Supply-Side and Demand-Side Cost Sharing in Deregulated Social Health Insurance: Which Is More Effective?*

Maria Trottmann†, Peter Zweifel‡, Konstantin Beck§

Version: September 25, 2009

Abstract

Microeconomic theory predicts that if patients are fully insured and providers are paid fee-for-service, utilization of medical services exceeds the efficient level ('moral hazard effect'). In Switzerland, both demand-side cost sharing and supply-side cost sharing have been introduced to mitigate this problem. Analyzing a panel dataset of about 150,000 adults, we find both types of cost sharing to be effective in curtailing the use of medical services. However, demand-side cost sharing options are preliminarily chosen by individuals in excellent health, causing 'true' cost savings achieved by supply-side cost sharing to be more important.

Keywords: Health insurance, moral hazard, managed care, copayment, two stage residual inclusion

JEL-Classification: I11; G22; D82

---

*We thank the CSS Institute for Empirical Health Economics for providing data, financial support, and many insights, Randall Ellis, Wynand Van de Ven, Ute Kunze, Ute Studer-Merkle, Bernhard Keller, Stefan von Rotz, Urs Kaeser, Hansjoerg Lehmann, Johannes Schoder, and participants at the 7th European Conference on Health Economics for helpful comments and discussion.

†Corresponding author: Socioeconomic Institute, University of Zurich, Hottingerstrasse 10, CH-8032 Zurich, maria.trottmann@access.uzh.ch

‡Socioeconomic Institute, University of Zurich

§Socioeconomic Institute, University of Zurich and CSS Institute for Empirical Health Economics, Lucerne

1 Introduction

Health insurance creates the problem of demand-side moral hazard because insurers can neither ex ante observe clients' effort to prevent losses, nor ex post verify the size of the loss. As a consequence, they base reimbursement on the observed utilization of medical care, giving patients an incentive to use more or more expensive care. Demand-side cost sharing, specifically in the guise of deductibles and copayments, has been analyzed as a corrective (e.g. Zeckhauser 1970, Zweifel and Manning 2000). However, demand-side cost sharing exposes consumers to risk, contradicting the very objective of insurance (Zeckhauser 1970, Ellis and McGuire 1993). In addition, it may be politically unacceptable as being unfair to the chronically ill.

These considerations have created interest in the alternative of supply-side cost sharing. Because of their information advantage, providers of medical care can influence the demand for their services to a greater extent than other professionals (Arrow 1963). If paid fee-for-service, with the fee exceeding the marginal cost of provision, they share patients' incentive for too much or too expensive care. Supply-side cost sharing is designed to make them oppose their patients' moral hazard and to limit the provision of health care to the efficient level (McGuire 2000). One way to achieve this objective is prospective payment. It causes providers to bear the full marginal cost of provision, exposing them to the risk of bearing part of the treatment cost (Ellis and McGuire 1986, Newhouse 1996, and Zweifel, Breyer and Kifman 2009, ch. 10).

Both demand-side and supply-side cost-sharing have been empirically examined in terms of their effectiveness. Researchers have benefited from randomized experiments [the famous RAND study; Manning et al. (1987)] or natural experiments [Chiappori et al. (1998), Eichner (1998), or Winkelmann (2004)]. When individuals have a choice of plan, self-selection effects need to be accounted for because those who expect high future HCE are more likely to opt for more comprehensive insurance. The instrumental variable (IV) approach, which requires the availability of at least one variable that influences contract choice but not utilization ('identifying instrument'), is frequently used to deal with this problem. Schellhorn (2001) and Gerfin and Schellhorn (2006) rely on premium level and supplementary hospital insurance as identifying instruments. Cameron et al. (1988) advocate income as determinant of insurance coverage but not utilization. Cardon and Hendel (2001) model both the demand for health insurance and health care; their identifying restriction is the fact that different employers offer different premiums and copayment levels.

With increasing availability of panel data, a novel approach pioneered by Wolfe and Godderies (1991) has gained popularity. It uses HCE from prior years to proxy unobserved differences between individuals which become predetermined in the year the comparison between plans is performed (Lehmann and Zweifel 2004, Van Kleef et al. 2008).

The novelty of this paper is that it directly compares the effects of demand-side and supply-side cost sharing, using contract variants offered by the same health insurer. This has the advantage that many side conditions (underwriting policy, billing procedure) are kept constant. Moreover, it complements Lehmann and Zweifel (2004), who construct a proxy for unobserved health status from prior HCE, by the two-stage residual inclusion estimator (2SRI, Terza et al. 2008). In this way, self-selection effects are more fully controlled for. Finally, it extends the set of instruments influencing choice of plan but not HCE by including the premium for the baseline contract, the potential premium reduction for a restricted plan, the individual's credit record, and years of membership with the same fund. For the prepaid plan, an additional instrument is a dummy indicating whether or not an independent practice association (IPA) was operative in the county of the individual.

The remainder of this article is structured as follows. Section 2 contains an overview of Swiss health insurance. Section 3 is devoted to a description of the data base. In Section 4, we explain the econometric methods used to separate moral hazard from self-selection effects and to deal with the very skewed distribution of HCE data. The estimation results are presented in section 5. Section 6 discusses policy implications in view of related literature, while the final section 7 contains a summary and conclusions.

2 Swiss Health Insurance

Swiss health insurance is of the 'managed competition' type (Enthoven 1974, Van de Ven et al. 2007). Insurance coverage is mandatory for a rather comprehensive 'basic' basket of medical services and pharmaceuticals, written by some 80 not-for-profit insurers competing in a regulated market. Insurers must accept all applicants during semi-annual open enrollment periods. Premiums can be differentiated only by area of residence. Reductions are possible for young adults (19-25) and individuals who have accident coverage through the employer.

With premiums mandated to be uniform but health risks varying widely, incentives for risk selection are provoked. To mitigate them, a risk adjustment scheme redistributes payments from insurers with an above-average share of young and male enrollees to competitors with more older and female enrollees. Premium subsidies for low-income individuals are funded out of general tax.

In the baseline contract, insured individuals enjoy unlimited access to all licensed physicians and most hospitals in their region of residence. They face a minimum annual deductible of CHF 300 (some EUR 200 as of 2009) and a co-insurance rate of 10 percent up to a cap of CHF 700 (EUR 470) per year. Physicians in independent practice are reimbursed fee-for-service according to a nationwide fee schedule that is collectively bargained between the providers' and the insurers' associations. Hospitals receive per diems for patients treated (the introduction of a DRG system is under way). The cantons[1] together with regional hospital associations finance hospital investment and one-half of operational cost. While this system is generally found to ensure access to comprehensive health care to all citizens, it is criticized for high and rapidly increasing HCE, lack of co-ordination between providers, and lack of information about quality and efficiency (OECD 2006).

In response to these problems, insurers have been granted the right to offer managed-care type options (since 1994) and higher deductibles (since 1996) in return for lower premiums. However, policy makers feared that these options would attract low risks. In addition to a risk adjustment scheme based on age and sex, they imposed limits on possible premium reductions. For voluntary deductibles, these are fixed percentages of the base premium or 80 percent of the additional deductible, whichever is less. The eligible deductible levels are also regulated, as shown in table 1. In managed-care type contracts, the insurer must prove that the reduction is justified by efficiency gains rather than self-selection effects. Furthermore, it must not exceed 20 percent during the first five years since the launch of the contract.

Table 1 about here

[1]Switzerland is divided into 26 cantons, with population ranging from 1,307,600 (Zurich) to 15,500 (Appenzell i.R.), Source: Swiss Federal Statistical Office, www.bfs.admin.ch.

Deductible level in CHF / Year	300	500	1,000	1,500	2,000	2,500
Maximum reduction in percent of base premium	-	5	15	30	38	43
Maximum absolute premium reduction	-	160	560	960	1,360	1,760

Table 1: Regulation of deductibles and maximum premium reductions in Swiss mandatory health insurance 2006, CHF 1 $\approx$ EUR 0.66

3 Data

The data base consists of individual records of more than 160,000 Swiss adults insured by CSS, a major Swiss insurer, and covering the years 2003 - 2006. It includes age, gender, residential location, contract choice, and HCE. Individuals who were not observed over the entire four years are excluded from the analysis, with death constituting the main cause. While the deathbound are known to cause a considerable amount of HCE, they exhibit an idiosyncratic pattern of health care utilization (see Werblow et al. 2007), justifying separate analysis in future research. The influence of closeness to death also calls for exclusion of individuals who died during 2007.

Table 2 shows descriptive statistics according to contract choice as of 2006. For simplicity, deductibles are grouped into three categories (low: 300, medium: 500, high >= 1,000 CHF per annum). More than 70 percent of those who chose a deductible in excess of CHF 500 opted for the CHF 1,500 level. Furthermore, observed HCE across the high deductible levels appeared to be similar[2]. Buyers of the high-deductible plans are younger and more likely to be male than those with the low deductibles. Their mean HCE amounts to CHF 1,051 or 23 percent of that pertaining to individuals with the minimum deductible. The fraction of those reporting positive HCE is 57 rather than 88 percent. If only those with positive HCE are taken into account, the mean is CHF 1,799 or 34 percent of the low-deductible benchmark, respectively. These differences point to sizeable effects of demand-side cost sharing (which still need to be corrected for self-selection effects, see below).

[2]In earlier work (e.g. Lehmann and Zweifel 2004), only HCE in excess of the deductible was analyzed on the grounds that patients have no incentive to submit their claims unless HCE exceeds the deductible. However, by now the lion's share of billings are transmitted directly from providers to insurers. Moreover, this insurer failed to find significant differences when internally comparing the distribution of claims below the deductible level in cantons where direct billing is prevalent with that in cantons where patients still submit bills.

Table 2 about here

Contract (DED = Deductible, IPA = Independent Practitioners Association)	Mean Age	Male Share	Mean HCE	HCE > 0 Share	Mean HCE if HCE > 0
low DED (baseline contract)	55	0.40	4,665	0.88	5,299
medium DED	54	0.43	3,255	0.81	3,941
high DED	45	0.54	1,051	0.57	1,799
Prepaid IPA, low DED	54	0.44	2,934	0.85	3,428
Prepaid IPA, medium DED	49	0.46	1,672	0.77	2,107
Prepaid IPA, high DED	43	0.57	828	0.58	1,408

Table 2: Age, sex, and HCE according to type of contract, n = 163,686, CHF 1≈ EUR 0.66

Turning to the supply-side cost sharing alternative (lower half of table 2), one notices that the high-deductible variant is again characterized by a comparatively low mean age and a higher share of men. Average HCE is CHF 828 or 28 percent of the low-deductible benchmark of CHF 2,934. The share of individuals with positive HCE is 58 percent rather than 85 percent, while mean HCE conditional on being positive amounts to CHF 1,408 or 41 percent of the benchmark.

However, the HCE values for the IPA plans are lower throughout than for the conventional FFS plans with the same deductible level. This may well be due to changed incentives facing physicians. Similar to the United States, participating physicians (mainly general practitioners) are paid a risk-adjusted capitation payment designed to cover all services rendered or prescribed up to a threshold of CHF 10,000 per patient and year. Beyond that limit, the insurer reimburses 90 percent of cost FFS. Capitation payments are adjusted for age, gender, deductible level, hospitalization during previous year, nursing home stay during previous year, and 21 pharmaceutical cost groups. The pharmaceutical cost groups are similar to those used in the Dutch risk adjustment scheme (Lamers and Van Vliet 2003). While the insurer does not impose guidelines or utilization reviews, many networks run them internally, combined with quality monitoring by independent auditors in some cases.

In order to get a preliminary indication of the extent to which the cost differences may be caused by self-selection effects, it is instructive to compare the HCE of consumers who switch to higher deductibles and IPA plans with that of those who do not (see table 3). The switchers from a low-deductible FFS plan in 2005 to a high-deductible one had caused HCE of CHF

812, a mere 19 percent of the non-switchers. Those changing to a medium-deductible alternative had caused HCE amounting to CHF 1,892 in 2005, or 41 percent of the non-switchers. Switchers who moved from a FFS to an IPA plan had cost CHF 1,600, or 46 percent of the stayers. These figures point to substantial self-selection effects in both demand-side and supply-side cost sharing.

Table 3 about here

Switch at beginning of 2006 HCE 2005	FFS, low to high DED	FFS, low to medium DED	FFS (all DED) to prepaid IPA
Switchers	812	1,892	1,600
Non-Switchers	4,329	4,329	3,245

Table 3: Prior mean HCE of switchers and non-switchers, DED = Deductible, IPA = Independent Practitioners Association, CHF 1≈ EUR 0.66

4 Econometric Modeling

4.1 Developing a Proxy for Unobserved Health Status

The dataset does not contain direct information on health status such as diagnostic codes, restrictions on activities of daily living, or self-reported health. However, panel data allows to develop an indicator of health status from prior HCE (see Van Kleef et al. 2008, Lehmann and Zweifel 2004, Wolfe and Godderies 1991). In particular, Lehmann and Zweifel show that residuals from a random-effects Tobit regression of prior HCE on exogenous variables can serve as a proxy for unobserved health.

However, in view of considerable heteroscedasticity in the dataset, the two-part model is preferable over the Tobit. The first part is a random-effects probit model predicting the probability of observing positive HCE for individual i in year t [see Eq. (1)]. The second part estimates the amount of HCE given that it is positive. The log transformation serves to reduce the skewness of the dependent variable. Equation (2) can also be justified by noting that an individual's health is to be seen relative to her age, gender, and regional peers. The present panel is unbalanced, as many individuals had positive HCE in some but not in all years. A

Wooldridge test of serial correlation in the error term (Wooldridge 2002) rejected the null hypothesis of no autocorrelation. Therefore, the feasible generalized least squares procedure proposed for unbalanced panels by Baltagi and Wu (1999) is applied to gain efficiency while avoiding biased estimation of standard errors. The model applied for deriving the health status proxy thus reads (all error terms assumed normally distributed),

$$Pr(HCE_{i,t} > 0) = \Phi(a + \beta X_{i,t} + \nu_i + \upsilon_{i,t}) \quad (1)$$

$$log(HCE_{i,t}|HCE_{i,t} > 0) = b + \theta X_{i,t} + u_i + \epsilon_{i,t} \quad (2)$$

$$\text{with} \qquad \epsilon_{i,t} = \rho * \epsilon_{i,t-1} + \xi_{i,t}$$

Eqs (1) and (2) are estimated on the first three years of the dataset, ie 2003 to 2005. Explanatory variables are age, age interacted with gender, urbanization, area of residence and a year dummy to account for inflation. Estimation results are shown in appendix A. Deviations from the expected value of HCE are averaged over the three years in order to reduce the influence of transitory health shocks.

Note that while only individuals with the baseline contract are included here, estimated coefficients will be used to predict individual HCE for the whole sample. This has the advantage that endogeneity of contract choice does not bias estimators. However, predicted HCE are likely to be too high when extrapolating to individuals with higher-deductibles and IPA contracts (who are expected to be healthier than average). In addition, lowered observed HCE due to mitigated moral hazard is interpreted as a sign of better health. Both effects work to reduce positive-valued (and increase negative-valued) residuals, causing health status of buyers of higher deductible and IPA plans to be overrated. The positive correlation between the indicators of health status and cost savings achieved by these plans might lead to an overestimation of risk-selection effects and an underestimation of moral hazard reduction effects (ceteris paribus).

4.2 Potential Omitted Variable Bias

Even if the proxy can sufficiently control for unobserved differences in current health status, there are additional unmeasured variables that may cause someone opting for the minimum deductible to have a great deal of HCE, resulting in an overestimation of moral hazard effects. Examples are private information about probabilities of future illness, general attitude towards medical care, and previous experience with the health care system. Ignoring these confounders will lead to omitted variables bias in the HCE equation. Terza et al. (2008) show that the residuals from an equation modeling contract choice to be good estimators of these confounders. Therefore, including these residuals into the HCE equation alongside observed contract choice and the proxy for latent health serves to control for unobserved confounders (two stage residual inclusion estimation, 2SRI). The 2SRI method yields also consistent estimates if the HCE equation is nonlinear. However, it requires equations for contract choice to be specified.

4.3 Modelling Contract Choice

For identification, at least one explanatory variable in the contract choice equation must not appear in the HCE equation. Five such variables are available.

1. Premium for the baseline contract: Premiums vary within a given premium region because some consumers have accident insurance through their employer, while those under 26 are eligible for a youth reduction. Therefore, baseline premiums and dummies for premium region are not collinear. However, they do affect contract choice because a large baseline premium increases the attractiveness of higher-deductible and IPA options. At the same time, there is no reason why they should influence HCE (see Schellhorn 2001 for further discussion).

2. Absolute premium reductions for a high-deductible or IPA options: It differs among individuals with the same deductible because of interactions with other reductions and 'maximum reduction' regulations (see section 2).

3. Number of years of CSS membership[3]: Long-standing members are known not to switch contracts, making them less likely to opt for a higher-deductible or an IPA option. However, loyalty is correlated with health status because consumers who develop chronic conditions face a premium hike if they sign up with another insurer for the supplementary

[3] This variable is truncated at 1999 because retrieving data from previous years is cubersome. There was a change in IT architecture in 1998.

component (which they usually prefer to have from the same insurer to avoid ambiguity as to responsibility for payment). Nevertheless, preliminary estimations showed it to be insignificant in the HCE equation when entered in combination with the health status proxy. It therefore qualifies as identifying restriction.

4. Dummy indicating a bad credit record: This may reflect lower income, which is relevant for contract choice. At the same time, a bad credit record proved unrelated to HCE, once the proxy for health status was included.

5. IPA officially on offer within the individual's zipcode area: This proved to be unrelated to utilization if regional differences were controlled for by dummies. However, the availability of an IPA importantly favors the choice of the corresponding option.

Modeling the choice of deductible calls for an ordered probit model, while for the choice of the IPA a probit model is sufficient. Starting with the latter for simplicity, the generalized residuals are given by Gourieroux et al. (1987). Let h_i be an indicator variable equal to one if the IPA plan was chosen and zero otherwise, z_i a vector of covariates, and $\hat{\theta}$ a vector of the estimated coefficients. Then the generalized residuals are given by

$$\hat{u_i} = h_i * \frac{\phi(z_i'\hat{\theta})}{\Phi(z_i'\hat{\theta})} + [1 - h_i] * \frac{-\phi(z_i'\hat{\theta})}{1 - \Phi(z_i'\hat{\theta})} = \frac{[h_i - \Phi(z_i'\hat{\theta})]\phi(z_i'\hat{\theta})}{[1 - \Phi(z_i'\hat{\theta})]\Phi(z_i'\hat{\theta})}, \tag{3}$$

where Φ denotes the cumulative and ϕ, the standard normal density respectively. In the same spirit, the generalized residuals for multinomial or ordered choice models have been defined by Vella (1993). Let there be i= 1.... N individuals choosing from k = 1...K ordered alternatives, and d_{ik} denote an indicator function taking the value 1 if individual i has chosen alternative k and zero otherwise. Then the generalized residual is

$$\hat{v_i} = \Sigma_{k=1}^{K} d_{ik} \frac{\hat{\pi}_{ik}[d_{ik} - \hat{\Pi}_{ik}]}{[1 - \hat{\Pi}_{ik}]\hat{\Pi}_{ik}} \tag{4}$$

with $\hat{\Pi}_{ik}$ denoting the estimated probability that individual i chooses the k-th alternative and $\hat{\pi}_{ik}$, the estimated value of the density at that point. These two quantities are determined as follows. Let $\hat{\gamma}$ be the vector of estimated coefficients from the ordered probit and $\hat{\alpha_k}$, the estimated cut points with $\alpha_0 = -\infty$, and $\alpha_K = \infty$. Then,

$$\hat{\pi} = \phi(\alpha_{k-1} - z_i'\hat{\gamma}) - \phi(\alpha_k - z_i'\hat{\gamma}) \text{ and } \hat{\Pi} = \Phi(\alpha_{k-1} - z_i'\hat{\gamma}) - \Phi(\alpha_k - z_i'\hat{\gamma}). \quad (5)$$

4.4 Zero-values, Skewness, and Heteroscedasticity

The distribution of HCE has a cumulation point at zero. Among the alternatives available for dealing with this fact, the two-part model is preferred over e.g. the Tobit model for two reasons. First, the zeros are perceived as reflecting choices rather than missing values (see Jones 2000). Second, both supply- and demand-side cost sharing are known to affect the decision to use health care in a different manner than the decision concerning HCE. This difference cannot be accommodated in censored data models such as the Tobit.

The specification of the second part ($HCE|HCE > 0$) has been discussed by Manning (1998) and Manning and Mullahy (2001, MM hereafter). Because of the positive skewness of the dependent variable, raw-scale estimates can be imprecise even in large datasets. The log transformation is often used to mitigate skewness, with coefficients interpreted as (semi-) elasticities of the mean response. However, Manning (1998) shows that if the error variance is heteroscedastic in a way that is correlated with the covariates, these coefficients are no longer consistent elasticity estimates. Moreover, absolute savings due to cost sharing may be of interest, calling for a retransformation of predicted values.

Blough et al. (1999), MM and others suggest estimating $ln(E(y|x))$ directly by a GLM procedure with a log link (i.e. $ln(E(y|x)) = x\beta$) and an appropriate variance function. As MM point out, the GLM models are consistent as long as the mean function is correctly specified, but might lead to imprecise estimates if the residuals are positively skewed even after transformation to log. Following the procedure for model selection suggested by MM, we start with a consistent GLM model, the gamma regression. The kurtosis of the residuals on the log scale is 3.53. This creates a tradeoff between imprecision (GLM) and possible bias (OLS applied to ln(y)). In this work, GLM is used because taking heteroscedasticity into account is deemed more important than precision. Given GLM, a Park test is performed to select the variance function. The estimated λ is 1.81, which is closest to the gamma specification.

5 Results

5.1 Effects of Demand-Side and Supply-Side Cost Sharing

The results of a probit estimation of the probability of reporting positive HCE in 2006 are shown in table 4. For the variables of interest (DED, IPA), marginal effects are calculated for a representative individual (in italics below the coefficients), ie a woman at the age of 52, living in a suburban community in the Zurich region, having the baseline contract plus accident coverage, and a supplement covering alternative medicine. The health proxy is taken at its sample average. This individual's estimated probability of positive HCE is roughly 91 percent. For interaction terms, marginal effects are calculated according to the formulas provided by Norton and al. (2004)[4].

The residuals from the choice-of-deductible equation are significant but not those from the choice-of-IPA equation. This is intuitive as the choice of deductible is strongly related to expected future HCE, while the decision to join an IPA likely depends on other unobserved factors such as perceived IPA quality. The restricted model of table 5 excludes insignificant regressors; the naïve model, also the health proxy and residuals from the contract choice equations.

Regardless of the specification, voluntary deductibles progressively reduce the probability of positive HCE; however, their effect is about seven times smaller in the full and restricted than in the naïve specification, pointing to considerable self-selection effects. On the other hand, they cannot be said to depend on the type of plan (DED * IPA insignificant). By way of contrast, membership in an IPA is associated with a higher probability of positive HCE. This may be the effect of preventive services offered. For example, one large IPA hands out vouchers for free immunizations against the flu in the fall. The variable 'drugs via pharmacy' measures the percentage of drug expenditure sold by pharmacies as opposed to physicians in the individual's area of residence. Some cantons allow physicians to dispense pharmaceuticals on their own account, creating an incentive to over-prescribe. However, this fact does not

[4] To be specific, let β_a and β_b be the coefficients of two dummies, β_{ab} the coefficient of their interaction and $\bar{x}'\beta$ the influence of all other variables at representative values. The marginal effect of the interaction term is $\Phi(\beta_a + \beta_b + \beta_{ab} + \bar{x}'\beta) - \Phi(\beta_a + \bar{x}'\beta) - \Phi(\beta_b + \bar{x}'\beta) + \Phi(\bar{x}'\beta)$. For a dummy without interaction, the marginal effect is $\Phi(\beta_a + \bar{x}'\beta) - \Phi(\bar{x}'\beta)$. As these marginal effects are combinations of all coefficients, their standard errors are calculated by the delta method. The calculations are run in STATA using the nlcom command.

seem to have an impact on HCE[5]. Finally, it is noteworthy that the squared and the cubic form of the health proxy are highly significant as well. Still, a higher value of the proxy has a positive effect on the probability of positive HCE throughout the sample although the squared term has a negative coefficient.

In the second part of the model, the amount of HCE is estimated by GLM with a log link and a gamma specification (see table 5). Here, the residuals from both choice equations are insignificant, confirming Lehmann and Zweifel (2004) who concluded that the health proxy sufficiently controls for risk-selection effects, obviating additional correction[6]. Higher voluntary deductibles are again found to progressively reduce HCE regardless of specification. This time, the full and restricted models point to effects that are four times smaller than according to the naïve model. Type of contract does not play a role (DED * IPA insignificant). Turning to the IPA alternative, one notices a reduction of HCE amounting from 15 (full model) to 17 percent (restricted model), roughly one-half of the estimate suggested by the naïve specification. Somewhat surprisingly, supplemental hospital coverage (which provides for accommodation in a more expensive private room) turns out nonsignificant except in the naïve specification. Finally, coverage for alternative medicine seems to be associated with less HCE in mandatory insurance as individuals might substitute services paid through mandatory insurance by alternative therapies.

Table 4 about here

Table 5 about here

[5]The existing literature on the issue is inconclusive. For example, Vatter and Ruefli (2003) find physician dispensing to lower HCE, while Beck et al. (2004) and Zweifel (1985) find a positive effect.

[6]Their test is very similar to ours as they include a generalized inverse Mills ratio from a selection model into the second stage HCE equation.

	Full Model		Restricted Model		Naive Model	
Dummies for 7 age groups	YES		YES		YES	
Gender, interacted with age	YES		YES		YES	
Berne city	0.058*	(0.029)	0.042	(0.026)	0.018	(0.025)
Lucerne city	-0.040	(0.052)	-0.101**	(0.023)	-0.107*	(0.045)
Geneva city	0.197**	(0.033)	0.223**	(0.028)	0.185**	(0.027)
Health proxy	0.465**	(0.010)	0.465**	(0.010)		
(Health proxy)^2	-0.058**	(0.004)	-0.058**	(0.004)		
(Health proxy)^3	0.005**	(0.000)	0.005**	(0.000)		
Suppl. hospital	0.065**	(0.011)	0.065**	(0.011)	0.155**	(0.010)
	*0.009***	*[0.002]*	*0.017***	*[0.003]*	*0.001*	*[0.003]*
Suppl. altern. med.	0.037**	(0.010)	0.037**	(0.010)	0.085**	(0.009)
	*0.006***	*[0.002]*	*0.017***	*[0.003]*	*0.001*	*[0.003]*
Drugs via pharmacy	0.096	(0.072)			0.007	(0.063)
$\hat{v}_i$ *DED*	-0.056**	(0.012)	-0.055**	(0.012)		
$\hat{u}_i$ *IPA*	-0.070	(0.139)				
Medium DED	-0.035*	(0.016)	-0.031*	(0.016)	-0.258**	(0.010)
	*-0.005***	*[0.002]*	*-0.007***	*[0.003]*	*-0.054***	*[0.003]*
Medium DED * IPA	0.090	(0.063)				
	0.013	*[0.008]*				
High DED	-0.192**	(0.025)	-0.209**	(0.025)	-0.859**	(0.009)
	*-0.034***	*[0.004]*	*-0.038***	*[0.005]*	*-0.240***	*[0.005]*
High DED *IPA	0.048	(0.037)				
	0.012	*[0.006]*				
IPA	0.101*	(0.043)	0.117**	(0.019)	0.008	(0.017)
	*0.015**	*[0.006]*	*0.017***	*[0.003]*	*0.001*	*[0.003]*
Constant	1.420**	(0.066)	1.499**	(0.028)	1.132**	(0.057)
Observations	163,686		163,686		163,686	
Log likelihood	-55,302		-55,304		-72,394	

Coefficients for male dummies and additional regional dummies not shown
Standard errors in parentheses, ** p<0.01, * p<0.05, estimated marginal effects in italics

Table 4: Probability of reporting positive HCE in 2006, Probit estimation
DED = Deductible, IPA = Independent Practitioners Association

5.2 Estimating Overall Effects

This section is devoted to estimating the overall effects of demand- and supply-side cost sharing on expected HCE, ie the product of the probability of positive HCE and the amount of HCE. To this end, expected HCE according to type of contract is estimated first by predicting both components of the two-part model, with contract choice dummies as observed. These results are shown as estimate (1) of table 7; for instance, individuals with a FFS contract and

	Full Model		Restricted Model		Naive Model	
	Coefficient	se.	Coefficient	se.	Coefficient	se.
Dummies for 7 age groups	YES		YES		YES	
Gender, interacted with age	YES		YES		YES	
Berne city	0.043	(0.033)	0.067*	(0.029)	0.015	(0.029)
Lucerne city	-0.292**	(0.068)	-0.200**	(0.023)	-0.285**	(0.025)
Geneva city	0.175**	(0.032)	0.148**	(0.024)	0.133**	(0.026)
Health proxy	0.538**	(0.013)	0.538**	(0.012)		
(Health proxy)^2	-0.092**	(0.007)	-0.092**	(0.007)		
(Health proxy)^3	0.004**	(0.001)	0.004**	(0.001)		
Suppl. hospital	0.026	(0.015)	0.026	(0.015)	0.068**	(0.013)
Suppl. altern. med.	-0.081**	(0.014)	-0.082**	(0.014)	-0.067**	(0.013)
Drugs via pharmacy	-0.142	(0.096)				
$\hat{v}_i$ *DED*	-0.005	(0.020)				
$\hat{u}_i$ *IPA*	-0.167	(0.244)				
Medium DED	-0.065**	(0.014)	-0.065**	(0.015)	-0.248**	(0.014)
Medium DED* IPA	0.004	(0.075)				
High DED	-0.175**	(0.045)	-0.179**	(0.021)	-0.815**	(0.019)
High DED*IPA	0.056	(0.071)				
IPA	-0.148*	(0.058)	-0.170**	(0.028)	-0.350**	(0.027)
Constant	8.044**	(0.086)	7.934**	(0.030)	8.150**	(0.032)
Observations	128,744		128,744		128,744	
AIC	18.09		18.08		18.37	

Robust standard errors in parentheses, ** p<0.01, * p<0.05

Coefficients for male dummies and additional regional dummies not shown

Table 5: Amount of HCE if positive, GLM with a log link and gamma variance function
DED = Deductible, IPA = Independent Practitioners Association

the minimum deductible of CHF 300 had expected HCE of CHF 4,285 (the reference value), while those with a high deductible combined with the IPA option had CHF 804 only.

Since the coefficients of the plan choice variables displayed in tables 4 and 5 are net of risk-selection effects, they can immediately be used for deriving moral hazard effects. This is done by assuming everybody to have chosen the FFS contract combined with the minimum deductible (baseline contract). Technically, the dummies for deductibles and IPA plan are set to zero when predicting expected HCE. The results are shown as estimate (2) of table 7. For example, individuals having a high-deductible combined with the IPA option are predicted to have expected HCE amounting to CHF 1,182. As estimates (2) assume everybody to have chosen the baseline contract, differences from the reference value amount to pure risk-selection effects. For individuals in the high-deductible-and-IPA option, these are estimated at CHF

3,103 (4,285 - 1,182).

Estimates (1) and (2) of the same column show predicted HCE for the same group of individuals, with (1) taking plan choice as observed and (2) assuming everyone to have chosen the baseline contract. Then, the difference between estimates (1) and (2) within one column is the estimated moral hazard reduction; for high deductibles combined with IPA, it amounts to CHF 378 (=1,182 - 804). This is 32 percent of the CHF 1,182 that would have obtained if the same individuals had been subject to the minimum deductible (see bottom line of table 7). For individuals in the high deductible and FFS option, the estimated moral hazard reduction amounts to CHF 308 (=1,416-1,108), while risk-selection amounts to CHF 2,869 (=4,285-1,416). The IPA option combined with the minimum deductible profits from a moderate selection effect only (CHF 804), pointing to rather favourable health status. In this subpopulation, the IPA option achieves an absolute moral hazard reduction of CHF 508 or 15 percent of estimate (2).

Table 7 about here

	Minimum DED		Medium DED		High DED	
	FFS	IPA	FFS	IPA	FFS	IPA
Avg $\widehat{HCE_i}$, estimate (1)	4,285 (ref)	2,973	3,164	1,963	1,108	804
Avg $\widehat{HCE_i}$, estimate (2)		3,481	3,390	2,453	1,416	1,182
Selection, (ref.) - (2)	0	804	895	1,832	2,869	3,103
MH, (2) - (1)	0	508	226	490	308	378
MH, percent of (2)	0	15	7	20	22	32

Table 6: Effects of cost sharing on expected HCE, 2006, CHF 1≈ EUR 0.66
MH: Moral Hazard
Estimate (1): Expected HCE per contract
Estimate (2): Expected HCE of same individuals, assuming they had chosen the minimum deductible and no IPA

5.3 Which Types of Care Are Most Affected by Cost Sharing?

It is insightful to analyze which types of medical services are most affected by cost sharing. To this end, the estimation technique described in the previous section is applied to HCE per type of medical care, namely general practitioners' services, specialists, drugs, physiotherapy[7], outpatient hospital services and inpatient hospital services. Note that all services rendered by qualified specialists are attributed to 'specialist medicine' while in fact qualified specialists provide many primary care services. The residuals from the first stage choice equations are only included if significant. Individuals who did not use any care are excluded from all estimations. Therefore, table 7 estimates the probability of using a specific type of care, conditional on the utilization of any care.

A medium deductible significantly reduces the probability only for drugs. For specialist medicine, a significantly positive influence is estimated. This is the only estimate that contradicts intuition. Looking at the second part of the two part model, a medium deductible has a negative impact on the utilization of GP care and drugs. On the other hand, a high deductible reduces the probability of GP care, drugs and hospital care. The impact on hospital care is surprising as most patients have used up the deductible before entering a hospital. However, patients with high deductibles are less likely to enter the whole process of diagnostic testing and procedures, which also reduces the probability of being hospitalized. Conditional on use, a high deductible reduces the amount of GP care, specialist medicine and drugs. This is intuitive as these kinds of care are usually used before the deductible is up. The prepaid IPA seems to encourage the use of specialist care but discourages the use of physiotherapy, hospital outpatient und hospital inpatient services. This likely reflects the fact that specialists are often affiliated with the IPA while hospitals are not[8]. The IPA reduces the amount of care used for almost all types of care, most strongly for specialist und drugs. Interestingly, the IPAs manage to reduce the amount of inpatient care used, even though Swiss IPAs cannot directly deny reimbursement to providers outside their networks. This hints at successful process innovations, for example better information exchange leading to a reduction of double ex-rays or other diagnostic procedures.

Supplemental hospital insurance seems to lead to more specialist care and physiotherapy which reflects the fact that it is bought by wealthy patients who are more likely to live in areas with high provider density. Those patients also have a higher probability to use hospital care, hinting at demand inducement as physicians in independent practice often provide services in

[7]This includes chiropractic and occupational therapy

[8]This holds for the IPAs in our data set, not in general.

	GP Care	Specialist Care	Drugs	Physio-therapy	Hospital Outpatient	Hospital Inpatient
Dummies for 7 age groups			YES			
Gender, interacted with age			YES			
1. stage residual			YES, if significant			
Suppl. hospital	-0.004	0.127**	-0.014	0.058**	0.020*	0.033**
	(0.010)	(0.009)	(0.012)	(0.010)	(0.009)	(0.011)
	-0.001	*0.046***	*-0.002*	*-0.018***	*0.007**	*0.006***
Suppl. alternative	0.045**	0.023**	-0.052**	0.023*	-0.070**	-0.048**
	(0.009)	(0.009)	(0.012)	(0.009)	(0.008)	(0.010)
	*0.009***	*0.009***	*-0.008***	*0.007**	*-0.027***	*-0.008***
Medium DED	-0.006	0.042**	-0.074**	0.009	-0.011	-0.000
	(0.011)	(0.010)	(0.015)	(0.010)	(0.009)	(0.012)
	-0.001	*0.015***	*-0.013***	*0.003*	*-0.004*	*-0.000*
High DED	-0.173**	-0.039	-0.321**	-0.044	-0.014	-0.034*
	(0.023)	(0.022)	(0.028)	(0.024)	(0.022)	(0.015)
	*-0.041***	*-0.015*	*-0.064***	*-0.013*	*-0.005*	*-0.006**
IPA	0.029	0.130**	0.066	-0.069**	-0.091**	-0.062**
	(0.018)	(0.035)	(0.046)	(0.019)	(0.017)	(0.022)
	0.006	*0.047***	*0.010*	*-0.020***	*-0.034***	*-0.010***
Constant	0.755**	1.033**	0.841**	-1.065**	-0.189**	-0.969**
	(0.060)	(0.056)	(0.074)	(0.062)	(0.055)	(0.067)
Log Likelihood	-60,766	-75,193	-39,785	-64,061	-80,261	-48,268
Observations	128,744	128,744	128,744	128,744	128,744	128,744

Standard errors in parentheses, ** p<0.01, * p<0.05

Table 7: Probability of Positive Cost per Speciality, Probit estimation
DED = Deductible, IPA = Independent Practitioners Association

	GP care	Specialist care	Drugs	Physio-therapy	Hospital Outpatient	Hospital Inpatient
Dummies for 7 age groups			YES			
Gender, interacted with age			YES			
1. stage residual			YES, if significant			
Suppl. hospital	0.012	0.098**	-0.008	0.046**	-0.128**	0.011
	(0.008)	(0.013)	(0.019)	(0.014)	(0.025)	(0.025)
Suppl. altern. med.	-0.045**	-0.018	-0.109**	0.034*	-0.068**	-0.012
	(0.008)	(0.013)	(0.025)	(0.014)	(0.024)	(0.022)
Medium DED	-0.044**	-0.013	-0.084**	-0.026	-0.043	-0.046
	(0.008)	(0.013)	(0.020)	(0.015)	(0.026)	(0.026)
High DED	-0.148**	-0.081**	-0.128**	0.003	0.043	-0.051
	(0.011)	(0.018)	(0.039)	(0.021)	(0.039)	(0.036)
IPA	-0.079**	-0.148**	-0.156**	-0.058*	-0.087	-0.118**
	(0.017)	(0.023)	(0.053)	(0.029)	(0.046)	(0.046)
Constant	6.382**	6.867**	6.108**	6.470**	6.729**	8.543**
	(0.049)	(0.078)	(0.118)	(0.105)	(0.163)	(0.136)
Observations	101265	86208	112941	28241	46923	17205
AIC	14.41	15.31	15.23	15.25	16.04	19.75

Robust standard errors in parentheses, ** p<0.01, * p<0.05

Table 8: Amount of HCE if positive per Speciality, GLM Estimation with a log Link and Gamma variance function
DED = Deductible, IPA = Independent Practitioners Association

private hospitals. Interestingly, the coefficient for the amount of outpatient hospital services used is significantly negative. A possible explanation is that these patients are in outpatient hospital care only in very minor cases, because hospitals have a strong incentive to keep them inpatient. The amount of inpatient expenditures are not affected as our dataset only includes cost paid out of mandatory insurance. Finally, the buyers of a supplement for alternative medicine have a higher probability of using physician services and physiotherapy, but a low utilization of drugs and hospital services. This corresponds well to a taste for a personalized 'low-technology' type of medicine.

6 Discussion

The aim of this section is to discuss the policy implications of our results, relating them to recent literature. A first interesting result from a policy point of view is that the estimated absolute moral hazard reduction due to a deductible of CHF 500 rather than 300 (CHF 226, see table 7 again) exceeds the maximum increase in out-of-pocket expenditure (CHF 200 = 500 - 300). Thus, raising the minimum annual deductible to CHF 500 p.a.[9] could be Pareto improving since the savings generated suffice to lower the premium by CHF 200 to consumers while benefiting the health insurer. This conclusion is confirmed by two other recent studies using Swiss data from earlier years when the minimum deductible was CHF 230 and the next lowest CHF 400 (see table 8).

Van Kleef et al. (2008, table 3)					
Deductible levels (FFS, 2003)	230	400	600	1,200	1,500
Estimated moral hazard reduction	3	382	443	276	318
Gardiol et al. (2005, table 6)					
Deductible levels (FFS, 2000)	230	400	600	1,200	1,500
Estimated excess HCE due to moral hazard	697	512	306	62	0

Table 9: Estimated moral hazard reductions, CHF 1≈ EUR 0.66

Van Kleef et al. (2008) estimate that raising the deductible from CHF 230 to 400 would serve to reduce moral hazard by CHF 382, calling even more strongly for an increase of the minimum deductible[10]. Gardiol et al. (2005) take the maximum deductible of CHF 1,500 as the point of reference and calculate moral hazard effects from there. The transition from the medium deductible of CHF 400 to the minimum of CHF 230 is estimated to generate 'true' savings of CHF 185 (=697-152), which again exceeds the out-of-pocket difference of CHF 170. The second point relates to risk adjustment (RA). Note from table 7 that estimated moral hazard reductions not only fall far short of gross differences in expected HCE as indicated by estimates (1) but are markedly plan specific. Van Kleef et al. (2006, 2008) discuss the challenges this varying mix of risk-selection and moral hazard effects poses to regulators in a system which community rating and RA. The issue is the extent to which insurers should be allowed to pass on gross savings to consumers. The appropriate amount seems to be the amount of 'true' savings net of risk-selection effects. Yet, Van Kleef et al. (2006) show that if only very low risks opt for higher deductibles at first, premium reductions reflecting 'true' savings are too small to create incentives for these options[11]. As a remedy, it is beneficial not to

[9]For comparison, Swiss unions consider CHF 36,000 per year to be the minimum wage

[10]Note also that Van Kleef et al. apply a correction for unfiled claims. Still, their estimated moral hazard reduction effects (due to deductibles only) exceed the demand-side values of table 7, lending support to the notion that unfiled claims are not an influential source of bias.

[11]This reflects the Swiss experience after the introduction of voluntary deductibles in 1996.

entirely net out risk-selection effects for determining allowable premium reductions. Empirical evidence by Van Kleef et al. (2008) shows that the current RA schemes of the Netherlands and Switzerland do leave room for risk-selection effects in the premium reductions.

7 Conclusions

Managed competition in social health insurance aims at creating incentives for insurers to increase efficiency and respond to consumer preferences while preserving solidarity between high- and low-risk types (Van de Ven et al. 2007). Therefore, it is important to know whether contractual innovations such as deductibles or prepaid IPA plans enhance efficiency rather than merely serving as a means for risk selection. This research measures and compares the impacts of demand-side cost sharing (through voluntary deductibles) and supply-side cost sharing (through prepaid IPA plans) on total health care expenditure (HCE), controlling for risk-selection effects. The data comes from a large panel of Swiss adults covering the years 2003 to 2006. Since unobserved health status influences both contract choice and HCE, a proxy is constructed from HCE during the first three years of the observation period, complemented by the residuals from the contract choice equation [two stage residual inclusion method (Terza et al. 2008)].

Higher annual deductibles and IPA plans are both found to achieve marked reductions of moral hazard. An increase in the deductible by CHF 200 (some EUR 133) decreases the estimated probability of positive HCE during a given year by about 1 percentage point, while the IPA plan is associated with an increase of about 1.5 points. The amount of positive HCE is reduced by some 6.5 percent and 17 percent, respectively. Increasing the deductible by CHF 700 (some EUR 466) reduces the probability of reporting HCE by about 3.8 percent and the amount of positive HCE by about 17 percent. In the case of a transition from the minimum CHF 300 and the CHF 500 deductible, absolute savings (CHF 226) exceed the extra out-of-pocket expenditure (CHF 200), suggesting potential for Pareto improvement through an increase in the mandatory minimum deductible. Recent research using Swiss data is found to support these findings.

Still, this research is subject to several limitations. First, since the data set only comprises individuals who were with one and the same insurer from 2003 - 2006, it fails to measure risk-selection effects associated with changes between competing insurers. Second, even 'within' risk-selection effects may not be controlled for perfectly. There is no guarantee that the HCE equation is correctly specified for the three preceding years, yielding residuals that serve as good proxies for unobserved health. The same caveat applies to the residuals of the contract choice equations. Thus, estimates of expected HCE reductions achieved by higher deductibles and IPA plans could still be biased. Finally, results relating to IPA plans have limited generality as long as they cannot be related in detail to the incentives faced by participating health care providers.

Nevertheless, the findings permit to draw the conclusion that allowing insurers to offer plans with both demand-side and supply-side cost sharing resulted in efficiency gains in Swiss social health insurance. After controlling for risk-selection effects, both variants are estimated to achieve marked reductions in moral hazard that can be passed on to consumers in the guise of premium reductions without jeopardizing insurers' solvency.

References

[-] Arrow KJ. 1963. Uncertainty and the Welfare Economics of Medical Care, *The American Economic Review*, 53: 941 - 973.

[-] Baltagi B, Wu P. 1999. Unequally Spaced Panel Data Regressions with Ar(1) Disturbances, *Econometric Theory*, Cambridge University Press, 15: 814-823.

[-] Beck, K, Kunze U, Oggier W. 2004. Selbstdispensation: Kosten treibender oder Kosten daempfender Faktor? (Drug Dispensing by Physicians: Cost Increasing or Cost Decreasing?), *Managed Care*, 6: 5-8.

[-] Blough DK, Madden CW, Hornbrook MC. 1999. Modeling Risk Using Generalized Linear Models, *Journal of Health Economics*, 18: 153-171.

[-] Cameron A, Trivedi P, Milne F, Piggott J. 1988. A Microeconometric Model of the Demand for Health Care and Health Insurance in Australia, *Review of Economic Studies*, 55: 85-106.

[-] Cardon JH, Hendel I. 2001. Asymmetric Information in Health Insurance: Evidence

from the National Medical Expenditure Survey, *RAND Journal of Economics*, 32: 408-427.

[-] Chiappori PA, Durand F, Geoffard PY. 1998. Moral Hazard and the Demand for Physician Services: First Lessons from a French Natural Experiment, *European Economic Review*, 42: 499-511.

[-] Devlin RA, Sharma S. 2008. Do Physician Remuneration Schemes Matter? The Case of Canadian Family Physicians, *Journal of Health Economics*, 27: 1168-118.

[-] Dowd B, Feldman R, Cassou S, Finch M. 1991. Health Plan Choice and the Utilization of Health Care Service, *Review of Economics and Statistics*, 73: 85-93.

[-] Eichner M. 1998. The Demand for Medical Care: What People Pay Does Matter, *AER Papers and Proceedings*, 88: 117-121.

[-] Ellis RP, McGuire TG. 1986. Provider Behavior Under Prospective Reimbursement: Cost Sharing and Supply, *Journal of Health Economics*, 5: 129-151.

[-] Ellis RP, McGuire T. 1993. Supply Side and Demand Side Cost Sharing in Health Care, *The Journal of Economic Perspectives*, 7: 135-151.

[-] Enthoven A. 1978. Consumer-Choice Health Plan, *The New England Journal of Medicine*, 12: 650-658 and 13: 709-720.

[-] Gardiol L, Geoffard PY, Grandchamp C. 2005. Separating Selection and Incentive Effects in Health Insurance, *PSE Working Papers 2005-38*, PSE.

[-] Gerfin M, Schellhorn M. 2006. Nonparametric Bounds on the Effect of Deductibles in Health Care Insurance on Doctor Visits - Swiss Evidence, *Health Economics*, 15: 1011-1020.

[-] Gourieroux C, Monfort A, Renault E, Trogon A. 1987. Generalized Residuals, *Journal of Econometrics*, 34: 5-32.

[-] Jones A. 2000. Health Econometrics, in: Culyer AJ and Newhouse JP (eds). *Handbook of Health Economics*. Volume 1A. Elesevier. Amsterdam. 265-344.

[-] Lamers LM, van Vliet RCJA. 2003. Health-based Risk Adjustment: Improving the Pharmacy-based Cost Group Model to Reduce Gaming Possibilities, *European Journal of Health Economics*, 4: 107-114.

[-] Lehmann H, Zweifel P. 2004. Innovation and Risk Selection in Deregulated Social Health Insurance, *Journal of Health Economics*, 23: 997-1012.

[-] Newhouse JP. 1996. Reimbursing Health Plans and Health Providers: Efficiency in Production Versus Selection, *Journal of Economic Literature*, 34: 1236-1263.

[-] Norton EC, Wang H, Ai C. 2004. Computing Interaction Effects and Standard Errors in Logit and Probit Models, *The Stata Journal*, 4: 154-167.

[-] Manning W, Newhouse J, Duan N, Keeler E, Leibowitz A. 1987. Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment, *The American Economic Review*, 77: 251-277.

[-] Manning, WG. 1998. The Logged Dependent Variable, Heteroscedasticity, and the Retransformation Problem, *Journal of Health Economics*, 17: 283-295.

[-] Manning WG, Mullahy J. 2001. Estimating Log Models: To Transform or Not to Transform?, *Journal of Health Economics*, 20: 461-494.

[-] McGuire T. 2000. Physician Agency, in: Culyer AJ and Newhouse JP (eds). *Handbook of Health Economics*, Volume 1A, Elesevier, Amsterdam.

[-] OECD. 2006. Switzerland, *OECD Reviews of Health Systems*, www.oecd.org.

[-] Schellhorn M. 2001. The Effect of Variable Health Insurance Deductibles on the Demand for Physician Visits, *Health Economics*, 10: 441-456.

[-] Terza JV, Basu A, Rathouz PJ. 2008. Two-stage Residual Inclusion Estimation: Addressing Endogeneity in Health Econometric Modeling, *Journal of Health Economics*, 27: 531-543.

[-] Van de Ven WPMM, Beck K, Van de Voorde C, Wasem J, Zmora I. 2007. Risk Adjustment and Risk Selection in Europe: Six Years Later, *Health Policy*, 83: 162-179.

[-] Vatter A, Ruefli C. 2003. Do Political Factors Matter for Health Care Expenditure? A Comparative Study of Swiss Cantons, *Journal of Public Policy*, 23: 301-323.

[-] Van Kleef RC, van de Ven WPMM, van Vliet RCJA. 2006. Premium Rebate in Exchange for a Voluntary Deductible in Social Health Insurance with Risk Equalization: Community-rated or Risk-rated?, *Journal of Risk and Insurance*, 73: 529-550.

[-] Van Kleef RC, Beck K, Van de Ven WPMM, Van Vliet RCJA. 2008. Risk Equalization and Voluntary Deductibles: a Complex Interaction, *Journal of Health Economics*, 27: 427-443.

[-] Vella, F. 1993. A Simple Estimator for Simultaneous Models with Censored Endogenous Regressors, *International Economic Review*, 34: 441-457.

[-] Werblow A, Felder S, Zweifel P. 2007. Population Ageing and Health Care Expenditures: A School of 'Red Herrings'?, *Health Economics*, 16: 1109-1126.

[-] Winkelmann, R. 2004. Co-payments for Prescription Drugs and the Demand for Doctor Visits - Evidence from a Natural Experiment, *Health Economics*, 13: 1081-1089.

[-] Wolfe, J, Godderies J. 1991. Adverse Selection, Moral Hazard, and Wealth Effects in the Medigap Insurance Market, *Journal of Health Economics*, 10: 433-459.

[-] Wooldridge JM. 2002. Econometric Analysis of Cross Section and Panel Data, *MIT Press*, Cambridge, MA.

[-] Zeckhauser RJ. 1970. Medical Insurance: A Case Study of the Tradeoff Between Risk Spreading and Appropriate Incentives, *Journal of Economic Theory*, 2: 10 - 26.

[-] Zweifel P. 1985. Technology in Ambulatory Medical Care: Cost Increasing or Cost Saving?, *Social Science and Medicine*, 21: 1139 - 1151.

[-] Zweifel P, Breyer F. Kifmann M. 2009. *Health Economics*, 2nd Ed., Springer, Boston (in print).

[-] Zweifel P, Manning WG. 2000. Moral Hazard, in: Culyer AJ and Newhouse JP (eds). *Handbook of Health Economics*. Volume 1A. Elesevier. Amsterdam: 410-459.

Appendices

A Estimating a Proxy for Health Status

	Random Effects Probit $Pr(HCE_i > 0)$		Random Effects $log(HCEi)\|HCE_i > 0$	
	Coef.	Std. Err.	Coef.	Std. Err.
31 - 40	0.141**	(0.033)	0.287**	(0.016)
41 - 50	0.115**	(0.032)	0.447**	(0.017)
51 - 60	0.446**	(0.034)	0.751**	(0.017)
61 - 70	0.744**	(0.036)	0.971**	(0.016)
71 - 80	1.147**	(0.042)	1.225**	(0.018)
81+	1.458**	(0.057)	1.506**	(0.021)
Male	-1.221**	(0.034)	-0.372**	(0.020)
Male * 31 - 40	0.126**	(0.046)	0.193**	(0.028)
Male * 41 - 50	0.429**	(0.045)	0.225**	(0.027)
Male * 51 - 60	0.512**	(0.048)	0.244**	(0.027)
Male * 61 - 70	0.864**	(0.052)	0.352**	(0.027)
Male * 71 - 80	1.078**	(0.064)	0.350**	(0.029)
Male * 81+	1.111**	(0.101)	0.211**	(0.038)
Greater metropolitan area	-0.016	(0.021)	-0.077**	(0.010)
Wealthy communities	0.100*	(0.041)	-0.068**	(0.020)
Regional centers	-0.084**	(0.032)	-0.199**	(0.017)
Rural, mainly industrial	-0.071**	(0.025)	-0.171**	(0.013)
Rural, mainly argicultural	-0.174**	(0.028)	-0.211**	(0.038)
Berne	0.085**	(0.032)	0.036*	(0.016)
Lucerne	-0.058*	(0.028)	-0.240**	(0.014)
Geneva	0.391**	(0.042)	0.381**	(0.019)
Year 2004	0.006	(0.012)	0.092**	(0.005)
Year 2005	0.015	(0.012)	0.093**	(0.005)
Constant	1.937**	(0.036)	6.909**	(0.018)
Observations	256,918		221,332	
α	0.694		0.534	
ρ	-		0.091	

Table 10: Estimation results, **significant with p≤0.01, * p≤0.05
ρ Estimated autocorrelation coefficient
α Fraction of error variance due to individual-specific term

B Predicting Contract Choice

	Choice of Deductible Ordered Probit	Choice of prepaid IPA Probit
Health proxy	-0.339**	-0.218**
	(0.006)	(0.012)
(Health proxy)^2	0.041**	0.054**
	(0.003)	(0.005)
(Health proxy)^3	-0.002**	-0.004**
	(0.000)	(0.001)
Berne city	0.604**	-0.120
	(0.052)	(0.088)
Lucerne city	1.907**	-1.267**
	(0.205)	(0.144)
Geneva city	-1.524**	1.997**
	(0.138)	(0.130)
Years of CSS membership since1999	-0.042**	-0.051**
	(0.004)	(0.007)
Bad credit record	-0.274**	-0.358**
	(0.014)	(0.027)
Baseline premium	0.018**	0.007**
	(0.002)	(0.001)
Premium reduction for medium DED	0.002	
	(0.011)	
Premium reduction for high DED	0.017**	
	(0.003)	
Premium reduction for IPA		0.013**
		(0.001)
IPA operational in zipcode area		1.439**
		(0.061)
Constant		2.237**
Cut points	7.755 / 8.432	
Log likelihood	-140,645	-27,158
Number of observations	163,686	163,686

Coefficients for age, gender and additional regional dummies not shown
Standard errors in parentheses, ** p<0.01, * p<0.05

Table 11: Contract Choice Equations