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Abstract

In many countries, health insurers or health plans choose to contract either with any willing providers or with preferred providers. We compare these mechanisms when two medical services are imperfect substitutes in demand and are supplied by two different firms. In both cases, the reimbursement is higher when patients select the in-network provider(s). We show that these mechanisms yield lower prices, lower providers' and insurer's profits, and lower expense than in the uniform reimbursement case. Whatever the degree of product differentiation, a not-for-profit insurer should prefer selective contracting and select a reimbursement such that the out-of-pocket expense is null. While all providers join the network under any-willing-provider contracting in the absence of third-party payment, an asymmetric equilibrium may exist when this billing arrangement is implemented.

Keywords: coinsurance; selective contracting; any-willing-provider contracting; product differentiation; price competition; network

JEL Classification: D43, I11, I13, L13.

1 Introduction

In many developed countries, health authorities or health insurers play an active role as purchasers of health care services. They can build a providers' network and decide either to contract with any willing provider or to design a selective contracting mechanism. Both types of contracts can be implemented in private insurance/provider systems as well as in public contract systems when the price of certain medical services (goods) is not regulated and when patients are not fully insured. For instance, traditional Medicare requires contracts with providers but any provider is allowed to join the network if it accepts Medicare's conditions. In contrast, the payer can restrict contracting providers to a subset of suppliers. By influencing the choice of enrollees, a health plan can increase the flow of patients choosing the selected providers. So the plan is in a position to negotiate discounts and offer lower copayments to its enrollees (see McGuire (2012)).

When any-willing-provider contracting is implemented, the insurer sets a price and a copayment and any provider is allowed to join the network. In certain US states, "any willing provider" laws require managed care organizations to grant network participation to any qualified provider willing to join and meet network requirements.[1] This kind of mechanism is also implemented in countries characterized by a public health care system when all medical services are not covered by the public insurance. In this case, when the price of these goods is not regulated, complementary health insurance companies can act as a purchaser of health care. Hence, in France, certain private insurers select this "open network" approach to reimburse the expenses related to lenses. The public insurance reimbursement of these goods is very low and suppliers freely set their prices. To limit the cost, the insurer announces price and reimbursement conditions and any seller can accept these conditions and join the network or refuse and freely set its price. In this case, the reimbursement is higher in the network than outside the network.[2]

Selective contracting is equivalent to payer-driven competition (Dranove et al. (1992), Dranove (2012)). It implies that providers compete

[1] More than 30 states (Alabama, Connecticut, Florida, Massachussets, New Jersey,...) have some form of "any willing provider" law. They do not require health plan to contract with all providers but they require they state evaluation criteria and ensure due process for providers wishing to contract with the plan. See Carroll and Ambrose (2002).

[2] For instance, the French mutualist health insurance MGEN reimburses 45€ for unifocal equipment and 105€ for multifocal equipment per lens, out of the network, whereas in the network, it reimburses 60€ for the former and 140€ for the latter. For the same equipements, the public insurance reimburses 1.49€ and 4.76€ per lens.

for health plan contracts. For instance, an insurer can set up a drug formulary excluding certain products and describing the copayment for each covered drug. In the US, a drug formulary specifies three tiers of pricing to plan members (see Glazer, Huskamp and McGuire (2012)). Generic drugs are on tier 1 with the lowest copayment. "Preferred brand" drugs are on tier 2 and require a higher but moderate copayment while "Non-preferred brand" drugs are on tier 3 with the highest copayment.[3] Such a mechanism can be designed when the covered products (or more generally the covered medical services) are partially but not perfectly substitutable. In this setting, suppliers compete on price in the first stage to be included on tier 2 in the formulary. In a second stage, facing a demand system with differentiated products and different reimbursements, the non selected firms set the non-preferred brand drug price.

In both approaches, providers can join the network in different ways. Under selective contracting, the number of firms is chosen by the insurer and suppliers compete on price to be selected. Under any-willing-provider contracting, the network is open: any willing supplier can join it at the conditions chosen by the insurer. While the former mechanism involves a market structure chosen by the insurer and prices chosen by the providers, the latter involves prices chosen by the insurer and a market structure chosen by the providers.[4] Few theoretical papers have considered these contracting mechanisms. Berndt, McGuire and Newhouse (2011) analyze the drug formulary but do not attempt to be normative. Barros and Martinez-Giralt (2008) compare any-willing-provider contracting and bargaining in an horizontal differentiation setting. However, to the best of our knowledge, no paper has tried to compare selective contracting and any-willing-provider contracting. This is the aim of this paper.

To focus on price strategies, we assume that the insurance premium is given. As patients are not fully insured, they care about price. So price elasticity matters. We consider two medical services which are imperfect substitutes in demand and can be provided by two firms. When the insurer implements a network, the copayment can be reduced but the enrollees bear no extra payment. We characterize the optimal equilibrium prices under these two mechanisms for a given premium. Our results show that *both types of networks result in a higher cost borne*

[3] According to Glazer et al. (2012), the 2010 out-of-pocket prices average \$11 for tier 1 drugs, \$28 for tier 2 drugs and \$49 for tier 3 drugs.

[4] To focus on price formation, we do not consider in the following the other conditions stipulated in both types of contracts. For instance, selected contracting allows to rule out some providers for reasons of low quality.

by the insurer, a lower providers' profit, a lower expense, and a higher policyholders' net utility. Moreover, we show that, in both cases, the optimal policy of a not-for-profit insurer is to choose a reimbursement (under selective contracting) or a reimbursement and a price (under any-willing-provider contracting) such that the enrollees' out-of-pocket expense is null when they choose an in-network provider. In the any-willing-provider contracting case, this policy induces the entry of both providers in the network. As *selective contracting involves a more vigorous price competition*, it yields lower provider's rents than any-willing-provider contracting. Hence, *from a policyholder's net utility point of view, selective contracting performs better than any-willing-provider contracting.* In contrast, the opposite result holds when considering a utilitarian criterion. Finally, we analyze how these results change when the insurer advances the reimbursement in the network. As this policy lowers the degree of product substitutability, we show that it is detrimental to the enrollees under selective contracting because it involves a less intense price competition. Moreover, we show that asymmetric equilibria may exist under this third-party payment when any-willing-provider contracting is implemented. In this case, only one provider joins the network and consumers benefit from this billing arrangement.

The paper is organized as follows. The model is presented in Section 2. Price equilibrium under selective contracting and "any willing provider" contracting are respectively considered in Sections 3 and 4. Both policies are compared in Section 5. Consequences of third-party payment are analyzed in Section 6 while some conclusions are drawn in Section 7.

2 The model

We consider one product among a certain class of health care products or services (drugs, lenses, hearing aids, medical services, etc.). This product is sold by two competing firms i, $i \in \{1, 2\}$, each providing a single good. We assume that the price of this product is not regulated and results from providers competition. Though the goods produced by these two firms satisfy the same care need, they are not identical. From the patients' point of view, *they are partial but not perfect substitutes.* Substitutability is often high among drugs within a therapeutic class (see Berndt et al. (2011) that give the example of statin drugs) or among lenses for the same vision correction. More generally, this is the case for many medical services in their segment of the market (for instance, primary care visits or preventive care visits provided by different physicians). In this setting of *product differentiation and imperfect substitutability*, following Spence (1976) and Dixit and Stiglitz (1977), we assume that the demand can be derived from the optimization problem of a representative patient with a taste for variety. As shown by Anderson et al. (1992) and Vives (2000), this set up captures an aggregation of demands from an underlying model in which *patients vary in preferences*. In particular, this representative consumer approach is equivalent to other approaches that analyze the heterogeneity of consumer tastes, like the characteristics approach (Lancaster (1966)) and the discrete choice models (Anderson et al. (1992)).

Assuming that the representative patient has utility separable and linear in income, we consider the case of a quadratic symmetric and strictly concave utility function

$$U(q_1, q_2) = \alpha(q_1 + q_2) - \frac{1}{2}({q_1}^2 + {q_2}^2 + 2\gamma q_1 q_2)$$

with $\alpha > 0$, $1 > \gamma > 0$, when q_i is the consumption of good i. The degree of product substitutability is γ^2. As $\gamma > 0$, the goods are substitutes. The more γ is closed to 1, the more products are substitutes. As both selective contracting and any-willing-provider contracting are implemented when products are highly but not perfectly substitutable, we assume that $1 > \gamma > 0.5$.

As a benchmark, let us consider the Bertrand equilibrium prices without insurance.[5] When firm i sets a price p_i, utility maximization yields the following demand system

$$q_i(p_i, p_j) = Max\{0, Min\{\frac{\gamma p_j - p_i + \alpha(1-\gamma)}{1-\gamma^2}, \alpha - p_i\}\} \ \forall i \neq j \in \{1,2\}$$

As goods are substitutes, own-price effects are negative while cross-prices effects are positive. Moreover, as $\gamma < 1$, the own-price effect dominates the cross-prices effect when both firms charge the same price.

Berndt (2002) considers that variations in manufacturing costs do not significantly affect prices of branded pharmaceutical on the market for pharmaceutical products. In the same way, on many markets for medical services, prices reflect marginal values, not marginal production costs. To focus on price competition, we assume that marginal costs are both equal to zero. Thus, total expense is equal to the sum of profits. Each provider maximizes its profit $\Pi_i = p_i q_i(p_i, p_j)$ with respect to its price p_i taking p_j as given. As the profit functions exhibit increasing differences,

[5] In this paper, we assume that providers compete "à la Bertrand" when consumers face uniform reimbursement conditions. Similar results regarding the implementation of contracting mechanisms are obtained under Cournot competition (see Appendix 4).

decisions are strategic complements. Best-reply functions are positively sloped and such that[6]

$$p_i(p_j) = \frac{\gamma p_j + \alpha(1-\gamma)}{2} \quad (1)$$

As shown by Singh and Vives (1999), Bertrand equilibrium is unique. Under our assumptions, the symmetric equilibrium price and the equilibrium level of quantities are respectively

$$\begin{aligned} p_1 = p_2 = p^0 &= \frac{\alpha(1-\gamma)}{2-\gamma} \\ q_1 = q_2 = q^0 &= \frac{\alpha}{(1+\gamma)(2-\gamma)} \end{aligned} \quad (2)$$

yielding profits $\Pi_1 = \Pi_2 = \Pi^0 = \frac{\alpha^2(1-\gamma)}{(1+\gamma)(2-\gamma)^2}$.

Assume now that a monopoly health insurance is introduced and that prices are not regulated. Prices paid to providers differ from prices paid by patients when they buy medical services. An insurer (or a managed care health plan) reimburses a fixed amount of the consumer's expense. It can choose either a uniform reimbursement policy or a policy based on a provider network and differentiated reimbursements. Let us consider these two approaches.

2.1 Uniform reimbursement

Assume that, whatever the price p set by the supplier, the payer reimburses $Min\{k,p\}$ for each unit bought by the consumer. If we assume that $p > k$, the profit of supplier i becomes $\Pi_i = p_i q_i(p_i - k, p_j - k)$. The symmetric Bertrand equilibrium price is

$$p_1 = p_2 = p^k = \frac{(k+\alpha)(1-\gamma)}{2-\gamma} = p^o + \frac{k(1-\gamma)}{2-\gamma} \quad (3)$$

and $p^k - k = p^o - \frac{k}{2-\gamma} > 0$ if $k < \widetilde{k} = \alpha(1-\gamma)$, what we assume in the following. The equilibrium level of quantities and profits are given respectively by:

$$\begin{aligned} q_1 = q_2 = q^k &= \frac{k+\alpha}{(1+\gamma)(2-\gamma)} = q^o + \frac{k}{(1+\gamma)(2-\gamma)} \\ \Pi_1 = \Pi_2 = \Pi^k &= \frac{(k+\alpha)^2(1-\gamma)}{(1+\gamma)(2-\gamma)^2} > \Pi^o \end{aligned}$$

[6] As demands are linear, the profit function exhibit increasing differences. Thus equilibria in pure strategies in this supermodular game with substitute products will always exist.

Uniform reimbursement allows suppliers to increase price and profit. As patients are less sensitive to prices, quantities are higher than in the absence of insurance. In this case, the cost incurred by the insurer is $C_I^k = 2kq^k$ and the net utility of policyholders, $V(q_1, q_2, p_1, p_2)$, equal to the difference between $U(q_1, q_2)$ and total cost (equal to the sum of the cost borne by the insurer and the out-of-pocket expense) is

$$V^k(\gamma, k) = U^k - 2p^k q^k = \frac{(k+\alpha)(\alpha - k(3-2\gamma))}{(1+\gamma)(2-\gamma)^2}$$

2.2 Differentiated reimbursement and provider networks

Instead of setting the same reimbursement whatever the provider, the insurer can built a provider network and differentiate the price and reimbursement conditions.[7] The main contracting mechanisms used by health insurers are selective contracting and any-willing-provider contracting. In the former, the insurer sets the number of providers in the network and the in-network and off-network unit reimbursements (k^s and k). Then, it auctions the right to be inside the network and selects the most competitive providers. This mechanism can be considered as a specific form of competition for the market. In the latter, insurance companies set the price and the in-network unit reimbursement, p^a and k^a, as well as the off-network unit reimbursement k. Any provider willing to accept these conditions can join the network.

In this paper, we compare these mechanisms from the different actors' viewpoints when k is equal to the previous uniform reimbursement. Two types of insurers can be considered. First, *stock health insurance companies* maximize their profit. As the expense we consider is only a part of the risk covered by the insurance, the premium can be assumed as given (and sunk). So the insurer has only to minimize its cost. Second, when health insurance is provided by a *mutual insurance company,* policyholders are both customers and owners of the company. In this case, this not-for-profit insurer can select a contract offering the highest net utility of policyholders $V(q_1, q_2, p_1, p_2)$. When using such a criterion, the not-for-profit insurer acts as a perfect agent of the consumers. Note that this criterion is equivalent to profit maximization if the representative consumer's utility increases when the insurer implements selective or any-willing-provider contracting. In this case, if consumers select an insurance offering the highest net utility taking into account the out-of-pocket expense and the premium they have to pay, insurers can use this

[7] For instance, in France, the law of December 20th 2013 allows the insurers to differentiate the reimbursements when they build a network.

increase in consumers' utility to increase market share.

3 Selective contracting

Assume first that the payer implements a selective contracting mechanism. For instance, the two-stage formulary approach described by Berndt et al. (2011) takes the form of a reduction of the copayment if patients choose in-network suppliers. In the first stage, the payer announces that it will choose one good to be provided in its network. This good will be the one whose provider offers the lower procurement price at the auction stage. Then, firms submit simultaneously bids to the insurer and the firm with the lowest bid is selected.[8] Let us assume that firm 1 is the winning firm and denote by p_1 the price it offers. In the third stage, patients choose the product they buy. If they buy the in-network product, they benefit from a higher unit reimbursement ($k^s > k$) and their unit expense is equal to $Max\{p_1 - k^s, 0\}$, while if they purchase the off-network product, their unit payment is equal to $Max\{p_2 - k, 0\}$, where p_2 is the price of firm 2. So imperfect competition between the two suppliers is introduced by the payer.

In this symmetric setting (in terms of demand and cost structure), if firms do not collude, an equilibrium must be such that no firm has an incentive to deviate. As in-network product consumers benefit from a lower out-of-pocket price, each firm will compete for the right to be inside the network by lowering its price until in-network and off-network profits are equal.[9] So the equilibrium prices (p_1, p_2) are such that simultaneously p_2 is the best response of firm 2 to p_1 and in-network and off-network profits are equal : $p_1 q_1(p_1 - k^s, p_2(p_1) - k) = p_2(p_1) q_2(p_1 - k^s, p_2(p_1) - k)$. Under our assumptions, if $p_1 - k^s > 0$ and $p_2 - k > 0$,

$$\Pi_2 = \frac{p_2(\gamma(p_1 - k^s) - (p_2 - k) + \alpha(1-\gamma))}{1-\gamma^2}$$
$$\Pi_1 = \frac{p_1(\gamma(p_2 - k) - (p_1 - k^s) + \alpha(1-\gamma))}{1-\gamma^2}$$

As both profit functions exhibit increasing differences,[10] price decisions are strategic complements. Even if the out-of-pocket price of good 2 is higher than the out-of-pocket price of good 1, certain enrollees could

[8] As both providers have a zero marginal cost, we do not consider the optimal auctioning mechanism that should be designed to select the preferred provider.

[9] See Berndt et al. (2011) and McGuire (2012). They consider a framework in which the insurer sets an in-network copayment while the off-network good is not covered.

[10] $\partial^2\Pi_i/\partial p_i \partial p_j = \gamma/(1-\gamma^2) > 0$.

prefer, in terms of therapeutic options, paying $p_2 - k$ to consume this good. Thus, firm 2's reaction function is positively sloped and given by

$$p_2(p_1) = \frac{k + \gamma(p_1 - k^s) + \alpha(1-\gamma)}{2} \tag{4}$$

Taking into account this optimal best reply, profits can be rewritten

$$\Pi_1(p_1, p_2(p_1)) = \frac{p_1((k^s + \alpha - p_1)(2-\gamma^2) - \gamma(k+\alpha))}{2(1-\gamma^2)}$$
$$\Pi_2(p_1, p_2(p_1)) = \frac{(\gamma(k^s + \alpha - p_1) - (k+\alpha))^2}{4(1-\gamma^2)}$$

No deviation is profitable when $\Pi_1(p_1, p_2(p_1)) = \Pi_2(p_1, p_2(p_1))$. Solving this equation with respect to p_1 and replacing in $p_2(p_1)$, q_1 and q_2, we obtain Proposition 1.

Proposition 1 *Selective contracting induces a reduction of prices such that the equilibrium price pair* (p_1^s, p_2^s) *and the corresponding quantities* (q_1^s, q_2^s) *are defined by*

$$p_1^s = \frac{2(k^s+\alpha) - 2\gamma(k+\alpha) - \sqrt{X}}{4-\gamma^2} \tag{5}$$
$$p_2^s = \frac{(k+\alpha)(4-3\gamma^2) - \gamma(k^s+\alpha)(2-\gamma^2) - \gamma\sqrt{X}}{2(4-\gamma^2)} \tag{6}$$
$$q_1^s = \frac{(k^s+\alpha)(2-\gamma^2)^2 - \gamma^3(k+\alpha) + (2-\gamma^2)\sqrt{X}}{2(4-5\gamma^2+\gamma^4)} \tag{7}$$
$$q_2^s = \frac{(k+\alpha)(4-3\gamma^2) - \gamma(k^s+\alpha)(2-\gamma^2) - \gamma\sqrt{X}}{2(4-5\gamma^2+\gamma^4)} \tag{8}$$

with $X = 4(k^s - k)(k + k^s + 2\alpha)(1-\gamma^2) + \gamma^2(k - \gamma k^s + \alpha(1-\gamma))^2 > 0$.

As the contract is awarded to the firm with the lowest price, p_1^s is the unique solution of $\Pi_1(p_1, p_2(p_1)) = \Pi_2(p_1, p_2(p_1))$ satisfying $p_2(p_1) \geq p_1$, which implies $p_1 \leq \frac{\alpha(1-\gamma)+k-\gamma k^s}{2-\gamma} < p^k$. This inequality is always verified when $k^s > k$.[11] Equilibrium prices (p_1^s, p_2^s) are such that $p_2^s > p_1^s$. Moreover, $p_1^s > k^s > k$ if $k < k^s < \overline{k}^s = \frac{(k+\alpha(1-\gamma))^2}{2(\alpha(2-\gamma-\gamma^2)-\gamma k)}$ and $k < \overline{k} = \frac{\alpha(1-\gamma)}{2\gamma+1} < \frac{\alpha(2-\gamma-\gamma^2)}{\gamma}$, which is assumed in the following. When $p_2^s > p_1^s > k^s$, $p_2^s > k$. Besides, for any $k^s < \overline{k}^s$, $p^k > p_2^s > p_1^s$. Hence, *both prices are lower under*

[11] When $k^s = k$, the equilibrium is such that $p_2^s = p_1^s = p^k$. The other equilibrium $p_1^s = \frac{(k+\alpha)(1-\gamma)}{2+\gamma} < p_2^s = \frac{(k+\alpha)(1-\gamma^2)}{2+\gamma} < p^k$ yields lower profits to both firms. Then, when $k^s = k$, selective contracting results in the same price as Bertrand equilibrium.

selective contracting. This is a consequence of the *strategic complementarity of prices.* When the insurer lowers the out-of-pocket price of the in-network good, the off-network provider also optimally lowers its price. Patients choosing the in-network good but also patients choosing to buy the off-network good pay less than in the uniform-reimbursement setting. By reducing choice of enrollees, *the insurer forces both providers to choose lower equilibrium prices.* As competition between the two firms is more intense than in the absence of selective contracting, *patients benefit from this mechanism.* As γ^2 expresses the degree of product substitutability and as p_1^s and p_2^s decrease with γ, *the more substitutable the products, the lower the prices.* As a greater reimbursement implies a higher demand for the product of the winning firm, both suppliers have an incentive to lower prices at the procurement stage. Moreover, both prices p_1^s and p_2^s are decreasing and convex functions of the reimbursement k^s.

Let us now consider the influence of this fall in prices on quantities. While q_1^s increases with k^s, q_2^s decreases with k^s. Due to the different cross-price and own-price effects, $q_1^s > q^k > q_2^s > 0$. *The quantity of the in-network product rises, while the quantity of the off-network product falls.* However, $q_2^s > 0$ for any $k^s < \overline{k}^s$ and any γ. If the premium is sunk, the insurer's profit depends only on its cost C_I^s equal to $k^s q_1^s + k q_2^s$. Straightforward calculations show that C_I^s is increasing with k^s.[12] Thus, the insurer's cost is lower under uniform reimbursement. So we obtain Proposition 2.

Proposition 2 *When the insurance premium is the same under both mechanisms, the insurer's profit is lower under selective contracting than under uniform reimbursement.*

This result may seem paradoxical. A profit maximizing insurer should not implement selective contracting. The main reason is that *a more intense competition between the two firms results in lower prices.* Besides, when selective contracting is implemented, as $q_1^s > q^k$ and $k^s > k$, the reimbursement of in-network consumers is higher than in the uniform-reimbursement case. Moreover, the lower reimbursement of the off-network consumers ($kq_2^s < kq^k$) is more than compensated by the increase of the reimbursement of consumers choosing an in-network provider. Let us now consider the representative consumer's net utility $V^s(k^s) = U(q_1^s, q_2^s) - p_1^s q_1^s - p_2^s q_2^s$. It is easy to check that $V^s(k^s)$ is increasing with k^s when $k^s < \overline{k}^s$. Hence, an insurer maximizing V^s must

[12] The derivative of C_I^s with respect to k^s is equal to zero for a value of k^s lower than k and is positive when $k^s > k$.

choose $k^s = \overline{k}^s$, which implies $p_1^s = \overline{k}^s$: the *out-of-pocket expense of a consumer choosing the in-network provider is null.* Moreover, $V^s(\overline{k}^s)$ is increasing with γ, when $k < \overline{k}$. *The higher the degree of substitutability, the higher the consumer's net utility.* Taking our previous results into account, we obtain the following Proposition.

Proposition 3 *When $k < k^s \leq \overline{k}^s$, the representative consumer's net utility is higher under selective contracting than under uniform reimbursement. A not-for-profit insurer maximizing V^s should choose a reimbursement $k^s = \overline{k}^s$ such that the out-of-pocket expense is equal to zero when the enrollee chooses the in-network provider. In this case, we obtain the optimal values of prices, quantities, and profits*

$$p_1^{s^*} = \overline{k}^s = \frac{(k+\alpha(1-\gamma))^2}{2(\alpha(2-\gamma-\gamma^2)-\gamma k)}, \; p_2^{s^*} = \frac{k+\alpha(1-\gamma)}{2}$$

$$q_1^{s^*} = \frac{\alpha(2-\gamma-\gamma^2)-\gamma k}{2(1-\gamma^2)}, \; q_2^{s^*} = \frac{k+\alpha(1-\gamma)}{2(1-\gamma^2)}$$

$$\Pi_1^{s^*} = \Pi_2^{s^*} = \frac{(k+\alpha(1-\gamma))^2}{4(1-\gamma^2)}$$

While a profit maximizing insurer should not implement selective contracting, an insurer acting as an agent of the enrollees should choose this mechanism. Uniform and differentiated reimbursements involve two different types of competition. Bertrand competition is symmetric when the reimbursement is uniform while selective contracting is based on a first stage of price competition to obtain a greater market share. So competition is more intense. Hence, prices are lower. Taking into account the own-price and the cross-price effects, $q_1^{s^*} + q_2^{s^*} > 2q^k$, which implies a higher net utility under selective contracting. Besides, the optimal selective contracting mechanism results in a zero out-of-pocket expense in the network but in a positive out-of-pocket expense if the enrollees choose an off-network provider. From the policyholders' point of view, competition for the market dominates competition in the market. Moreover, when $k < \overline{k}$, $\Pi^{s^*} < \Pi^k$: *selective contracting allows the insurer to lower the provider's rent and consequently to lower total expense.* Furthermore, as its cost is higher, the insurer should either increase the premium for accessing the network or make cross-subsidization with other insured medical services.

4 Any-willing-provider contracting

Under this mechanism, the insurer sets simultaneously the unit reimbursement k^a and the price p^a, $p^k \geq p^a \geq k^a$, paid to the provider when patients choose to buy a good produced by firms belonging to the network. In this setting, firms decide to join, or not to join, the network. If they enter, they are price takers. If they do not enter, they set the price paid by patients deciding to buy their product. The payer reimburses k to the enrollees outside the network (as under selective contracting) and k^a inside the network.[13]

i) *When both firms decide to stay out of the network* (strategy NJ), they are price makers. So the benchmark case results apply. $p_1 = p_2 = p^k$ and $\Pi_1(NJ, NJ) = \Pi_2(NJ, NJ) = \Pi^k$.

ii) *When both firms decide to join the network* (strategy J), each provider is price taker and has to serve the same downward sloping demand $q_i(p^a, k^a) = (k^a + \alpha - p^a)/(1 + \gamma)$. The profit earned by each provider is $\Pi_1(J, J) = \Pi_2(J, J) = \Pi(J, J) = p^a(k^a + \alpha - p^a)/(1 + \gamma)$

iii) *When one firm* (without loss of generality, say firm 1) *joins the network while the other stays out*, firm 2 is price maker and sets its price by maximizing its profit Π_2 with respect to p_2, with

$$\Pi_2 = \frac{p_2(\gamma(p^a - k^a) - (p_2 - k) + \alpha(1 - \gamma))}{1 - \gamma^2}$$

As previously, this profit function exhibits increasing differences. So, the reaction function of firm 2 is positively sloped and equal to the reaction function in (4) with $(p^a - k^a)$ replacing $(p_1 - k^s)$. Off-network firm obtains a profit $\Pi_2(J, NJ) = \frac{(k+\alpha-\gamma(k^a+\alpha-p^a))^2}{4(1-\gamma^2)}$ while the entering firm earns a profit $\Pi_1(J, NJ) = p^a q^a = \frac{p^a((k^a+\alpha-p^a)(2-\gamma^2)-\gamma(k+\alpha))}{2(1-\gamma^2)}$. $\Pi_1(J, NJ) > 0$ if $p^a - k^a < \frac{\alpha(2-\gamma-\gamma^2)-k\gamma}{2-\gamma^2}$.

Taking these three cases into account, we obtain the following symmetric profit matrix

1/2	J	NJ
J	$\Pi(J, J), \Pi(J, J)$	$\Pi_1(J, NJ), \Pi_2(J, NJ)$
NJ	$\Pi_1(NJ, J), \Pi_2(NJ, J)$	Π^k, Π^k

with $\Pi_1(NJ, J) = \Pi_2(J, NJ)$ and $\Pi_2(NJ, J) = \Pi_1(J, NJ)$. Let us first consider the Nash equilibria of this game before refining these equilibria.

4.1 Nash equilibria

Both firms join the network when the strategy pair (J, J) is an equilibrium. In this case, no firm has an incentive to be unilaterally off-network,

[13] These contracts have been analyzed by Barros and Martinez-Giralt (2008) in a different setting characterized by horizontal product differentiation and full insurance. They also assume that the third-party payer announces a price and leaves to the providers the option of joining, or not, the network. In this different setting, they show that there is no asymmetric equilibrium.

i.e., $\Pi_1(J,J) \geq \Pi_1(NJ,J)$ and $\Pi_2(J,J) \geq \Pi_2(J,NJ)$. These conditions are satisfied when the announced price p^a is greater than a price p^J, with

$$p^J = \frac{(k^a+\alpha)(2-2\gamma+\gamma^2)-\gamma(k+\alpha)-2\sqrt{Y}}{(2-\gamma)^2} \tag{9}$$

and $Y = (1-\gamma)(k^a-k)((k+\alpha)+(k^a+\alpha)(1-\gamma)) > 0$. When $p^J \geq k^a$, p^J is decreasing and convex in k^a and $p^J \geq k^a$ if

$$k^a \leq k^a_J = \frac{(k+\alpha(1-\gamma))^2}{4\alpha(1-\gamma)} \tag{10}$$

No firm joins the network when the strategy pair (NJ,NJ) is an equilibrium, i.e., when no firm has an incentive to join unilaterally the network : $\Pi^k \geq \Pi_1(J,NJ)$ and $\Pi^k \geq \Pi_2(NJ,J)$. These conditions are satisfied when $p^a \leq p^{NJ}$, with

$$p^{NJ} = \frac{(2-\gamma)((k^a+\alpha)(2-\gamma)-\gamma(k+\alpha))-\sqrt{Z}}{2(2-\gamma^2)(2-\gamma)} \tag{11}$$

and $Z = (2-\gamma)^2((k^a+\alpha)(2-\gamma^2)-\gamma(k+\alpha))^2-8(k+\alpha)^2(2-\gamma)(1-\gamma)^2 > 0$. p^{NJ} is decreasing and convex in k^a and $p^{NJ} \geq k^a$ if

$$k^a \leq k^a_{NJ} = \frac{2(k+\alpha)^2(1-\gamma)^2}{(\alpha(2-\gamma-\gamma^2)-k\gamma)(2-\gamma)^2} \tag{12}$$

Finally, let us consider the case of *one firm joining the network while the other stays out*. The pair of strategies (NJ,J) and (J,NJ) can be obtained as Nash equilibria for $p^a \leq p^J$ and $p^a \geq p^{NJ}$.

As our setting is symmetric in terms of demand and cost structure, $p^J < p^{NJ} < p^k \ \forall k^a > k$ (see Appendix 1). So, *asymmetric equilibria do not exist* and we only have to consider the symmetric Nash equilibria (J,J) and (NJ,NJ).

4.2 Nash equilibrium refinement

Equilibria (J,J) and (NJ,NJ) arise when $p^J \leq p^a \leq p^{NJ}$. Profits comparison shows that $\Pi_i(NJ,NJ) = \Pi^k \geq \Pi_i(J,J)$ if

$$p^a \leq p^P = \frac{(k^a+\alpha)(2-\gamma)-\sqrt{(k^a+\alpha)^2(2-\gamma)^2-4(1-\gamma)(k+\alpha)^2}}{2(2-\gamma)} \tag{13}$$

with $p^{NJ} < p^P < p^k$ if $k < k^a$ and $p^{NJ} = p^P$ if $k^a = k$ (see Appendix 3).

Using Pareto dominance to refine the Nash equilibrium, (k^a, p^a) are such that the Nash equilibrium is (J,J) if $p^k > p^a \geq Max\{p^{NJ}, k^a\}$

(area ABC in Fig. 1) and (NJ, NJ) if $p^{NJ} > p^a \geq k^a$ (area OAC in Fig. 1)

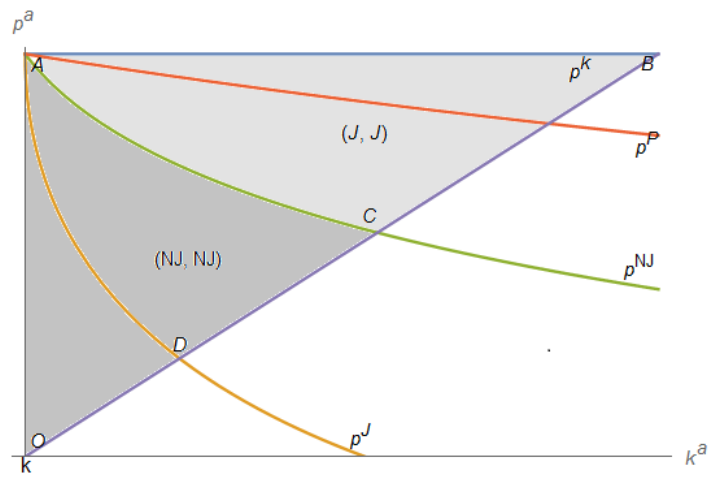

Figure 1

4.3 Optimal price and reimbursement

Assume first that the insurer acts as a profit maximizer and minimizes its cost for a given premium. It is easy to check that this cost is higher when both providers join the network than when they stay out. $C_I(J, J) = 2k^a q^a = \frac{2k^a(k^a+\alpha-p^a)}{1+\gamma}$, is decreasing with p^a for any k^a and increasing in k^a. As the strategy pair (J, J) is a Nash equilibrium when $p^k \geq p^a \geq Max\{p^{NJ}, k^a\}$, the insurer must choose $p^a = p^k$ and $k^a = k$ to minimize its cost. As in the case of selective contracting, not implementing a network is the best strategy of a profit maximizer insurer when the premium is given.

Assume now that the insurer maximizes the net utility V. It must compare V_{JJ} when the Nash equilibrium is (J, J) with V_{NJNJ} when the Nash equilibrium is (NJ, NJ), i.e., when $p^{NJ} \geq p^a \geq k^a$. As $V_{JJ}(p^a, k^a)$ is decreasing in p^a for any k^a, increasing in k^a when $p^a = p^{NJ}(k^a)$, and decreasing in k^a when $p^a = k^a$, the optimal policy is characterized by $p^{a^*} = k^{a^*} = k^a_{NJ}$, which corresponds to Point C in Fig. 1. As $V_{JJ}(p^{a^*}, k^{a^*}) > V_{NJNJ}(p^k, k)$ when $k < \widetilde{k}$, we obtain Proposition 4.[14]

Proposition 4 *A profit maximizing insurer should not implement any-willing-provider contracting. An insurer acting as an agent of the policyholders must choose a price and a reimbursement* $p^{a^*} = k^{a^*} = k^a_{NJ}$

[14] See Appendix 4 for the Cournot case.

such that both firms join the network and the policyholders' out-of-pocket expense is equal to zero.

As the out-of-pocket is null, the quantity of product $q^{a^*} = \frac{\alpha}{1+\gamma}$ depends neither on p^a nor on the reimbursement. When a not-for-profit insurer implements any-willing-provider contracting, the providers' profit $\Pi^{a^*} = \frac{\alpha p^{a^*}}{1+\gamma}$ is lower than Π^k, the representative consumer's utility $U^{a^*} = \frac{\alpha^2}{1+\gamma}$ and the representative consumer's net utility V^{a^*} are respectively greater than U^k and V^k (see Appendix 2). As in the case of selective contracting, implementing any-willing-provider contracting decreases total expense but increases the insurer's cost and the representative consumer's net utility.

5 Optimal contracting

To compare the two mechanisms, we have to take into account the point of view of the different actors when $k < \overline{k}$. We have shown that both selective contracting and any-willing-provider contracting perform better than uniform reimbursement from the enrollee's point of view but result in a lower insurer's and suppliers' profit. These results are summarized in Proposition 5:

Proposition 5 *From an insurer's profit as well as from a providers' profit point of view, uniform reimbursement dominates both selective contracting and any-willing provider contracting, while it is dominated by both contracting mechanisms from the policyholders' point of view.*

Before comparing the two contracting mechanisms, we first have to consider their effects on prices and quantities.

5.1 Price and quantity comparison

Taking our previous results into account shows that $p_1^{a*} > p_1^{s*}$. The price of product 1 (provided inside the network in both cases) is lower under selective contracting than under any-willing-provider contracting, because the former mechanism is based on price competition. In contrast, the sign of $p_2^{a*} - p_2^{s*}$ depends on k and γ. Product 2 is provided outside the network under selective contracting and inside the network under any-willing-provider contracting. When the degree of substitutability is high ($\gamma > 0.885$), both prices are lower under selective contracting. When it is low ($\gamma < 0.806$), any-willing-provider contracting results in a price p_2^{a*} lower than p_2^{s*}. This result holds for an intermediate value of γ if $\overline{k}(\gamma) > k > k_o = \frac{\alpha(-4+8\gamma-2\gamma^2-3\gamma^3+\gamma^4)}{4-4\gamma+\gamma^3}$.

Let us now consider the effects of both mechanisms on quantities. Quantities q_1^{a*} and q_2^{a*} are equal when both firms join the network under any-willing-provider contracting, while $q_1^{s*} > q_2^{s*}$ when selective contracting is implemented. As the out-of-pocket is null in the network, q_1^{s*} does not depend on p_1 while q_1^{a*} and q_2^{a*} depend neither on p_1 nor on p_2. So we only have to consider the effects of a positive net price $p_2^s - k$ on q_1^s and q_2^s. As $\frac{\partial q_1^s}{\partial(p_2^s-k)} > 0$ and $\frac{\partial q_2^s}{\partial(p_2^s-k)} < 0$, $q_1^{s*} > q_1^{a*} = q_2^{a*} > q_2^{s*}$. Selective contracting yields a higher quantity of product 1 (in-network in both cases) but a lower quantity of product 2. Taking these prices and quantities into account, we can now consider the representative consumer's net utility.

5.2 Representative consumer's net utility and social welfare

Considering the representative consumer's net utility, we have to compare V^{s^*} with V^{a^*}. We prove the following Proposition in Appendix 2

Proposition 6 *When $k < \overline{k}$, selective contracting results in a higher representative consumer's net utility than any-willing-provider contracting.*

This result implies that the insurer should choose selective contracting when it maximizes the net utility of the enrollees. It is easy to check that $\Pi^{a^*} > \Pi^{s^*}$ when $k < \overline{k}$. Hence, total expense is higher under any-willing-provider contracting.[15] As a not-for-profit insurer acts as an agent of the enrollees, it chooses the mechanism resulting in the lower providers' rent and, consequently, in the lower total expense. While selective contracting is based on price competition, the price selected by the payer under any-willing-provider contracting is used to deter a provider from not joining the network unilaterally. So it does not result from price competition and yields a higher providers' profit than selective contracting. Consequently, $V^{s^*} > V^{a^*}$.

Let us now consider the consequence of the optimal choice of a not-for-profit insurer in terms of social welfare. As utilitarian social welfare is equal to the representative consumer's utility, straightforward calculations show that $U^{a^*} - U^{s^*} > 0$ (see Appendix 2). So the optimal choice of a not-for-profit insurer is not socially optimal from a utilitarian point of view: *any-willing-provider contracting welfare-dominates selective contracting.* This is mainly due to the fact that $q_2^{a^*} - q_2^{s^*} > q_1^{s^*} - q_1^{a^*}$. As the

[15] This conclusion is consistent with the results of the empirical studies of Vita (2001) and Durrance (2009).

utility function is symmetric, the increase in q_2 prevails on the decrease in q_1 when any-willing-provider contracting and selective contracting are compared from a social welfare point of view.

6 In-network third-party payment

In certain countries, different methods of billing, depending on whether providers are in or off-network, can be associated with the contracting mechanisms. The insurer can make the advance of its reimbursement to the policyholders who select the in-network provider. *This third-party payment reduces the amount consumers pay up-front to out-of-pocket expense.* For instance, under selective contracting, reimbursement $k^s q_1$ is billed by the provider to the insurer and the policyholder has only to make a payment equal to his out-of-pocket expense $(p_1 - k^s)q_1$. In contrast, when choosing the off-network provider, consumers have to make a payment equal to the full expense $p_2 q_2$. Then, they submit their reimbursement claim kq_2 to the insurer and receive it after a delay. This discriminatory billing mechanism may involve a change in the degree of substitutability. As the delay may be costly for certain consumers, two highly substitutable products may become less substitutable when the insurer gives preferential reimbursement treatment to the in-network purchase. Hence, γ is lower when the enrollee has not to make the advance of the full expense. Let us denote by $\gamma_T \leq \gamma$ the degree of substitutability under third-party payment. Note that this billing arrangement introduces *asymmetry between providers under any-willing-provider contracting*: when either no provider or all providers join the network, the substitutability parameter is still equal to γ while it is equal to γ_T when only one provider joins the network. Let us consider how our previous results change when this billing arrangement is implemented.

6.1 Selective contracting

Under third-party payment, equilibrium prices p_1^s and p_2^s are still given by (5) and (6) with γ_T replacing γ. If the insurer wants that selective contracting results in a fall of prices in the network, it must choose the reimbursement k^s such that $p^k > p_1^s$, which implies that $k^s > \widetilde{k}^s$ with

$$\widetilde{k}^s = \frac{1}{\gamma_T^2(2-\gamma)}(-\gamma_T \alpha^2(2-\gamma) + (k+\alpha)(\gamma_T(2-\gamma) + 2(1-\gamma) - \sqrt{Y'}))$$

with $Y' = 4\gamma_T(1-\gamma_T^2)(1-\gamma)(2-\gamma) + (2-\gamma_T^2)^2(1-\gamma)^2 > 0$, $\widetilde{k}^s = k$ when $\gamma_T = \widetilde{\gamma} = \frac{\gamma}{3-2\gamma}$, $\widetilde{k}^s > k$ when $\gamma_T < \widetilde{\gamma}$ while $p^k = \widetilde{k}^s = \overline{k}^s$ when

$\gamma_T = \widetilde{\widetilde{\gamma}} = \frac{\alpha^2+k^2(\gamma-1)+k\alpha\gamma-\sqrt{X'}}{\alpha(2k(1-\gamma)+4(4-3\gamma))}$ (see Fig. 2).[16]

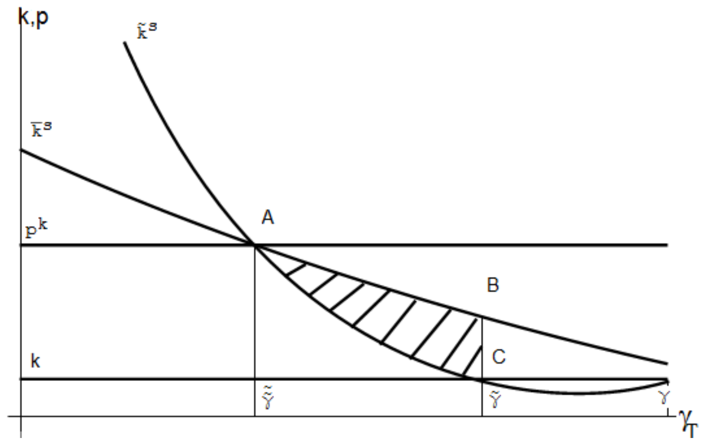

Figure 2

When k^s is low ($k < k^s < \widetilde{k}^s$), the advantage of being in the network is weak. So providers are not encouraged to reduce prices. In contrast, when γ_T is low relative to γ, the advantage of being in the network due to the reduction of up-front expenses is strong, which also involves a less intense price competition. If the change in the reimbursement mechanism involves a very substantial reduction in the degree of substitutability ($\gamma_T < \widetilde{\widetilde{\gamma}}$), there is no value of the reimbursement k^s such that $p^k > p_1^s > k^s$. The insurer cannot implement a selective contracting mechanism leading to a fall in prices in the network. If $\gamma_T > \widetilde{\gamma}$, implementing a selective contracting mechanism involves a fall in price p_1^s for any $k^s > k$ while in the intermediary case ($\widetilde{\widetilde{\gamma}} \leq \gamma_T \leq \widetilde{\gamma}$), it is only possible when $\widetilde{k}^s \leq k^s \leq \overline{k}^s (k^s \in ABC)$. Hence, implementing selective contracting under third-party payment depends on how the consumers's preferences response to a change in the billing arrangement. In the following, we assume that its implementation is possible for any reimbursement $k < k^s < \overline{k}^s$, i.e., $\gamma_T > \widetilde{\gamma}$.

For any reimbursement k^s, selective contracting yields an in-network price lower than p^k. In this case, as p_1^s and p_2^s decrease with γ when $k < \widetilde{k}^s$ and $k^s < \overline{k}^s$, *both prices are higher when k^s is charged by provider 1 to the insurer.* While p_1^s and p_2^s are lower than p^k when both providers charge the full expense to the consumer, p_2^s is greater than p^k under third-party payment when γ_T is low or when $k^s < \widehat{k}^s = \frac{(k+\alpha)(\gamma^2+\gamma_T^2(1-3\gamma+\gamma^2)+\alpha(2-\gamma)(\gamma_T^2-\gamma)\gamma_T)}{(\gamma-2)(\gamma_T^2-\gamma)\gamma_T}$. As $\widehat{k}^s = \widetilde{k}^s$ when $\gamma_T = \overline{\gamma} = \frac{(k+\alpha)\gamma}{\alpha(2-\gamma)} >$

[16]With $X' = (k+\alpha)((1-\gamma)^2(k^3+9\alpha^3) - \alpha k^2(5-6\gamma+\gamma^2) - \alpha^2 k(5-2\gamma-3\gamma^2))$

$\widetilde{\gamma}$, p_2^s is greater than p^k either when $\overline{\gamma} < \gamma_T < \gamma$ if $k^s < \widehat{k}^s$ or when $\widetilde{\gamma} \leq \gamma_T < \overline{\gamma}$ if $k < k^s < \overline{k}^s$. This is a consequence of a less intense price competition when $\gamma_T < \gamma$.

When a third-party payment is implemented, the optimal price and reimbursement are identical to p_1^s and k^s in Proposition 3 with γ_T replacing γ. As both prices decrease with the substitutability parameter, they are higher under third-party payment. Consequently, V^s is lower when the amount consumers pay up-front is reduced to the out-of-pocket expense. Hence, giving a non-price advantage to policyholders choosing the in-network provider would have a deleterious effect on the representative consumer's net utility. *Policyholders have not to make the advance of the reimbursement but their net utility is lower.* This is a consequence of the change in the providers' strategies. As products are less substitutable, price competition is less intense when there is a non-price preferential treatment. So, this preferential treatment is detrimental to the enrollees.

6.2 Any-willing-provider contracting

Under this mechanism, the substitutability parameter is still γ in cases i) and iii) while it is γ_T in case ii). Prices p^J and p^{NJ} depend now on γ and γ_T and are higher than k^a when respectively

$$k^a \leq k_J^a(\gamma, \gamma_T) = \frac{(k + \alpha(1-\gamma_T))^2(1+\gamma)}{4\alpha(1-\gamma_T^2)}$$
$$k^a \leq k_{NJ}^a(\gamma, \gamma_T) = \frac{2(k+\alpha)^2(1-\gamma_T^2)(1-\gamma)}{(\alpha(2-\gamma_T-\gamma_T^2) - k\gamma_T)(2-\gamma)^2(1+\gamma)}$$

While $p^J < p^{NJ} < p^k$ $\forall k^a > k$ when there is no third-party payment, there may exist some values of γ_T such that both curves intersect, so that $k_{NJ}^a < k_J^a$. We show in Appendix 3 that there exists a value $\widehat{\gamma} < \gamma$, such that p^{NJ} and p^J intersect below (resp. above) the line $p^a = k^a$ when $\gamma_T < \widehat{\gamma}$ (resp. $\gamma_T > \widehat{\gamma}$).

Let us consider the case of a strong reduction in the substitutability parameter ($\gamma_T < \widehat{\gamma}$). If the insurer makes the advance of the reimbursement when the policyholders select the in-network provider(s) and if $\gamma < \widehat{\gamma}$, $p^J > p^{NJ}$ for any k^a lower than a value k_1^a (see Appendix 3). The strategy pair (J, J) is an equilibrium if $\text{Max}\{k^a, p^J\} < p^a \leq p^k$ (area BDC in Fig. 3) while (NJ, NJ) is an equilibrium if $k^a \leq p^a < p^{NJ}$ (area EFO in Fig. 3) and (J, NJ) (or (NJ, J)) is an equilibrium if $\text{Max}\{k^a, p^{NJ}\} < p^a \leq Min\{p^k, p^J\}$ (area ABDFE in Fig. 3). In contrast with the previous case ($\gamma_T = \gamma$), asymmetric equilibrium does exist.

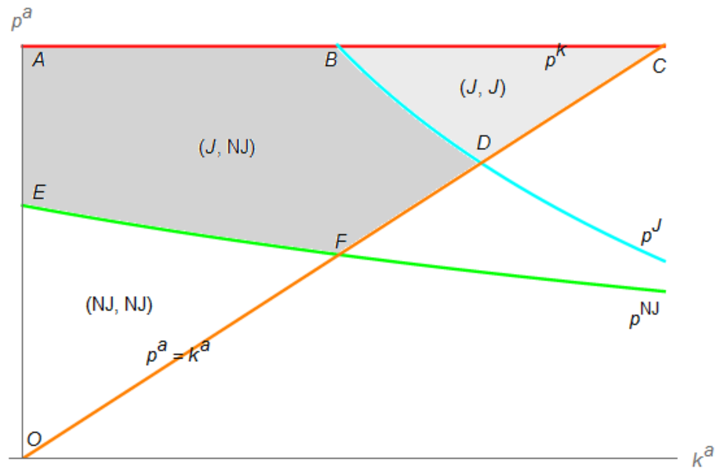

Figure 3

To select his optimal price $p^a \geq k^a$, the insurer could use a profit criterion and choose the equilibrium such that its cost is minimized. However, when either (J, J) or (J, NJ) are selected by providers, the insurer's cost is greater than in the absence of network. As indicated in Fig. 3, the insurer must select $\{k^a, p^a\} \in OEF$ to minimize its cost. As no firm joins the network, both providers charge price p^k and the reimbursement is equal to k. If we assume that the insurer maximizes the net utility V, it has to compare V_{JJ}, V_{JNJ} and V_{NJNJ}. In area BDC, V_{JJ} is decreasing with p^a for any k^a and is maximized at point D ($p^J(k_J^a(\gamma, \gamma_T)) = k_J^a(\gamma, \gamma_T)$). In area ABDFE, V_{JNJ} is decreasing with p^a for any k^a and is maximized at point F ($p^{NJ}(k_{NJ}^a(\gamma, \gamma_T)) = k_{NJ}^a(\gamma, \gamma_T)$). Moreover, it can be shown that V_{NJNJ} is always dominated by either V_{JJ} or V_{JNJ} for any (p^a, k^a) when $p^a \geq k^a$. Consequently, depending on the exogenous variables $(\gamma_T, \gamma, \alpha, k)$, the optimal policy is obtained either when $p^a = p^J(k^a) = k^a$ or when $p^a = p^{NJ}(k^a) = k^a$: *the optimal policy may be associated either to a symmetric or to an asymmetric equilibrium.*

To illustrate this result, let us assume that $\alpha = 1200$, $\gamma = 8/10$ and $k = 10$. In this case, $k_{NJ}^a < k_J^a$ when $\widetilde{\gamma} < \gamma_T < \widehat{\gamma} = 0.6550$ and $V_{JNJ}^a(p^a = k_{NJ}^a(\gamma, \gamma_T), k_{NJ}^a(\gamma, \gamma_T)) > V_{JJ}^a(p^a = k_J^a(\gamma, \gamma_T), k_J^a(\gamma, \gamma_T))$ when $\gamma_T < 0.6551$. Hence, when the implementation of the third-party payment strongly decreases the substitutability parameter in $]\widetilde{\gamma}, \gamma[$, it induces asymmetry between in-network and off-network providers. In this setting, the optimal policy of the not-for-profit insurer is to choose a price inducing an asymmetric Nash equilibrium such that only one firm joins the network. This mechanism results in quantities q_1^{a*} and q_2^{a*} equal respectively to q_1^s and q_2^s with γ_T replacing γ. This is the consequence of the asymmetric equilibrium under both mechanisms. Moreover, as the in-network price is equal to the reimbursement, under any-willing-provider contracting as well as under selective contracting, q_1 is the quantity purchased when the out-of-pocket expense is null. As q_2 results from the same reaction function, $q_2^a = q_2^s$. If we now compare the representative consumer net utility when the third-party payment is implemented $(V_{JNJ}^a(p^a = k_{NJ}^a(\gamma, \gamma_T), k_{NJ}^a(\gamma, \gamma_T)))$ with its value when it is not implemented $(V_{JJ}^a(p^a = k_{NJ}^a(\gamma), k_{NJ}^a(\gamma)))$, it can be shown that consumers may benefit from this billing arrangement. The effect of price competition prevails on the effect of the reduction in the substitutability parameter. For instance, it is true with the values considered in the example. Hence, a not-for-profit insurer should not implement third-party payment under selective contracting while it should implement it under any-willing contracting when the reduction in the substitutability parameter is strong. However, these different billing arrangements do not change the policy ranking : as $k_{NJ}^a(\gamma, \gamma_T) > \overline{k}^s(\gamma)$, selective contracting still results in a higher net utility than any-willing-provider contracting.

7 Conclusion

In many countries, health insurers or health plans choose to contract either with any willing providers or with certain preferred providers. In this paper, taking into account the suppliers' best strategy when medical products are partially but not perfectly substitutable, we characterize the equilibrium prices under both mechanisms. We show that equilibrium prices and total expense are lower than in the uniform reimbursement case and that all firms join the network under any-willing-provider contracting. Implementing a provider network is a powerful tool to reduce health care expenditure. Taking these prices into account, we are able to compare any-willing-provider contracting and preferred-provider contracting from the view points of the different actors. Our study provides new insights into the policy ranking. When the insurance premium is sunk, the payer's and the suppliers' profits are lower under both contracting mechanisms than in the absence of network. So a for-profit insurer should not implement these mechanisms. In contrast, a not-for-profit insurer maximizing the net utility of the enrollees should organize the two types of networks and set a reimbursement (and a price under any-willing-provider contracting) such that the out-of-pocket expense is null. Moreover, as *selective contracting transfers more rents away from suppliers than any-willing-provider contracting, the former mechanism* *yields lower expenditure and performs better than the latter from a representative consumer net utility point of view.* This result is mainly explained by the more vigorous price competition involved by selective contracting. Finally, we show how these results change when the insurer implements a third-party payment mechanism. In particular, asymmetric equilibrium may exist under any-willing-provider contracting.

As we have considered a representative patient with a taste for variety, both products are sold and both firms are active whatever the mechanism chosen by the payer. Consumers buying the in-network product as well as consumers buying the off-network product pay less than under uniform reimbursement. On the one hand, as both mechanisms imply lower out-of-pocket expense, they encourage a better compliance with therapy. So, in the case of drugs, in the absence of moral hazard, there is no negative externality between their coverage and other health care spending (i.e., the so called "offset effect" of drug coverage), which implies lower other health care costs (see Chandra, Gruber, and McKnight (2010) and Gaynor, Li, and Vogt (2007)). On the other hand, this lower out-of-pocket expense may be the source of ex-post moral hazard inefficiency coming from an in-network over consumption.

Taking into account a greater number of firms or identical increasing and convex cost functions would not add further insights. In the same way, if we had considered coinsurance rates instead of fixed reimbursements, we would have obtain similar results. Nevertheless, some questions remain open. First, what is the degree of substitutability between medical services? If high substitutability seems an appropriate assumption for drugs or lenses, this is less true for some other medical products or services. Second, we could assume that marginal costs are different and private information. In this case, the auctioning mechanism matters and asymmetric equilibria could be optimal. Third, we do not tackle the issue of the insurance market. As our results show that the insurer's cost as well as the policyholders' utility depend on the selected purchasing mechanism, a substantial impact on market shares might be expected and we could analyze the case of competing health insurers choosing to contract either with a selected subset of providers or with any willing provider.[17] Further research could address these issues.

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[17] In a setting of differentiation "à la Hotelling", Gal-Or (1997) considers this issue in the case of selected contracting and shows that an exclusionary outcome may be the unique equilibrium of the game.

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Appendix 1 - Nash equilibria under any-willing-provider contracting

Taking (9) into account, when $p^J > k^a$, p^J is decreasing and convex in k^a :

$$\frac{dp^J}{dk^a} = \frac{((2-2\gamma+\gamma^2) - \frac{(1-\gamma)(\alpha(2-\gamma)+2k^a(1-\gamma)+\gamma k)}{\sqrt{Y}})}{(2-\gamma)^2} < 0$$
$$\frac{d^2p^J}{dk^{a^2}} = \frac{(k+\alpha)^2)(1-\gamma)^2}{Y^{3/2}} > 0$$

Taking (11) into account, p^{NJ} is decreasing and convex in k^a.

$$\frac{dp^{NJ}}{dk^a} = \frac{1}{2}(1 + \frac{(2-\gamma)(\gamma(k+\alpha) - (k^a+\alpha)(2-\gamma))}{\sqrt{Z}}) < 0$$
$$\frac{d^2p^{NJ}}{dk^{a^2}} = \frac{4(k+\alpha)^2(2-\gamma)(1-\gamma)^2(2-\gamma)^2}{Z^{3/2}} > 0$$

Both equilibria (J, J) and (NJ, NJ) arise when $p^J \leq p^a \leq p^{NJ}$. Moreover, $\Pi_i(NJ, NJ) > \Pi_i(J, J)$ when $p^a < p^P$. Let us compare p^J, p^{NJ} and p^P.

Lemma 7 $p^{NJ} > p^J$ *for any* $p^k \geq k^a > k$.

Proof. When $p^k \geq k^a \geq k$, $k^a = k$ is the unique value such that $p^{NJ} - p^J = 0$. Moreover p^J and p^{NJ} strictly decreases with k^a. $p^J(k^a) = k^a$ when $k^a = k^a_J(\gamma) = \frac{(k+\alpha(1-\gamma))^2}{4\alpha(1-\gamma)}$ and $p^{NJ}(k^a) = k^a$ when $k^a = k^a_{NJ}(\gamma) = \frac{2(k+\alpha)^2(1-\gamma)^2}{(\alpha(2-\gamma-\gamma)-k\gamma)(2-\gamma)^2}$. When $k < \widetilde{k} = \alpha(1-\gamma)$, $k^a_{NJ}(\gamma) > k^a_J(\gamma)$. Then $p^{NJ} > p^J$ $\forall k^a > k$ when $p^a \geq k^a$. ■

Lemma 8 $p^k > p^P > p^{NJ}$ *for any* $p^k \geq k^a > k$.

Proof. From (3) and (13) , $p^k - p^P$ has the same sign as $4(k+\alpha)(k^a - k)(2-\gamma)(1-\gamma)$ which is positive. From (11) and (13), $p^P - p^{NJ}$ has the same sign as $4(k+\alpha)(k^a-k)(2-\gamma)^2(2-\gamma)(1-\gamma)$ which is positive. ■

Appendix 2. Comparison of mechanisms

Replacing prices and quantities by their optimal values in V^a, we obtain

$$V^{a^*} = \frac{\alpha(4k^2(1-\gamma)^2 + \alpha k(8 - 12\gamma + 4\gamma^2 + \gamma^3) + \alpha^2(-4 + 4\gamma + 2\gamma^2 - 3\gamma^3 + \gamma^4))}{(2-\gamma)^2(1+\gamma)(\alpha(-2+\gamma+\gamma^2) + k\gamma)}$$

In the same way, replacing prices and quantities by their optimal values in V^s, we obtain

$$V^{s*} = \frac{\alpha^2(3 + 2\gamma - 5\gamma) - 5k^2 - 6k\alpha(1-\gamma)}{8(1-\gamma)}$$

$V^{s*} - V^{a^*} = 0$ for three real values of $k : k = \widetilde{k}$, a value higher than $\widetilde{k}$ and a negative value for $\gamma \geq 0.5$. Thus the sign of $V^{s*} - V^{a^*}$ is constant and positive for $0 \leq k \leq \overline{k} < \widetilde{k}$ when $\gamma \geq 0.5$.

Using our previous results, $U^{a^*} = \frac{\alpha^2}{1+\gamma}$, $U^{s*} = \frac{\alpha^2(7-6\gamma-\gamma^2)-k^2+2k\alpha(1-\gamma)}{8(1-\gamma)}$ and $U^{a^*} - U^{s^*} = \frac{(k-\alpha(1-\gamma))^2}{8(1-\gamma^2)} > 0$.

Appendix 3 - Existence of $\widehat{\gamma}$.

Under third-party payment, both firms join the network if $\Pi_1(J,J) \geq \Pi_1(NJ,J)$, i.e., if p^a is greater than p^J, with

$$p^J(\gamma,\gamma_T) = \frac{\alpha(1-\gamma_T)(2+\gamma_T(1-\gamma)) + k^a(2-\gamma_T^2(1-\gamma)) - k\gamma_T(1+\gamma) - 2\sqrt{Y_j}}{4-\gamma_T^2(3-\gamma)}$$

and

$$Y_J = (1-\gamma_T^2)(k^{a^2}(1-\gamma_T^2) + k^a(k\gamma_T(1+\gamma) + \alpha(2(1-\gamma_T^2) + \gamma_T(1+\gamma)))$$
$$+\alpha^2(1-\gamma_T)(\gamma_T-\gamma) - k(1+\gamma)(k+\alpha(2-\gamma_T))$$

if $k^a \geq k_3^a = \frac{(k+\alpha)\sqrt{(1+\gamma)(4-\gamma_T^2(3-\gamma))}-((k+\alpha)(1+\gamma)\gamma_T+2\alpha(1-\gamma_T^2))}{2(1-\gamma_T^2)} > k$. If $k < k^a < k_3^a$, $\Pi_1(J,J) < \Pi_1(NJ,J)$.

$p^k > p^J$ if $k^a > k_4^a > k_3^a$, with

$$k_4^a = \frac{(k+\alpha)(2(1-\gamma)+\gamma_T(2+\gamma-\gamma^2)) + \gamma_T^2(k(1-\gamma^2)+\alpha(3-\gamma))}{\gamma_T^2(2-\gamma)(1+\gamma)}$$
$$-\frac{2(k+\alpha)\sqrt{(2-\gamma_T^2)(1-\gamma)((1-\gamma_T^2)(1-\gamma)+\gamma_T(2+\gamma-\gamma^2))}}{\gamma_T^2(2-\gamma)(1+\gamma)}$$

and $p^J > k^a$ if $k^a < k_J^a(\gamma,\gamma_T) = \frac{(k+\alpha(1-\gamma_T))^2(1+\gamma)}{4\alpha(1-\gamma_T^2)} > k_3^a$.

Both firms do not join the network if $p^a \leq p^{NJ}$, with

$$p^{NJ} = \frac{((k^a+\alpha)(2-\gamma_T^2) - (k+\alpha)\gamma_T)(2-\gamma)(1+\gamma) - \sqrt{Y_{NJ}}}{2(2-\gamma_T^2)(2-\gamma)(1+\gamma)}$$

and

$$Y_{NJ} = (1+\gamma)(8(k+\alpha)^2(2-\gamma_T^2)(1-\gamma_T^2)(-1+\gamma) +$$
$$((k^a+\alpha)(2-\gamma_T^2) - (k+\alpha)\gamma_T)^2(2-\gamma)^2(1+\gamma)).$$

$p^{NJ} > k^a$ if $k^a < k_{NJ}^a(\gamma,\gamma_T) = \frac{2(k+\alpha)^2(1-\gamma_T^2)(1-\gamma)}{(\alpha(2-\gamma_T-\gamma_T^2)-k\gamma_T)(2-\gamma)^2(1+\gamma)}$.

For any k^a, p^{NJ} decreases when γ_T decreases while p^J increases: $p^{NJ}(\gamma_T,\gamma,k^a) < p^{NJ}(\gamma,k^a)$ and $p^J(\gamma_T,\gamma,k^a) > p^J(\gamma,k^a)$ $\forall k^a$. Moreover, when $\gamma_T = \gamma$, $p^{NJ}(\gamma,k^a=k) = p^J(\gamma,k^a=k)$ while $p^{NJ} > p^J$ for any $k^a > k$. Thus, for any $\gamma_T < \gamma$, curves p^{NJ} and p^J intersect in the $k^a p^a$-plane.

We show that there exists $(\widehat{\gamma},\widehat{k^a})$ such that $p^{NJ}(\widehat{\gamma},\gamma,\widehat{k^a}) = p^J(\widehat{\gamma},\gamma,\widehat{k^a}) = \widehat{k^a}$ when $\gamma_T \in [\widetilde{\gamma},\gamma]$. $p^J(\gamma,\gamma_T,k^a) = k^a$ if $k^a = k_J^a(\gamma,\gamma_T)$ and $p^{NJ}(\gamma,\gamma_T,k^a) = k^a$ if $k^a = k_{NJ}^a(\gamma,\gamma_T)$. $k_J^a(\gamma,\gamma_T)$ decreases with γ_T if $k < \frac{\alpha(1-\gamma_T)}{\gamma_T}$, which is verified as $k < \overline{k}(\gamma) < \frac{\alpha(1-\gamma_T)}{\gamma_T}$ when $\gamma_T < \gamma$ and $k_{NJ}^a(\gamma,\gamma_T)$ increases with γ_T. Thus $k_J^a(\gamma,\gamma_T) - k_{NJ}^a(\gamma,\gamma_T)$ strictly decreases with γ_T. Using the sign of the successive derivatives of the numerator of $k_J^a(\gamma,\gamma_T) - k_{NJ}^a(\gamma,\gamma_T)$ with respect to k, with $k < \overline{k}(\gamma)$, it can be shown that when $\gamma_T = \widetilde{\gamma}$, $k_J^a(\gamma,\gamma_T) - k_{NJ}^a(\gamma,\gamma_T) > 0$ and when $\gamma_T = \gamma$,

$k^a_J(\gamma,\gamma_T) - k^a_{NJ}(\gamma,\gamma_T) < 0$. Hence there exists $\widehat{\gamma}$ such that $k^a_J - k^a_{NJ} = 0$ and $p^J(\widehat{\gamma}, k^a(\widehat{\gamma})) = p^{NJ}(\widehat{\gamma}, k^a(\widehat{\gamma})) = k^a(\widehat{\gamma}) = \widehat{k^a}$. If $\gamma_T < \widehat{\gamma}$, there exists a value k^a_1 such that p^{NJ} and p^J intersect below the curve $p^a = k^a$: $p^{NJ}(\gamma_T,\gamma,k^a_1) = p^J(\gamma_T,\gamma,k^a_1) < k^a_1$. If $\gamma_T > \widehat{\gamma}$, there exists a value k^a_2 such that p^{NJ} and p^J intersect above the curve $p^a = k^a$: $p^{NJ}(\gamma_T,\gamma,k^a_2) = p^J(\gamma_T,\gamma,k^a_2) > k^a_2$.

Appendix 4. Cournot competition

Under uniform reimbursement, the inverse demand system is given by

$$p_i = k + \alpha - q_i + \alpha q_j \;\forall i \;\forall j, j \neq i$$

At Cournot equilibrium,

$$p_1 = p_2 = q_1 = q_2 = q^c = p^c = \frac{k+\alpha}{2+\alpha}$$
$$\Pi_1 = \Pi_2 = \Pi^c = (\frac{k+\alpha}{2+\alpha})^2 > \Pi^k$$
$$V^c = \frac{(k+\alpha)(\alpha(1+\gamma) - k(3+\gamma))}{(2+\alpha)^2}$$

Under selective contracting, equilibrium prices and quantities are still given by equations (5) to (8) and all the results of Section 3 hold. Under any-willing-provider contracting, in case i) $\Pi_i(NJ,NJ) = \Pi^c$. p^J is still given by (9). In contrast, $\Pi^c \geq \Pi_1(J,NJ)$ and $\Pi^c \geq \Pi_2(NJ,J)$ for any $k^a < \overline{k}^a = \frac{2\sqrt{2}(k+\alpha)\sqrt{(1-\gamma^2)(2-\gamma^2)}+k\gamma(2+\gamma)-\alpha(2+\gamma)^2(1-\gamma)}{(2+\gamma)(2-\gamma^2)}$ and for

$$p^a < p^{NJ}_C = \frac{(2+\gamma)(-(k+\alpha)\gamma + (k^a+\alpha)(2-\gamma^2)) - \sqrt{X^C}}{2(2+\gamma)(2-\gamma^2)}$$

otherwise, with $X^C = (2+\gamma)((k+\alpha)\gamma - (k^a+\alpha)(2-\gamma^2))^2 - 8(k+\alpha)^2(2-\gamma^2)(1-\gamma^2)$.

Moreover, $p^{NJ}_C > p^J$ when $k^a > \overline{k}^a$ and $\Pi^c \geq \Pi_1(J,J)$ when

$$p^a < \overline{p}^C = \frac{1}{2}\left((k^a+\alpha) - \frac{\sqrt{\alpha^2\gamma^2 - 4k(k+2\alpha)(1+\gamma) + (2+\gamma)^2 k^a(k^a+2\alpha)}}{(2+\gamma)}\right)$$

These results are synthesized in Fig. 4: the strategy pair (J,J) is optimal in area AGDCEF and (NJ,NJ) in area AOCDG. Proceeding as in Section 5, it can be shown that the optimal price is such that both providers join the network. In this case, when the insurer maximizes V, the optimal policy is such that the out-of-pocket expense is null (point C in Fig. 4):

$$p^a = k^a = \frac{2(k+\alpha)^2(1-\gamma)^2}{(2+\gamma)^2(-k\gamma+\alpha(2-\gamma-\gamma^2))}$$

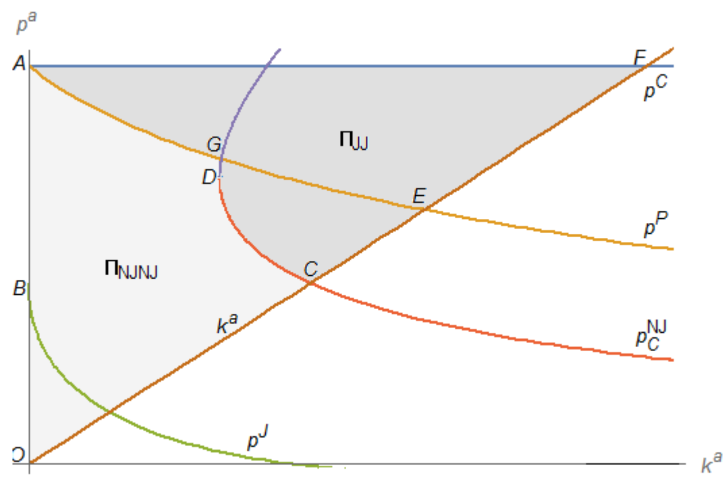

Figure 4

As in the case of Bertrand competition, the representative consumer's utility is higher under selective contracting than under any-willing contracting.