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**CENTRE FOR HEALTH ECONOMICS
RESEARCH AND EVALUATION**

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INSURANCE AND MONOPOLY POWER IN A MIXED PRIVATE/ PUBLIC HOSPITAL SYSTEM

Discussion Paper
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Abstract

Consumers, when ill, often have the choice of being treated for free in a public hospital or at a positive price in a private hospital. To compensate for the positive price, private hospitals offer a higher quality treatment. Private hospitals and doctors also have a degree of monopoly power in their pricing. In this setting, it is shown that the presence of insurance does not affect the number of consumers treated in the private hospital, rather the private hospital and the doctor respond to the presence of insurance by increasing the prices they charge and the quality of the private hospital experience.

JEL Classification Numbers: I110, L120

Keywords: Insurance, Monopoly, Private Health Care

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1.   Introduction

In many countries, including Australia and Great Britain, sick consumers have the choice of being treated for free in a public hospital, by a doctor appointed by the public hospital, or at a price in a private hospital, by a doctor of their choice. Although the final health outcome is usually the same regardless of which type of hospital is chosen, the treatment experience differs. To justify the positive price, the treatment experience in a private hospital is of a higher quality taking the form of a shorter waiting time, single rather than shared rooms, higher quality meals, higher staff-patient ratios, etc. Another characteristic of private treatment is that private hospitals and the doctors that work in them often have a degree of monopoly power. In the case of private hospitals, the barrier to entry is large fixed costs and in the case of specialist doctors, it is membership of an association.

Before becoming sick, consumers can usually purchase insurance to offset the cost of private treatment. This paper examines the interaction between the quality of treatment in private hospitals relative to public hospitals, the prices charged by private hospitals and the doctors that work in them, private health insurance, and the number of consumers treated privately.

There is a small literature that examines parts of this interaction in a standard moral hazard framework. Chiu (1997), in a representative agent model in which health care providers act in the best interests of their patients, demonstrates that the presence of insurance, a coinsurance rate and a premium, increases the demand for health care. He shows that if the supply of health care is fixed, its competitive price rises to such an extent that the consumer is worse off in the presence of insurance than in its absence.

Gaynor, Haas-Wilson, and Vogt (2000) demonstrate that the argument that monopoly power may offset the distortionary effects of moral hazard

and be welfare increasing is incorrect once the endogeneity of the coinsurance rate is taken into consideration. However, they just examined exogenous price changes and did not formally model imperfect competition. Vaithianathan (2004) explicitly modelled health care providers as Cournot competitors and obtained a similar result to Chiu (1997), namely, that at relatively low marginal costs of provision, consumers are worse off in the presence of insurance than in its absence. Essentially, at low marginal cost, the quantity response to insurance is very small and so the result of Chiu with fixed competitive supply is recovered.

This paper has a private hospital, a doctor, an insurance industry, and consumers interacting in a multi-stage game. In the first stage, given public hospital quality, the monopolist private hospital chooses its quality of treatment and the per-unit price it charges. In the second stage, the monopoly doctor chooses its per-unit price. In the next stage, consumers, who differ in their wealth, choose whether to be insured against private health care expenditures. Uncertainty is then resolved, and in the final stage sick consumers choose whether to be treated in a public or private hospital.

The main difference between this set-up and the literature is that traditional moral hazard in the form of "excess" use is eliminated by assuming treatment consists one one unit of doctor and hospital services. Nevertheless, many interesting results are obtained. (1) In the absence of insurance the wealthy choose to be treated in the private hospital and both the quality of treatment and the number of consumers treated are below the efficient level. (2) In the presence of insurance, those who chose private treatment in its absence are the only ones who choose to be insured and if sick choose to be treated privately. Private hospital and doctor prices are higher as is the quality of treatment. However, as only the wealthy are insured only they

gain from the presence of insurance. (3) An insurance premium subsidy increases the prices of the private hospital and the doctor, but has no effect on the number of consumers insured. Once again, only the wealthy gain and it is because quality increases. (4) A reduction in the quality of the public hospital does not change the expected number of consumer treated publicly or privately. However, if the marginal cost of quality is increasing in quality, then although private hospital quality decreases its relative quality increases as does its price and the doctor's price. The private health sector does not act as a safety valve for a stressed public sector, but takes the opportunity provided by reduced public hospital quality to reduce its own quality and increase private hospital profit and doctor income.

These results depend crucially on the quasi-linearity of consumers preferences, the particular functional form chosen for these preferences, the assumption of zero marginal cost of private treatment, the order of the stages, the assumption that doctors maximize income, and the assumption of one private hospital and one doctor. The relaxation of these assumptions is discussed prior to the conclusion. One particularly interesting result that follows from the presence of many monopoly private hospitals is that although they are monopoly providers of private treatment their pricing decisions are interdependent through the insurance premium. As the number of private hospitals becomes large, the prices they charge rise to such an extent that few consumers purchase insurance because the premium is too high. There is "over" pricing by providers in contrast to "excess" use by consumers in the standard moral hazard set-up. This provides a strong incentive for private hospitals to collude on pricing even though they are local monopolies.

2. The Agents and the Game Structure

2.1. Consumers

All consumers have the same separable utility function given by

$$U(x, H) = V(x) + H, \tag{1}$$

where x is the quantity of a consumption good, $V(x)$ is a strictly concave function, and $H \in [\underline{H}, \overline{H}]$ is the level of consumer health. The consumer is sick with probability ρ and healthy with probability $(1 - \rho)$. The number of consumers is given by $\frac{N}{\rho}$, so N is the expected number of sick consumers. If the consumer is healthy, then $H = \overline{H}$. If the consumer is sick and is not treated, then $H = \underline{H}$. Treatment consists of one unit of doctor services of fixed quality and one unit of hospital services of quality q. If sick and treated, the level of consumer health is then given by $H = H(q)$, where $\underline{H} < H(q) < \overline{H}$ and $\frac{dH}{dq} > 0$. It is assumed that

$$V(x) = \ln x, \tag{2}$$

so the consumer has an Arrow-Pratt coefficient of relative risk aversion that is constant and equal to 1.

2.2. Public Hospital - Public Doctor

If sick, then consumers can be treated at zero cost in a public hospital by a doctor employed by the hospital. The quality of the services provided by the pubic hospital is normalized to zero, $q = 0$, and is determined by the amount of resources allocated to the public hospital by government.

2.3. Private Hospital

The private hospital differentiates its services from the public hospital through the quality of it services. The cost of providing quality q is $k(q)$ and the

price it charges consumers for these services is p_q. Barriers to entry and the differentiated nature of its services gives private hospitals monopoly power in determining this price.

The quality of private hospital services can be viewed as an index that reflects the relative quality of the private hospital experience while undergoing or waiting for treatment, for example, private rooms, gourmet meals, low patient nurse ratios, short waiting lists, etc.

2.4.   Doctor Working in the Private Hospital

A doctor working in the private hospital charges sick consumers p_d for the one unit of service provided under treatment. Barriers to entry and the presence of doctor associations which support collusion gives a doctor monopoly power in determining this price.

2.5.   Stage Game Structure

In stage one, the private hospital chooses quality, q, and price, p_q, to maximize expected profit. In stage two, given q and p_q, the doctor chooses price p_d to maximize expected income.[1] In stage three, sick consumers choose whether to be treated in a public or private hospital. The insurance stage is introduced in section 4. As is usual, this game is solved backwards for the sub-game perfect Nash equilibrium.

3.   Model

3.1.   Stage 3 - Consumer Choice of Where to be Treated

Given q, p_q, and p_d, sick consumers choose whether to be treated in a public or private hospital. Consumers differ in their wealth, and the wealth of

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[1]As discussed below in section 6.2, reversing the order of stage one and two or making them simultaneous does not qualitatively effect the results.

consumer i is denoted w_i. Wealth is distributed uniformly on $(0, W]$ with distribution function $F(w) = \frac{w}{W}$. The distribution function gives the fraction of consumers and sick consumers with wealth less than w.

Let the total price a consumer pays for private treatment be $p = p_q + p_d$. A consumer, who is sick, chooses to be treated in a private hospital if

$$\ln(w_i - p) + H(q) \geq ln(w_i) + H(0). \tag{3}$$

Let $h(q) = H(q) - H(0)$. Rearranging (3) yields

$$h(q) \geq \ln \frac{w_i}{w_i - p} \quad or \quad \exp^{h(q)} \geq \frac{w_i}{w_i - p}. \tag{4}$$

If $w_i - p < 0$, then $\ln(w_i - p)$ is not defined. However, this consumer chooses to be treated in a public hospital because their wealth is insufficient to cover the cost of private treatment. Further rearranging yields

$$w_i \geq \frac{\exp^{h(q)}}{\exp^{h(q)} - 1} \cdot p = \theta(q) \cdot p, \tag{5}$$

where $\theta(q) = \frac{\exp^{h(q)}}{\exp^{h(q)} - 1}$ and is a decreasing function of q. All consumers with wealth greater than or equal to $\theta(q) \cdot p$ choose private treatment. Therefore, demand is given by

$$n(p, q) = (1 - \frac{\theta(q) \cdot p}{W}) \cdot N \tag{6}$$

and inverse demand by

$$p(n, q) = \frac{W}{\theta(q)} - \frac{W}{\theta(q) \cdot N} \cdot n. \tag{7}$$

Note that inverse demand is linear in n and increasing in q. The horizontal intercept of inverse demand is N and is independent of $\theta(q)$.

3.2. Stage 2 - Doctor Choice of Price

Given p_q and q, the doctor chooses n, and so p_d, to maximize expected income. That is

$$\max_n \quad I \equiv \left(p(n, q) - p_q\right) \cdot n. \tag{8}$$

This has first order condition

$$p_q = \frac{W}{\theta(q)} - \frac{2W}{N\theta(q)} \cdot n. \tag{9}$$

The second order condition is satisfied. As written, the first order condition gives the inverse demand for private hospital services. The right hand side of (9) is the marginal revenue curve of $p(n, q)$ denoted $MR(n, q)$.

3.3. Stage 1 - Private Hospital Choice of Quality and Price

For simplicity, it is assumed that the cost of providing one unit of private hospital services is constant and equal to zero. The private hospital's problem is to choose q and p_q to maximize expected profit. It turns out that this is best done in two stages, first $p_q(q)$ is chosen and then q is chosen.

Given q the private hospital chooses n to maximize expected profit. That is,

$$\max_n \quad \Pi(q) \equiv p_q(n, q) \cdot n \tag{10}$$

This has first order condition

$$0 = \frac{W}{\theta(q)} - \frac{4W}{N\theta(q)} \cdot n. \tag{11}$$

The second order condition is satisfied. The right hand side of (11) is the marginal marginal revenue curve of $p(q, n)$ denoted $MMR(n, q)$. Solving (11) for n and denoting the solution by n^* yields

$$n^* = \frac{N}{4}. \tag{12}$$

Note that this solution is independent of $\theta(q)$. Substituting n^* into $p_q(n, q)$ and $p(n, q)$ yields

$$p_q^* = \frac{W}{2\theta(q)}; \quad p^* = \frac{3W}{4\theta(q)}; \quad and \quad p_d^* = \frac{W}{4\theta(q)}. \tag{13}$$

Given $p_q^*(q)$ and n^* the private hospital chooses quality to maximize expected profit, that is,

$$\max_q \ \Pi = p_q^*(q) \cdot n^* - k(q). \tag{14}$$

This has first order condition

$$\frac{\partial \Pi}{\partial q} = \frac{N}{4} \cdot \frac{W}{2\exp^{h(q)}} \cdot \frac{dh}{dq} - \frac{dk}{dq} = 0. \tag{15}$$

A sufficient condition for the second order condition for a maximum to be satisfied is that $\frac{d^2 h}{dq^2} \leq 0$ and $\frac{d^2 k}{dq^2} \geq 0$ which is assumed. The solution to (15) is denoted q^*.

Stages 1 and 2 involve a double marginalization as the model can be reinterpreted as a monopolist private hospital selling services to a doctor at price p_q and then a monopolist doctor selling a package of doctor services and private hospital services to consumers at price p. Given q^*, the solutions for p_q^*, p_d^*, and p^* are shown in Figure 1.

It is well known that a double marginalization creates an incentive for vertical integration as neither the private hospital nor the doctor take into account the affect of their decisions on the profit or income of the other party. Although doctors are often owners of small private hospitals, this is not the case with larger private hospitals so this paper assumes doctors and private hospitals act independently.

Welfare: Expected welfare is the sum of expected consumer surplus, the dark shaded area in Figure 1, plus expected hospital revenue and expected doctor income, the light shaded area in Figure 1, minus $k(q^*)$. Given that the marginal cost of treating consumers privately is zero, the double marginalization results in the number of consumers treated privately, n^*, being less than the number that maximizes the sum of expected consumer surplus plus expected hospital revenue and expected doctor income, N. In addition, n^*, q^* does not maximize expected welfare because the private hospital does not take into account the effect increases in quality have on doctor income or consumer surplus.

Figure 1

Prices and Welfare
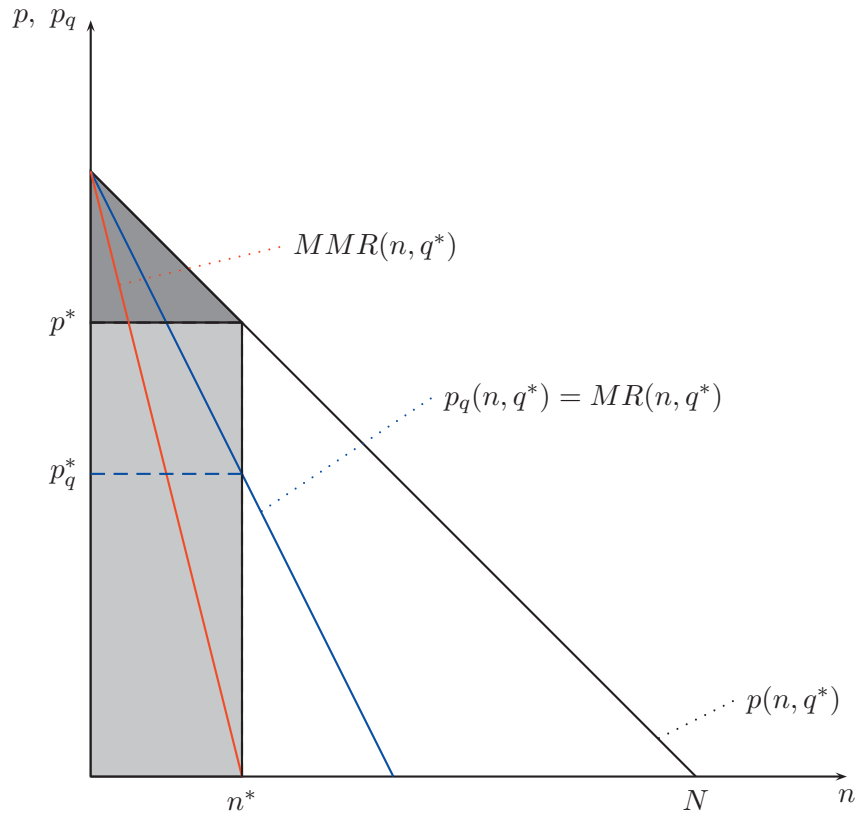
4. Insurance

After the doctor has chosen p_d and the private hospital has chosen p_q and q, a new stage is introduced in which, given ρ and insurance premium α, the consumer chooses whether to purchase private health insurance. This stage is called stage two-three. As all consumers have the same probability of falling sick, adverse selection is not an issue. In addition, as treatment involves one unit of doctor and hospital services, moral hazard in its usual

form of "excess" use of health care services is also not an issue. Therefore, the insurance industry offers complete insurance. A competitive insurance industry is assumed so insurance is actuarially fair, that is, the insurance premium is set equal to the expected payout, therefore,

$$\alpha = \rho \cdot p. \tag{16}$$

4.1. Stage 3 - Consumer Choice of Where to be Treated

If sick and uninsured, a consumer's choice of where to be treated is identical to that in Section 3. If sick and insured, a consumer chooses to be treated in a private hospital if

$$\ln(w_i - p - \alpha + p) + H(q) \geq \ln(w_i - \alpha) + H(0). \tag{17}$$

As $H(q) > H(0)$, insured consumers always choose to be treated in the private hospital.

4.2. Stage 2/3 - Insurance Choice

A consumer chooses to have private health insurance if the expected utility from having insurance is at least as large as the expected utility without insurance. The expected utility from having insurance is

$$EU^I = (1 - \rho) \cdot \left(\ln(w_i - \alpha) + \overline{H}\right) + \rho \cdot \left(\ln(w_i - \alpha) + H(q)\right) \tag{18}$$

because, if sick, a consumer with insurance chooses to be treated in a private hospital. The expected utility from having no insurance depends on whether the consumer is treated in a private or public hospital. First consider a consumer, who has no insurance, and chooses to be treated in a private hospital. The expected utility of this consumer is

$$EU^{priv} = (1 - \rho) \cdot \left(\ln(w_i) + \overline{H}\right) + \rho \cdot \left(\ln(w_i - p) + H(q)\right) \tag{19}$$

This consumer will choose to purchase insurance if $EU^I \geq EU^{priv}$, that is, if

$$\ln(w_i - \rho p) \geq (1 - \rho) \ln w_i + \rho \ln(w_i - p). \tag{20}$$

This inequality holds for all w_i because of the concavity of $\ln(x)$. Therefore, all consumers who if sick would choose to be treated in a private hospital in the absence of insurance choose to purchase insurance in its presence and if sick choose to be treated in a private hospital.

Now consider a consumer, who has no insurance, and if sick chooses to be treated in a public hospital. The expected utility of this consumer is

$$EU^{pub} = (1 - \rho) \cdot \big(\ln(w_i) + \overline{H}\big) + \rho \cdot \big(\ln(w_i) + H(0)\big). \tag{21}$$

This consumer will choose to purchase insurance if $EU^I \geq EU^{pub}$, that is, if

$$\ln(w_i - \rho p) + \rho H(q) \geq \ln w_i + \rho H(0). \tag{22}$$

Rearranging yields

$$w_i \geq \rho \cdot \frac{\exp^{\rho h(q)}}{\exp^{\rho h(q)} - 1} \cdot p = \theta^I(q) \cdot p, \tag{23}$$

where $\theta^I(q) = \rho \cdot \frac{\exp^{\rho h(q)}}{\exp^{\rho h(q)} - 1}$. Now $\theta^I(q) < \theta(q)$, because $\rho < 1$, so some consumers who if sick chose to be treated in a public hospital in the absence of insurance, choose to purchase insurance in its presence and choose to be treated in a private hospital if sick. The preceding discussion is summarized in the following proposition.

Proposition 1: *Given p_q, q, and p_d, those consumers, who in the absence of insurance, chose to be treated in a private hospital if sick, in the presence of insurance, choose to purchase insurance and if sick choose to be treated in a private hospital. In addition, some consumers, who in the absence of*

insurance, chose to be treated in a public hospital if sick, in the presence of insurance, choose to purchase insurance and if sick choose to be treated in a private hospital.

This proposition is unsurprising. Risk averse consumers, who in the absence of insurance chose to be treated in a private hospital if sick, choose to insure against private hospital expenses in the presence of insurance to avoid risk. In addition, some relatively wealthy consumers, who in the absence of insurance chose to be treated in a public hospital if sick, also choose to insure against private hospital expenses in the presence of insurance to avoid risk and if sick are treated in a private hospital.[2]

From (23) inverse demand is given by

$$p^I(n,q) = \frac{W}{\theta^I(q)} - \frac{W}{\theta^I(q) \cdot N} \cdot n. \tag{24}$$

It gives the maximum price that the nth consumer can be charged for private treatment if sick and still choose to be insured before uncertainty is resolved. Comparing (7) to (24) reveals that the presence of insurance leaves the horizontal intercept of inverse demand unchanged, but increases the vertical intercept.

4.3. Stage 2: Doctor Choice of Price

The analysis is identical to that in section 3.2 with $\theta(q)$ replaced by $\theta^I(q)$.

4.4. Stage 1: Private Hospital Choice of Quality and Price

As above, the analysis is identical to that in section 3.3 with $\theta(q)$ replaced by $\theta^I(q)$. The solution for the number of patients treated in the private

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[2]The consumer, who in the absence of insurance was indifferent between private and public treatment, in the presence of insurance strictly prefers private treatment and to purchase insurance because risk is now less costly.

hospital, n^{I*}, is

$$n^{I*} = n^* = \frac{N}{4}. \qquad (25)$$

This follows from the fact that $p^I(n, q)$ is linear and the presence of insurance does not change its horizontal intercept. The solutions for prices, however, differ from those where there was no insurance and are given by

$$p_q^{I*} = \frac{W}{2\theta^I(q)}; \quad p^{I*} = \frac{3W}{4\theta^I(q)}; \quad and \quad p_d^{I*} = \frac{W}{4\theta^I(q)}. \qquad (26)$$

As $\theta^I(q) < \theta(q)$, for a given q, the prices charged by the doctor and the private hospital are greater in the presence of insurance than in its absence.

Although the analysis of the doctor and private hospital pricing decisions is similar to that in section 3, its interpretation is quite different. With complete insurance, the total price does not directly influence the number of consumers treated privately, but does so indirectly through its effect on the insurance premium. An increase in total price, increases the insurance premium and reduces the number of consumers with insurance. This in turn reduces the expected number of consumers seeking private treatment. As there is a monopoly private health sector it takes the effects of changes in total price on insurance premiums into account when it makes its pricing decisions.

This contrasts with the usual moral hazard set up of Pauly (1968) and Zeckhauser (1970), where insured consumer have an incentive for "excess" use because there are many of them and so the effect of any one consumer's use on the insurance premium is negligible and ignored. The equivalent in this paper would arise if there were many doctors or private hospitals, for then each provider's price would have a negligible effect on the insurance premium and so each providers demand. With insured consumers, doctors and private hospitals would have an incentive to "over" price. This is discussed

further in section 6.3.

Given $p_q^{I*}(q)$ and n^{I*} the private hospital chooses quality to maximize expected profit, that is,

$$\max_q \ \Pi^I = p_q^{I*}(q) \cdot n^{I*} - k(q). \tag{27}$$

This has first order condition

$$\frac{\partial \Pi^I}{\partial q} = \frac{N}{4} \cdot \frac{W}{2 \exp^{\rho h(q)}} \cdot \frac{dh}{dq} - \frac{dk}{dq} = 0. \tag{28}$$

At q^*, $\frac{\partial \Pi^I}{\partial q} > 0$ because $\rho < 1$. Therefore, $q^{I*} > q^*$ by the second order condition for a maximum. The presence of insurance induces the private hospital to increase quality above what it would be in the absence of insurance.

Proposition 2: *The presence of insurance increases the price charged by the private hospital, the price charged by the doctor, and the quality of private hospital services, above what they would be in the absence of insurance. However, the presence of insurance does not change the number of consumers treated in the private hospital from the number treated in the absence of insurance.*

The intuition for Proposition 2 follows. The presence of insurance increases the demand for treatment in the private hospital. However, because of the linearity of private treatment demand and the way it is affected by insurance, doctors and private hospitals respond by increasing prices to such an extent that no additional consumers seek treatment in the private hospital.

Welfare: Although the presence of insurance does not alter the number of consumers treated privately, it does increase expected welfare, because risk averse individuals are insured and because quality has increased. The effect on expected welfare of just the increase in quality is shown in Figure 2 by

the light shaded area minus $k(q^{I*}) - k(q^*)$. Given q^{I*}, the effect on expected welfare of insurance is shown in Figure 2 by the sum of the two darker shaded areas. The darkest shaded area is the net gain in expected consumer surplus, while the sum of the two lighter shaded areas is the increase in expected revenue of the private hospital and the doctor that results from the higher prices.[3] The only consumers who benefit from the presence of insurance are the ones who in its absence choose to be treated privately, that is, the relatively wealthy. These consumers pay higher prices, but are completely insured and so these higher prices are only a burden for the wealthy because they increase the insurance premium the wealthy have to pay. Although quality has risen, q^{I*} does not maximize expected welfare, given n^{I*}, because the private hospital does not take into account the effect increases in quality have on doctor income or consumer surplus.

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[3]Chiu (1997) found that the presence of insurance increased the price of health care to such an extent that the expected welfare of his representative consumer actually decreased. His result differs from that here because moral hazard in its standard form of "excess" use has been assumed away.

Figure 2

Insurance
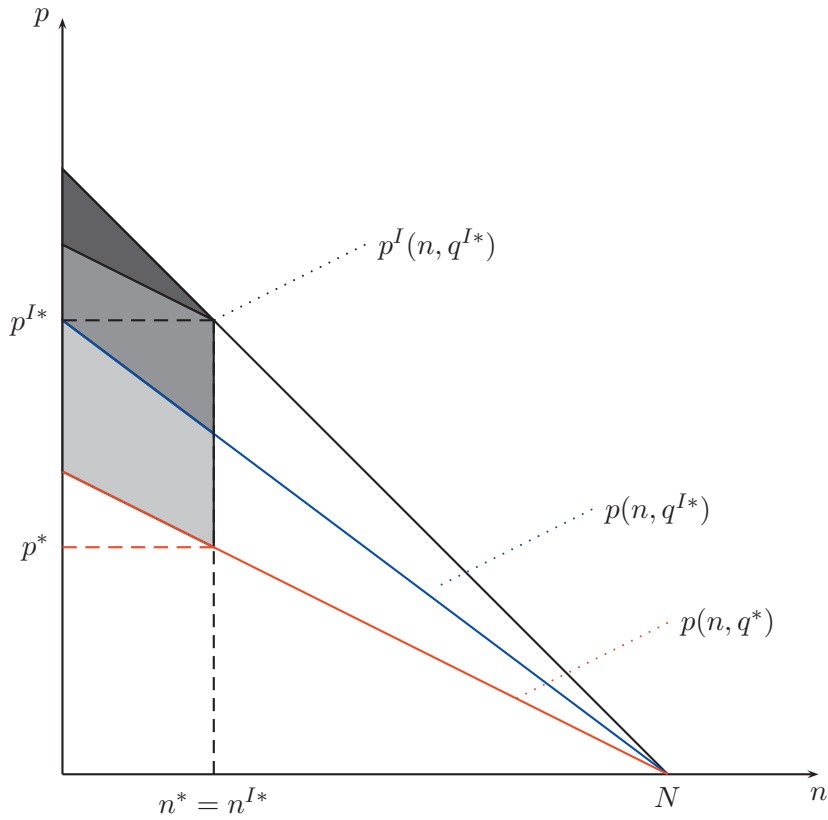
5.   Extensions

5.1.   Subsidy on the Insurance Premium

It was noted above that the double marginalization caused by having a monopoly private hospital and a monopoly doctor resulted in the number of consumers using the private hospital being doubly restricted below the efficient level. One policy response to increase the number of consumers

choosing private treatment is a subsidy on the insurance premium.[4]

In a competitive insurance industry the insurance premium is set equal to the expected payout, that is, $\alpha = \rho \cdot p$. The effect of a subsidy on the insurance premium is to reduce the amount paid by the consumer to $(1-s)\alpha$, where s is the percentage subsidy. This amends condition (23) to

$$w_i \geq (1-s) \cdot \rho \cdot \frac{\exp^{\rho \cdot h(q)}}{\exp^{\rho \cdot h(q)} - 1} \cdot p = (1-s) \cdot \theta^I(q) \cdot p \qquad (29)$$

and inverse demand becomes

$$p^{Is}(n, q) = \frac{W}{(1-s) \cdot \theta^I(q)} - \frac{W}{(1-s) \cdot \theta^I(q) \cdot N} \cdot n. \qquad (30)$$

The presence of the subsidy on the insurance premium leaves the horizontal intercept of inverse demand unchanged, but increases the vertical intercept.

The effects on prices are qualitatively the same as the effects of introducing insurance. The introduction of an insurance premium subsidy does not alter the number of patients treated in the private hospital. It increases the prices charged by the private hospital and the doctor by a factor of $\frac{1}{1-s}$.[5] Therefore,

$$p_q^{Is*} = \frac{p_q^{I*}}{1-s}; \quad p^{Is*} = \frac{p^{I*}}{1-s}; \quad and \quad p_d^{Is*} = \frac{p_d^{I*}}{1-s}. \qquad (31)$$

The effect on quality is also qualitatively the same as the effect of introducing insurance. The first order condition for quality becomes

$$\frac{\partial \Pi^{Is}}{\partial q} = \frac{N}{4} \cdot \frac{W}{(1-s)2\exp^{\rho h(q)}} \cdot \frac{dh}{dq} - \frac{dk}{dq} = 0. \qquad (32)$$

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[4]This policy is exactly the one chosen by the Australian Government in 1999 to increase the number of consumers privately insured and so the number choosing private treatment.

[5]Private health expenditure also increases. This is consistent with the findings of Jack and Sheiner (1997) who show, in a standard moral hazard framework, that an insurance premium subsidy increases health expenditures. Although the models are different, both results are driven by the fact that increases in the insurance premium, caused by increases in prices (this paper), or lower coinsurance rates (Jack and Sheiner), are less costly to the consumer in the presence of an insurance premium subsidy.

At q^{I*}, $\frac{\partial \Pi^{Is}}{\partial q} > 0$ because $(1-s) < 1$. Therefore, $q^{Is*} > q^{I*}$ by the second order condition for a maximum. The presence of the insurance premium subsidy induces the private hospital to increase quality above what it would be in the absence of the subsidy.

Welfare: Although the insurance premium subsidy does not alter the number of patients treated privately, it does alter expected welfare because quality has increased. The effect on expected welfare of the increase in quality is shown in Figure 3 by the sum of the two darker shaded areas minus $k(q^{Is*}) - k(q^{I*})$. The darkest shaded area is the net gain in expected consumer surplus, while the other dark area is the increase in the expected revenue of the private hospital and the doctor. The light shaded area is the increase in the expected revenue of the private hospital and the doctor as a result of the subsidy and is a transfer from taxpayers.

Given n^{I*}, quality is below the level that maximizes expected welfare in the absence of a subsidy. As the subsidy increases quality it has the potential to increase expected welfare. Let the subsidy that maximizes expected welfare be s^{opt}. Given the second order condition for a maximum is satisfied, if the subsidy is set too far in excess of s^{opt}, then the subsidy can reduce expected welfare.

Finally, the distributional aspects of the optimal subsidy, s^{opt}, warrant discussion. The optimal subsidy involves a transfer from taxpayers to the private hospital and the doctor. Quality is increased, but only the relatively wealthy consumers benefit as only they have private health insurance. Is a policy that contributes to Ferrari driving doctors treating wealthy patients in hotel like accommodation an appropriate policy from a social perspective?

Figure 3

Insurance Premium Subsidy
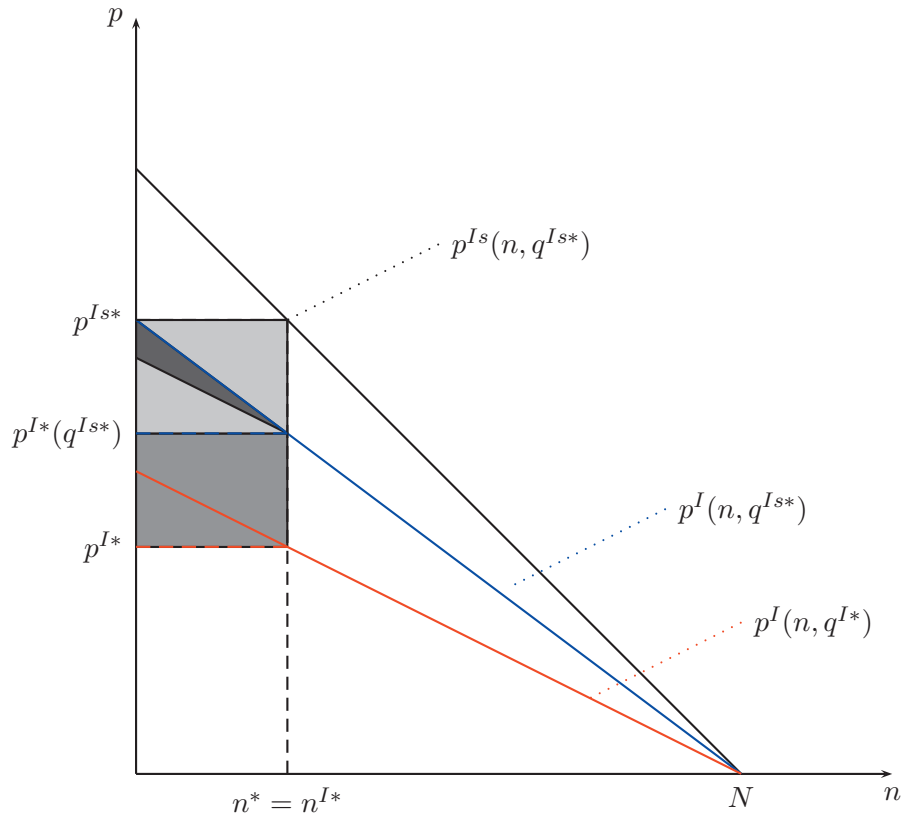
5.2. Changing Resource Allocation to Public Hospitals

A reduction in the amount of resources devoted to the public hospital reduces the quality of treatment in the public hospital to $\tilde{H}(0) < H(0)$. This section examines the positive effects of this on the optimal quality chosen by the private hospital, the number of patients treated by the private hospital, and the prices charged by the private hospital and the doctor in the absence of

insurance.[6]

From (3), the difference $h(q) = H(q) - H(0)$ is crucial in determining private treatment demand. Define $\tilde{q}$ by $H(\tilde{q}) - \tilde{H}(0) = H(q^*) - H(0)$. By definition $h(\tilde{q}) = h(q^*)$ and $\tilde{q} < q^*$.

Proposition 3: *If $\frac{\partial^2 k}{\partial q^2} = 0$, then the optimal choice of h by the private hospital, the number of patients treated by the private hospital, and the prices charged by the private hospital and the doctor are invariant to any reduction in the amount of resources devoted to public hospitals. However, private hospital quality decreases to $\tilde{q} < q^*$. If $\frac{\partial^2 k}{\partial q^2} > 0$, then the optimal choice of h by the private hospital increases, the number of patients treated by the private hospital is unchanged, the price charged by the private hospital increases, and the price charged by the doctor increases when the amount of resources devoted to the public hospital decreases. Private hospital quality decreases to $\hat{q}$, where $\tilde{q} < \hat{q} < q^*$.*

Proof: By the definition of $\tilde{q}$, $h(\tilde{q}) = h(q^*)$. If $\frac{\partial^2 k}{\partial q^2} = 0$, so that marginal cost of quality is constant, then $\frac{\partial \Pi}{\partial q}$ evaluated at $\tilde{q}$ is zero and $\tilde{q}$ maximizes expected profit with $\tilde{H}(0)$. By the definition of $\tilde{q}$, $\theta(\tilde{q}) = \theta(q^*)$ so optimal prices with $\tilde{H}(0)$ are p_q^*, p_d^*, and p^*. The horizontal intercept of private treatment demand is unchanged so n^* consumers are treated in the private hospital with $\tilde{H}(0)$. By definition $\tilde{q} < q^*$.

If $\frac{\partial^2 k}{\partial q^2} > 0$, given $\tilde{q} < q^*$, then $\frac{\partial \Pi}{\partial q}$ evaluated at $\tilde{q}$ is greater than zero. Therefore, by the second order condition for a maximum, the optimal quality, $\hat{q}$, is greater than $\tilde{q}$. As $\hat{q} > \tilde{q}$, $\theta(\hat{q}) < \theta(\tilde{q})$, and optimal prices with $\tilde{H}(0)$ are greater than with $H(0)$. That is, $\hat{p}_q > p_q^*$, $\hat{p}_d > p_d^*$, and $\hat{p} > p^*$. As above, n^* remains optimal. Finally, $\frac{\partial \Pi}{\partial q}$ evaluated at q^* with $\tilde{H}(0)$ is less

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[6]A normative analysis of this change would require modeling the optimal allocation of resources to the public hospital. The presence of insurance complicates the analysis and adds nothing to the discussion that does not follow trivially from section 4 above.

than zero, because $H(q^*) - \tilde{H}(0) > H(q^*) - H(0)$. Therefore, by the second order condition for a maximum, $\hat{q} < q^*$. ♣

The intuition and implications are clear. If the marginal cost of quality is constant, then a decrease in public hospital quality causes an equal reduction in private hospital quality so that demand for private treatment is unchanged. This leaves the number of patients treated in private hospitals and the prices they are charged unchanged. The public hospital has no less patients, but less resources to treat them. On the other hand, if the marginal cost of quality is increasing in quality, then a decrease in public hospital quality causes an increase in the difference between private hospital quality and public hospital quality which in turn increases the demand for private treatment. This leads to higher prices and an increase in private hospital profit and doctor income, but no more consumers are treated privately than before. The private health sector does not ease the pressure on the public health sector when the public health sector faces a reduction in its resources, rather the private sector takes the opportunity to decrease its quality (but increase its quality differential), increase prices, and increase hospital profit and doctor income.

5.3. Subsidy on Private Treatment - Reduce Monopoly Power

If the goal of public policy is to increase the number of consumers choosing private treatment, then we have seen that an insurance premium subsidy or a reduction in the amount of resources devoted to the public sector fail to achieve the goal. What is needed is a policy that directly increases the number of consumers choosing private treatment in the absence of insurance, that is, a policy that increases, n^*. A percentage subsidy on private treatment expenditures will have the same effect as an increase in qual-

ity, or the presence of insurance, namely, it will increase prices and private hospital quality, but not change the number of consumers choosing private treatment.

In a model in which there are two types of consumers, ones who choose public treatment, *publics*, and ones who choose private treatment, *privates*, in the absence of insurance, Vaithianathan (2002) shows that an insurance premium subsidy need not result in more consumers choosing private treatment as only uninsured *privates* take up insurance as a result of the subsidy. She suggests a direct subsidy on private treatment would reduce the use of the public health sector. This contrasts with the result above, where a direct subsidy on private treatment only increases price and not the number of consumers choosing private treatment.

The problem with the policies considered so far is that the monopoly private hospital and doctor respond to increased demand for there services by increasing price to such an extent that the number of consumers choosing private treatment remains unchanged. What is needed is a policy that reduces monopoly power. Perhaps private hospital and doctor prices could be regulated.

6. Limitations

In this section, the effect of changing some of the assumptions is discussed.

6.1. Consumer Demand and Zero Marginal Cost of Treatment

So far, a consumer utility function that exhibits constant relative risk aversion has interacted with uniformly distributed wealth to create a linear demand curve for private hospital treatment. Changes in private hospital quality or the presence of insurance change the slope of this demand curve,

but do not change the horizontal intercept. This feature together with zero marginal cost of treatment is what makes the number of consumers choosing private hospital treatment invariant to changes in private hospital quality and to the presence of insurance and an insurance premium subsidy. A more general utility function and distribution function and/or a positive marginal cost of treatment would lead to not only price, but also quantity changing in response to quality or insurance changes.

The presence of insurance, the introduction of an insurance premium subsidy, and a decrease in the amount of resources devoted to public hospitals would all lead to an increase in the number of patients treated privately if the marginal cost of treatment was positive. This adds to the welfare increasing nature of these changes and makes the welfare implications of Propositions 1-3 less stark. However, the main thrust of the paper remains. Monopolist private hospitals and doctors respond to insurance by increasing prices that to some extent reduces the impact insurance has on welfare.

6.2. Order of Moves

The order of moves in this paper has been (1) the private hospital chooses price and quality, (2) the doctor chooses price, (3) consumers chooses whether to be insured, (4) uncertainty is resolved and, if sick, consumers choose whether to be treated in a public or private hospital.

Reversing (1) and (2) gives the first mover advantage to the doctor so the doctor charges the higher price. The total price remains unchanged. Private hospital quality is lower because $\frac{\partial p_q^*}{\partial q}$ is lower for all q. The propositions are qualitatively unchanged. If (1) and (2) were simultaneous, then the private hospital price and the doctor price would be equal, $p_d^* = p_q^* = \frac{W}{3\theta(q)}$ and the total price would be lower. The propositions would still be qualitatively

unchanged.

A more fundamental reordering of moves would be to have (3) first. Consumers choose whether to be insured and then the private hospital and the doctor choose prices. Given complete insurance, the per-unit price for private treatment would be infinite and so no insurance would be offered. Like Vaithianathan (2004), the insured consumers are subject to a hold-up problem which renders insurance unprofitable. Essentially, by having private hospitals and doctors choose prices first the hold-up problem of Vaithianathan (2004) is eliminated.

6.3. Number of Doctors and Private Hospitals

In this paper, it has been assumed that there is one private hospital and one doctor and that they each have monopoly power. The model is easily extended to the case of many doctors, if they collude through a doctor association, or to many private hospitals, if they form a cartel. However, if there is more than one doctor association or a cartel is not possible, then the presence of insurance makes the decisions of monopoly doctor associations or private hospitals interdependent. To highlight the effects of this, the model of the paper is modified to eliminate the vertical structure between the doctor and the private hospital and private health care quality is assumed constant.

Assume there are two private hospitals that are monopolists, one in each of two different locations.[7] Each hospital serves a population of $\frac{N}{2\rho}$. Assume that consumer preferences are as above. Therefore, for hospital $j = 1, 2$ demand and inverse demand are given by

$$n_j = (1 - \frac{\theta p_j}{W}) \cdot \frac{N}{2}; \quad and \quad p_j = \frac{W}{\theta} - \frac{2W}{\theta N} \cdot n_j, \qquad (33)$$

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[7]Equally it could be assumed that there are two doctor associations one for each of two distinct specialities.

respectively. In the absence of insurance the monopoly prices and number of consumers treated privately are

$$p_j^* = \frac{W}{2\theta}; \quad and \quad n_j^* = \frac{N}{4}. \tag{34}$$

It is assumed that all consumers are charged the same insurance premium regardless of where they are located. With competitive insurance, this premium equals the expected payout per person which is

$$\frac{\frac{N}{2\rho}(\rho p_1 + \rho p_2)}{\frac{N}{\rho}} = \rho \cdot \left(\frac{p_1 + p_2}{2}\right) = \alpha. \tag{35}$$

As in section 4 above, with insurance, hospital j demand is given by

$$n_j = \frac{N}{2} \cdot (1 - \frac{\frac{\theta^I}{\rho} \cdot \alpha}{W}) = \frac{N}{2} - \frac{\theta^I N}{2W} \cdot \left(\frac{p_1 + p_2}{2}\right). \tag{36}$$

After substitution of (35) into (36) the profit of hospital j is

$$\Pi_j = p_j \cdot \left(\frac{N}{2} - \frac{\theta^I N}{2W} \cdot \left(\frac{p_1 + p_2}{2}\right)\right). \tag{37}$$

Although the private hospitals are local monopolies, in the presence of insurance, their profits are interdependent. The joint profit maximizing solutions for prices are $p_1^J + p_2^J = \frac{W}{\theta^I}$. Assuming symmetry, the joint profit maximizing solutions for the number of consumers treated privately are $n_j^J = \frac{N}{4}$; $j = 1, 2$, as expected. However, the nash equilibrium prices are $p_j^N = \frac{2W}{3\theta^I}$; $j = 1, 2$ and the nash equilibrium number of consumers treated privately are $n_j^N = \frac{N}{6}$; $j = 1, 2$.

Under joint profit maximization, the presence of insurance has increased the prices charged for private treatment, but left the number of consumers treated privately unchanged. This mirrors the results of section 4 above. However, in the nash equilibrium, prices rise even more and the number of consumers treated privately decreases. The presence of insurance has introduced an interdependency whereby each private hospital has an incentive to

increase its price above the joint profit maximizing level because each hospital ignores the effect of changes in its price on the other hospital's profit. In equilibrium, there is "over" pricing. This is the pricing equivalent of "excess" use by consumers in traditional moral hazard models as discussed in Pauly (1968) and Zeckhauser (1970). As the number of monopoly private hospitals approaches infinity, the nash equilibrium prices approach $\frac{W}{\theta T}$ and the number of consumers treated privately approaches zero.

In the absence of collusion between private hospitals, the presence of insurance introduces an interdependency between the hospitals which leads to less consumers being treated privately than in the absence of insurance. In the limit, no consumers are insured and no consumers are treated privately. This provides private hospitals with a strong incentive to collude on pricing even if they are local monopolies. In this light, agreements between insurance companies and private providers that set prices may be viewed as collusion enhancing devices. The introduction of coinsurance would also limit the extent of "over" pricing in this model just as it limits the extent of "excess" use in Pauly (1968) and Zeckhauser (1970).

Where there are two or more monopoly private hospitals, the introduction of an insurance premium subsidy has the same qualitative effects as in section 5.1. Prices are scaled up by the factor $\frac{1}{1-s}$ in both the joint profit maximising solution and the nash equilibrium, while the number of consumers treated in private hospitals remain unchanged. Once again, this latter result relies on the linearity of demand and zero marginal cost.

7. Conclusion

In a mixed private/public hospital system, private hospitals differentiate their product from public hospitals by offering a higher quality treatment

experience. This product differentiation and various other barriers to entry give private hospitals and the doctors that work in them monopoly power. This paper has examined the implications of this monopoly power in a world where consumers can insure against private hospital expenses.

The main results centre around the ability of private hospitals and doctors to extract part of the surplus generated by insurance through higher prices. Although quality increases in the presence of insurance, it is below the efficient level because private hospitals ignore consumer surplus and doctor income when making their quality decision.

The main policy implication of the analysis is that if the policy maker wants to increase the number of consumers insured and seeking private treatment, then it needs to tackle the inefficiency at its source, namely, reduce monopoly power, rather than use insurance premium or private treatment expenditure subsidies.

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