A Simple Model of Health Insurance Competition

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Abstract

This paper investigates competition between health insurance companies under different financing regulations. We consider two alternatives advanced in recent German health care reform discussions: competition by contribution rates (health contributions) and by fees (health premia). We find that contribution rate competition yields lower company profits and higher consumer welfare than premia competition when switching between insurance companies is costly.

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1 Introduction

Budgetary pressures arising from demographic change and medical progress place the debate about suitable strategies for cost containment in public health care continuously on top of the policy agenda in most industrialized countries. The situation in Germany delivers a showcase in that respect, because the German health care system uses comparatively much resources to produce only average results in international comparison (OECD, 2008).[1]

From an economic perspective, the promotion of competition suggests itself as a solution. In fact, many advisors perceive the problems of health insurance as problems of an uncompetitive environment and consequently argue in favor of a strengthening of market forces - see Wissenschaftlicher Beirat beim BMF (2004) and OECD (2008) as characteristic examples for that view.

Income-dependent contributions to health insurance are commonly viewed as an obstacle to the workings of free markets. Therefore, the proposal to enhance competition is often accompanied by the suggestion to replace income-related contributions by uniform fees, so-called health premia. It is frequently argued that the concomitant removal of income redistribution from health insurance would kill two birds with one stone: on the one hand, both the excess burden of the implicit income tax and the overconsumption of health services due to distorted price signals would be removed. On the other hand, competition between insurance companies would intensify and customer expenditures would be lower, because insurants face stronger incentives to switch to more advantageous contracts (Wissenschaftlicher Beirat beim BMF, 2004; OECD, 2008). This view - inspired by the Swiss system - has influenced recent changes in German health care (Richter, 2009).

While the first part of this argument has been discussed thoroughly in the literature, the finding being mixed findings once compensation for the income losses of poorer households is accounted for (Breyer & Haufler, 2000; Buchholz, 2005; Fehr & Jess, 2006; Schubert & Schnabel, 2009), its second part is often alluded to (Buchholz, 2005; Fehr & Jess, 2006, Richter, 2009) but goes virtually unexamined. To the best of our knowledge, there is no theoretical analysis of the competitive virtues of contribution/tax rates versus user fees; neither in the health care context nor from a general perspective. The existing strand of literature adressing the choice of taxes versus fees focusses almost mostly on political economy aspects and/or the provision of public goods and does not touch on competition issues (Bös, 1980; Fraser, 1996; Swope & Janeba, 2005). This is also true for Kifmann (2005) who discusses the political economy of income-related contributions in the realm of health care.[2]

1 See Fehr and Jess (2006) and Richter (2009) for surveys on the German debate.

2 Vaithianathan (2006) discusses interactions between health insurance and health care markets, allowing for imperfect competition in the latter. However, health insurance is assumed to be perfectly competitive and any role of its mode of financing is blurred as all households have identical incomes.

On the empirical side, Cutler & Reber (1998) identify a substantial competition effect from a shift from income-related to uniform health plan employer subsidies for Harvard University employees. However, they do not delve into a detailed analysis of strategic interactions in pricing decisions between insurance companies.[3] In a recent paper, Frank & Lamiraud (2009) challenge the above-mentioned claim that competition necessarily improves consumer choice in health insurance. Using Swiss data, they find price differences to be persistent and switching to cheaper insurance plans to be weak. However, they do not address the question to what extent switching decisions are affected by financing mechanisms.

This gap in the literature is somewhat surprising, as it is far from obvious that the implementation of health premia is a prerequisite for competition. Competition by contribution rates is equally conceivable and has to some extent been operated in Germany albeit under tight regulations.

The present paper is a first attempt to address this gap. In a simple stylized duopoly model, we examine how consumers fare when insurance companies compete by setting either health contributions proportional to income or uniform health premia. Interestingly, our plain analysis does not provide support for the efficiency argument for financing health insurance by premia. While the question of premia versus contribution competition turns out to be virtually irrelevant when customers are infinitely reactive to price differentials, contribution rate competition leads to lower aggregate health insurance expenditures and hence higher consumer welfare when demand inertia is considered. This result is grounded in the fact that contribution rate competition renders richer individuals the favorite customers of insurance companies, as they pay higher prices for medical insurance. However, by the same token, richer people react also more sensitively to contribution rate differentials than poorer people. The attempt to attract high-income persons induces a strong incentive for insurance companies to mitigate contribution rates.

The paper is organized as follows. Section 2 presents the basic structure of the model. Section 3 analyzes both fee and contribution rate competition with an infinitely reactive demand, whereas Section 4 considers loyal consumers reacting sluggishly on price differentials. Section 5 provides some extensions and Section 6 concludes.

3 Moreover, However, the applicability of their findings is limited by the imperfect analogy between removing income-related subsidies and removing income-related contributions.

2 The Model

Consider an economy populated by a large number of individuals with total mass of one. Persons differ with respect to gross income according to an income distribution characterized by the p.d.f. $f(y)$ with support $\left[\underline{y}, \overline{y}\right]$. Let $\mu = \int_{\underline{y}}^{\overline{y}} y f(y) dy$ denote mean (=aggregate) income, while σ is the variance. These variables determine the squared coefficient of variation of the income distribution: $svc = \sigma/\mu^2$.

Each individual faces a risk of illness π, in which case a damage c arises. We assume that this risk is the same for every person, that is, it is uncorrelated to income. This assumption will be relaxed in the Extensions Section.

There are two health insurance companies A and B which compete for their customers either by setting health premia p_i or health contribution rates τ_i with $i \in \{A, B\}$. In accordance with important characteristics of the German and Swiss Health Insurance Systems, we posit that insurance is compulsory for all persons and that insurance providers have to accept every customer, that is, there is an obligation to contract. Moreover, state authorities prescribe the extent of treatment in case of illness. As a useful benchmark, we stipulate that the treatment has to compensate for the whole personal damage. To simplify the exposition, the respective cost is assumed to amount to c as well.

Due to these features, all individuals are fully insured and insurance companies face total treatment expenditures of $\pi \cdot c$. Consequently, the sum of consumer expenditures and producer profits in the health insurance market amounts to total treatment cost $-\pi \cdot c$, irrespective of contribution rate or fee levels. Hence, every equilibrium in the health insurance market is Pareto-efficient: it is impossible to improve the situation of any market participant without harming another. However, these equilibria differ in terms of the division of gains between insurers and insured on the one hand and the insured on the other hand. In the following analysis, we address both issues by considering two separate indicators: consumer expenditures, the total payments by the insured and consumer welfare, the sum of resulting individual utilities. More precise definitions of the measures follow below.

3 Competition with Perfectly Reactive Customers

This section addresses competition between insurers when customers are infinitely reactive, that is, they switch providers immediately whenever this creates the slightest utility gain. We start with the case of fee competition, then turn to contribution rate competition and finally compare the equilibria.

3.1 Health Premia

Suppose that both insurance companies offer full insurance in exchange for premia p_A and p_B, respectively. Then, the expected utility of a person with income y choosing company i is:

$$\pi \cdot u\left(y - c - p_i + c\right) + (1 - \pi) \cdot u\left(y - p_i\right) = u(y - p_i), \tag{1}$$

where $u(\cdot)$ is the strictly concave individual utility function.

Since the benefits in case of illness are regulated to be equal for both companies, preferences over both offers are determined by cost considerations: the individual chooses A over B with certainty when $p_A < p_B$ and vice versa. For equal fees, the person is indifferent.[4] Hence, depending on the levels of the premia, the share of people with income y choosing company i - i's market share in income group y - can be described by:

$$d_i^P(y, g) = \begin{cases} 1 & : \quad p_i < p_j \\ \frac{1}{2} & : \quad p_i = p_j \\ 0 & : \quad p_i > p_j \end{cases}, \tag{2}$$

where $g = (p_A, p_B)$ is the vector of premia and $j \neq i$ denotes the competing company.

Then, the profits for insurance company i are:

$$\int_{\underline{y}}^{\overline{y}} \left[p_i - \pi \cdot c\right] d_i^P(y, g) f(y) dy. \tag{3}$$

Proposition 1. *In the premia competition equilibrium with perfect customer mobility, both insurance companies set their premia equal to expected treatment cost:* $p_A = p_B = p^* = \pi \cdot c$*. Company profits are zero.*

Proof. From (3), we have the following best-response function of company i:

$$p_i(p_j) = \begin{cases} p_j - \varepsilon & : \quad p_j > \pi \cdot c \\ p_j & : \quad p_j = \pi \cdot c \\ p_i > p_j & : \quad p_j < \pi \cdot c \end{cases}. \tag{4}$$

This gives the unique equilibrium: $p_A = p_B = \pi \cdot c$, where both companies have 50% of the households as their customers and make no profits. $\square$.

This Bertrand-result is due to the infinitely high reactiveness of customers. Because all insured switch to the cheaper company, each insurer has a strong incentive to undercut the

4 To simplify the exposition, we abstract from any problems arising from negative incomes due to health premia exceeding personal gross income. Doing so strengthens the case for premia.

competitor whenever the expected treatment cost can still be covered. Competition drives fees down to expected treatment cost and all profits are eradicated.

3.2 Contribution Rates

When health insurance is funded by income-related contribution rates, an individual with income y contracting with company i experiences utility:

$$u\Big((1-\tau_i)y\Big).$$

It is straightforward that each individual chooses the company with the lower rate whenever it exists and is indifferent otherwise. As a consequence, the share of persons with income y opting for company i is given by:

$$d_i^R(y,\tau) = \begin{cases} 1 & : \quad \tau_i < \tau_j \\ \frac{1}{2} & : \quad \tau_i = \tau_j \\ 0 & : \quad \tau_i > \tau_j \end{cases}, \tag{5}$$

with $\tau = (\tau_A, \tau_B)$ as the vector of contribution rates. Profits are:

$$\int_{\underline{y}}^{\overline{y}} \left[\tau_i y - \pi \cdot c\right] d_i^R(y,\tau) f(y) dy. \tag{6}$$

Proposition 2. *In the health contribution rate equilibrium with perfect customer mobility, both insurance companies set their contribution rates equal to the share of expected treatment cost to average income: $\tau_A = \tau_B = \tau^* = \pi \cdot c/\mu$. Company profits are zero.*

Proof. From (6), we get the best-response function:

$$\tau_i(\tau_j) = \begin{cases} \tau_j - \varepsilon & : \quad \tau_j > \pi \cdot c/\mu \\ \tau_j & : \quad \tau_j = \pi \cdot c/\mu \\ \tau_i > \tau_j & : \quad \tau_j < \pi \cdot c/\mu \end{cases}. \tag{7}$$

Hence, there is a unique equilibrium: $\tau_A = \tau_B = \pi \cdot c/\mu$, where revenue equals expected treatment expenditures. Q.E.D.

Again, the fierce competition drives profits down to zero. A situation with positive profits for a company can not constitute an equilibrium as the competitor would have an incentive to capture total demand by offering a marginally lower contribution rate.

3.3 Comparing Equilibria

We are now in the position to compare the resulting equilibria. As mentioned above, two measures will be used: consumer expenditures CE and consumer welfare CW. The first measure CE is concerned with the division of the surplus between insurants and insurers. Since consumer expenditures and company profits always add up to $-p \cdot c$, consumer expenditures equal company revenues. Hence we have:

$$CE^P = p^*, \quad CE^R = \tau^* \mu \tag{8}$$

for fees and contribution rates, respectively.

Consumer welfare CW, however, explicitly considers the distribution of consumer expenditures among individuals. Here we have:[5]

$$CW^P = \int_{\underline{y}}^{\overline{y}} u(y - p^*) f(y) dy, \quad CW^R = \int_{\underline{y}}^{\overline{y}} u((1 - \tau^*) y) f(y) dy. \tag{9}$$

Proposition 3. *With perfect customer mobility, health premia and health contribution rates competition yield identical results in terms of total consumer expenditures. However, consumer welfare is higher with health contributions.*

Proof. The first statement follows immediately from the fact that company profits are zero in both equilibria. Hence revenues must be same and so have to be total consumer expenditures. The distribution of these expenditures among households is uniform for fee competition and progressive for contribution rate competition. With diminishing marginal utility of income, the sum of utilities is higher under contribution rate competition. Q.E.D.

As a first outcome, we find that the current setup does not deliver an argument in favor of premia rather than contribution rates competition. Both types of competition impose the same total cost on the insured, while contribution rates are preferable from a distributional perspective. However, this preference is merely grounded in the fact that no other instruments for income redistribution are at hand. Allowing for an additional proportional income tax would easily allow fee competition to reproduce the level of consumer welfare achieved with contribution rate competition. In that case, the mode of competition would be irrelevant for all market participants and hence for society.

5 The utilitarian formulation is for convenience only. All results go through for arbitrary positive degrees of inequality aversion.

4 Competition with Loyal Customers

It is well known that immediate switching serves rather as a useful theoretical benchmark than as a good description of actual customer behavior. Instead, substantial price differences seem to go hand in hand with a low intensity of changing providers - see Frank & Lamiraud (2009) for respective evidence for the Swiss Health Care System. Therefore, we revisit the issue of fee and contribution rate competition in a setting where consumers are imperfectly reactive to price differentials. For this purpose, we introduce customer loyalty to the analysis. Apart from that, we proceed like in the precedent section: considering premia competition first, we then turn to contribution rate competition and finally compare.

4.1 Health Premia

We assume now that individuals differ not only with respect to income, but also along a second dimension labelled customer loyalty. This loyalty or attachment is modelled as a personal cost experienced from not being insured by the favorite company.

As this loyalty is meant to reflect personal characteristics unrelated to income, we assume the distributions of loyalty and income to be uncorrelated. To fix ideas, define the cost λ as as the loyalty for company A over company B and take it to be uniformly distributed in the interval $\left[-\bar{\lambda}, \bar{\lambda}\right], \bar{\lambda} \geq 0$ for each income level. Hence the probability that a person with income y has the cost λ is $1/(2\bar{\lambda})$. The higher $\bar{\lambda}$, the higher the dispersion of customer loyalties. As the distribution has a zero mean, loyalties are symmetrically distributed between both companies: all other things equal, one half of individuals prefers A over B whereas the other half prefers B over A.

Obviously, loyalty affects demand also in the presence of fee differences: A person with income y chooses insurer A when $u(y - p_A + \lambda) > u(y - p_B)$, which is tantamount to:

$$\lambda > p_A - p_B,$$

that is, his loyalty for A is stronger than the premium differential. Taking care of the support of the loyalty distribution, we arrive at the following expression for A's markets share among people with income y:

$$\tilde{d}_A^P(y, g) = \begin{cases} 1 & : \ p_A < p_B - \bar{\lambda} \\ \dfrac{\bar{\lambda} - (p_A - p_B)}{2\bar{\lambda}} & : \ p_A \in [p_B - \bar{\lambda}, p_B + \bar{\lambda}] \\ 0 & : \ p_A > p_B + \bar{\lambda} \end{cases}, \tag{10}$$

whereas $\tilde{d}_B^P(y) = 1 - \tilde{d}_A^P(y)$. The profit of company i is given by:

$$\int_{\underline{y}}^{\overline{y}} [p_i - \pi \cdot c] \, \tilde{d}_i^P(y) f(y) dy. \tag{11}$$

Maximizing this expression with respect to p_i yields the first-order condition:

$$\int_{\underline{y}}^{\overline{y}} \tilde{d}_i^P(y) f(y) dy + \int_{\underline{y}}^{\overline{y}} [p_i - \pi \cdot c] \, \frac{\partial \tilde{d}_i^P(y)}{\partial p_i} f(y) dy = 0. \tag{12}$$

In what follows, we concentrate on symmetric equilibria.

Proposition 4. *In the symmetric premia competition equilibrium with customer loyalty, premia equal a markup on expected treatment cost which depends positively on the dispersion of switching costs:*

$$p_A = p_B = \tilde{p} = \pi \cdot c + \bar{\lambda}. \tag{13}$$

Proof. In the symmetric equilibrium, we have $\tilde{d}_i^P = 1/2$ and $\frac{\partial \tilde{d}_i^P(y)}{\partial p_i} = -\frac{1}{2\bar{\lambda}}$. Using these expressions in (12) gives:

$$\frac{1}{2} - (p_i - \pi \cdot c) \int_{\underline{y}}^{\overline{y}} \frac{1}{2\bar{\lambda}} f(y) dy = 0. \tag{14}$$

As $\int_{\underline{y}}^{\overline{y}} f(y) dy = 1$, that condition becomes: $1 - (p_i - \pi \cdot c)/2\bar{\lambda} = 0$, which is solved by (13). Q.E.D.

Condition (12) shows the tradeoff between positive and negative marginal effects of raising the fee level. The positive effect - called *extraction effect* in the sequel - accrues because higher premia generate more revenue from the customers. The negative effect - called *erosion effect* in the sequel - is the reduction in profits due to the loss of customers. This erosion effect is the weaker, the more dispersed switching cost are. Thus, equilibrium premia depend positively on $\bar{\lambda}$.

4.2 Contribution Rates

Consider now the case where insurance companies compete by health contributions. The preference of a person with income y of A over B is now reflected in the condition:

$$\lambda > (\tau_A - \tau_B) y \tag{15}$$

As above, A is preferred by everyone whose degree of loyalty exceeds his difference in health insurance expenditures. However, this difference varies among people as it depends on personal gross income. Payments being proportional to income, any given contribution rate differential affects high income earners stronger than low income earners.

From (15), the share of people with income y opting for company A becomes:

$$\tilde{d}_A^R(y,\tau) = \begin{cases} 1 & : \quad \tau_A < \tau_B - \frac{\bar{\lambda}}{y} \\ \dfrac{\bar{\lambda} - (\tau_A - \tau_B)y}{2\bar{\lambda}} & : \quad \tau_A \in [\tau_B - \frac{\bar{\lambda}}{y}, \tau_B + \frac{\bar{\lambda}}{y}] \\ 0 & : \quad \tau_A > \tau_B - \frac{\bar{\lambda}}{y} \end{cases} . \tag{16}$$

Inspection of (16) shows that this market share is income-dependent for moderate contribution rate differentials: Among people with equal income, the proportion choosing A decreases in y when $\tau_A > \tau_B$ and increases when $\tau_A < \tau_B$. Intuitively, the higher income, the higher the financial sacrifice of choosing the more expensive provider and hence the lower the loyalty actually expressed towards that company. By the same token, richer people are more responsive to contribution rate increases:

$$\frac{\partial \tilde{d}_A^R(y,\tau)}{\partial \tau_A} = \begin{cases} -\dfrac{y}{2\bar{\lambda}} & : \quad \tau_A \in [\tau_B - \frac{\bar{\lambda}}{y}, \tau_B + \frac{\bar{\lambda}}{y}] \\ 0 & : \quad \text{otherwise} \end{cases} . \tag{17}$$

Taking this behavior into account, companies maximize:

$$\int_{\underline{y}}^{\overline{y}} [\tau_i y - \pi \cdot c]\, \tilde{d}_i^R(y) f(y) dy, \tag{18}$$

with respect to their health contribution rate τ_i. This leads to the first-order condition:

$$\int_{\underline{y}}^{\overline{y}} y \tilde{d}_i^R(y) f(y) dy + \int_{\underline{y}}^{\overline{y}} [\tau_i y - \pi \cdot c]\, \frac{\partial \tilde{d}_i^R}{\partial \tau_i} f(y) dy \leq 0, \tag{19}$$

with equality when (18) is positive. This expression can be interpreted analogous to (12). The first term denotes the positive extraction effect, the higher revenue generated from the customer base. The second term measures the erosion effect, that is the reduction of profits due to the reduction of the customer base. Obviously, the profit reduction can be decomposed in a reduction of revenue and cost, respectively.

Proposition 5. *In the contribution rate equilibrium with switching costs, contribution rates equal the share of expected treatment cost to average income, if the squared coefficient of variation of the income distribution exceeds the ratio of maximum loyalty to expected treatment cost. Otherwise, contribution rates exceed the share of expected treatment cost to average income by a markup depending positively on the dispersion of loyalty cost and negatively on the squared coefficient of variation:*

$$\tau_A = \tau_B = \tilde{\tau} = \begin{cases} \dfrac{\pi \cdot c}{\mu} & : \quad svc > \dfrac{\bar{\lambda}}{\pi \cdot c} \\ \dfrac{\pi \cdot c + \bar{\lambda}}{\mu} \cdot \dfrac{1}{1 + svc} & : \quad svc < \dfrac{\bar{\lambda}}{\pi \cdot c} \end{cases} . \tag{20}$$

Proof. In a symmetric equilibrium, we have: $\tilde{d}_i^R = 1/2$ and $\frac{\partial \tilde{d}_i^R}{\partial \tau_i} = -\frac{y}{2\bar{\lambda}}$ from (17). Hence, for $\int(\tau_i y - \pi \cdot c)\tilde{d}_i^R(y)dy > 0$, (19) becomes:

$$\begin{aligned}
\int_{\underline{y}}^{\overline{y}} \frac{y}{2}dy - \int_{\underline{y}}^{\overline{y}} (\tau y - \pi \cdot c)\frac{y}{2\bar{\lambda}} f(y)dy &= 0 \iff \mu - \int_{\underline{y}}^{\overline{y}} \frac{\tau y^2}{\bar{\lambda}} f(y)dy + \frac{\pi \cdot c}{\bar{\lambda}}\mu = 0 \\
\mu\left(1 + \frac{\pi \cdot c}{\bar{\lambda}}\right) &= \frac{\tau}{\bar{\lambda}} \int_{\underline{y}}^{\overline{y}} y^2 f(y)dy \qquad (21)
\end{aligned}$$

Because the second moment of the income distribution equals the sum of the variance and the squared mean:

$$\int_{\underline{y}}^{\overline{y}} y^2 f(y)dy = \sigma + \mu^2 = \mu^2(1 + svc),$$

(21) can be written as:

$$\frac{\bar{\lambda} + \pi \cdot c}{\mu} = \tau(1 + svc), \qquad (22)$$

However, (22) renders (18) negative whenever $svc > \bar{\lambda}/\pi \cdot c$. In that case $\tilde{\tau} = \pi \cdot c/\mu$. Q.E.D.

Affecting both the extraction and the erosion effect, the shape of the income distribution becomes contentious for equilibrium contribution rates. The extraction effect is proportional to average income because a marginal increase in the contribution rate collects a infinitesimally higher income share from all customers. The erosion effect is influenced by the higher sensitivity of richer people to contribution rate increases and can be disentangled into impacts on revenue and cost. On the one hand, the cost savings due to the shrinking number of customers are proportional to average income in our setup. On the other hand, the loss in revenues is more than proportional, because not only the reduction of the customer base but also the revenues per insurant increase in income. That's why the second moment of the income distribution and hence the squared coefficient of variation come into play. As an increase in that coefficient increases the relative strength of the revenue component of the erosion effect, contribution rates are driven down to a zero-profit equilibrium when income inequality is sufficiently high.

4.3 Comparing Equilibria

How do the two equilibria compare regarding consumer expenditures and consumer welfare? The following proposition gives a clear-cut answer.

Proposition 6. *Whenever there is income inequality, health contribution competition leads to lower consumer expenditures and higher consumer welfare than premia competition.*

Proof. See Appendix.

The intuition behind this result is simple: compared to premia competition, contribution rate competition shifts the focus of companies towards richer individuals because they are the more lucrative clients. However, these clients also react more sensitively on contribution rate increases. This renders health contribution competition fiercer: both companies moderate their claims in order not to put the high-income insurants off.

This intuition is easily substantiated by considering the relative strengths of extraction and erosion effects. Take the case of a degenerate income distribution ($svc = 0$) as the starting point. For such a distribution, the distinction between premia and contribution competition is meaningless. So both modes of competition yield identical results, as can be seen by comparing (13) and (20) for $svc = 0$.

Introducing income inequality by a mean-preserving spread of the income distribution has no effect on premia competition for neither extraction nor erosion effects are income-dependent. However, things are different with contribution rate competition. While the extraction effect is proportional to mean income, the erosion effect is strictly convex in income. Hence income inequality emphasizes the negative erosion effect relative to the positive rent effect. Therefore insurance company profits must be lower under contribution rate competition whenever the income distribution is not degenerate. These lower profits translate into lower consumer expenditures. As contribution rate competition also reliefs poorer households, it also delivers higher consumer welfare.

5 Extensions

In this section, we discuss the robustness of the results with respect to three possible extensions.

5.1 Income Ceilings

Some countries limit public health insurance to a subset of the population. For example, in Germany only persons with an income below a threshold are mandatory members of public health insurance.

Spillovers in insurance company pricing decisions for persons above and below that threshold being unlikely, allowing for such an income ceiling would not affect our results.[6] Our findings do not depend on the precise shape of the income distribution and would hence be reproduced with a respectively truncated distribution.

6 Spillovers could only arise if the average treatment cost increases in the number of clients. However, this would affect pricing decisions also in the absence of income ceilings.

5.2 Income-Related Risks

We have assumed that the risk of illness is the same for every person. However, one salient finding of the literature is that income and health are positively correlated (van Ourti et al., 2009). Allowing for this correlation strengthens our results because it increases the attractiveness of richer customers to insurance companies.

To be precise, let $\pi(y)$ denote the probability of illness for a person with income y, with $\pi'(y) < 0$ and $\bar{\pi} = \int_{\underline{y}}^{\overline{y}} \pi(y)f(y)dy$ as the average risk of illness. Leaving individual decision patterns unaltered, this modification affects insurance company profits. With health premia, the profit of company i amounts to:

$$\int_{\underline{y}}^{\overline{y}} [p_i - \pi(y) \cdot c] \, \tilde{d}_i^P(y)f(y)dy. \tag{23}$$

Focussing directly on the case of customer loyalty, we arrive at the first order condition:

$$\int_{\underline{y}}^{\overline{y}} \tilde{d}_i^P(y)f(y)dy + \int_{\underline{y}}^{\overline{y}} [p_i - \pi(y) \cdot c] \, \frac{\partial \tilde{d}_i^P(y)}{\partial p_i} f(y)dy = 0, \tag{24}$$

which in a symmetric equilibrium is solved by $g = \bar{\lambda} + c \cdot \bar{\pi}$. For contribution rate competition, profit is $\int_{\underline{y}}^{\overline{y}} [\tau_i y - \pi(y) \cdot c] \, \tilde{d}_i^R(y)f(y)dy$ and the first-order condition with respect to τ_i becomes:

$$\int_{\underline{y}}^{\overline{y}} y\tilde{d}_i^R(y)f(y)dy + \int_{\underline{y}}^{\overline{y}} [\tau_i y - \pi(y) \cdot c] \, \frac{\partial \tilde{d}_i^R}{\partial \tau_i} f(y)dy = 0, \tag{25}$$

with the symmetric solution:

$$\tau = \frac{\bar{\lambda} + c \int_{\underline{y}}^{\overline{y}} \pi(y)yf(y)dy}{\mu(1 + svc)}.$$

Contribution rate competition leads to lower customer expenditures than premia competition when $g > \tau\mu$. This condition is tantamount to:

$$\sigma \left[c \cdot \bar{\pi} + \bar{\lambda}\right] \quad > \quad c \int_{\underline{y}}^{\overline{y}} \pi(y)yf(y)dy - c\bar{\pi}\mu^2 = c \cdot \mu \int_{\underline{y}}^{\overline{y}} [\pi(y) - \bar{\pi}] \, yf(y)dy \tag{26}$$

The left hand side of that expression is non-negative and positive whenever the income distribution is non-degenerate. The right hand side of (26) is non-positive and is negative whenever illness risk decreases in income - see the Appendix for details.[7] Hence, the inequality in (26) holds and contribution rate competition is superior to fee competition. As stated above, this finding is rooted in an even more intense competition for high income earners for they are more likely to be net contributors for insurance companies.

7 For income-independent risks, the right hand side of (26) is zero, hence the inequality is fulfilled. See the Proof to Proposition 6.

5.3 Partial Insurance

The full insurance of risks assumed hitherto is typically prevented by problems of moral hazard. While we will not engage in a detailed incorporation of asymmetric information to the model, we now consider a setting where not the full damage, but only $\gamma < c$ is covered by health insurance. Again, we focus on the case with customer loyalty.

With fee competition, the person indifferent between company A and B has loyalty $\tilde{\lambda}_P$, determined by:

$$\begin{aligned} &\pi \cdot u\left(y - p_A + \gamma - c + \tilde{\lambda}_P\right) + (1-\pi) \cdot u\left(y - p_A + \tilde{\lambda}_P\right) \\ = \;& \pi \cdot u\Big(y - p_B + \gamma - c\Big) + (1-\pi) \cdot u\Big(y - p_B\Big). \end{aligned} \tag{27}$$

While there is no closed-form solution for $\tilde{\lambda}_P$, we can easily state A's market share among persons with income y as:[8]

$$\tilde{d}_A^P(y, g) = \frac{\bar{\lambda} - \tilde{\lambda}_P}{2\bar{\lambda}}. \tag{28}$$

This market share reacts on a fee increase according to :

$$\frac{\partial \tilde{d}_A^P}{\partial p_A} = \frac{\partial \tilde{d}_A^P}{\partial \tilde{\lambda}_P} \cdot \underbrace{\frac{\partial \tilde{\lambda}_P}{\partial p_A}}_{=1} = -\frac{1}{2\bar{\lambda}}.$$

Moreover, $\tilde{\lambda}_P = 0$ in a symmetric equilibrium. Hence, the first-order condition:

$$\int_{\underline{y}}^{\overline{y}} \tilde{d}_i^P(y) f(y) dy + \int_{\underline{y}}^{\overline{y}} (p_i - \pi \cdot \gamma) \frac{\partial \tilde{d}_i^P(y)}{\partial p_i} f(y) dy = 0, \tag{29}$$

simplifies to:

$$\frac{1}{2} - (p_i - \pi \cdot \gamma) \int_{\underline{y}}^{\overline{y}} \frac{1}{2\bar{\lambda}} f(y) dy = 0$$

which coincides with (14) except for $\gamma \neq c$ and thus is solved by $g = \pi \cdot \gamma + \bar{\lambda}$.

The same principle applies to contribution rate competition. A's market share among earners of y totals:

$$\tilde{d}_A^R(y, \tau) = \frac{\bar{\lambda} - \tilde{\lambda}_R}{2\bar{\lambda}}, \tag{30}$$

where $\tilde{\lambda}_R$ is the critical level of loyalty for which indifference between both companies holds. This level is implicitly defined by:

$$\begin{aligned} &\pi \cdot u\left((1-\tau_A)y + \gamma - c + \tilde{\lambda}_R\right) + (1-\pi) \cdot u\left((1-\tau_A)y + \tilde{\lambda}_R\right) \\ = \;& \pi \cdot u\Big((1-\tau_B)y - c + d\Big) + (1-\pi) \cdot u\Big((1-\tau_B)y\Big), \end{aligned}$$

8 This condition states the case of an interior solution, as must be the case in a symmetric solution. We omit boundary solutions of market shares arising from sufficiently high fee differentials in order to simplify the exposition.

and responds on a contribution rate increase according to:

$$\frac{\partial \tilde{\lambda}_R}{\partial \tau_A} = y.$$

Consequently, the reaction of A's market share remains income dependent:

$$\frac{\partial \tilde{d}_A^R}{\partial p_A} = -\frac{y}{2\bar{\lambda}},$$

and is more pronounced for high incomes. Imposing symmetry on the first order condition

$$\int_{\underline{y}}^{\overline{y}} y \tilde{d}_i^R(y) f(y) dy + \int_{\underline{y}}^{\overline{y}} [\tau_i y - \pi \cdot \gamma] \frac{\partial \tilde{d}_i^R}{\partial \tau_i} f(y) dy \leq 0 \tag{31}$$

gives

$$\int_{\underline{y}}^{\overline{y}} \frac{y}{2} dy - \int_{\underline{y}}^{\overline{y}} [\tau y - \pi \cdot c] \frac{y}{2\bar{\lambda}} f(y) dy \leq 0,$$

the solution to which is analogous to (20):

$$\tilde{\tau} = \begin{cases} \dfrac{\pi \cdot \gamma}{\mu} & : \quad svc > \dfrac{\bar{\lambda}}{\pi \cdot \gamma} \\ \dfrac{\pi \cdot \gamma + \bar{\lambda}}{\mu} \cdot \dfrac{1}{1 + svc} & : \quad svc < \dfrac{\bar{\lambda}}{\pi \cdot c} \end{cases} \tag{32}$$

Partial insurance has no structural effect on equilibrium fees and contribution rates in our model. Hence, the comparison of consumer expenditures yields results identical to the case of full insurance.

6 Conclusion

The analysis has shown that health insurance competition via contribution rates can be fiercer than via premia. This result stands in contrast to popular conjectures in the literature and in public debate.

Simple as it is, the model should not be misinterpreted such that contribution rates are definitely preferable to premia. A number of aspects, which may tilt the balance in favor of premia, like the eradication of implicit income taxation have not been incorporated to the analysis. However, as many studies find those aspects to be of mixed importance, the decision over contribution rates versus fees as financing instruments for health care appears more delicate than presumed.

Important aspects neglected in the analysis are quality differentiation between suppliers and private coinsurance. However, the significance of these points varies among countries. While public health care services are tightly standardized in Switzerland, Germany allows health insurance companies to compete in both price and quality. In a model allowing for these features, we expect the income-dependency of risk aversion to have an important bearing on the findings. While we conjecture that our results go through when risk aversion is sufficiently low and not too decreasing in income, we leave a fully-fledged analysis for future research.

Proof of Proposition 6

In order to prove that contribution rate competition implies lower consumer expenditures, a comparison of company revenues is sufficient. These revenues amount to $\tilde{\tau}\mu$ and $\tilde{p}$ respectively.

Contribution rate competition is superior to premia competition if and only if $\tilde{p} > \tilde{\tau}\mu$ which is definitely fulfilled when $svc > \bar{\lambda}/\pi \cdot c$. For $svc \leq \bar{\lambda}/\pi \cdot c$, we have:

$$\pi \cdot c + \bar{\lambda} > \frac{(\pi \cdot c + \bar{\lambda})\mu}{\mu(1 + svc)} \quad \Longleftrightarrow \quad svc(\pi \cdot c + \bar{\lambda}) > 0 \Longleftrightarrow \sigma(\pi \cdot c + \bar{\lambda}) > 0.$$

Consumer welfare is higher under contribution rate competition as consumer expenditures are lower in total and more progressively distributed than under premia competition.

Income dependent risks

In order to show that the right-hand side of (26) is negative when illness risk and income are negatively correlated, we employ the following Lemma which is due to Eaton & Rosen (1980).

Lemma: *Given a random variable y with p.d.f. $f(y)$ and support [a, b] and given a function $\theta(y)$ with the property that there exists an $y^* \in [a, b]$ such that $\theta(y) > 0$ for $y > y^*$ and $\theta(y) < 0$ for $y < y^*$, then, if*

$$\int_a^b \theta(y) f(y) dy = 0, \tag{33}$$

the expression

$$\int_a^b \Theta(y)\theta(y) f(y) dy < 0, \tag{34}$$

if $\Theta(y)$ is uniformly decreasing.

Let $a = \underline{y}, b = \overline{y}, y^* = \mu, \theta(y) = \bar{\pi} - \pi(y)$, such that the required properties and (33) hold. Let $\Theta(y) = -y$, so the left hand side of (34) coincides with the right-hand-side of (26). Since $\Theta'(y) < 0$, this right hand side must be negative according to the Lemma.

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