ABSTRACT: Health plans can create competition among hospitals by threatening to “steer” patients to preferred facilities. Mergers can reduce this competition and economists have begun using travel cost models to measure their effects. If a patient passes one hospital to go to another, the difference in travel time becomes a proxy for the “price” that patients “pay” for the preferred attributes of the chosen hospital. This allows competition economists to estimate the increased bargaining power of merged hospitals in much the same way that environmental economists estimate willingness to pay for environmental amenities.

In this paper, we apply some external validity checks to the methodology. We find that mergers have implausibly small effects, when measured in minutes of travel time. Similarly, patients seem to place an implausibly low value on their own lives, i.e., they are unwilling to travel more than a few minutes to get to hospitals with lower mortality risk. Our results raise questions about how well travel cost models measure the market power created by mergers among hospitals.

**JEL classification:** C25, C78, L41,

**Keywords:** hospital competition; patient choice; demand estimation, travel cost methodology; bargaining, merger, antitrust.
I. Introduction

In 2002, after seven straight unsuccessful merger challenges, then-FTC Chairman Timothy J. Muris announced a series of retrospective studies of consummated hospital mergers. The studies were designed to measure the price effects of hospital mergers and to identify potential targets for litigation. The Evanston Northwestern-Highland Park retrospective found a 20% price increase (Haas-Wilson and Garmon, 2009) which led to a FTC challenge and eventual relief. However, this was the only retrospective study to result in a successful merger challenge, and the failure to find clear anticompetitive effects in other retrospectives seems to raise as many questions as it answers (Tenn, 2008 vs. Gowrisankaran, 2010 and Thomas et al., 2011; Thompson, 2009).

The studies and trial did, however, serve to discredit the shipments methodology (Elzinga and Hogarty, 1974) that had been used by defendants in the earlier cases to delineate very broad geographic markets (Farrell et al., 2009). By then, the antitrust agencies had already abandoned the shipments methodology (Werden, 1989), focusing instead on the effects of mergers on the bargaining between health plans and hospitals (e.g., Vistnes, 2000). Health plans can create competition among hospitals by threatening to “steer” patients to preferred facilities. Mergers can reduce this competition and economists have begun using travel cost models to measure their effects (Town and Vistnes, 2001; Capps et al., 2003; Gaynor and Vogt, 2003; Ho, 2006, 2009; Fournier and Gai, 2007; Balan and Garmon, 2009). Since the Evanston case, the FTC has made the methodology a part of its enforcement strategy (Perry, 2010) which, when applied to the question of market delineation, results in much narrower markets than the shipments methodology (Gaynor et al., 2011).

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3 United States v. Long Island Jewish Medical Center, 983 F. Supp. 121 (E.D.N.Y. 1997)
4 While exclusive contracting and restricted networks are not as common as they once were, increasingly payors are using tiered networks which achieve a similar bargaining result.
The methodology is borrowed from environmental economics, where it has been used for decades by economists to estimate demand for environmental amenities, such as pollution reduction (e.g., Haab and McConnell, 2003). Just as a tourist who passes a polluted lake to get to a clean one reveals a preference for the pollution reduction over the extra travel time, so too does a patient who passes one hospital to get to another reveal a preference for the attributes of the chosen hospital over the extra travel time. While the travel cost methodology is not new to hospitals, its use to measure the market power created by merger is relatively recent.

There are several reasons to think that the methodology may be ill-suited to this application. Unlike the environmental application, imputed dollar denominated travel costs are quite small relative to the actual cost of the hospital service, and third-party insurance indemnifies the majority of patients from the actual costs. In addition, prospective patients may be unaware of differences in service attributes and, like all experience goods, it is difficult to convey the significant dimensions of the quality until after the service has already been consumed. Further, due to the well-documented decision biases surrounding the processing of low probability negative outcomes, patients may not rationally process information about hospital quality. Finally, the true decision-maker may be the physician, which may imply that a different competitive mechanism is at work.

The purpose of this paper is to determine how well travel cost models of demand characterize demand for hospital services and, by implication, the loss of competition between hospitals caused by merger. To do this, we expose the travel cost methodology to a couple of external validity checks. First we apply the environmental travel cost methodology to estimate the effects of a hypothetical merger among two Philadelphia hospitals. The methodology comes up with implausibly low price effects because the merger effect, measured in travel time, is tiny. Next, we estimate the value that patients place on reductions in mortality from a common elective procedure, heart catheterization. The methodology implies that patients place an implausibly low value on their own lives, i.e., they are unwilling to travel more than a few minutes to get to hospitals with lower mortality risk.
Our results raise obvious questions about how well travel cost models characterize existing competition among hospitals and, by implication, how well they measure the increase in market power created by merger. We conclude that the logical link that takes us from observed patient choices to a predicted merger effect is somehow broken. We suspect that the source of the problem is with the assumption of a rational patient who chooses among hospitals according to their characteristics. In the conclusion, we speculate that hospital demand may be better characterized by a “physician workshop” model (Pauly and Redisch, 1973; Pauly, 1980).

II. Inferring merger effects from patient choices

In this section, we outline the basic methodology that takes us from observed patient choices to a predicted merger effect. To set up our analysis, we find it useful to describe the travel-cost methodology as having two separate steps. In the first step, demand for hospital care is estimated using a patient-choice model of demand. Just as tourists who travel further to get to a clean lake reveal a preference for pollution reduction over the extra travel time, so too do patients who pass one hospital to get to another one reveal a preference for the chosen hospital over the increase in travel time.

At the first step, there is no substantive difference between the environmental and competition economics methodologies. Both estimate demand using travel time as the “price” that consumers “pay” for pollution reduction or for hospitals. Both compute consumer willingness to pay (WTP) from changes in estimated consumer surplus, with and without a clean lake or with and without a merged hospital. These “compensating differentials” measure the change in consumer surplus in minutes of travel time.

At the second step, however, the methodologies diverge. To transform the change in consumer surplus, measured in minutes of travel time, into a dollar figure, an environmental economist assumes an opportunity cost of travel, computed as foregone income, which averages about $25/hour.\(^5\) The

\(^5\) If individuals have heterogeneous opportunity costs, “mixed logit” or “random coefficient” models are used, e.g., Ho (2006).
assumption allows the environmental economist to place a dollar value on the benefit of pollution reduction, which is obviously useful for policy.

In contrast, a competition economist places a dollar value on the bargaining power of each hospital by regressing prices or profits on the compensating differentials. The regression coefficient transforms the merger effect, measured in minutes, into a price effect, measured in dollars. Typically, a log-log specification is used and the estimated elasticity is near 0.6. So, for example, a merged hospital that increases its willingness to pay by, say, ten percent would be predicted to raise price by six percent (e.g., Fournier and Gai, 2007).

The justification for the second-stage regression equation comes from a model of multilateral bargaining between health plans and providers of medical care. Our treatment of the multilateral bargaining follows that in Werden et al. (2011) and in Fournier and Gai (2007).

We consider the case of a single buyer (a health plan) bargaining separately with multiple sellers (hospitals). Chipty and Snyder (1999) show that the buyer can exercise bargaining power if the demand and cost conditions in the market make the surplus function concave. In our application, concavity means that the marginal value to the network of the first hospital is larger than the marginal value of the second hospital. In this case, the health plan can capture a bigger share of the surplus by creating competition among the hospitals to get into the network.

To illustrate the role that such concavity plays in the bargaining between health plans and hospitals, consider a simple numerical example taken from Werden and Froeb (2008b).

Suppose that a health plan can market its network to an employer for $100 if it contains either of two merging hospitals, for $120 if it contains both, and cannot market it at all without one of the hospitals. The gain to the managed care plan from adding either of the hospitals to its network when it already has the other is $20. By threatening each of the merging hospitals with being dropped from the network, the managed care plan can keep the $100 for itself and make the gain from striking a bargain with a second hospital just $20, which the Nash bargaining solution predicts is evenly split. Thus, before the merger each hospital gets $10 for joining the managed care network.

Now suppose the hospitals merge and offer both as a package on a take-it-or-leave-it basis. The managed care plan can no longer drop one of the hospitals, and the gain from striking a bargain
with the merged hospital is the full $120, which again is evenly split in the Nash bargaining solution. The merged hospital thus can [gain] $60, while the separate merging hospitals could [gain] only a total of $20.

Note that this division of the pre-merger surplus corresponds to several axiomatic solutions to the bargaining problem: the least core, the prenucleolus, and the prekernel (Werden et al., 2011).

The bargaining power of the health plan derives from concavity of the surplus function which means that the first deal is worth more ($100) than the second ($20). The concavity is determined by two factors: (i) the degree of substitution between the merging hospitals, and (ii) the degree of substitution between the merging and non-merging hospitals. If the merging hospitals are close substitutes, the threat by one to drop out of the health plan means that surplus drops only by a small amount, e.g., $20. In addition, if the non-merging hospitals are distant substitutes to the merging hospitals, the threat of both hospitals dropping out of the network together imposes a bigger potential loss on the health plan, e.g., $120 in the example above. Eliminating a close substitute when non-merging substitutes are relatively “distant,” would allow the merged hospital to negotiate a better price with the health plan, e.g., $60 instead of $20.

Note that the same bargaining power can be exercised by threatening to put one of the hospitals on a less preferred “tier,” i.e., with a higher out-of-pocket payment. In this case, prospective patients would be “encouraged” to choose hospitals in the preferred tier with a similar effect: the threat to exclude a hospital from a preferred tier gives the health plan a degree of marketing power that it can use to negotiate better prices.

One obvious weakness with this treatment is that it misses the role played by capacity constraints. In particular, the counterfactual threat of a hospital leaving the system would have bigger consequences if, by leaving, it would cause rivals to become capacity constrained. Ho (2009) provides reduced form estimates of how much more a capacity constrained hospital can expect to earn, which could be used to calculate the increased value of a threat that pushes demand for a provider network over its capacity. Acquisitions that allow a merged hospital to do this may increase the bargaining power of hospitals
beyond the change in consumer surplus. On the other hand, if a hospital is already a “must have”
provider, then merger may not increase its bargaining power at all, as in Froeb et al. (2002) and Kalnins et
al. (2011).

III. The Estimated Effect of Hypothetical Merger in Downtown Philadelphia

In this section, we estimate the effects of a hypothetical merger among two acute-care hospitals in
downtown Philadelphia, not unlike those involved in the Evanston-Northwestern merger challenged by
the FTC. Our estimation approach closely follows that in Fournier and Gai (2007).

We estimate the patient choice model with 2008 calendar year data from the Pennsylvania Health
Care Cost Containment Council (PHC4). For all patients in the data that choose one of the two hospitals,
we show the zip codes of origin in Figure 1 below. One difference in our analysis and that proposed by
Fournier and Gai (2007) is that we estimate that choice model on all patients in the data, not just the
Medicare patients, who can go to any hospital. However, most of the health plans in the Philadelphia area
have “open” networks that do not limit patient choices or try to “steer” patients to “preferred” hospitals.

One of the decisions that must be made when estimating a discrete-choice demand model is which
hospitals enter the choice set. This is important because the estimated coefficients are often sensitive to
the choice specification (Parsons and Haub, 1998), which would also change how we compute the
compensating differentials. To construct our choice set, we begin with the merging hospitals. This pair
of hospitals defines the set of zip codes they draw patients from. For each zip code, we identify the set of
hospitals from which patient chose. This is what we call our “restricted” choice set. The “universal”
choice set is the union of all the individual zip code choice sets.

We allow the disease-specific constants and the coefficients on travel time to shift for each major
disease category. We present the results of our estimation in Table 1 below. We see an aversion to travel
that varies by condition, and with patient demographics, including income. The aversion to travel is
particularly important for determining merger effects because it determines the degree of substitution
between the merging hospitals, and between the merging and non-merging hospitals. A high travel cost can attenuate merger effects because it means that there is less competition lost between the merging hospitals, but it can also amplify merger effects because it means there is less competition between the merging and non-merging hospitals. The latter effect will typically dominate if the merged hospitals are close to each other, and far from non-merging rivals. Other factors that affect the compensating differentials are the inherent attractiveness or “mean quality” of the hospital and the locations of the merging hospitals relative to the population they serve and to the location and attractiveness of non-merging hospitals.

In Figure 3, we present the changes in consumer surplus (the change in maximum utility caused by merger). These values are computed by calculating the consumer surplus with and without each hospital individually, and then with and without both hospitals jointly. Taking a hospital out of the choice set to see how much consumer surplus falls is interpreted as a measure of the bargaining power that the hospital has against the health plans. Taking both hospitals out of the choice set together makes for a bigger loss in consumer value if the hospitals are substitutes.

In Figure 3, we see that the merger results in an increase in bargaining power of about 67K minutes of travel time, which represents an increase of about 14.7%. Using the estimated elasticity from Fournier and Gai (2007) of 0.6, the competition economic methodology would predict a price increase of about 8.8%. On an average hospital admission charge of about $10,000, this would represent an increase of $880.

Using the environmental economics methodology, we find a much smaller price effect. The 67,024 minute change in willingness to pay is spread over 33,175 hospital admissions, which represents about 2 minutes/patient. With an opportunity cost of travel of about $25, this represents an increase in willingness to pay for the merged hospital of only $0.84, or less than 0.01% of a $10,000 hospital charge.

We do understand that the opportunity cost of travel to a nearby hospital is may be larger than the cost of foregone income. But factors like the increased demand for proximity related to acute care, the
increased travel time related to numerous visits to the hospital by family and friends, and the emotional value to being close to loved ones in a hospital should be picked up a bigger coefficient on travel cost.

However, our analysis does ignore the effect of capacity constraints. We can imagine two different ways that this could affect the predicted merger effects. The first is the possibility that a merged hospital pulling out of a network would push remaining demand beyond capacity. This would tend to amplify the price effect of the merger, beyond that predicted by this analysis that ignores the effect of capacity constraints.

But capacity constraints could also attenuate merger effects. If the hospital is already a “must have” facility – that is, there is insufficient slack capacity in the market to serve existing demand without the facility – it is likely that the hospital has already extracted any surplus due to its market power. A merger between two “must have” facilities may not confer any additional market power. In our example UPENN and Thomas Jefferson are the largest facilities in the greater Philadelphia area with occupancy rates of 80% and 92% respectively. The occupancy rate of the greater Philadelphia area as a whole is 75%. While it is conceivable that a health plan could choose to not include the pair of facilities, and the market could absorb the reallocation of commercial patients, many of the other hospitals do not supply the advanced tertiary or quaternary care. For the purposes of this exercise, what is most significant is whether TJH could accommodate the incremental patient volume for specialized services if UPENN was not in the network and vice versa. Given their occupancy and high utilization rates for specialized services this would be implausible without a corresponding crowding out of Medicare and Medicaid patients. If we assume that such crowding out and reallocation of public payor patients across facilities does not occur it may be that each of these facilities is already a “must have”.

IV. How far are patients willing to travel to reduce mortality risk?

In this section, we apply a second external validity check to the methodology by looking at how far patients would travel to go to a hospital with a lower mortality risk.
To frame this issue, consider patient demand for Lipitor, a blockbuster drug with over $12B in annual sales in the United States. The benefit of Lipitor is that it reduces the risk of a heart attack, compared to a placebo, from 3% to 2% for patients at risk of heart attack. Consumers obviously recognize the value of this risk reduction, and are willing to pay for it, albeit indirectly, through third-party health plans.

Now consider a patient choosing a hospital for Cardiac Catheterization, a diagnostic and therapeutic procedure that carries some mortality risk. In our sample of hospitals from Philadelphia the mortality risk varies from 0% to 9%. To estimate how far patients are willing to travel to decrease this risk, we have to assume that the observed risk differentials are “causal,” i.e., not caused by selection bias. It cannot be the case that higher-risk patients travel to the best hospitals, which would induce a spurious positive correlation between quality and mortality.

If we suppress the hospital-specific coefficients, we can estimate the choice model for Cardiac Catheterization as a function of hospital characteristics, such as mortality. Using the same all-payer data set, we estimate demand for over 1,477 commercial inpatients in the Philadelphia area in 2008. In Table 2, we present results of estimated demand for Cardiac Catheterization for the restricted and universal choice sets. We see that the Mortality Index has a negative effect in both specifications, and that most of the hospital characteristics are significantly related to the probability of choosing the hospital.

We can use the estimated coefficient on the mortality index to compute the value of a decrease in the mortality risk. The choice model says that an absolute risk reduction of 1% (the same as that for Lipitor) is worth only 2.6 minutes of travel time using the restricted choice set, and worth only 0.68 minutes in the unrestricted choice set. Again, we find these numbers implausibly low.

V. Conclusion

At the same time that the government’s health reform is creating incentives for hospitals to consolidate, the competition agencies have replaced the old “shipments” test with one that has much
stricter merger thresholds. Due to what appears to be a strong patient aversion to travel, the travel cost methodology would likely result in more merger challenges.

In this paper, we have raised a number of questions about the methodology. We have shown that it implies implausibly low demand for medical care, which results in implausibly small merger effects, when measured in minutes. The second stage price regression then turns the small compensating differentials, measured in minutes, into very large price effects, measured in dollars.

On the central question of whether the methodology is giving enforcement agencies the right answer, we have no opinion. What we are saying is that the logical link that takes us from observed patient choices to a predicted merger effect is somehow broken. We suspect that the source of the problem is with the assumption of a rational patient who chooses among hospitals according to their characteristics. The individual who passes a polluted lake to recreate a clean lake, is presumably well informed, and personally bears all the costs and benefits from his decision. The extension to the case of hospitals is less clear.

One element missing in the analysis is the role played by physicians: hospitals have long been considered physician workshops (Pauly and Redisch, 1973). The primary competition among hospitals has been to attract more and better physicians to the hospital through choices of technology, physician office buildings, and the physician experience. In short, physicians determined the demand function for hospitals. Physicians were the actor. The recent focus on the purchase of primary care physician practices had at its core the objective of securing patient referrals. While hospitals have begun to independently brand their facilities in an attempt to establish loyalty directly with patients, the physician may remain the primary determinant of where a patient is hospitalized.

Despite the clear importance of the physician, the existing choice models that form the basis of the travel cost methodology are silent on the physician’s explicit role. Recasting the observed choice as those of physicians may change the interpretation one would lend to the empirical exercise. We leave it
to future research to clarify the role of the physician in measuring the increased market power created by mergers.
VI. References


Tenn, Steven and John M. Yun, “Biases in Demand Analysis Due to Variation in Retail Distribution,” FTC working paper No. 287 (February, 2007).


Figure 1: Draw Areas of University of Pennsylvania Hospital and of Thomas Jefferson Hospital
Figure 2: Universal Choice Set Near Philadelphia
Table 1: Estimated Coefficients on Patient Choice Model

<table>
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*** significant at 1%; ** significant at 5%, and * significant at 10%

Wald chi2(71) = 174,177.04
Prob > chi2 = 0.000; Log likelihood = -583,785.21
Figure 3: Effect of Hypothetical Merger on WTP (in minutes of time)

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<td>UPenn Health System</td>
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Table 2: Cardiac Catheterization Choice Model

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<th>Value 2</th>
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</thead>
<tbody>
<tr>
<td>Number of Inpatients</td>
<td>1477</td>
<td>1477</td>
</tr>
<tr>
<td>Number of Hospitals in Choice Set</td>
<td>2 to 10</td>
<td>34</td>
</tr>
<tr>
<td>Likelihood Function (no predictors)</td>
<td>-2094.0</td>
<td>-2940.9</td>
</tr>
<tr>
<td>Likelihood Function (at convergence)</td>
<td>-2038.7</td>
<td>-2847.4</td>
</tr>
</tbody>
</table>

Parameter Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>-0.025**</td>
<td>-0.123***</td>
</tr>
<tr>
<td>Income*Time</td>
<td>-4.41E-07***</td>
<td>-1.04E-07</td>
</tr>
<tr>
<td>For-Profit Status</td>
<td>-0.441***</td>
<td>-0.838***</td>
</tr>
<tr>
<td>Nursing Intensity</td>
<td>-323.014***</td>
<td>-318.638***</td>
</tr>
<tr>
<td>Capital Intensity</td>
<td>0.13</td>
<td>0.139</td>
</tr>
<tr>
<td>Transplant Service Offered</td>
<td>-0.149</td>
<td>0.046</td>
</tr>
<tr>
<td>MRI Service Offered</td>
<td>-0.710***</td>
<td>-0.927***</td>
</tr>
<tr>
<td>Teaching Status</td>
<td>0.520***</td>
<td>0.987***</td>
</tr>
<tr>
<td>Computed Tomography Service Offered</td>
<td>0.290**</td>
<td>0.569***</td>
</tr>
<tr>
<td>Cardiac Beds</td>
<td>-0.012***</td>
<td>-0.020***</td>
</tr>
<tr>
<td>Mortality Index</td>
<td>-0.131***</td>
<td>-0.088***</td>
</tr>
</tbody>
</table>

Marginal Effect of Time

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(evaluated at median income)</td>
<td>-0.05</td>
<td>-0.13</td>
</tr>
</tbody>
</table>

Implied WTP for of 1% Change in Mortality (valued in minutes) | 2.6 | 0.68 |

*** significant at 1%, ** significant at 5%