Public Health Insurance with Monopolistically Competitive Providers and Optional Spot Sales

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Abstract

We study the implications of extending public-insurance coverage, over differentiated medical products of the same therapeutic group, for market outcomes. The public insurer can set the reimbursement level and copayment rate for medical care provided under the policy coverage, but cannot directly control the providers’ spot (outside of insurance) price. In this setup the price offered by the public insurer to medical providers 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 copayment rate, and that setting the copayment rate properly can promote welfare while increasing consumers’ surplus, and may also yield 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 copayment rate can still support market efficiency.

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1 Introduction

Most developed economies operate large public medical 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 - such as pharmaceuticals - medical prices are commonly subject to direct regulation\(^1\). For example, the regulation of pharmaceutical prices in the European Union is commonly imposed directly on the supply side - at the factory or pharmacy level. However, in the US, medical providers generally retain their option to sell outside of the public insurance program, directly to consumers, at a non-regulated price in the spot market. Yet, the dominant public insurers, i.e. Medicare and Medicaid, are able to bring down the price paid for their insured members by exercising their significant market power.

This work provides the first analysis of such interaction between a public insurer and medical providers who sell differentiated products either by contracting with the public insurer, or by offering their products 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 typical structure of an insurance policy, which combines a copayment rate along with the price set by the public insurer, is a powerful instrument that enables manipulating providers' reservation values from spot market sales. By correctly using these tools the public insurer can increase consumers' surplus and improve overall market efficiency.

Our analysis employs Salop's spatial model of imperfect competition, with a single public insurer and an endogenous number of differentiated medical providers. Within this framework, we show that providers' option values from selling "outside of insurance" are eroded as the copayment rate is reduced. This occurs because a low copayment rate increases ex-post relative demand for providers 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 copayment rate. In particular, it can bring these minimum prices down.

First, we study the implications of public insurance for market outcomes in terms of product diversification and medical prices. Salop (1979) showed that spot market competition in his model yields excessive product diversification compared with the social optimum. That is, too many sellers enter the market as the entry cost incurred by the marginal provider exceeds the decrease in spatial costs to consumers associated with her market entry. The long lasting prevalence of C.O.N (Certificate of need) regulation in American medical markets suggests that excessive-entry in the health care industry has been a major concern, at least for policy makers\(^2\). Similarly, the ongoing debate surrounding "Follow-on" (or "Me-Too") drugs suggests that excessive entry level of generic drugs into pharmaceutical markets is also a common concern\(^3\).

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\(^1\) Sood et al. (2009) summarize various regulatory practices in pharmaceutical markets in OECD countries. Carone et al. (2012) summarize the common policies in regulating pharmaceuticals prices in the EU countries.

\(^2\) Today, however, they are mainly imposed on long-term care- nursing homes and home care services. A compact review of the C.O.N laws in the US is available at: http://www.ncsl.org/research/health/con-certificate-of-need-state-laws.aspx

\(^3\) As, for example, recently phrased in "Forbes" magazine: "They may have some unique niche in the market, but..."
We find that, under universal public health insurance with actuarially-fair premiums, market efficiency can be obtained, along with increases in consumers’ surplus as medical prices under insurance go below their spot sales equilibrium level. In this case spot market sales are practically eliminated. The welfare maximizing copayment rate is increasing with the marginal cost of medical care and market size, and is decreasing with market entry cost and the 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 copayment 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 copayment rate is decreasing with the uninsured rate, and setting a zero copayment 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 copayment rate.

The remainder of the paper is organized as follows. Section 2 offers a recap of the relevant literature. Section 3 introduces the baseline model, deriving the market outcomes under spot sales and under competitive insurance sales, which are used as references for our later analysis. Section 4 begins the analysis of market competition under a monopoly insurance fund. Next, Section 5 considers extensions of the model to include the issues of moral hazard and uninsured subpopulations. Section 6 incorporates quality choice, i.e. vertical differentiation, into the analysis, while Section 7 summarizes the results.

2 Literature

There is, by now, a very large literature on the consequences of insurance for industry competition, costs, service quality, and technical progress. A major channel through which health insurance affects market outcomes is by creating a wedge between the price producers receive and the price insured consumers pay for care. It is widely accepted that this price wedge may induce excessive utilization of medical care, i.e. moral hazard, and weaken competition in health care markets, resulting in higher prices and excessive quality provision.

The present study contributes to recent research on the implications of health insurance policies for market outcomes, and in particular for product diversification, when medical providers sell differentiated products.

they are fairly redundant with other therapies that are already available. Many of these you could call me-too drugs." The full article is available at http://www.forbes.com/sites/johnlamattina/2015/01/19/im.pact-of-me-too-drugs-on-health-care-costs/.

For more on follow-on drugs, see Bardey et al. (2016a) and DiMasi and Paquette (2004).

4 This result is line with the empirical finding of Duggan and Scott-Morton (2010,2011) regarding the negative effect of Medicare-Part D on pharmaceutical prices.

5 Gaynor and Town (2011, Ch. 9) summarize this literature.
Nell et al. (2009)\textsuperscript{6} show that insurance sales increase medical prices set by providers, thereby encouraging 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 copayment rate, and are therefore less sensitive to price increases. Competitive insurance firms do not internalize this market level effect and therefore set the copayment below the efficient level. This result was obtained in the same setup we will employ here, and will therefore serve as a main reference in our analysis.

Grossman (2013) studies the implications of insurance contracts, along with price and entry regulation for pharmaceutical prices and R&D\textsuperscript{7}, and also finds that the copayment rate has a negative effect on non-regulated medical prices\textsuperscript{8}. Both studies, however, abstract from the providers’ option to sell directly to consumers.

Lakdawalla and Sood (2009, 2013) analyze efficiency gains arising from health insurance in markets where the price is set by a monopolistic medical-provider, using a two-part pricing structure: a fixed up-front premium payment and a per-unit copayment. 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\textsuperscript{9}. In both papers, monopolistic prices are higher when selling through insurance compared with their spot market level.

Both papers also consider powerful insurers who negotiate prices with monopolistic providers. However, such negotiations cannot 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 competitive interaction among them.

To understand this result, 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

\textsuperscript{6}Nell et al.(2009) generalize their analysis to all "repair markets".

\textsuperscript{7}Which corresponds our analysis of quality provision.

\textsuperscript{8}Vaithianathan (2006) derives similar results for an oligopolistic market for homogeneous health care products (under Cournot competition) with an exogenous number of firms and perfectly competitive insurers.

\textsuperscript{9}See Section 2.6.2 (p.5) there.
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 products sold on the spot market. This means that each provider finds it beneficial to individually contract with the public insurer for a lower price, 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 to increase consumers’ surplus and improve market efficiency.

In our monopolistically-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 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 at both margins - entry level and quality provision - can be achieved by combining a minimum quality requirement with the proper insurance policy design.

Finally, our work is also closely related to three recent studies on the implications of alternative insurance payments schemes to market outcomes, accounting for their effect on product diversity. Brekke et al. (2016) and Bardey et al.(2016a) study the implications of different reference price and cost sharing policies in a pharmaceutical market with horizontally differentiated drugs. Brekke et al. (2016) employ Salop’s model to study competition between an incumbent innovator of a branded drug that’s patent expires, and providers of differentiated generic drugs over consumers that are heterogenous regarding their preference for the branded drug. Bardey et al. (2016a) consider simultaneous entry of symmetric differentiated providers, and emphasize the role of product diversity in decreasing consumers’ risk with respect to treatment effectiveness\(^{10}\). Bardey et al.(2016b) explores the ability of insurers to extract the medical-providers’ surplus by instituting cost-sharing schemes which combine copay levels and copayment rates.

These studies, however, do 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. As mentioned earlier, this environment is relevant to cases were large public insurers, such as Medicaid or Medicare, are including new differentiated medical products of the same therapeutic category under their policy coverage, without being able to regulate spot market prices.

\(^{10}\)In this respect, our modeling approach follows Bardey et al.(2016a).
3 The Baseline Model

First, we replicate the equilibrium in Salop’s (1979) circular spot market, which then serves as a benchmark for the following analysis of market equilibrium under public insurance sales. There is a continuum of consumers of unit mass. Each consumer faces an independent probability $\pi$ 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 $c > 0$. Each seller independently sets her product price $p_j$, to maximize her profit.

In the absence of medical need, a consumer’s utility is $v$. Any medical need reduces consumer’s utility to zero if not satisfied. A consumer with a need $x_i$ who utilizes medical product $y_j$ bears a utility loss of $m |x_i - y_j|$, where $m$ is the mismatch (“transportation”) cost parameter. When there is only one product, $j$, consumer’s expected mismatch cost is $m/4$ (because the actual minimal spatial distance to $y_j$ is uniformly distributed from zero to $1/2$). Hence, at spot price $p_j$, expected utility for each consumer is

$$ (1 - \pi) v + \pi \left( v - p_j - m \int_0^1 |x_i - y_j| \, di \right) = v - (p_j + \frac{m}{4}) $$

When multiple products are offered by $N$ symmetrically-located sellers, each sick consumer chooses which provider to patronize based on the price and associated spatial distance. Under (the assumed) symmetric locations, the distance between two neighboring sellers is $1/N$. Hence, the maximal mismatch cost is $m \cdot \frac{1}{2N}$. If all $N$ products are uniformly priced at $p$, then each consumer attends only her nearest medical provider, the ex-ante probability of utilizing any given product is $\frac{2}{N}$, and the expected mismatch cost is $2Nm \int_0^{1/2N} x \, dx = \frac{m}{4N}$. Consumer’s expected utility in the medical market defines consumer’s surplus, $CS$:

$$ CS = \pi \left[ v - \left( \frac{m}{4N} + p \right) \right] $$(1a)

Producers’ surplus is $PS = \pi (p - c)$, so market welfare $CS + PS - Nf$ is given by $W(N)$:

$^{11}$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 accounting for gains from insurance services. Thus, our basic massage would be unaltered. Abstracting from risk aversion for the sake of tractability is common in the related literature that employs similar spatial models. See for example Gal-Or (1999), Bardey et al. (2012), Douven et al. (2014), and Brekke et al. (2016).
\[ W(N) = \pi \left( v - \frac{m}{4N} - c \right) - Nf \]  

The efficient product diversification level, denoted \( N^{**} \), which maximizes (2), is

\[ N^{**} = \frac{1}{2} \sqrt{\frac{\pi m}{f}} \]  

(2a)

The entry level defined in (2a) maximizes also the expected welfare in the medical market under competitive insurance sales and the public insurance policy presented below.

We turn now to demonstrate Salop’s (1979) famous results, showing that the spot market equilibrium in models of this sort yields excessive entry and product variety. In the absence of health insurance a mass of \( \pi \) sick consumers, who’s medical needs are uniformly distributed on the market circle, are shopping for medical products. The consumer who is indifferent between buying from seller \( j \) and a neighboring seller located at \( y_j + \frac{1}{N} \) is located at \( \bar{x} = \frac{1}{2} \left( \frac{p_j - p}{m} + \frac{1}{N} \right) \), where \( p \) is the uniform price charged by seller \( j \)’s (neighboring) competitors\(^{12} \). Thus, the demand faced by seller \( j \) is \( D_j = \pi 2\bar{x} \), and the implied surplus, \( PS_j = \pi (p_j - c) \left( \frac{p_j - p}{m} + \frac{1}{N} \right) \). Producer’s surplus is maximized by the price \( p_j = \frac{1}{2} (p + \frac{m}{N} + c) \). Under symmetric equilibrium all producers set the uniform price \( p^* = \frac{m}{N} + c \). Substituting this price back into the surplus expression, and imposing a zero profit condition pins down equilibrium product diversification and the corresponding price in terms of the model parameters:

\[ N_s^* = \sqrt{\frac{\pi m}{f}}, \quad p^*_s = \sqrt{\frac{fm}{\pi}} + c \]  

(3)

We assume that \( \sqrt{\frac{\pi m}{f}} = N_s^* > 1 \) and \( v - \frac{m}{2} > c \), to assure that all sick people utilize medical care, and all medical products will be utilized in equilibrium. Comparing (3) with (2a) 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 competitive insurers offer an insurance policy \( I \) to consumers, defined by a combination of an actuarially fair premium \( \alpha \) (paid up-front, unconditionally) and a copayment rate \( \delta_{CI} \), hence \( I \equiv (\alpha, \delta_{CI}) \). The surplus to be maximized by each provider under a competitive insurance market is \( \pi (p_j - c) \left( \frac{\delta_{CI} (p_j - p)}{m} + \frac{1}{N} \right) \), and the corresponding optimal price is \( p_j = c + \frac{m}{\delta_{CI} N} \), which is decreasing in the copayment rate.

The zero-profit entry condition in this scenario implies

\[ N_{CI}^* = \sqrt{\frac{\pi m}{\delta_{CI} f}}, \quad p_{CI}^* = \sqrt{\frac{fm}{\delta_{CI} \pi}} + c \]  

(3a)

\(^{12}\) Following the indifference condition: \( \bar{p} + m (\bar{x} - y_i) = p_j + m \left[ (y_i + \frac{1}{2N}) - \bar{x} \right] \)
4 The Model with a Public Insurer

We turn now to the analysis of market competition and efficiency under a monopolistic public insurance, which offers insurance policy \( I \equiv (\alpha, \delta_{PI}) \) as defines above. Next, we assume the public insurer sets an actuarially fair premium \( \alpha = \pi (1 - \delta_{PI}) p_{PI} \). We assume that mismatch costs are not insurable.

The public insurer makes a take-it-or-leave-it offer simultaneously to \( N \) providers, described by the insurance contract, which defines the overall per-unit compensation price \( p_{PI} \) and the share \( \delta_{PI} \) to be collected from the insured\(^{13}\). Notice also that the insurance contract offer must meet the participation constraint, which is done by matching a provider’s reservation value from unilaterally selling on the spot market. This is a key feature that underlies the following analysis and our main results.

The construction of the equilibrium follows a simple time line, for the actions of the insurer, the monopolistically-competitive service providers, and the consumers\(^{14}\).

1) The public insurer makes a take-it-or-leave-it offer of participation to the suppliers. The insurance contract covers all consumers.

2) \( N \) suppliers enter the market symmetrically. Suppliers who decline to participate can still sell on the spot market.

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.

The model will be solved backwards as usual. Hence, when providers choose to enter the market they already correctly expect the contract the insurer will offer post entry. Clearly, this time line is assumed to enhance tractability, and is not necessarily realistic.

To understand the nature of the equilibrium, suppose that all providers but one, the \( j^{th} \), are under insurance coverage. Then, the demand faced by seller \( j \) from selling outside of insurance, i.e. directly to consumers on the spot market, is given by\(^{15}\) \( \bar{x} = \frac{1}{2} \left( \frac{\delta_{PI} p_{PI} - p_j}{m} + \frac{1}{N} \right) \), and the corresponding surplus is

\[
PS_j = \pi \left( p_j - c \right) \left( \frac{\delta_{PI} p_{PI} - p_j}{m} + \frac{1}{N} \right)
\]  \( (4) \)

The demand function presented above and the implied surplus term in (4) coincides with those presented in Section 3 for the case \( \delta_{PI} = 1 \). However, for \( \delta_{PI} < 1 \), which is the relevant case here, expression (4) reveals the negative effect of insurance sales on the profitability of spot market sellers: once the competitors (neighboring sellers) of seller \( j \) sell through the public insurer, the surplus of seller \( j \) from selling on the spot market for any given price is decreasing as the copayment rate goes down. This is because the sick insured who are shopping for medical care nearby seller

\(^{13}\)Setting a maximal price and a reimbursement level (instead of rate) would not affect our results.

\(^{14}\)Which is similar to the ones employed in Brekke el al.(2016) and Bardey (2016a,b).

\(^{15}\)based on the modified indifference condition presented in Footnote 9.
are comparing the full spot price set by seller \( j \) with the fraction \( \delta_{PI} \) of the price being paid to the competing sellers who are under insurance coverage. The maximization of (4) with respect to \( p_j \) shows that the price provider \( j \) would charge if she were the only one who sold service outside of insurance is also increasing in the copayment rate:

\[
p_j = \frac{\delta_{PI} p_{PI} + \frac{m}{N} + c}{2}
\]

(4a)

Plugging (4a) back into (4) yields the maximal surplus for the single seller who opts out of insurance sales:

\[
PS_j = \frac{\pi}{4m} \left( \frac{\delta_{PI} p_{PI} + \frac{m}{N} - c}{2} \right)^2
\]

(5)

When all \( N \) providers are selling through the public insurer, the surplus for each one of them is \( \frac{\pi}{N} (p_{PI} - c) \). The public insurer can in effect set the price \( p_{PI} \) to equalize the surplus under insurance with the individual reservation surplus from selling on the spot market given in (4a)

\[
\frac{\pi}{m} \left( \frac{\delta_{PI} p_{PI} + \frac{m}{N} - c}{2} \right)^2 = \frac{\pi}{N} (p_{PI} - c)
\]

(6)

In addition, free entry implies zero equilibrium profit

\[
\frac{\pi}{N_{PI}} (p_{PI} - c) = f \Rightarrow p_{PI} = \frac{N_{PI} f}{\pi} + c
\]

(7)

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

\[
\frac{\pi}{4m} \left[ \delta_{PI} \left( \frac{N_{PI} f}{\pi} + c \right) + \frac{m}{N_{PI}} - c \right]^2 = f
\]

(8)

**Proposition 1** Conditions (7)-(8) define the Nash-equilibrium number of providers in the market with public insurance \( N_{PI}^* \), for any copayment rate and price set in the offered contract.

**Proof.** Conditions (7) and (8) combine the participation condition with the zero profit condition. The left hand side of (8) is convex in \( N \) and has a minimum at \( N = \sqrt{\frac{m}{\delta_{PI}}} \). With this value of \( N \) the left hand side of (8) is lower than the right hand side for any \( \delta_{PI} < 1 \) (with equality for \( \delta_{PI} = 1 \)). Hence, for any \( \delta_{PI} < 1 \) equation (8) has two solutions - one is greater than \( \sqrt{\frac{m}{\delta_{PI}}} \) and the other is smaller. However, for any given price \( p_{PI} \) in the insurance contract there is only one value of \( \frac{m}{N_{PI}} \) which satisfies (6). Hence, given the insurance contract \( (p_{PI}, \delta_{PI}) \) there is unique number of providers \( N_{PI} \) that satisfies both conditions (7) and (8), under which the market is saturated and no single provider can benefit from opting out of insurance into spot sales. 

Proposition 2  For $\delta_{PI}^* = \frac{c}{\frac{1}{2} \sqrt{\frac{2m}{\pi}} + c} < 1$ and $p_{PI} = \frac{1}{2} \sqrt{\frac{mf}{\pi}} + c : N_{PI}^* = N^{**}$ and $CS_{PI}^* > CS_*$.

The equilibrium under public insurance can support market efficiency, with higher consumer surplus than that arising under spot market provision.

Proof. The copayment rate and price that support market efficiency are derived by imposing the efficient entry level (2a) on (7) and (8). Comparing consumers’ surplus under public insurance and spot market equilibrium yields a 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). It can be further shown that for any lower price, equation (8) implies that equilibrium market entry level is increasing in the copayment rate $\delta_{PI}$.

5  Extensions

The analyses above establish the ability of a public insurer to produce efficient outcomes in a free entry, monopolistically competitive medical market through the correct design of the insurance contract offered to consumers and providers. Of course, a public authority could theoretically achieve the same results by directly regulating supply prices and entry, but in the case at hand, such direct extensive intervention is not necessary. 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 incomplete consumer insurance coverage and moral hazard.

5.1 Uninsured Consumers

We turn next to the effect of uninsured consumers on market outcomes. Suppose that only fraction $\theta$ of the population is covered by public insurance, while the remaining population must buy on the spot market. 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 $\hat{p}$, coincides with that presented in Section 3: $\hat{p} = \frac{m}{N} + c$, and the surplus for each provider is $PS = \frac{\pi}{N} \left[ \theta (p_{PI} - c) + (1 - \theta) \frac{m}{N} \right]$. Hence, the zero-profit equilibrium with all providers under insurance is: $\frac{\pi}{N} \left[ \theta (p_{PI} - c) + (1 - \theta) \frac{m}{N} \right] = f$, implying $p_{PI} = \frac{1}{\theta} \left( \frac{Nf}{\pi} - \frac{m}{N} \right) + \frac{m}{N} + c$. 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

$$PS_j = \frac{\pi}{N} \left[ \theta \left( \frac{\delta_{PP} p_{PI} - p_j}{m} + \frac{1}{N} \right) + (1 - \theta) \left( \frac{\hat{p} - p_j}{m} + \frac{1}{N} \right) \right] (p_j - c)$$

$^{16}$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.
The surplus in (9) combines the revenue gains for provider \( j \) from stealing both insured and uninsured consumers from her neighboring providers. The price that maximizes (9) is \( p^*_j = \frac{\delta p P - (2 - \theta)(\frac{m}{N} + c)}{2} \). Plugging \( p^*_j \) and \( \hat{p} \) back into (9) yields

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

(9a)

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

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

(10)

Rearranging (10) we obtain

\[
\delta p_{PI} = \frac{1}{\theta} \left[ 2\sqrt{\frac{m}{\pi}} - (2 - \theta) \frac{m}{N} \right] + c
\]

(10a)

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

**Proof.** Imposing the efficient entry level, \( N^{**} = \frac{1}{2} \sqrt{\frac{2m}{\theta}} \), on (11a) yields \( \delta_{PI}^* = \frac{e^{-\frac{2(1 - \theta)}{\theta} \sqrt{\frac{m}{\pi}}}}{2} \sqrt{\frac{m}{\pi} + c} \). For \( \delta_{PI} \) to be non-negative the coverage rate \( \theta \) should be sufficiently high: \( \frac{\theta}{(1 - \theta)} \geq \frac{2}{e} \sqrt{\frac{m}{\pi}} \). Otherwise the efficient entry level cannot be achieved, and the optimal copayment rate, which still minimizes entry, is \( \delta_{PI} = 0 \). ■

For equilibrium with interior solution, as described in Proposition 2, it can be easily verified that the price paid by the public insurer is lower than the price charged in the spot market. Moreover, the price paid in the spot market is higher than the spot price presented in equation (3), which would prevail if there was no public insurance. This is due to the decrease in the number of providers, which reduces competition in spot sales and thereby drives up spot prices up.

**5.2 Moral Hazard**

It is not difficult to incorporate the possibility of moral hazard, as modeled 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 suppose the level of moral-hazard is decreasing with the copayment rate, so \( \pi_{PI} = \pi_{PI} (\delta_{PI}) \) and \( \pi'_{PI} (\delta_{PI}) < 0 \). Clearly, this modelling approach is a reduced form representation of the moral hazard phenomenon, which abstracts from any complete analysis of consumers’ behavior in the face of an insurance contract. Nevertheless, it captures the overall
expected positive impact of insurance on the utilization of medical services (due to either ex-post or ex-ante moral hazard). Repeating the steps presented in equations (5)-(8), we modify the right-hand side of (6) to \( \frac{\pi_{PI}(\delta_{PI})}{N_{PI}(\delta_{PI})} (p_{PI} - c) \), and the break-even price from (7) becomes \( p_{PI} = \frac{N_{f}}{\pi_{IP}(\delta)} + c \). Then, the modified equilibrium condition which corresponds to (8) is

\[
\frac{\pi_{PI}(\delta_{PI})}{4m} \left[ \frac{N_{PI}f}{\pi_{PI}(\delta_{PI})} + \frac{m}{N_{PI}} - (1 - \delta_{PI}) c \right]^2 = f
\]

(11)

From this we get the following proposition.

**Proposition 4** Moral hazard increases the copayment rate that maximizes welfare in the medical market.

**Proof.** The copayment rate that maximizes welfare in the medical market here is derived by plugging the modified expression for (2a), \( \frac{1}{2} \sqrt{\frac{\pi_{PI}(\delta_{PI})}{f} m} \), into (11), to obtain: \( \delta_{PI}^* = \frac{c}{\frac{1}{2} \sqrt{\pi_{PI}(\delta_{PI})} + c} < 1 \).

The fix point theorem assures that there exists unique solution for the latter implicit function of \( \delta_{PI}^* \), which is higher than that presented in Proposition 1.

Figure 1 below illustrates the effect of moral hazard on the copayment rate that supports market efficiency.

![Figure 1: Moral Hazard and Efficient Coinsurance Rate](image)

The horizontal axis is the copayment rate. The 45° ray is the left-hand side of the efficiency condition \( \delta_{PI} = \frac{c}{\frac{1}{2} \pi_{PI}(\delta_{PI}) \sqrt{m f} + c} \) 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. For the purpose of this illustration we employ the linear form \( \pi(\delta) = \pi_0 + a(1 - \delta) \), for which the parameter \( a \) represents the strength of the moral hazard effect\(^{17}\). Hence, the upper down-sloping curve is derived for a higher value of \( a \), where all other parameters are the same for the two lines.

\(^{17}\)Where \( a < (1 - \pi_0) \)
The intersections between the decreasing curves and the 45° ray mark the corresponding welfare-maximizing copayment rates ($\delta_{PI}^{**}$). Under high moral hazard, the efficient copayment rate is higher. Both decreasing curves converge to the same level $\pi_0 (\delta_{PI} = 1)$, where moral hazard is eliminated. This is the efficient copayment rate with no moral hazard, presented in Proposition 1.

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 $C(q) = \frac{1}{2} q^2$. This tractable formulation implies the cost of quality is not quantity 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 (presented in Section 4), except that now sellers make their entry choice by picking location, and then choose quality and whether to contract with the public insurer or to sell outside of insurers. Equation (1a), which defines consumers’ surplus (i.e. consumer’s expected utility) is modified to

$$CS = v + \pi \left[ q - \left( \frac{m}{4N} + \delta_{IPPP} \right) \right] - n\alpha$$

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

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

The first order condition for efficient quality choice implies: $\frac{\pi m}{4N} = \gamma q^{**}$, 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

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

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

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

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

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

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Combining the optimal price condition in (15a) 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

\[
N_s^* = \sqrt{\frac{2\pi m - \frac{x^2}{2}}{2f}}, \quad q_s^* = \sqrt{\frac{2f}{\frac{x^2m}{\pi} - \gamma}}, \quad p_s^* = c + m \sqrt{\frac{2f}{2\pi m - \frac{x^2}{2}}}
\]

(16)

Comparing (16) with (14) 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 for 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 is easily verified that the efficient market outcome cannot be supported by setting the price and the copayment rate only.

This is unsurprising for the usual reason: contract terms provide an insufficient number of instruments. Thus, the public insurance fund will need an additional means of effecting seller behavior. Hence, following common practice, we assume the public insurer can also set a minimum-quality requirement \( q_{\text{min}} \) equal to the efficient level in (14), \( q_{\text{min}} = q^{**} = \sqrt{\frac{2f}{\frac{x^2m}{\pi} - \gamma}} \), which is binding for the initial spot market equilibrium. Following the zero profit entry condition, \( \frac{\pi m}{(N^*)^2} = f + \frac{\gamma (q^*)^2}{2} \), so with this quality requirement alone entry into the spot market would be double the efficient level:

\[
N_s(q_{\text{min}}) = \sqrt{\frac{\pi m - \frac{x^2}{2}}{f}}.
\]

However, under public insurance coverage, the surplus for each provider is given by

\[
\pi (p_j - c) \left( \frac{\delta_{pp} c + m + c}{m} - \frac{1}{N} \right) - \left( f + \frac{\gamma q_{\text{min}}^2}{2} \right)
\]

(17)

The optimal price to be charged on the spot market in this case, and the corresponding surplus, are \( p_j = \frac{\delta_{pp} c + \frac{m + c}{2}}{2} \) and \( PS_j = \frac{\pi}{m} \left( \frac{\delta_{pp} c + \frac{m + c}{2}}{2} \right)^2 \), respectively, as in Section 4. Hence, the calculations presented in (6)-(8) still hold, implying the following zero profit equilibrium condition

\[
\frac{\pi}{4m} \left[ \delta_{PI} \left( \frac{f + \frac{\gamma q_{\text{min}}^2}{2}}{\pi} \right) + m \frac{N_{PI}}{\pi} - (1 - \delta_{PI}) c \right]^2 = f + \frac{\gamma q_{\text{min}}^2}{2}
\]

(18)

**Proposition 5** A public insurer can support market efficiency by setting a minimal quality requirement \( q_{\text{min}} = q^{**} \), along with the copayment rate \( \delta_{PI}^{**} = \frac{c}{\pi m q_{\text{min}} + c} < 1 \).

**Proof.** Recall that \( N^{**} = \frac{\pi}{\gamma q_{\text{min}}} \). Imposing \( N_{PI} = \frac{\pi}{\gamma q_{\text{min}}} \) in (18) implies \( \delta_{PI}^{**} = \frac{c}{\pi m q_{\text{min}} + c} < 1 \). Following (15a), in this equilibrium, the minimal quality requirement is weakly binding for providers under the insurance contract. ■
7 Conclusions

This study contributes to the recent literature on the implications of health insurance policies for market outcomes when medical providers sell differentiated products, with a particular focus on the resulting diversification level. We have analyzed 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. This structure describes American medical markets where large public insurance plans possess significant market power but have no direct control of spot prices.

In this paper, we show how the judicious selection of price and copayment level by the public insurance fund can affect the providers’ option value from spot sales, and how this mechanism can be used to obtain efficient product diversification and first-best welfare. In general, when sellers are differentiated and entry is free, the famous results of Salop (1977) apply, and free entry equilibria exhibit excessive diversification. This phenomenon has concerned policy makers in the US for many years, as evidenced by the widespread application of CON and similar restrictions. However, when providers are unrestricted with respect to their spot sales activities, the two-part structure of the typical insurance contract can be used to improve social welfare.

We also argue that the insurance contract pricing mechanism described here remains useful even in the presence of several significant extensions of the underlying market environment, including the problems of incomplete insurance coverage and moral hazard. Even when service quality itself is endogenous, the combination of the insurance pricing mechanism with minimum provider quality levels can support efficient welfare outcomes.

References


