of high risks having plan B are equal, the cost savings can be fully incorporated into the premium reduction for plan B. Note that RACPs are influenced by cost savings in plan B when these are different for the two risk groups (e.g. average cost savings are higher for the low risks than for the high risks). The resulting over-compensations (for the low risks) and under-compensations (for the high risks), however, have no effect on the premium reduction since the risk composition of the two plans is identical. More specifically, the total over-compensation (for the low risks) and under-compensation (for the high risks) is equal in both plans, such that the net effect of RACPs on the premium reduction is zero.

3.3 Scenario III

In practice, the level of concentration probably lays in between the extremes of scenario I and II. If this is the case then only in one exceptional scenario the premium reduction will equal the average cost savings: when the average cost savings in the (entire) risk groups is exactly the same, i.e. $S_H = S_L$. In the terminology of tables 5 and 6 this can be written as: $S_H^B = \frac{h_L}{h_H} S_L^B$. For instance, if 50 percent of the low risks have plan B and 25 percent of the high risks have plan B then no cost savings are captured by the RACPs if S_H^B is $\frac{0.50}{0.25}$ times S_L^B.

3.4 Scenario IV

Also in the fourth scenario identical risk types are to some extent concentrated in the same health plans, but $s_H^B < \frac{h_L}{h_H} s_L^B$. This is exactly the case in our empirical illustration: the share of individuals having the voluntary-deductible plan equals 0.30 for the young and 0.09 for the old while the average cost savings for the old with that plan (i.e. 1,096 euro) are lower than $\frac{0.30}{0.09}$ times the average cost savings for the young with that plan (i.e. 642 euro). In this scenario RACPs will (partly) capture cost savings in plan B, which can therefore not fully return in the premium reduction compared to plan A.

3.5 Scenario V

Also in the last scenario identical risk types are to some extent concentrated in the same health plans, but $s_H^B > \frac{h_L}{h_H} s_L^B$. Under these conditions the premium reduction for plan B can exceed the average cost savings in plan B. In our empirical example this would have been the case when the average cost savings of high risks in plan B exceeded 2,086 euro (i.e. $\frac{0.30}{0.09}$ * 642 euro).

4. Real-world examples: deductibles and managed care

What can we learn from the previous exhibition? Hence, we will show the relevance of our framework for two common types of cost containing health plans in practice: voluntary-deductibles plans and managed-care plans. The questions to be answered are: “Will cost savings be (partly) captured by the RACPs?” and if yes “What will be the policy implications?”.

4.1. Cost saving on the demand side: voluntary-deductible plans

In practice, it is evident that low risks have a stronger preference for deductible plans than high risks (Bakker et al., 2000; Schellhorn, 2001; Gardiol et al., 2006; Van Kleef et al., 2008).[8] The resulting concentration of identical risk types in the same health plans has serious implications: with a sophisticated set of risk adjusters the capitation system might reduce the premium reduction such that deductible plans will hardly be attractive, not even for the healthiest individuals in the population. The explanation is as follows. Bakker et al. (ibid.) have shown that the premium reduction of deductible plans compared to no-deductible plans can roughly consist of three components: the out-of-pocket expenses by consumers, the moral hazard reduction and the effect of selection (i.e. health-related cost differences between individuals who prefer a deductible and those who do not). As better risk adjusters are taken into account in the capitation formula, the effect of self-selection will be smaller since RACPs will compensate for health-related cost differences between consumers with a deductible and consumers without a deductible, which is in fact an important goal of RACPs. However, when RACPs are based on the expected costs of individuals – as is currently the case in most health insurance schemes – not just the self selection effect will be compensated for but also the real cost savings (i.e. the out-of-pocket expenses and moral hazard reduction). Thus, if the capitation formula includes a sophisticated set of risk adjusters, the premium reduction for deductible plans may be lower than the average cost savings. Consequently, deductible plans might be hardly attractive – particularly for high risks who expect their out-of-pocket expenses to exceed the premium reduction – which makes deductible plans a less effective instrument to reduce moral hazard.

[8] For other evidence on (adverse) selection we refer to Browne (1992), Beck (2004) Van de Ven and Van Vliet (1994).

Given that low risks tend to concentrate in deductible plans, we expect to end up in scenario IV. Occurrence of scenario III or V is unlikely since it requires that average cost savings in a deductible plan are *much* higher for high risks than for low risks. High cost savings (i.e. out-of-pocket expenses and moral hazard reduction) require substantial expected expenses, which are exactly the reason for not choosing a deductible plan.

4.2. Cost savings on the supply side: managed care

Our framework is also relevant for cost savings on the supply side of health care, e.g. cost savings due to managed care. Concentration of identical risk types in the same health plans can occur for different reasons. For example, health plans specialized in managing the care for diabetes might attract relatively many diabetes patients. When diabetes is included as a risk adjuster in the capitation formula – e.g. in the form of a pharmacy cost group or diagnostic cost group (Lamers, 1998; Lamers, 1999) – the RACPs will not just correct for health-related expenditure differences between health plans but also for the cost savings in the specific diabetes plans. A second example is health plans specialized in managing the care in specific geographical regions which attract relatively many consumers in these regions. If region is included as a risk adjuster in the capitation formula, the RACPs will not just compensate for health-related cost differences between regions but also level out cost savings achieved in geographical plans. A third example is health plans specialized in managing the care for the elderly which attract relatively many old consumers. In general terms the argument is the same as above: if age is included as a risk adjuster in the capitation formula, the RACPs will not just compensate for health-related cost differences between age groups but also for the cost savings achieved in age-specific health plans. In fact, this argument is similar for all scenarios in which health plans are specialized in groups of consumers which are to some extent identical in terms of the risk adjusters in the capitation formula. When health plans learn about this, the financial incentives for cost containment diminish compared to a situation without risk adjusted capitation payments.

Given that health plans will attract risk types in which they are specialized, we expect to end up in scenario IV. Occurrence of scenario III or V is unlikely since it requires that average cost savings in a managed care plan are *much* higher for risk types that are underrepresented in the plan than for risk types that are concentrated in the plan. Exactly the opposite is expected to occur: average cost savings are likely to be higher for risk types in which plans are specialized.

5. How to avoid that RACPs capture cost savings

In theory, two alternative ways of calculating RACPs can avoid that RACPs capture cost savings. The first is basing RACPs on expected cost differences *within* health plans, as summarized in formula (2), with $C_{j,p}$ as the average expected costs of risk group j in plan p and C_p as the average expected costs in plan p. This alternative is a feature of the payment scheme proposed by Barros (2003). When RACPs are based on expected cost differences within health plans then cost differences between health plans will not affect RACPs. As a result, plan-related cost savings stay with health plans and can be fully incorporated into premiums. From a practical point of view, however, this alternative has two serious drawbacks. In the first place, the condition of horizontal equity, as defined by Schokkaert and Van de Voorde (2004), will be violated in the sense that RACPs can differ for the same risk types in different plans. In the second place, this alternative requires a substantial number of individuals per health plan to make valid estimations of the expected costs. With a sophisticated set of risk adjusters, however, the number of individuals in a particular risk cell might be too low for making such valid estimations.

(2) $RACP_{j,p} = C_{j,p} - C_p$

The second alternative is to correct the expected costs for cost savings before RACPs are calculated, as summarized in formula (3) with S_j as the average cost savings in risk group *j* and *S* the average cost savings in the population. Under this procedure RACPs are based on some sort of acceptable costs rather than expected costs (Schokkeart et al., 2006). However, also this alternative has some serious drawbacks. In the first place, it requires that average cost savings are known, e.g. in case of deductible plans information must be available on the out-of-pocket expenses and the moral hazard reduction and in case of managed care plans information must be available on the relative cost savings. Whereas it might be possible to gather information on out-of-pocket expenses, it will be difficult to find valid information on the moral hazard reduction and other types of cost saving. Literature broadly reports on the methodological problems of estimating these effects.[9] In the second place, such a correction is complicated because average cost savings are not static, but result from a dynamic interaction between the premium reduction and the group of consumers choosing that plan. For example, the average cost savings in a deductible plan depends on the risk profile of those choosing a deductible. This risk profile, however, depends on the premium reduction, which again depends on the risk profile, and so on.

(3) $RACP_j = (C_j + S_j) - (C + S)$

[9] e.g. Gardiol et al. (2006), Grandchamp (2006) and Van Vliet (2004).

6. Conclusion

An important goal of risk-adjusted capitation payments (RACPs) to community-rated health plans – that may differ in coverage and/or the organization of delivering care – is to reduce incentives for risk selection while maintaining incentives for cost containment. This paper has illustrated that “simply” basing RACPs on the expected costs of enrollees can reduce incentives for cost containment. The explanation is simple: when identical risk types concentrate in the same health plans – e.g. due to selection, specialization of health plans or just coincidence – cost savings will be (partly) captured by the RACPs and leak away from these plans. As more cost savings are captured by the RACPs, incentives for cost containment diminish.

Our theoretical framework shows that whether or not cost savings are captured by the RACPs depends on the level at which identical risk types are concentrated in the same health plans and the relation between risk types and absolute cost savings. In practice, this framework is relevant for both demand-side cost containment and supply-side cost containment. For example: low risks are more likely to be in a deductible plan than high risks. When RACPs are based on the expected costs they will not just compensate for health-related cost differences between low risks and high risks but also for the cost savings in the deductible plan. As a result, health plans are not able to fully incorporate their cost savings into a premium reduction, which makes deductible plans less attractive, probably resulting in hardly any consumer opting for a deductible and hardly any reduction in moral hazard. An example with respect to supply-side cost containment is specialization of health plans in particular groups of consumers, e.g. diabetic, residents of a geographical region or the elderly. When health plans attract consumers who are identical in terms of risk adjusters, RACPs will not just compensate for health-related cost differences relative to other risk types, but also for cost savings achieved in these health plans.

These conclusions bring us to some interesting paradoxes. In the first place, improvement of capitation formulas in terms of risk adjusters might reduce incentives for risk selection, but might at the same time reduce incentives for cost containment when new risk adjusters reveal concentration of identical risk types in the same health plans. An extreme example: when deductible choice would be included as an explicit risk adjuster, it would compensate for all cost differences between consumers with a deductible and those without, including the cost savings. As a result, deductible plans can offer no premium reduction compared to alternative plans. In the second place, health plans specializing in specific risk types that are explicitly adjusted for in the capitation formula – e.g. age, gender, region or a chronic diseases – will see more cost savings leaking away as they contract with more of these specific risk types. An extreme example: a health plan covering an entire geographical region will see all cost savings leaking away when that region is included as an explicit risk class in the capitation formula.

Acknowledgements

The authors gratefully acknowledge two anonymous reviewers and the Risk Adjustment Network (RAN) for their valuable comments on earlier versions of this paper. Remaining errors are ours.

References

- Bakker, F.M., R.C.J.A. Van Vliet, and W.P.M.M. Van de Ven (2000) ‘Deductibles in health insurance: can the actuarially fair premium rebate exceed the deductible?’, *Health Policy* 53: 123-141.
- Barros, P.P. (2003) ‘Cream-skimming, incentives for efficiency and payment system’, *Journal of Health Economics* 22: 419-443.
- Beck, K. (2004) *Risiko Krankenversicherung – Risikomanagement in einem regulierten Krankenversicherungsmarkt (Risk in health insurance – risk management in a regulated health insurance market)*, Bern: Haupt Verlag.
- Beck, K., S. Spycher, A. Holly, and L. Gardiol (2003) ‘Risk adjustment in Switzerland’, *Health Policy* 65: 63-74.
- Browne, M. J. (1992), *Journal of Risk and Insurance* 59: 13-34.
- Buchner, F., and J. Wasem (2003) ‘Needs for further improvement: risk adjustment in the German health insurance system’, *Health Policy* 65: 21-35.
- Gardiol, L., P-Y. Geoffard, and C. Grandchamp (2006) ‘Selection and Incentive Effects: An Econometric Study of Swiss Health-Insurance Claims Data’, in Chiappori, P-A, and C. Gollier (eds.) *Competitive Failures in Insurance Markets: Theory and Policy Implications*, Cambridge: MIT Press, pp. 81-95.
- Glazer, J. and T.G. McGuire (2000) ‘Optimal Risk Adjustment in Markets with Adverse Selection: An Application to Managed Care’, *American Economic Review* 90: 1055-1071.
- Grandchamp, C. (2006) *Self-Selection and Risk Selection on the Swiss Health Insurance Market*, University of Lausanne.
- Jack, W. (2006) ‘Optimal risk adjustment with adverse selection and spatial competition’, *Journal of Health Economics* 25: 908-926.

- Lamers, L.M. 1998. Risk-Adjusted Capitation Payments: Developing a Diagnostic Cost Groups Classification for the Dutch Situation. *Health Policy* 45(1):15-32.
- Lamers, L.M. 1999. Pharmacy Costs Groups: A Risk-Adjuster for Capitation Payments Based on the Use of Prescribed Drugs. *Medical Care* 37(8):824-830.
- Lamers, L.M., R.C.J.A. Van Vliet, and W.P.M.M. Van de Ven (2003) 'Risk adjusted premium subsidies and risk sharing: key elements of the competitive sickness fund market in the Netherlands', *Health Policy* 65: 49-62.
- Newhouse, J.P. (1996) 'Reimbursing health plans and health providers: efficiency in production versus selection', *Journal of Economic Literature* 34:1236-1263.
- Schellhorn, M. (2001) 'The effect of variable health insurance deductibles on the demand for physician visits', *Health Economics* 10: 441-456.
- Schokkaert, E., G. Dhaene and C. Van de Voorde (1998) 'Risk adjustment and the trade-off between efficiency and risk selection: an application of the theory of fair compensation', *Health Economics* 7: 465-480.
- Schokkaert, E., and C. Van de Voorde (2004) 'Risk selection and the specification of the conventional risk adjustment formula', *Journal of Health Economics* 23: 1237-1259.
- Schokkaert, E., K. Beck, A. Shmueli, W.P.M.M. van de Ven, C. Van de Voorde and J. Wasem (2006) 'Acceptable costs and risk adjustment: policy choices and ethical trade-offs', *Mimeo*.
- Van Barneveld, E.M., L.M. Lamers, R.C.J.A. van Vliet and W.P.M.M. van de Ven (2001) 'Risk sharing as a supplement to imperfect capitation: a tradeoff between selection and efficiency', *Journal of Health Economics* 20: 147-168.

- Van de Ven, W.P.M.M., and R.P. Ellis (2000) 'Risk adjustment in competitive health insurance markets', in Culyer A.J., and J.P. Newhouse (eds.) *Handbook of Health Economics*, Amsterdam: Elsevier, pp. 755-845.
- Van de Ven, W.P.M.M., K. Beck, F. Buchner, D. Chernichovsky, L. Gardiol, et al. (2003) 'Risk adjustment and risk selection on the health insurer market in five European countries', *Health Policy* 65: 75-98.
- Van de Ven, W.P.M.M., K. Beck, C. Van de Voorde, J. Wasem, and I. Zmora (2007) 'Risk adjustment and risk selection in Europe: 6 years later', *Health Policy* 83: 162-179.
- Van de Ven, W.P.M.M., and Van Vliet, R.C.J.A. (1994) 'Consumer information surplus and adverse selection in competitive health insurance markets: An empirical study'. *Journal of Health Economics* 14: 149-169.
- Van Kleef, R.C., K. Beck, W.P.M.M. Van de Ven, and R.C.J.A. Van Vliet (2008) 'Risk equalization and voluntary deductibles: a complex interaction', *Journal of Health Economics* 27: 427-443.
- Van Vliet, R.C.J.A. (2004) 'Deductibles and health care expenditures: empirical estimates of price sensitivity based on administrative data', *International Journal of Health Care Finance and Economics* 4: 283-305.

Appendix 1

Table 7 Change in RACPs for 26 age/gender-classes in the Swiss capitation formula of 2008 due to cost savings in the voluntary-deductible plan.

Class	**RACP without cost savings**	**RACP with cost savings**	**Difference**
Men, 31-35	-1859	-1926	-67
Men, 36-40	-1623	-1696	-73
Men, 41-45	-1431	-1480	-49
Men, 46-50	-1274	-1312	-38
Men, 51-55	-694	-727	-33
Men, 56-60	-217	-244	-27
Men, 61-65	265	248	-17
Men, 66-70	1054	1048	-6
Men, 71-75	2019	2054	35
Men, 76-80	2271	2327	56
Men, 81-85	2554	2623	69
Men, 86-90	2247	2324	77
Men, 90+	1937	2003	66
Women, 31-35	-1082	-1191	-109
Women, 36-40	-1192	-1272	-80
Women, 41-45	-1211	-1246	-35
Women, 46-50	-875	-885	-10
Women, 51-55	-524	-525	-1
Women, 56-60	9	27	18
Women, 61-65	379	413	34
Women, 66-70	906	969	63
Women, 71-75	1644	1733	89
Women, 76-80	2125	2229	104
Women, 81-85	2402	2518	116
Women, 86-90	2599	2711	112
Women, 90+	1955	2091	136

Appendix 2

Table 8 Premium reduction as a percentage of the average cost savings in a health plan under different assumptions about the share of individuals per risk type having that plan (vertical) and the relation between cost savings and risk types (horizontal)

	$S_H^B = \frac{9}{1} S_L^B$	$S_H^B = \frac{2}{8} S_L^B$	$S_H^B = \frac{3}{7} S_L^B$	$S_H^B = \frac{4}{6} S_L^B$	$S_H^B = \frac{5}{5} S_L^B$	$S_H^B = \frac{4}{6} S_L^B$	$S_H^B = \frac{3}{7} S_L^B$	$S_H^B = \frac{2}{8} S_L^B$	$S_H^B = \frac{1}{9} S_L^B$
$h_L = 1.0$ $h_H = 0.0$	p=0	p=0	p=0	p=0	p=0	p=0	p=0	p=0	p=0
$h_L = 0.9$ $h_H = 0.1$	p=100	p<100	p<100	p<100	p<100	p<100	p<100	p<100	p<100
$h_L = 0.9$ $h_H = 0.5$	p>100	p>100	p>100	p<100	p<100	p<100	p<100	p<100	p<100
$h_L = 0.5$ $h_H = 0.5$	p=100	p=100	p=100	p=100	p=100	p=100	p=100	p=100	p=100
$h_L = 0.5$ $h_H = 0.9$	p<100	p<100	p<100	p<100	p<100	p<100	p>100	p>100	p>100
$h_L = 0.1$ $h_H = 0.9$	p<100	p<100	p<100	p<100	p<100	p<100	p<100	p<100	p=100
$h_L = 0.0$ $h_H = 1.0$	p=0	p=0	p=0	p=0	p=0	p=0	p=0	p=0	p=0

Appendix 3

Table 9 Premium reduction as a percentage of the average cost savings in a health plan under different assumptions about the share of individuals per risk type having that plan (vertical) and the relation between cost savings and risk types (horizontal), *assuming that the groups of low risks and high risks have exactly the same size*

	$S_H^B = \frac{9}{1} S_L^B$	$S_H^B = \frac{2}{8} S_L^B$	$S_H^B = \frac{3}{7} S_L^B$	$S_H^B = \frac{4}{6} S_L^B$	$S_H^B = \frac{5}{5} S_L^B$	$S_H^B = \frac{4}{6} S_L^B$	$S_H^B = \frac{3}{7} S_L^B$	$S_H^B = \frac{2}{8} S_L^B$	$S_H^B = \frac{1}{9} S_L^B$
$h_L = 1.0$ $h_H = 0.0$	0%	0%	0%	0%	0%	0%	0%	0%	0%
$h_L = 0.9$ $h_H = 0.1$	100%	69%*	53%	43%	36%	31%	27%	24%	22%
$h_L = 0.9$ $h_H = 0.5$	144%	125%	109%	94%	81%	69%	59%	50%	41%
$h_L = 0.5$ $h_H = 0.5$	100%	100%	100%	100%	100%	100%	100%	100%	100%
$h_L = 0.5$ $h_H = 0.9$	41%	50%	59%	69%	81%	94%	109%	125%	144%
$h_L = 0.1$ $h_H = 0.9$	22%	24%	27%	31%	36%	43%	53%	69%	100%
$h_L = 0.0$ $h_H = 1.0$	0%	0%	0%	0%	0%	0%	0%	0%	0%

* Calculations for this cell are shown in tables 10 through 13.

Table 10 Distribution of individuals over health plans and risk types

	Plan A	Plan B	Total
Low risks	0.1	0.9	1
High risks	0.9	0.1	1
Total	1	1	2

Table 11 Average cost savings in CHF

	Plan A	Plan B	Total
Low risks	0	2	1.8
High risks	0	8	0.8
Total	0	2.6	1.3

Table 12 Effect of cost savings on RACPs in CHF

	Change in RACP
Low risks	-0.5 (=(C_L-1.8)-(C-1.3))
High risks	0.5 (=(C_H-0.8)-(C-1.3))

Table 13 Net effect of cost savings on the total costs and community-rated premiums in CHF

	Plan A	Plan B
Low risks	0,50	-1,50
High risks	-0,50	-8,50
Community-rated premium*	-0,40	-2,20

* Thus, the premium reduction of plan B (compared to plan A) equals 69% of the average cost savings in plan B, i.e. (-0.4 * 1 – (-2.2) * 1) / 2.6 = 69%.