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Abstract

We study the implications of extending public-insurance coverage to an existing medical market in Salop's spatial model of imperfect competition. In this setup a public insurer sets a price to medical providers, which must maintain their reservation profit from selling on the spot market directly to consumers. We show that the public insurer can manipulate this reservation profit by setting the coinsurance rate, and that setting the coinsurance rate properly yields the market first best product diversification. The results survive generalizations including moral hazard and incomplete coverage. When adding quality choice to the analysis, a minimum quality standard that is combined with a proper coinsurance rate can still support market efficiency.

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1 Introduction

In some important industries, the involvement of government authorities on the demand side is so profound that government policy amounts to a special and complex form of regulation. This phenomenon is perhaps nowhere more obvious than in the medical sector, where the presence of very large social insurance funds fundamentally alters the nature and avenues of competition. Traditional concerns of public interest economic regulation, such as efficient market structure and the mitigation of monopoly power, are invariably implicated by the mechanisms used by government to assure the provision of services to targeted groups of consumers. The ability of public insurance provision to affect the efficiency of medical markets is a topic of growing concern due to the high and rising costs of national health programs in most developed countries, and the debate surrounding the expansion of public insurance in the United States. In this paper, we investigate the proper and efficient design of contracts offered by a social insurance fund when service is provided by a private, free-entry, differentiated products industry. We argue that the correct design of insurance contracts can mitigate the traditional inefficiencies associated with such market structures.

Most developed economies operate large public insurance plans. These large insurers have significant monopsony power vis-a-vis medical providers (e.g., hospitals) and innovators (e.g., pharmaceutical companies), and in some markets they directly regulate medical prices[1]. Nonetheless, medical providers generally retain their option to keep selling outside of the public insurance program, directly to consumers on the spot market. New medical technologies are commonly approved for sale on the spot market by the clinical regulatory authority (e.g. FDA), before being selected - often by a different authority- for inclusion under public medical insurance coverage.

In this work we study the interaction between the public insurer and medical providers who sell differentiated products either by contracting with the public insurer or by offering their product on the spot market. The option to sell directly to consumers establishes the providers' reservation values for contracting with the insurer. However, we show that the two-part pricing structure of a typical insurance policy - an up-front premium and a per-unit co-payment - gives the public insurer a powerful instrument to manipulate providers reservation values from spot market sales, and thereby enables it to increase consumers' surplus and improve overall market efficiency.

Our analysis employs Salop's spatial model of imperfect competition, with a single public insurer and endogenous number of differentiated medical providers. Within this framework, we show that providers' option values from selling out of insurance are eroded as the coinsurance rate is reduced. This occurs because a low coinsurance rate increases ex-post relative demand for providers that are included under public coverage. Thus, the public insurer can use the terms of the insurance policy to manipulate prices that providers are willing to accept by strategically setting the coinsurance rate.

First, we study the implications of public insurance for market outcomes in terms of product diversification. Salop (1979) showed that spot market competition in his model yields excessive

[1]Sood et al. (2009) summarize various regulatory practices in pharmaceutical markets in OECD countries.

product diversification compared with the social optimum[2]. We find that, under universal public health insurance, market efficiency can be obtained by the public insurer, along with increases in consumers' surplus. In this case spot market sales are practically eliminated. The welfare maximizing coinsurance rate is increasing with the marginal cost of medical care and market size, and is decreasing with market entry cost and degree of product differentiation. If medical care utilization is increasing under insurance coverage due to moral-hazard, market efficiency can still be achieved, but with a higher coinsurance rate.

When public insurance coverage is incomplete, providers contract with the public insurance fund for one price and sell to the uninsured on the spot market for a higher price. Here, the welfare maximizing coinsurance rate is decreasing with the uninsured rate, and setting a zero coinsurance rate may be a second best policy.

Finally, we incorporate into the analysis the quality of medical care, which we assume is chosen strategically by medical providers (i.e. vertical differentiation). We find that the first best market outcome, in terms of product diversification and quality, can be achieved by adding a minimum quality requirement along with the proper coinsurance rate.

The balance of the paper is organized as follows. Section 2 offers a recap of some relevant literature, paying particular attention to the contributions of Lakdawalla and Sood (2009, 2013), who demonstrate that the format of the typical insurance contract provides the insurance provider with the opportunity to affect downstream behavior in particular ways. Section 3 introduces the model, deriving the simple spot market equilibrium and replicating the Salop result on excessive entry with spot sales. Section 4 begins the analysis of market competition under a monopoly insurance fund, and we show that correct selection of the coinsurance and premium levels can support efficient market outcomes. Further, this process is "self-funding" in the sense that efficiency can be achieved using fair insurance. Next, Section 5 considers extensions of the model to include the issues of moral hazard, uninsured subpopulations. We show how efficiency can usually be achieved even in the presence of these confounding effects, suggesting that the two-part nature of the insurance contracts is a powerful mechanism of indirect regulation. In the case of endogenous quality, however, the public authority must directly regulate providers through minimum quality standard, a result discussed in Section 6. Section 7 concludes with a discussion of the applicability of the analysis to some practical problems of regulation in health care and related markets.

2 Literature

Health insurance is a ubiquitous aspect of many medical markets, and there is a very large literature on the consequences of insurance for industry competition, costs, service quality, technical progress, and so on. As noted by Folland, Goodman, and Stano (2007), the presence of insurance in health services markets changes prices to insured persons, creates wedges between prices buyers pay and prices sellers receive, is often associated with direct negotiation over prices and quantities, and

[2] That is, too many sellers enter the market as entry cost incurred by the marginal provider exceeds the decrease in spatial cost to consumers associated with her market entry.

often alters the incentives of sellers to be efficient. At the same time, however, a monopoly public authority which writes a contract for services, and is capable of making “take it or leave it” offers to providers, is in a strong position to influence market performance.

Lakdawalla and Sood (2009, 2013) analyze the efficiency gains arising from health insurance in markets where the price is set by a monopolistic medical-provider, due to the two-part pricing structure of the insurance policy: a fixed up-front premium payment and a per utilization unit co-payment. In the 2009 paper they focus on the effect of subsidized public health insurance on Pharmaceutical R&D and prices. They show that subsidizing a properly-designed public health insurance program can improve both static efficiency (associated with insufficient monopolistic output) and dynamic efficiency (which relates to efficient R&D investment). Their 2013 study shows that similar static efficiency gains can be achieved by a profit maximizing insurer without subsidies. Here, however, total welfare gains are achieved along with a shifting of surplus in favor of the monopolistic provider.

Both papers encompass the possible coincidence of spot market sales of medical products along with their provision through medical insurance. In the 2009 paper it is assumed that only a part of the population is covered by a public drug-insurance program and the remaining part buys drugs on the spot market. In the second paper, spot market purchases are a result of adverse selection under pooling equilibrium[3]. In both papers, monopolistic prices are higher when selling through insurance, compared with their spot market level.

Both papers also consider powerful insurers that negotiate prices with the monopolistic providers. However, such negotiations can not bring the monopolistic surplus below its spot market reservation levels, so long as the monopoly is not forced to contract with the public insurer. Our analysis demonstrates that this can happen, however, when differentiated medical providers are engaged in monopolistic competition: a powerful public insurer can design a cost-sharing policy that reduces providers' reservation surplus from spot sales, by taking advantage of the strategic competitive interaction among them.

To understand this, suppose that initially all providers were selling on the spot market at price p^s, and the public insurer offered full insurance to consumers (zero out-of-pocket payment at utilization). Each provider that is offered a contract with the public insurer, given that other providers did not contract, realizes that even at the price p^s her profit will increase, because demand for her product by the insured will increase at the expense of the products that are sold on the spot market. This means that each provider finds it beneficial to individually contract with the public insurer, and by doing so each generates a "negative externality" on the reservation surplus from spot sales of all other providers. The public insurer can take advantage of this negative externality on behalf of the insured.

In our monopolistcally-competitive health care market, efficiency is measured at the extensive margin, i.e., by the numbers of providers and differentiated products. In contrast to Lakdawalla and Sood (2013), we can show that the welfare improving policy increases consumers surplus. In

[3]See Section 2.6.2 (p.5) there.

Lakdawalla and Sood (2009), improvement in dynamic efficiency, i.e. R&D investment, can be achieved by supporting the appropriate mark-up through a subsidized public insurance policy. In our corresponding analysis of quality provision, the mark-ups are affected not only by the structure of the insurance policy but also by endogenous market entry. Therefore, an efficient provision of quality can not be achieved by manipulating medical prices alone. Here, efficiency in both margins - entry level and quality provision - can be achieved only by combining a minimum quality requirement with the proper insurance policy design.

Two other recent papers study the implications of health insurance for market outcomes in Salop's circular model of spatial competition[4]. Nell et al. (2009)[5] study the implications of health insurance for market prices and firm entry. They show that insurance sales increase medical prices set by medical providers, thereby encouraging further welfare-impairing entry, even in the absence of moral hazard. This occurs because insured consumers face only a fraction of the actual prices, defined by the coinsurance rate, and are therefore less sensitive to price. Grossman (2013) studies the implications of insurance contracts, along with price and entry regulation for medical prices and pharmaceutical R&D[6], and also finds that the coinsurance rate has negative effect on non-regulated medical prices[7]. Both studies abstract from the providers' option to sell directly to consumers.

Finally, a recent study by Bradey et al.(2015) explores the ability of insurers to extract the medical-providers' surplus by instituting cost-sharing schemes which combine co-pay levels and coinsurance rates. However, this analysis does not consider the provider's option to sell directly to consumers on the spot market, an option which defines a reservation value for any contract with insurers. It is the strategic application of this ability to reduce the value of the "outside option" which is the focus of our analysis.

3 Model

We consider Salop's (1979) circular market populated by a continuum of consumers of unit mass. Each consumer faces an independent probability π of having a medical need. Medical needs, denoted x, are uniformly distributed on a unit perimeter circle. Consumers are ex-ante identical, and may differ ex-post only in their actual medical need indexed $i \in [0, 1)$. Differentiated medical products are provided by N sellers, indexed $j = \{1, 2, .., N\}$, symmetrically located on the circular market. Sellers locations, denoted y_j, define the available medical treatments. Sellers face a common sunk entry cost $f > 0$ and marginal provision cost of $c \geqslant 0$. Each seller independently sets her product price p_j, to maximize her profit.

We follow Salop's (1979) preference model. In the absence of medical need, a consumer's utility

[4] Gaynor and Town (2011, ch. 9) summarize the vast literature on insurance sales and competition health care markets.

[5] Nell et al.(2009) generalize their analysis to all "repair markets", but consider the market health care and medical insurance as a prominent one.

[6] Which corresponds our analysis of quality provision.

[7] Vaithianathan (2006) had simialr result for an oligopolistic market for a homogeneous health care products (under Cournot competition) with exogenous number given number of firms, and perfectly competitive insurers.

is v. Any medical need reduces consumer's utility to zero if not satisfied. A consumer with a need x_i who utilizes product y_j bears a utility loss of $m(x_i - y_j)$, where m is the mismatch ("transportation") cost parameter[8].

When there is only one product, j, a consumer's expected utility at spot price p_j is

$$(1-\pi)\,v + \pi\,(v - p_j - m\,|x_i - y_j|) \tag{1}$$

When multiple products are offered on the market, consumers choose which provider to patronize based on the price and associated spatial distance. Under (the assumed) symmetric locations, the distance between two neighboring sellers is $\frac{1}{N}$. Hence, the maximal mismatch cost is $m \cdot \frac{1}{2N}$.

A public insurer offers insurance policy I to consumers, defined by a combination of a premium α (paid up-front, unconditionally) and a coinsurance rate δ,denoted $I(\alpha,\delta)$. We assume that mismatch costs are not insurable, and $v - \frac{m}{2} > c$, implying all sick people utilize medical care, and all medical products will be utilized in equilibrium.

If all N products are uniformly priced at $\overline{p}$, then each consumer attends only her nearest medical provider, the ex-ante probability of utilizing any given product is $\frac{\pi}{N}$, and the expected mismatch cost is $2Nm\int_0^{\frac{1}{2N}} x dx = \frac{m}{4N}$. Hence, a consumer's expected utility is

$$E(u) = v - \pi\left(\frac{m}{4N} + \delta\overline{p}\right) - N\alpha \tag{2}$$

Next, we assume an unloaded, actuarially fair premium $\alpha = \pi(1-\delta)\,\overline{p}$, which implies that a consumer's expected surplus in the medical market is $CS = \pi\left[v - \left(\frac{m}{4N} + \overline{p}\right)\right]$, and producer's surplus is $PS = \pi(\overline{p} - c)$, so market welfare $CS + PS - Nf$ is given by $W(N)$:

$$W(N) = \pi\left(v - \frac{m}{4N} - c\right) - Nf \tag{3}$$

The efficient product diversification level, denoted N^{**}, which maximizes (3), is

$$N^{**} = \frac{1}{2}\sqrt{\frac{\pi m}{f}} \tag{3a}$$

Salop (1979) famously showed that the spot market equilibrium in models of this sort yields excessive entry and product variety. We briefly replicate this result, which then serves as a benchmark for the following analysis of market equilibrium under public insurance sales. In the absence of insurance sales a mass of π sick consumers must shop on the spot market for medical care, provided by N symmetrically-located sellers. The consumer who is indifferent between buying from

[8] Nell et al. (2009) assume utility functions that are concave in wealth and a monetary transportation cost (that is non-insurable). This formulation impairs tractability and gives rise to a demand for insurance services due to consumer risk-aversion. All our positive analysis could be derived under this formulation, but the welfare gain from insurance would be greater once one accounts for gains from insurance services. Thus, our basic massage would be unaltered.

seller j and a neighboring seller located at $y_j + \frac{1}{N}$ is located at $\widetilde{x} = \frac{1}{2}\left(\frac{\overline{p}-p_j}{m} + \frac{1}{N}\right)$[9]. Thus, the demand faced by seller j is $D_j = \ \pi 2\widetilde{x}$, and the implied surplus, $PS_j = \pi\left(p_j - c\right)\left(\frac{\overline{p}-p_j}{m} + \frac{1}{N}\right)$, is maximized by the price $p_j = \frac{m}{N} + c$. The zero profit condition pins down equilibrium prices and product diversification:

$$N_s^* = \sqrt{\frac{\pi m}{f}}, \ \ p_s^* = \sqrt{\frac{fm}{\pi}} + c \tag{4}$$

Comparing (4) with (3a) confirms that $N_s^* > N^{**}$. Nell et al.(2009) showed, within this framework, that the provision of medical products through competitive, price-taking, insurers yields even higher market entry due to higher prices (p.347). The surplus to be maximized by each provider under a competitive insurance market is $\pi\left(p_j - c\right)\left(\frac{\delta(\overline{p}-p_j)}{m} + \frac{1}{N}\right)$, and the corresponding optimal price is $p_j = c + \frac{m}{\delta N}$, which is decreasing in the coinsurance rate. The zero-profit entry condition implies

$$N_{CI}^* = \sqrt{\frac{\pi m}{\delta f}}, \quad p_{CI}^* = \sqrt{\frac{fm}{\delta\pi}} + c \tag{4a}$$

4 Equilibrium

We turn now to the analysis of market competition and efficiency under a monopoly social insurance fund. To support understanding of the equilibrium, we propose the following simplified time line for the actions of the insurer, the monopolistically-competitive service providers, and the consumers.

1) N suppliers enter and are symmetrically located about the circular market.

2) The public monopoly insurer makes a take-it-or-leave-it offer of participation to the suppliers. Suppliers who decline to participate can sell in the spot market only. The insurance contract covers all consumers.

3) Medical needs are realized, and consumers receive treatment with their preferred providers, who are then either reimbursed by the insurance fund according to the terms of the contract (if they elected to participate), or else are paid directly through spot sales to consumers.

As will be seen below, this time line is suggestive only, since in fact we will show that all providers can be induced to accept participation in the insurance program and, under the optimal insurance contract, the spot market will be eliminated. Further, under perfect foresight the efficient number of providers will enter the market.

A single public insurer makes a take-it-or-leave-it offer simultaneously to N providers, described by the insurance contract $I\left(\overline{p}, \delta\right)$. This contract offer is designed to match a provider's reservation value from unilaterally selling on the spot market. To understand the nature of the equilibrium, suppose that all providers but one, the j^{th}, are under insurance coverage. Then, the surplus for seller j from selling out of insurance - on the spot market - is given by

[9]Following the indifference condition: $p_i + m\left(\widetilde{x} - y_i\right) = p_j + m\left[\left(y_i + \frac{1}{2N}\right) - \widetilde{x}\right]$

$$PS_j = \pi \left(\frac{\delta \overline{p} - p_j}{m} + \frac{1}{N} \right) (p_j - c) \tag{5}$$

Maximizing (5) for p_j yields the spot price provider j would charge if she were the only one who sold service out of insurance

$$p_j = \frac{\delta \overline{p} + \frac{m}{N} + c}{2} \tag{5a}$$

Note that the optimal price for selling out of insurance, on the spot market, is increasing with the coinsurance rate and so is the corresponding surplus:

$$PS_j = \frac{\pi}{4m} \left(\delta \overline{p} + \frac{m}{N} - c \right)^2$$

When all N providers are selling through the public insurer, the surplus for each one of them is $\frac{\pi}{N}(\overline{p} - c)$. The public insurer can in effect set the price $\overline{p}$ to equalize the surplus under insurance with the individual reservation surplus from selling on the spot market given in (5a)

$$\frac{\pi}{m} \left(\frac{\delta \overline{p} + \frac{m}{N} - c}{2} \right)^2 \leq \frac{\pi}{N} (\overline{p} - c) \tag{6}$$

In addition, free entry implies zero equilibrium profit

$$\frac{\pi}{N} (\overline{p} - c) = f \Rightarrow \overline{p} = \frac{nf}{\pi} + c \tag{7}$$

Plugging this price back in (6) we obtain the following implicit expression for firms' entry level in equilibrium under public insurance, denoted N_{PI}:

$$\frac{\pi}{4m} \left[\delta \left(\frac{Nf}{\pi} + c \right) + \frac{m}{N} - c \right]^2 = f \tag{8}$$

Lemma 1 *Condition (8) defines a Nash-equilibrium number of providers in the market with public insurance N^*_{PI}, for any coinsurance rate set in the offered contract.*

Proof. Condition (8) combines condition (6) with the zero profit condition Hence, for any number of providers N_{PI} who contract with the public insurer, which satisfies (8), the market is saturated and no single provider can benefit from opting out of insurance into spot sales. ■

Lemma 2 *The coinsurance rate increases market entry.*

Proof. Equation (8) implies that the sign of $\frac{\partial N^*_{PI}}{\partial \delta}$ is positive if $\frac{\delta f}{\pi} - \frac{m}{N^2} < 0$. Evaluating the latter inequality for $N = N^*_s$ yields $\frac{f}{\pi}(\delta - 1) < 0$, which holds for any $\delta < 1$. That is, for any $N \leq N^*_s$, and $\delta \in (0, 1]$, a lower coinsurance rate is associated with lower market entry, i.e. $\frac{\partial N^*_{PI}}{\partial \delta} > 0$. ■

Proposition 1 *For* $\delta^{**} = \frac{c}{\frac{1}{2}\sqrt{\frac{fm}{\pi}}+c} < 1 : N^*_{PI} = N^{**}$ *and* $CS^*_{PI} > CS^*_s$. *The equilibrium under public insurance can support market efficiency, with higher consumer surplus than that arising under spot market provision.*

Proof. The coinsurance rate that supports market efficiency is derived by imposing the efficient entry level (3a) on (8). Comparing consumers' surplus under public insurance and spot market equilibrium yields lower expected cost in the former: $\frac{1}{4}\sqrt{\frac{fm}{\pi}} < \frac{1}{2}\sqrt{\frac{fm}{\pi}}$. ■

The higher consumers' surplus under public insurance is due to the positive effect of the lower price, $p^*_{PI} = \frac{N^{**}f}{\pi} + c$, which dominates the negative effect of higher spatial costs (due to a lower number of providers). Lemma 1 presents an equilibrium with all N_{PI} providers contracting to sell through the public insurer, as unilateral spot sales are not beneficial to a provider. However, the equilibrium can also be constructed starting with initial spot market equilibrium, under which the surplus for each provider is $PS_j = f$. If the public insurer sets the price and coinsurance rate as described above, the surplus for each provider who opts in, given that all others are staying on the spot market is

$$PS_i = \pi \left(\frac{p_s - \delta p^*_{PI}}{m} + \frac{1}{N^*_s} \right) (p^*_{PI} - c) \tag{9}$$

Each provider would (weakly) prefer opting into insurance if

$$\pi \left(\frac{\left(\frac{m}{N^*_s} + c\right) - \delta^* p^*_{PI}}{m} + \frac{1}{N^*_s} \right) \left(\frac{N^{**}f}{\pi} \right) \geq f \tag{10}$$

Equation (10) is the individual participation constraint. Plugging $p_s = \left(\frac{m}{N^*_s} + c\right)$ and $N^{**} = \frac{1}{2}N^*$ into the above condition, and simplifying, yields

$$c \geq \delta^* p^*_{PI} \Rightarrow c \geq \frac{c}{\frac{1}{2}\sqrt{\frac{fm}{\pi}} + c} \left(\frac{\frac{1}{2}N^* f}{\pi} + c \right) \Rightarrow c \geq c \tag{10a}$$

Hence, the individual participation constraint holds, weakly, for each provider: if we start with spot market equilibrium, and the price and coinsurance rate specified above are offered, then every seller would wish to opt in, but the insurance fund would allow only one half of the initial spot sellers to enroll. If we assume an even number of initial providers (on the spot market), symmetry can be maintained, with every second seller remaining, and the others exiting.

5 Extensions

The analyses above establish the ability of a monopoly insurer to produce efficient outcomes in a free entry, monopolistically competitive services market through the correct design of the insurance contract offered to consumers. In effect, the insurer acts as a regulator of the services industry not by specifying prices or restricting entry, but by achieving these goals through the demand side of the market. Of course, a public authority could theoretically achieve the same results by regulating prices, entry, and location directly, but in the case at hand here, direct intervention of that more traditional sort is not necessary. Fortunately, our conclusions in this regard can withstand some important generalizations, and that is the focus of this section.

In the subsections that follow, we will consider extensions of the analysis to the cases of moral hazard and incomplete consumer insurance coverage.

5.1 Moral Hazard

It is not difficult to incorporate the possibility of moral hazard as in Nell et al.(2009, p.348). Let moral hazard increase demand for medical products under insurance compared with spot sales, so $\pi_{PI} > \pi$, and the level of moral-hazard is decreasing with the coinsurance rate, so $\pi_{PI} \equiv \pi_{PI}(\delta)$ and $\pi'_{PI}(\delta) < 0$. Repeating the steps presented in equations (5)-(8), we modify the right-hand side of (6) to $\frac{\pi_{PI}(\delta)}{N}(\overline{p} - c)$, and the break-even price from (7) becomes $\overline{p} = \frac{Nf}{\pi_{IP}(\delta)} + c$. Then, the modified equilibrium condition which corresponds to (8) is

$$\frac{\pi}{4m}\left[\delta\frac{Nf}{\pi_{PI}(\delta)} + \frac{m}{N} - (1-\delta)c\right]^2 = f \qquad (11)$$

From this we get our second proposition.

Proposition 2 *The equilibrium under public insurance with moral hazard can support market efficiency when the coinsurance rate is set at* $\delta^{**} = \frac{c}{\frac{1}{2\pi_{PI}(\delta)}\sqrt{\frac{\pi m}{f}} + c}$

Proof. Plug (3a) into (11). ■

The coinsurance rate that supports the efficient outcome is increasing with the magnitude of the moral hazard, hence it is higher than the rate defined in Proposition 1.

Figure 1: Moral Hazard and efficient coinsurance rate

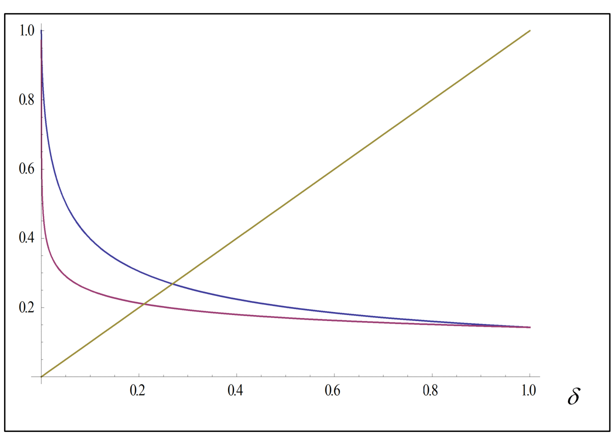

Figure 1 illustrates the effect of moral hazard on the coinsurance rate that supports market efficiency. The horizontal axis is the coinsurance rate. The 45^o ray is the left-hand side of the efficiency condition $\delta = \frac{c}{\frac{1}{2\pi_{PI}(\delta)}\sqrt{\frac{\pi m}{f}}f+c}$ in Proposition 2 The upper and lower decreasing curves mark the right-hand sides of the efficiency condition for low and high moral hazard effects, respectively. The intersections between the decreasing curves and the 45^o ray mark the corresponding efficient coinsurance rates. Under high moral hazard, the efficient coinsurance rate is higher. Both decreasing curves converge to the same level $\pi_{PI}(\delta = 1) = \pi$, where moral hazard is eliminated. This is the efficient coinsurance rate with no moral hazard derived earlier.

5.2 Uninsured Consumers

We turn next to the effect of uninsured consumers on market outcomes. Suppose that only fraction θ of the population is covered by public insurance, while the remaining population must buy on the spot market[10]. The public insurance contract does not restrict the price providers can charge when selling on the spot market. If all providers contract with the public insurer, the price they charge the uninsured in equilibrium, denoted $\widehat{p}$, coincides with that presented in Section 3: $\widehat{p} = \frac{m}{N} + c$, and the surplus for each provider is $PS = \frac{\pi}{N}\left[\theta\left(\overline{p} - c\right) + (1-\theta)\frac{m}{N}\right]$. Hence, the zero-profit equilibrium with all providers under insurance is: $\frac{\pi}{N}\left[\theta\left(\overline{p} - c\right) + (1-\theta)\frac{m}{N}\right] = f$, implying $\overline{p} = \frac{1}{\theta}\left(\frac{Nf}{\pi} - \frac{m}{N}\right) + \frac{m}{N} + c$. Then, if provider j opts out of the insurance contract (given that all other providers remain under contract), she sets a spot price that maximizes the surplus

$$PS_j = \pi\left[\theta\left(\frac{\delta\overline{p} - p_j}{m} + \frac{1}{N}\right) + (1-\theta)\left(\frac{\widehat{p} - p_j}{m} + \frac{1}{N}\right)\right](p_j - c) \tag{12}$$

The surplus in (11) combines the revenue gains for provider j from stealing both insured and uninsured consumers from her neighboring providers. The price that maximizes (11) is $p_j^* = \frac{\theta\delta\overline{p} + (2-\theta)\left(\frac{m}{N}+c\right)}{2}$. Plugging p_j^* and $\widehat{p}$ into (11) yields

$$PS_j = \frac{\pi}{4m}\left[\theta\left(\delta\overline{p} - c\right) + (2-\theta)\frac{m}{N}\right]^2 \tag{12a}$$

Imposing the zero-profit price, $\overline{p} = \frac{1}{\theta}\left(\frac{Nf}{\pi} - \frac{m}{N}\right) + \frac{m}{N} + c$, and the requirement that surplus under insurance equal the reservation surplus out of insurance, yields the equilibrium condition

$$\frac{\pi}{4m}\left[\theta\left(\delta\frac{Nf}{\pi} - (1-\delta)c\right) + (2-\theta)\frac{m}{N}\right]^2 = f \tag{13}$$

Rearranging (12) we obtain

$$\delta = \frac{\frac{1}{\theta}\left[2\sqrt{\frac{fm}{\pi}} - (2-\theta)\frac{m}{N}\right] + c}{\frac{Nf}{\pi} + c} \tag{13a}$$

[10] We ignore the issue of alternative private insurance. A similar market structure was studied by Lakdawalla and Sood (2009), but they assume the fraction of insured consumers depends on the insurance policy terms.

Proposition 3 *For $c \geq \frac{2(1-\theta)}{\theta}\sqrt{\frac{fm}{\pi}}$ the first best market outcome can be achieved by public insurance with $\delta^{**} \in [0,1)$. Otherwise, the second best optimal policy implies a zero coinsurance rate: $\delta^{**} = 0$*

Proof. Imposing the efficient entry level, $N^{**} = \frac{1}{2}\sqrt{\frac{\pi m}{f}}$, on (12a) yields $\delta^{**} = \frac{c - \frac{2(1-\theta)}{\theta}\sqrt{\frac{fm}{\pi}}}{\frac{1}{2}\sqrt{\frac{fm}{\pi}} + c} < 1$. For δ to be non-negative it must be that $c > \frac{2(1-\theta)}{\theta}\sqrt{\frac{fm}{\pi}}$. Otherwise the efficient entry level cannot be achieved, and the optimal coinsurance rate, which still minimizes entry, is $\delta = 0$. ■

6 Quality Choice

We now extend the analysis by allowing providers to determine their levels of service quality. Following Economides (1993), who analyzed the same setup for spot market competition,we assume quality choice is subject to the quadratic cost $C(q) = \frac{\gamma q^2}{2}$. This formulation is tractable, and is reasonable in the medical market context, but it does imply the cost of quality is not qunatity dependent. Hence, fixed cost is now $f + \frac{\gamma q^2}{2}$. To assure non-degenerate market outcomes (positive equilibrium values for q and N), we assume $m > \frac{2\pi}{\gamma}$. The analysis follows the previous time-line: sellers make their entry choice first by picking location, and then compete by choosing quality and price. Equation (2), which defines consumers' expected utility under symmetric equilibrium, is modified to

$$E(u) = v + \pi\left[q - \left(\frac{m}{4N} + \delta\overline{p}\right)\right] - n\alpha \tag{14}$$

The corresponding modification to the market welfare function (3) is

$$W(N,q) = \pi\left(v + q - \frac{m}{4N} - c\right) - N\left(f + \frac{\gamma q^2}{2}\right) \tag{15}$$

The first order condition for efficient quality choice implies: $\frac{\pi}{N} = \gamma q^{**}$,and the zero profit condition requires $\frac{\pi m}{4N^2} = f + \frac{\gamma q^2}{2}$. Combining both conditions yields the following optimal levels of product diversification and quality provision

$$N^{**} = \sqrt{\frac{\frac{\pi m}{2} - \frac{\pi^2}{\gamma}}{2f}},\ \ q^{**} = \sqrt{\frac{2f}{\frac{\gamma^2 m}{2\pi} - \gamma}},\ \ p(N^{**}) = c + m\sqrt{\frac{2f}{\frac{\pi m}{2} - \frac{\pi^2}{\gamma}}} \tag{16}$$

Under spot market sales each seller j chooses price and quality, given the uniform quality and price choices by all other producers, to maximize $\pi(p_j - c)\left(\frac{p_k - p_j + q_j - q_k}{m} + \frac{1}{N}\right) - \left(f + \frac{\gamma q_j^2}{2}\right)$. The first order conditions for profit maximization are

$$p_k + q_j^* - q_k + \frac{m}{N} + c = 2p_j^*\ ,\ \ \frac{\pi\left(p_j^* - c\right)}{m} = \gamma q_j^* \tag{17}$$

where p_k and q_k are the (uniform) price and quality chosen by all other sellers, but seller j. Under the symmetric equilibrium these conditions simplify to

$$p^* = c + \frac{m}{N^*},\ \frac{\pi}{N^*} = \gamma q^* \tag{17a}$$

Combining the optimal price condition in (17a) with the zero-profit entry condition yields $\frac{\pi m}{(N^*)^2} = f + \frac{\gamma (q^*)^2}{2}$. Then, combining the latter conditions with the optimal quality conditions we obtain the spot market equilibrium values

$$N_s^* = \sqrt{\frac{2\pi m - \frac{\pi^2}{\gamma}}{2f}},\ q_s^* = \sqrt{\frac{2f}{\frac{2\gamma^2 m}{\pi} - \gamma}},\ p_s^* = c + m\sqrt{\frac{2f}{2\pi m - \frac{\pi^2}{\gamma}}} \tag{18}$$

Comparing (19) with (17) reveals that $N_s^* > N^{**}$ and $q_s^* < q^{**}$, so the spot market equilibrium yields excessive product diversification and insufficient quality provision. This result was first obtained by Economides (1993).

We turn now to explore the implications of quality choice to market outcomes in the setup studied in Section 4, where providers can contract with a public insurer or, alternatively, sell their products on the spot market. It can be easily verified that the efficient market outcome cannot be supported by setting the price and the coinsurance rate only. This is unsurprising for the usual reason: contract terms provide an insufficient number of instruments. Hence, we assume the public insurer can also set a minimum-quality requirement $q_{\min}$ equal to the efficient level in (15), $q_{\min} = q^{**} = \sqrt{\frac{2f}{\frac{\gamma^2 m}{2\pi} - \gamma}}$, which is binding for the initial spot market equilibrium. Following the zero profit entry condition, $\frac{\pi m}{(N^*)^2} = f + \frac{\gamma (q^*)^2}{2}$, thus under this quality requirement alone entry into the spot market would be double the efficient level: $N_s(q_{\min}) = \sqrt{\frac{\pi m - \frac{2\pi^2}{\gamma}}{f}}$. However, under public insurance coverage, the surplus for each provider is given by

$$\pi (p_j - c)\left(\frac{\delta \overline{p} - p_j}{m} + \frac{1}{N}\right) - \left(f + \frac{\gamma q_{\min}^2}{2}\right) \tag{19}$$

The optimal price to be charged out of insurance in this case and the corresponding surplus are still $p_j = \frac{\delta\overline{p} + \frac{m}{N} + c}{2}$ and $PS_j = \frac{\pi}{m}\left(\frac{\delta\overline{p} + \frac{m}{N} - c}{2}\right)^2$, respectively, as in Section 4. Hence, the calculations presented in (6)-(8) still hold, implying the following zero profit equilibrium condition

$$\frac{\pi}{4m}\left[\delta \frac{N_{IP}\left(f + \frac{\gamma q_{\min}^2}{2}\right)}{\pi} + \frac{m}{N_{PI}} - (1-\delta)\, c\right]^2 = f + \frac{\gamma q_{\min}^2}{2} \tag{20}$$

Proposition 4 *A public insurer can support market efficiency by setting a minimal quality requirement* $q_{\min} = q^{**}$*, along with the coinsurance rate* $\delta^{**} = \frac{c}{\frac{\gamma}{4\pi m} q_{\min} + c} < 1$.

Proof. Following (15): $N^{**} = \frac{\pi}{\gamma q_{\min}}$. Imposing $N_{PI} = \frac{\pi}{\gamma q_{\min}}$ in (19) implies $\delta^{**} = \frac{c}{\frac{\gamma}{4\pi m} q_{\min} + c} < 1$. Following (16a), in this equilibrium, the minimal quality requirement is weakly binding for providers under the insurance contract. ■

7 Conclusions

When sellers are differentiated but entry is free, Salop (1977) demonstrated that excessive entry is a common defect of an unregulated market. This is an important point since many real markets would seem to correspond fairly well to this structural description. In the case of medical services, geriatric pharmaceuticals, and related markets, there are long-standing concerns regarding such excessive entry and, in many cases, public authorities have pursued a variety of direct restrictions on seller entry.

The extensive involvement of public insurance funds on the demand side of these markets provides an alternative mechanism for managing industry structure. This mechanism, introduced into the literature by Lakadawalla and Sood, emphasizes the competitive consequences of the two-part pricing design of most typical insurance contracts. We show in this paper that, under monopoly insurance, the proper selection of the copayment rate can affect the intensity and results of competition between service providers, and in some cases first-best market outcomes are available. The necessary insurance program is (theoretically, if not practically) self-funding, so the possible usefulness of these ideas is worth further investigation. This conclusion is bolstered by extensions of the basic model to incorporate partial coverage, moral hazard, and even endogenous service quality choice, although this last case requires an additional regulatory policy – minimum quality standards – be imposed on providers. Since we ignore any insurance benefits arising from consumer risk aversion, such benefits provide a further reason to consider strategic fixing of coinsurance rates.

Our analysis is cast against the background of a medical market, since, in such cases, a monopoly insurer is plausible. However, the analysis is somewhat more general than that. In particular, our results raise a more basic question applicable to many markets in which economic regulation is important. It is clear in the case analyzed in this paper that a monopoly insurer, acting as an agent for consumers, can achieve efficient industry performance without any direct regulation of entry or firm pricing. Alternately, one supposes the same efficient result could be had through direct regulation of the firms. We note an exception, though, in the case of endogenous service quality, where direct regulation of sellers appears necessary. Is this suggestive finding general? Does regulatory intervention on the buyer side generally offer an equally powerful alternative to more familiar economic regulation of the sellers? This is a topic for further research efforts.

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