Health Economics: ECON 364
Health Care Supply: Physicians in Marketplace

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We have consider how physicians' individual choices both as a firm, and as a constituent of a firm. To complete the analysis, we will now analyze their interaction with each other as firms, and with their patients. To be precise our discussion here will encompass;

1. Location of Physician practice in relation to other physicians in the market for their service which is a long run concern.
2. Understand how individual physicians are matched with their patients through the latter's search process in the market place, and the consequent price dispersion that we observe in the market.

1 Physician Location Decisions

As would recall in our introduction, we had considered several reasons for the role of government in managing health care, one of which is access to health care in remote destinations. Much of health care management by the government is to ensure access to all the general populace without discrimination in income or location. We will now try to understand whether if left to their own devices, whether physicians as enterprises/firms would effect prevent equal access to all patients?

1.1 Hotelling's Model of Location

This ideas were first examined by Hotelling (although not pertaining to health care), and consequently his model has been named Hotelling's Model rather unimaginatively. Consider a unit line with patients uniformly distributed along this line. Let the location of a particular patient be $0 \leq x \leq 1$. Let travel cost per unit of distance be t. Let there be two physicians who are deciding where they would locate along this line. Suppose they are each initially located at the ends of the line segment. Let physician 1 be at point 0, and 2 be at point 1 of this line. The total cost of any patient from using physician 1's service is that $p_1 + tx$

where p_1 is the price the physician 1 charges. Similarly, the cost to the same consumer for visiting physician 2 is $p_2 + t(1-x)$. From this characterization, you can see that the cost of using any particular physician increases in the distance the patient has to travel to obtain the physician's service (note that although this model is pitched as a spatial analysis where we analyze physician's physical location, this model can also be used for analysis of quality or service differentiation, where we characterize the unit line as some measure of quality).

Figure 1

Suppose *each consumer consumes only one unit of health service*, and that the service rendered by the two physician differ only by their location. The choice of the consumer is merely to visit the physician that yields the lowest cost. Note that the patient that is just indifferent between the two physicians is in fact located in the line segment, and we can describe her location with respect to the cost structure for the consumer,

$$\begin{aligned} p_1 + tx &= p_2 + t(1-x) \\ \Rightarrow 2tx &= p_2 - p_1 + t \\ \Rightarrow x = \frac{p_2 - p_1 + t}{2t} &= \frac{1}{2} + \frac{p_2 - p_1}{2t} \end{aligned}$$

Than the location of the indifferent consumer is dependent on the price differential $(p_2 - p_1)$ and the cost of travel t. If the price of the first physician is lower than that of the second, the first physician stand to gain a larger market share than half. If on the other hand, the price of the first physician were to be greater, than the second, she loses a little of her market share. Wait a minute, doesn't this describe the demand for physician one? If that is what you're thinking, you're absolutely right! To examine the pricing behavior, let the physician be indeed profit maximizing, so that the profit of the first physician is

$$\begin{aligned} \max_{p_1} \pi_1 &= \max_{p_1} (p_1 x - cx) \\ &= \max_{p_1} (p_1 - c)\left(\frac{p_2 - p_1 + t}{2t}\right) \end{aligned}$$

where both physicians are assume to have the same marginal cost of c. The profit maximizing level of pricing for the first physician would then be

$$\begin{aligned} \left(\frac{p_2 - p_1 + t}{2t}\right) + (p_1 - c)\left(-\frac{1}{2t}\right) &= 0 \\ \Rightarrow \frac{p_2 - p_1 + t}{2t} &= \frac{(p_1 - c)}{2t} \\ \Rightarrow p_2 - 2p_1 + t + c &= 0 \\ \Rightarrow R_1(p_2) = p_1 &= \frac{p_2 + t + c}{2} \\ \Rightarrow 2p_1 - p_2 - t &= c \\ \Rightarrow \text{Marginal Revenue} &= \text{Marginal Cost} \end{aligned}$$

And by a similar argument, physician two would price as follows;

$$R_2(p_1) = p_2 = \frac{p_1 + t + c}{2}$$
$$\Rightarrow 2p_2 - p_1 - t = c$$

The two equations is typically referred to as the reaction functions of the respective firms, since the pricing strategy is dependent on the pricing of the other firm. So that the equation describes how each would *react* to the other. Note that the pricing strategy is positively dependent on both marginal cost, and price of transport, so that an increase in either would raise own pricing, and so to the same for the price of the competition.To solve the equilibrium pricing, we can do so in two ways. First consider the traditional where we first note that firms equate marginal revenue to marginal cost. Since both firms face the same marginal cost,

$$\begin{aligned} 2p_1 - p_2 &= 2p_2 - p_1 \\ &\Rightarrow p_2 = p_1 \end{aligned}$$

That is in equilibrium, both firms would have the same price. Substituting this into the reaction function, we find that

$$\begin{aligned} p_1 &= \frac{p_2 + t + c}{2} \\ p_1 &= t + c > c \end{aligned}$$

and each physician captures half of the market share. Further, note that the price is above their marginal cost of production due to the cost of transport which is not borne by the physician. This equilibrium is a Nash equilibrium since neither physician has any impetus to deviate from their said strategy, since deviation would yield lower profits. This outcome is permissible because transport distance allows them to differenciate themselves one from the other, hence yielding positive profits even if they exist in a otherwise, perfectly competitive market regime.

Figure 2.

We can now examine how physicians might want to locate. We can do so through a two stage game, where the physicians first choose where to locate, then compete on pricing. The manner in which this can be solved is through backward induction, where we first solve for the second stage equilibrium prices, then location given the equilibrium price. In the above analysis, we have found that in equilibrium, the physicians would be earning positive profits. If location is also a variable, the firms would choose their location given their reaction function. There are two effects to be considered. For any given price, the closer the physician is to the other physician, the greater her market share, and consequently the greater the profits. This is the *direct effect*. However, this is not the end of the story. Since the reaction function is dependent on the price of the other firm, the other firm would react to any change in location,

which we will call the *strategic effect*. To see the effect, if physician one moves closer to physician 2 to capture greater market share, so too would physician 2 retaliate in a sense by moving towards her competition, thereby cancelling out the effect. If in equilibrium, both physicians are together in the middle, they would effectively become the same as one another in the eyes of the patients. This would prevent them from charging a premium above their marginal cost of c. In fact, in this equilibrium, the price of both physicians would be just c. This equilibrium is known as the *Bertrand-Nash Equilibrium*, where all you need is two firms to derive the perfect competitive outcome. This would mean that our original assumption of the physician's locating as each end of the spectrum would ensure maximum profits for each.

In fact, if price competition is intense, then firms tend to locate far apart from each other, what is typically called *a high degree of differentiation*. If price competition is not intense, then firms tend to locate close to the center, or *a low degree of differentiation*.

What this says is the following, the more similar the service rendered by the physicians the greater the degree of competition, and that in and of itself would ensure that physicians would at least spatially locate far from one another! Without recourse to public assistance! Does this prediction match with reality that we observe. On page 213 of your text, table 7.2 reveals the strength of economic forces directing the location of doctors of various specialties to locations with the highest population/physician ratio available. It show that with increase in doctors and immigration, doctors moved unimpeded, and without central direction towards increasingly smaller towns with the passing of time. Similar studies also showed movement of physicians across state lines from states with low economic returns, to those with higher returns. **Does this discredit the call to arms against a private health care system?**

1.2 The Health Service Corps

This idea suggests that public policy would have no effect on locating physicians. The National Health Service Corps in the United States attempted to do just that through the incentive of paying for the costs of medical school in exchange for their accepting an assignment in an "underserved" area upon graduation. It was hoped that physicians would settle into their new environment during the tour of duty, and eventually set up permanent bases in those locales. It was found after the program, that all areas were just as likely to get a doctor in the first place regardless of whether allocation was made in these locales. In general it was found that physicians who were located in rural locations through obligation were less likely to stay than those who locate in rural settings out of own volition.

2 Patient's Search and Market Equilibrium

Like all other markets, it has been found that the market for health services does not exist in a perfectly competitive markets structure due to evidence of wide price dispersion for similar services. Rather, in health economics, we typically think of health services firms as existing in a monopolistically competitive environment where each firm faces a downward sloping demand, that is it has its own market for its product or services. Nonetheless, as you should recall from your first year class, due to the competitive element in such market structures, firms can enter and exit freely, thereby ensuring that in the long run, all firm have zero profit, and where firm equilibrium is described diagrammatically as the tangency between the demand curve and the firm's average cost curve.

Figure 3

2.1 Search in Monopolistic Competition

In the extreme case when individuals do not engage in information collection when seeking health care service, the allocation of patients to physicians could be depicted as a random allocation, where the demand that each physician faces is just a fraction of the market demand, and if all physicians are the same, the demand is the same for all physicians. In such a case, all physicians would effectively be a monopoly in its market, and would charge monopoly prices and gain monopoly profits, and price dispersion would be small or non-existent.

However, as consumers engages in search among physicians by prices, it adds a new dimension to the choices that the physician makes. Consider the following, since the physician knows his potential patient searches for the lower cost, she faces the following strategic consideration. First, as she increases her prices, she knows she gains in profits, but at the same time, she knows a higher price would drive the searching patient away from her, and towards a lower priced physician. This then encourages physicians to lower their prices in equilibrium. In fact as a larger proportion of the market engages in search, prices would tend towards a competitive market price. The observed price dispersion we see argues that it could be due to two reasons,

1. First not all patients engages in search, and
2. Secondly not all physician firms faces the same cost structure.

Several studies characterizing search among patients has concluded that there is less search undertaken in markets with a high density of doctors, the seminal paper being that by Pauly and Satterthwaite (1981). The rationale being it is difficult with high concentration to find anyone who uses a particular physician. *Although the predictions of the model matches with anecdotal evidence where traditionally, prices of physicians are higher in large cities, then smaller ones.* The author of your text characterizes the search performed as in

Pauly and Satterthwaite as polling a group of friends about a particular physician. In a city with a higher density of physicians it is very unlikely that anyone of your peers would know anything about a particular physician you randomly or coincidentally found. He then notes the following critique;

1. In such a search method, it is not costly for anyone to poll any amount of individuals. Thus for search to be costly, the model proposed by Pauly and Satterthwaite would seem more applicable in the instance of quality.

2. Even if it is costly to poll your peers, it does not seem appropriate that the cost of searching should differ between inhabitants of a small as opposed to a large city.

It seems the critique is harsh and interprets the results too literally. It must be noted that most economic models are abstractions of reality, and consequently what we seek to gain is whether it has good predictive power. The notion gained by Pauly Satterthwaite is that it is difficult to verify how good or otherwise a doctor is. Whether it can be directly interpreted as a price search or quality search is moot since quality is positively correlated with prices, and insofar as quality are usually not observable, not even by co-workers, it is not fruitful to be excessively pedantic, nor literal in interpretation. Matter of fact, drawing the search idea to quality opens another can of worms! Consider the following; pricing is positively correlated with quality, and search is difficult, what incentive is there to prevent a physician from defrauding her patient by raising prices, and pretending to be high quality! Since it is impossible for anyone to find out about the physician's true quality?

Nonetheless, Phelps notes an important point in economics, a phenomenon we observe is often explained by more than one theoretical model. He cites the study by DeVany, House, and Saving (1983). They argue that if the sole difference between inhabits of a large city and a small one is that those in the former has a higher value of time, physicians could just as well price at a higher rate compared to those servicing a smaller city, so as to reduce waiting time for these set of patients in large cities. However, do you think the use of this model as a counter proof is valid? Consider the following;

1. Do we need additional information on patient/physician ratio to discern between pricing differences?

2. Do we need additional information on distribution of income within the two types of cities?

3. Should we be concerned with patient/physician ration by socioeconomic status?

The idea here with this questions is to highlight the idea, how far do we wish to go with a critique, and whether it is fruitful!

2.2 The Role of Health Insurance

1. As discussed earlier, the existence of health insurance in the health provision market reduces the elasticity of demand for health services. What this means is that price dispersion increases, as it reduces the degree of search required since demand is determined by the health insurance firm, and there is a reduction in incentive for patients to search for the lowest cost treatment as discussed through the course.

2. Equilibrium prices occur now higher up along the demand curve due to the lower elasticity.

2.3 Anecdotal Evidence for Search by Patients

In a survey of 632 households in Salt Lake City in 1974 about whether the respondents had ever changed doctors, it was found that 60% had ever, and 10% wanted to. Of which the reasons were as we had expected,

1. Length of Waiting Time

2. Poor quality of care

3. Second Opinion

4. Price of Care

However, note that this is not empirical evidence but anecdotal.

2.4 Estimates of the Demand Curve facing Physician-Firms

We know now that 1. Physicians disperse on their own accord to various regimes, and 2. have provided some possible explanation for price dispersion within a location (eg. city or rural town), namely search by consumers, and value of time. These has definitive testable implications for a physician firm's demand, namely;

1. If consumers do search on the basis of pricing, the price elasticity of physician demand should be large, particularly in large metropolitan areas. (*This should be considered in contrast to market demand which has been proven to be low from the RAND HIS survey.*)

2. The fact that demand is downward sloping is proof that the market structure is monopolistically competitive.

McCarthy, 1985 found that the elasticity of demand of primary care physicians to have a price elasticity of demand to be of -3, in contrast to the market demand estimated for the HIS at approximately -0.2 to -0.3. Yet if you consider the evidence carefully, does this necessarily imply that the result is due to search. Phelps claims that because of the "standard monopolistic model,

in which more firms in a community imply fewer customers per firm. This ... shifts inward the demand curve facing any firm, this reducing the price it can charge. This finding helps strengthen the belief that something other than "difficult search" makes prices higher in markets with more doctors." Yet just prior, he noted that the higher elasticity due to health insurance dictating demand, would ensure a more inelastic demand and consequently higher price.

What the evidence shows about pricing, and elasticity of demand pertain to two issues,

Firstly, the downward sloping demand shows monopolistic competition is the correct market structure to model physician firms,

Secondly, the elasticity reveals the inelastic demand dictated by Health Insurance.

The findings are static in nature, and not dynamic. That is we do not know how an entry by a firm would alter the search pattern of individuals. Considering that the number of firms are large, the additional search cost is at best miniscule, and consequently implies that there should be no change in pricing strategy by the physicians, and consequently a high price. Secondly, in a monopolistic competitive framework, the number of firms are large, so that the decrease in pricing would at best be small, so that prices would still remain high. Phelps is giving a dynamic interpretation to a static result which is incorrect. Further, search essentially induces greater price dispersion, and not just high prices, so that we should be examining variance in pricing in a city, as opposed to another with less sophisticate citizens! Is it possible?

2.5 Induced Demand

The study of a physician's demand is also complicated by the idea of induced demand, in a sense that physicians due to a greater amount of knowledge can induce greater demand for their service, and consequently their profits, an accusation which runs counter to the hippocratic oath that they take. Such a possibility would confound our conclusion since if it does exists, would ensure demand for physician service to be unnaturally high, i.e. it would make the disguishing mechanism of search and induced demand impossible to separate.

The principal reason that induced research into this idea stems from the observation made by Roemer, 1961, that locations where there were greater hospital bed supply had greater hopsital utilization. Economist of course immediately argued that this coincidence was due to the fact that supply followed the demand into high demand areas. Consider the following, physicians in choosing how much time they should advice their patients to be admitted into a hospital is in fact making a constrained choice, given the knowledge that how many people are typically admitted within a period. If the status quo was indeed a binding constraint, when that constraint becomes slack, we would see an increase in usage rates, particularly when the previous levels were itself suboptimal.

To verify this notion, Fuchs (1978) examined the demand for surgical procedures in a number of metropolitan areas (SMSAs), controlling for price, income, and other relevant variables, and using predicted supply of physician derived

from economic forces to eliminate the suggested effect from demand on supply. The method is called two stage least squares, and the it attempts to rid the model of causality issues. He found that for a 10% increase in predicted supply, there would be an induced increase of 3 %to 4% in surgical procedure. Can it be true? By the above arguement, yes it can, principally due to slackening of the constraint. Is it necessarily a violation of the hippocratic oath. According to our above arguement, no it isn't. Consider the following arguement, if indeed physicians are self serving, how much should the induced increase in demand be? Full? Of course there are other alternative explanations.

1. More physicians reduces the time costs to patients, thereby increasing demand.

2. Most of the studies focuses on one facet of demand; what if there is a substitution to what is being examined from another facet, such as office consultation.

Dranove and Wehner (1994) however revealed flaws in the statistical method used. The idea is as follows; if we look around us, we'd find positive correlation between the number of different types of operations and the number of those surgeons that perform those surgeries. Is it necessarily true for all that there is induced demand. As in our earlier study of the relationship between socioeconomic status the child health. Dranove and Wehner (1994) recognized that there are a whole slew of other problems with directing causality of demand and supply, since there are other issues involved that are unobservable such as the idea that we do not know what is the optimal length of hospital stay, and the various types of illnesses, or the changes in technology that occured between two period or more. That is even though the technique used by Fuchs may have tried to solve one problem, others aren't, namely that of unobservables. And the result he sees may be an illusion. To show this Dranove and Wehner deviced a very interesting study, they examine the demand and supply of Obstetricians and Gynaecologists. Assuredly, it is not possible for us to find Obstetricians inducing demand. If they technique used by Fuchs is correct, for Obstetricians and Gynaecologists, the induced demand effect would be zero, or near zero. Guess what they found? Yes! Obstetricians and Gynaecologists did induced demand!

Unabated, Economist continue to try to incriminate Medical Doctors with other forms of study. There are essentially two approaches,

Use a exogenous shift in demand that causes physicians to respond. For example, suppose a new drug reduces the need for a particular treatment (more profitable treatment), thereby raising supply of another substitute that is equivalently profitable.

Exogenous change in prices due to government intervention, creating the same incentive as the first, to recommend more expensive treatment.

One such study that used the first method, was performed by Gruber and Owings. They looked at the frequency of births that took place between 1970

and 1982, which fell by 13.5%. This would mean that the income of Obstetricians and Gynaecologists would have fallen during that time. The authors took utilizing the variation across states in the timing and magnitude of the fall to indentify the changes in this trend. They found that a 10 percentage point fall in fertility raised the C-Section rate by 0.6 percentage point. This implied a 10% change in birthrates raised C-Section rates by 3%, which was statistically significant and large. Could this be true? What might have created and perhaps biased the results. Several explanations are provided here,

1. That period of fall coincided with economic growth in the US. This increased the opportunity cost of having more children. At the same time, this period also saw increase in female labor force participation. If this increased incidence among women increases the likelihood of difficult pregnancy, the finding is flawed.

2. In a recent article by Marianne Bertrand, Esther Duflo and Sendhil Mullainathan, 2002, "How Much Should We Trust Difference-in-Difference Estimates?", they found that the difference-in-difference technique used by Griber and Owings, and alot of other economist was particularly flawed especially when individual observations are aggregated! They performed simulations, and randomly assigned changes to the states (the application was not on health but general) and found that it was very easy to get spurious results. Some suggested corrections were provided, but it cast doubt on the findings using the technique.