

FIRST DRAFT---COMMENTS SOLICITED---DO NOT CITE

HOW WELL DO TRAVEL COST MODELS MEASURE COMPETITION AMONG HOSPITALS?

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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. What we find is surprising. When measured in minutes of travel time, mergers have tiny effects. 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. The underlying choice model, and the aversion to travel, varies dramatically by condition. We conclude that travel-cost models of models of hospital demand—which are based on the notion that patients choose hospitals—are not very good at characterizing competition among hospitals. In the conclusion, we suggest an alternative.

JEL classification: C25, C78, L41,

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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.¹ 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.² 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 raises 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 hospitals³ (e.g., Vistnes, 2000). Health plans can create competition among hospitals by threatening to “steer” patients to preferred facilities.⁴ 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,

¹ The FTC's efforts to study the effects of consummated hospital mergers are addressed in Timothy J. Muris, Chairman, Federal Trade Commission, Everything Old Is New Again: Health Care and Competition in the 21st Century, Prepared Remarks Before the 7th Annual Conference in Health Care Forum, Chicago, Illinois (Nov. 7, 2002), available at </speeches/murishealthcarespeech0211.pdf>.

² In the Matter of Evanston Northwestern Healthcare Corporation and ENH Medical Group, Inc., File No. 011 0234, Docket No. 9315, available at <http://www.ftc.gov/os/adjpro/d9315/>

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.

2010) which, when applied to the question of market delineation, results in much narrower markets than the shipments methodology (Gaynor et al., 2011).

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). And while the travel cost methodology is not new to hospitals, its use to measure the market power created by merger has not been subject to the level of scrutiny as it has in other contexts. In this paper, we expose the travel cost methodology to some simple external validation tests.

To set up our critique, 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 environmental amenities 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.

To place a dollar value on the bargaining power created by merger, competition economists regress prices or profits paid by third-party payers 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 with a compensating differential of, say, ten percent would be predicted to raise price by six percent (e.g., Fournier and Gai, 2007).

In this paper, we apply some external validity checks to the methodology. First, we review the bargaining theories that have been used to interpret the compensating differentials as an increase in the bargaining power of the merged firm. All imply that the price change should be less than the change in the compensating differentials because the merged hospital “shares” some of the gains from merger with the health plan. This finding suggests a simple strategy for checking the external validity of the estimates: compare the compensating differentials which measure the change in consumer surplus, to the price effects of the merger, computed from the second stage price regression.

To do this, 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. Using the competition economics methodology, we estimate a price effect of 8.8%. We then estimate the merger effect using the environmental methodology which results in a price effect that is three orders of magnitude smaller (0.01%). The difference is driven by the second step: the competition approach predicts merger effects from the relative size of the compensating differentials, while the environmental approach makes a prediction from the absolute size, which is worth only about two minutes of travel time per patient.

Our second external validity check relates travel time to hospital mortality: we find that patients are reluctant to travel—even to get to hospitals with much lower risk. The travel cost model implies that patients either place an implausibly low value on their own lives, or have travel costs that are implausibly high⁶.

Finally, we find that travel time coefficient varies dramatically across conditions, in a predictable fashion. The implication of such between-condition variation in travel time is that merger effects would be different for different conditions. Our results suggest aggregation bias and suggest that merger effects would vary dramatically by condition.

The first two external validity checks point in the same direction: the compensating differentials reflect an implausibly low demand for medical care, and an implausibly high reluctance to travel. The third is less serious, but does suggest a different estimation strategy.

We conclude that something is wrong with the estimators used to compute the compensating differentials, and possibly with the theory linking compensating differentials to post-merger price increases. In the conclusion, we speculate that competition may be better characterized by a “physician workshop” model of hospital behavior (Pauly and Redisch, 1973; Pauly, 1980). If so, the observed reluctance of patients to travel may have little to say about the competitive effects of hospital mergers.

⁶ It could be argued that patients are ignorant of quality differences amongst hospitals. For conditions, such as cardiac surgery in which mortality risk exists, it seems implausible that a rational choice process would ignore such salient and publically available information.

II. Bargaining Between Payers and Providers

In this section, we examine the multilateral bargaining that goes on between payers and providers of medical care, and show how mergers can raise price. Our treatment of the material follows that in Werden, Froeb and Shor (2011) and in Fournier and Gai (2007).

As in Chipty and Snyder (1999), we consider the case of a single seller bargaining separately with multiple buyers. They show that the seller can exercise bargaining power if the demand and cost conditions in the market make the surplus function concave, i.e., if the marginal value to the network of the first hospital is larger than the marginal value of the second hospital, the payer can capture a bigger share of the surplus by creating competition among the hospitals.

To illustrate the role that such concavity plays in the bargaining between payers 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 bargain for \$60, while the separate merging hospitals could bargain for only a total of \$20.

The bargaining power of the payer derives from the substitution between the hospitals from the patients' point of view. If the hospitals are close substitutes, the threat to drop out of network means that surplus drops only by a small amount, i.e., only \$20 in the example above. The substitution between the hospitals

gives rise to concavity in the surplus function which allows the payers to create competition among the hospitals. Merger can eliminate this competition and allow the merged hospital to negotiate a better price.

To link this idea to the first stage demand estimation, competition economists compute the change in consumer surplus using a travel cost model of patient demand, where the patient's utility of choosing a given hospital is determined by hospital attributes, the opportunity cost of travel, and a random component. To compute the bargaining power of a hospital, economists compute the reduction in consumer surplus, integrated over a patient population, from removing a hospital from a provider network (e.g., Fournier and Gai, 2007).

Several axiomatic solutions to the bargaining between the payers and the hospitals imply that the increase in value created by merger is split evenly between the payer and the hospitals. Another axiomatic solution, the Shapley value gives more of the surplus to the pre-merger hospitals, which has the effect of reducing the merger effect (Werden et al., 2011). In any case, all of the axiomatic approaches imply that the change in price due to the merger is no more than the change in consumer value. This finding sets up our first external validity check: we compare the size of the estimated price increase--computed using the competition economics methodology--to the compensating differentials (the change in consumer surplus) computed using the environmental economics methodology.

Assessing the effect of a merger from the demand side is consistent with practice embodied in the *Horizontal Merger Guidelines*. Taking account of supply-side cost reductions due to the merger would lead to a *smaller* predicted merger price effect because the bargaining models imply that some of the cost synergies would be shared with the payer.

One weakness of the demand-side-only approach is that it misses the role played by capacity constraints. In particular, the counterfactual threat of a hospital leaving the system would have bigger profit 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 utilization of 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).

III. The Estimated Effect of Hypothetical Merger in Downtown Philadelphia

In this section, we estimate the effects of a hypothetical merger among two large hospitals in downtown Philadelphia. 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). We illustrate the draw areas of Thomas Jefferson and the University of Pennsylvania Hospital in Figure 1 below.

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 (Figure 1) and to the location and attractiveness of non-merging hospitals (Figure 2).

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 payers. 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 probably larger than the cost of foregone income. Travel time may be related to numerous visits to the hospital by family and friends, and there may be an emotional value to being close to loved ones in the hospital that is not picked up by the cost of foregone income. But the magnitude of the difference is striking: to generate a price increase of 8.8% using the environmental methodology, the cost of travel time would have to be over \$25,000/hour. We find this implausibly large.

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 payers.

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 negative 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.

This finding is similar to the small merger effect estimated above.

V. Travel cost varies by condition

The choice process by patients likely differs by the nature of their condition. The acuity, repeat nature of treatment regimen, and the elective nature all likely influence the search process and the patient's investment in the decision-making process. From the hospital perspective, some services are highly profitable and thus heavily marketed. In short, the choice process for a patient around childbirth will differ significantly from the choice process associated with cardiac procedures. We estimated our choice model separately for childbirth, cardiac catheterization, neurosurgery and chemotherapy. Table 3 presents the results of these four models. We find that patients are least willing to travel for childbirth and most willing to travel for neurosurgery, implying that the "market" for childbirth is much smaller than the market for neurosurgery.

Most hospitals however deliver services in many diagnostic categories. It is interesting to consider the choice specific constants for these same hospitals and the relationship amongst them for the same facility. Table 4 presents the Pearson correlation coefficients for the 55 hospitals in the greater Philadelphia area. What is noteworthy is that hospitals which are preferred for one service are not necessarily preferred for others. A hospital which has a large choice specific constant for childbirth tends to not be preferred for neurosurgery (a negative correlation of $-.322$). Taken together, it appears that

while there is a positive correlation amongst many of the pairwise comparisons, hospitals which are preferred for neurosurgery and chemotherapy are less likely to be preferred for more routine childbirth. If all hospitals exhibited similar service line preferences, aggregation would be sensible. If however, as appears in our example, preferences are uncorrelated, or negatively correlated a facility level analysis implicitly weights these service lines in ways which diverge from actual patient preferences.

VI. The Role of Capacity Constraints

The bargaining model between the health plan and the hospitals is predicated on the concavity of the surplus function. This concavity is in turn a function of how important that hospital is to the plan network. 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 2 “must have” facilities should 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 salient 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 is likely that each of these facilities is already a “must have”.

VII. 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 for a number of reasons.

Unlike the environmental application, imputed dollar denominated travel costs are frequently quite small relative to the actual cost of the hospital service. The existence of insurance indemnifies the individuals from actual costs. Actual differences in service attributes are further difficult to convey to the prospective consumer in tangible terms. As an experience good, health care suffers from an inability to adequately convey the salient dimensions of the experience a priori. 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 would imply an entirely different competitive mechanism at work.

For many years hospitals have been considered physician workshops (Pauly and Redisch, 1973). The primary competition among hospitals was 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 and attempt to establish loyalty directly with patients the physician likely remains 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 would change the interpretation one would lend to the empirical exercise. If, as seems likely, that physicians are free to switch hospitals at low cost, then the observed reluctance of patients to travel may have very little to say about the competitive effects of hospital mergers.

Figure 1: Draw Areas of University of Pennsylvania Hospital and of Thomas Jefferson Hospital

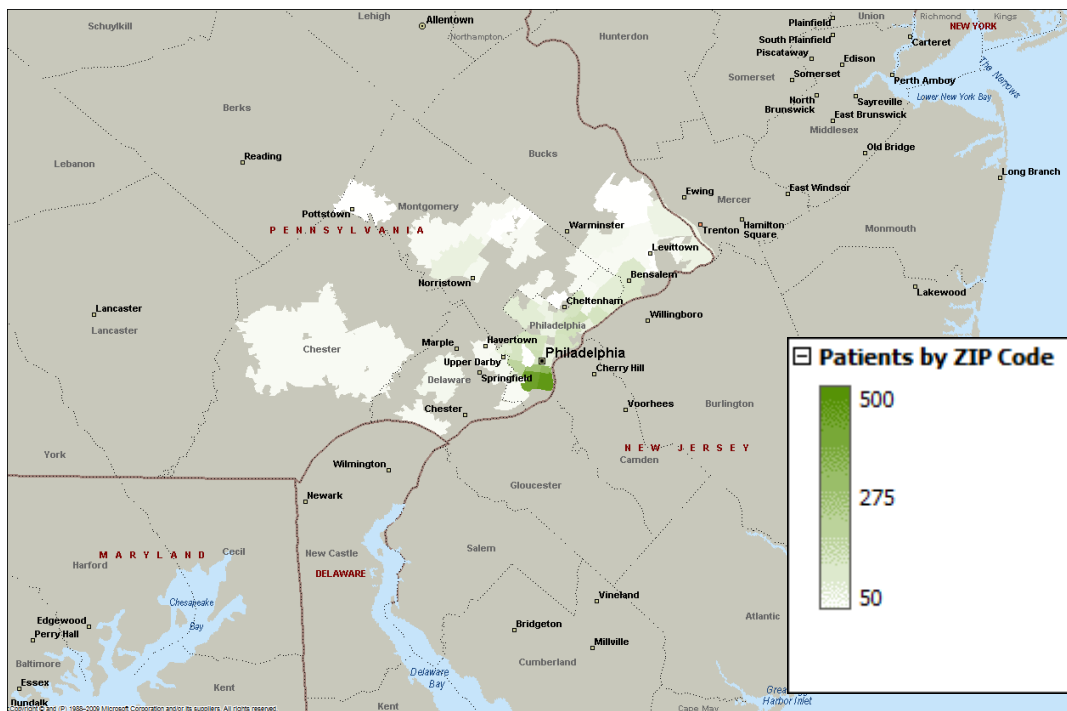
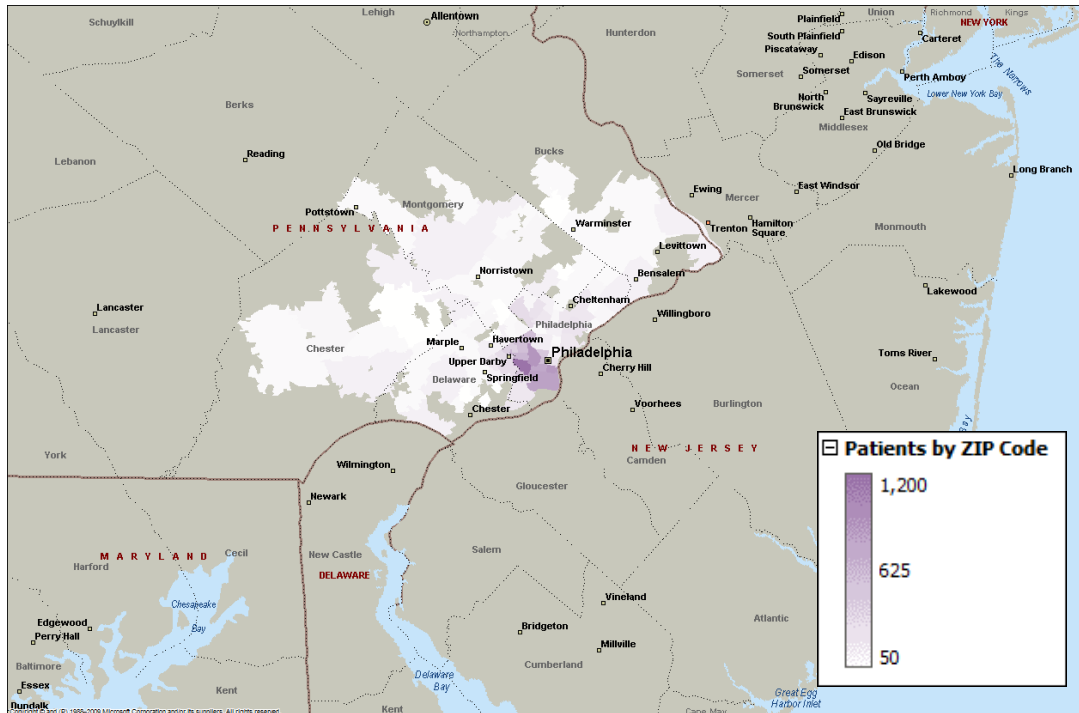


Figure 2: Universal Choice Set Near Philadelphia

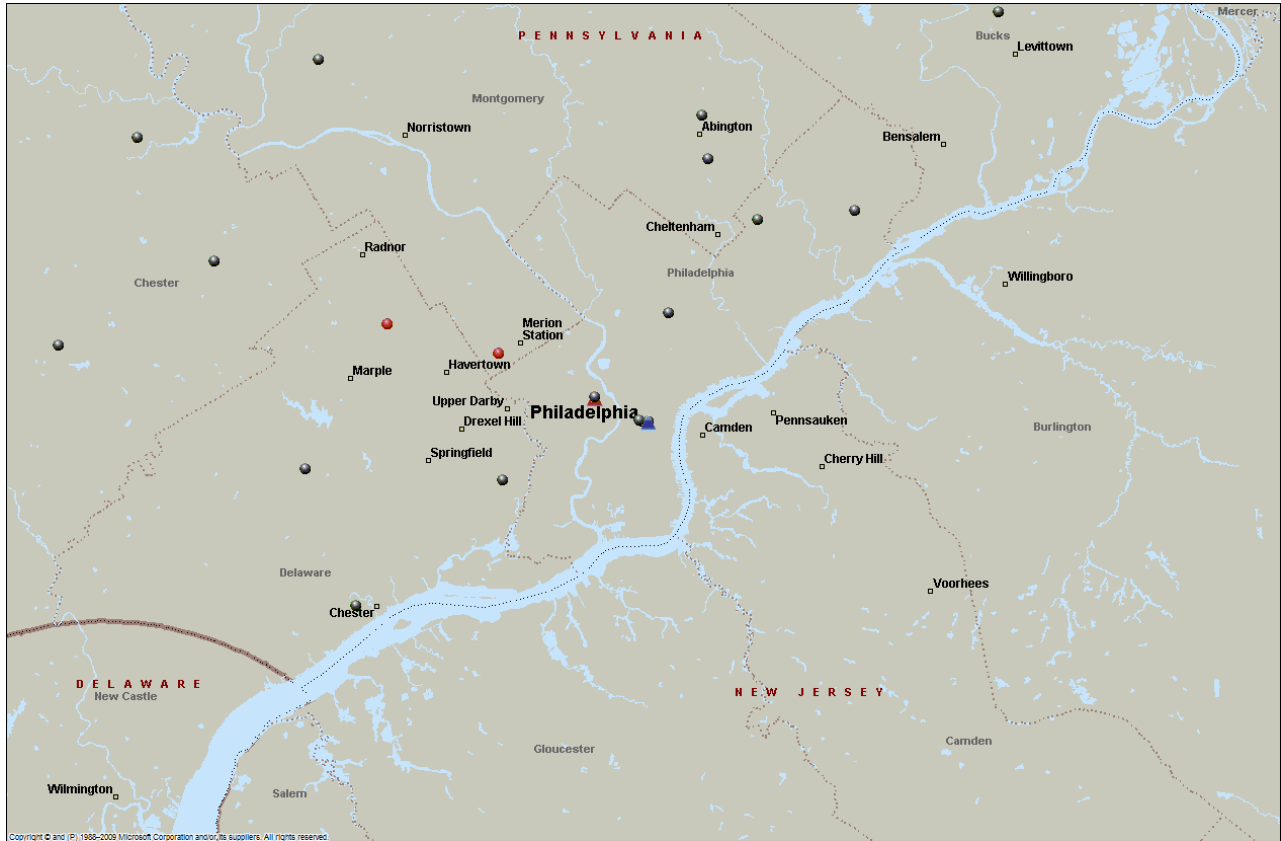


Table 1: Estimated Coefficients on Patient Choice Model

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Fp	-0.749***	0.045	cap*child	-0.112***	0.017	time*urinary	0.006***	0.001
fp*male	0.112***	0.017	cap*age	-0.007***	0.000	time*genital	0.018***	0.001
fp*white	-0.025	0.020	cap*income	7.370E-06***	0.000	time*psych	-0.003*	0.001
fp*elderly	-0.062**	0.029	cap*lstay	-0.005***	0.001	time*liver	0.009***	0.001
fp*child	-0.443***	0.041	cap*ndx	0.016***	0.002	time*endor	0.029***	0.001
fp*age	0.002***	0.001	cap*npx	0.016***	0.002	time*infection	0.018***	0.001
fp*income	0***	0.000	h_transplant	-0.096***	0.005	time*integ	0.001	0.001
fp*lstay	0.004***	0.001	h_nerv	0.228***	0.007	time*myelop	0.076***	0.001
fp*ndx	0.038***	0.004	h_nerv*nerv	0.249***	0.028	time*injury	0.014***	0.002
fp*npx	-0.099***	0.005	h_cardio	0.309***	0.006	time*ent	0.018***	0.002
Nurse	-222.169***	9.569	h_cardio*cardio	0.104***	0.014	time*image	-0.012***	0.002
nurse*male	28.194***	3.399	h_labor	0.461***	0.007	time*male	0.002***	0.000
nurse*white	81.947***	4.445	h_labor*labor	1.365***	0.020	time*white	0.012***	0.001
nurse*elderly	-26.476***	5.946	h_mri	-0.453***	0.006	time*elderly	-0.001	0.001
nurse*child	116.046***	8.112	h_mri_image	0.665***	0.062	time*child	0.008***	0.001
nurse*age	-0.055	0.168	h_psych	0.278***	0.005	time*age	-4.182E-04***	0.000
nurse*income	-0.001***	0.000	h_psych*psych	2.259***	0.042	time*income	-7.930E-07***	0.000
nurse*lstay	-0.517	0.336	time	-0.090***	0.002	time*lstay	2.802E-04***	0.000
nurse*ndx	10.306***	0.742	time*cardio	-0.001	0.001	time*ndx	0.002***	0.000
nurse*npx	11.815***	1.053	time*labor	-0.005***	0.001	time*npx	0.009***	0.000
Cap	0.143***	0.021	time*resp	-0.004***	0.001	time*fp	0.011***	0.001
cap*male	-0.081***	0.007	time*digest	0.001	0.001	time*nurse	4.694***	0.125
cap*white	-0.093***	0.009	time*muscl	0.036***	0.001	time*cap	-0.002***	0.000
cap*elderly	0.088***	0.013	time*nerv	0.036***	0.001			

*** 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)

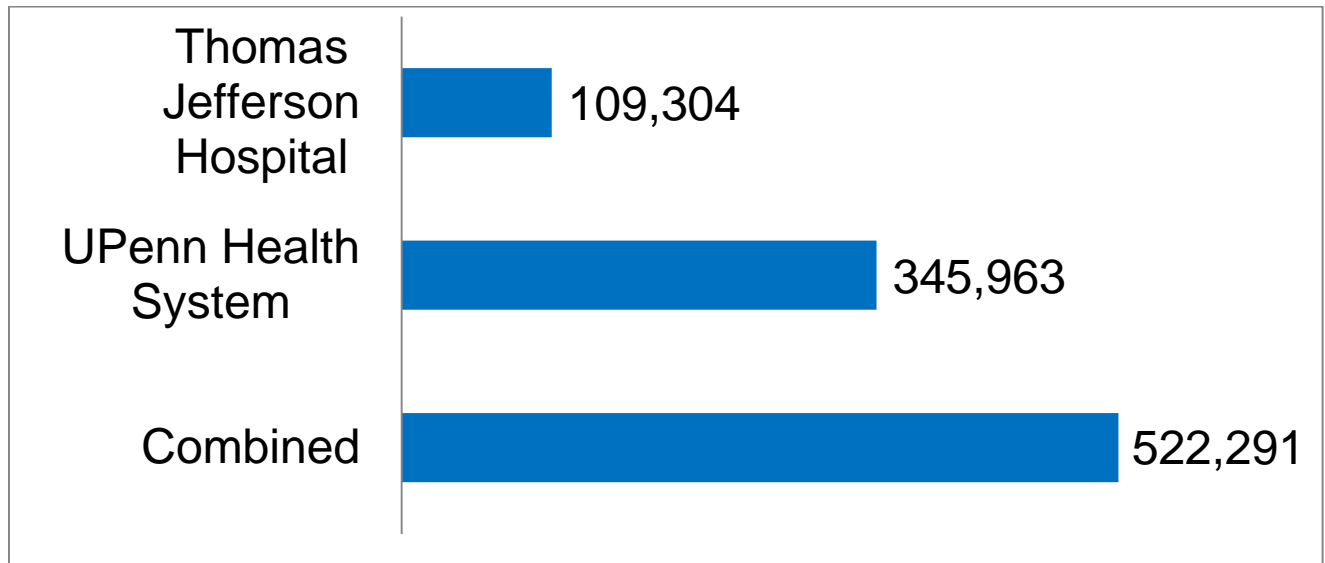


Table 2: Cardiac Catheterization Choice Model

Number of Inpatients	1477	1477
Number of Hospitals in Choice Set	2 to 10	34
Likelihood Function (no predictors)	-2094.0	-2940.9
Likelihood Function (at convergence)	-2038.7	-2847.4
Parameter Estimates		
Time	-0.025**	-0.123***
Income*Time	-4.41E-07***	-1.04E-07
For-Profit Status	-0.441***	-0.838***
Nursing Intensity	-323.014***	-318.638***
Capital Intensity	0.13	0.139
Transplant Service Offered	-0.149	0.046
MRI Service Offered	-0.710***	-0.927***
Teaching Status	0.520***	0.987***
Computed Tomography Service Offered	0.290**	0.569***
Cardiac Beds	-0.012***	-0.020***
Mortality Index	-0.131***	-0.088***
Marginal Effect of Time		
(evaluated at median income)	-0.05	-0.13
Implied WTP for of 1% Change in Mortality (valued in minutes)	2.6	0.68

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

Table 3: Choice Model for Four Elective Procedures, Choice-Specific Constants

	Childbirth (DRGs 767, 768, 774, 775)		Heart Catheterization (DRGs 24, - 251)		Chemotherapy (DRGs 846 -849)		Neurosurgery (DRGs 26,27)	
Number of Decision Makers	15194	15194	5110	5110	742	742	831	831
Number of Choices	55	55	55	55	38	38	34	34
Likelihood Function (no predictors)	-34143.69	-29364.01	-11290.62	-10663.25	-2267.15	-1543.92	-2571.06	-1624.71
Likelihood Function (at convergence)	-34116.47	-28529.36	-11197.54	-9905.07	-2250.09	-1412.51	-2550.17	-1542.11
Median Income of Sample	64957.05	64957.05	64310.76	64310.76	62416.79	62416.79	63255.48	63255.48
Paramter Estimates								
Time	-0.151***	-0.220***	-0.073***	-0.093***	-0.041***	-0.087***	-0.022***	-0.040***
Income*Time	2.23E-07***	7.02E-07***	-5.24E-07***	-5.97E-07***	-9.37E-08	-8.19E-09	-1.92E-07**	-2.32E-07*
Marginal effect of time	-0.137	-0.174	-0.107	-0.131	-0.047	-0.088	-0.034	-0.055

Table 4: Pearson Correlation Coefficients Across Hospital Choice Specific Constants

	Childbirth	Heart Cath	Chemotherapy	Neurosurgery
Childbirth	1			
Heart Cath	0.575	1.000		
Chemotherapy	0.320	0.834	1.000	
Neurosurgery	-0.332	0.281	0.751	1

VIII. References

- Balan, D. J., & Brand, K. J. (2009). Simulating hospital merger simulations. Retrieved from http://works.bepress.com/david_balan/7.
- Balan, David J. and Patrick S. Romano, [*A Retrospective Analysis of the Clinical Quality Effects of the Acquisition of Highland Park Hospital by Evanston Northwestern Healthcare*](#). Bureau of Economics, Federal Trade Commission, Working Paper # 307 ([abstract](#)) (November, 2010).
- Capps, Cory, David Dranove, and Mark Satterthwaite, "Competition and Market Power in Option Demand Markets," *RAND Journal of Economics*, September 2003, 34 (4), 737–763.
- Cooper, J., Froeb, L., O'Brien, D., & Vita, M. (2005). Vertical antitrust policy as a problem of inference. *International Journal of Industrial Organization*, 23, 639–664.
- Elzinga, K. G., & Hogarty, T. F. (1974). The problem of geographic market delineation in antimerger suits. *Antitrust Bulletin*, 18, 45–81.
- Farrell, Joseph, Paul A. Pautler, Michael G. Vita, Economics at the FTC: Retrospective Merger Analysis with a Focus on Hospitals, *Review of Industrial Organization*, 35 (2009) pp. 369–385
- Fournier, Gary M. and Gai, Yunwei, What Does Willingness-to-Pay Reveal About Hospital Market Power in Merger Cases? (April 2007). iHEA 2007 6th World Congress: Explorations in Health Economics Paper. Available at SSRN: <http://ssrn.com/abstract=993213>
- Froeb, Luke, Steven Tschantz and Philip Crooke, Bertrand Competition with Capacity Constraints: Mergers Among Parking Lots, *Journal of Econometrics* 113(1) (March, 2003) 49-67.
- Gal-Or, Esther, "Mergers and Exclusionary Practices in Health Care Markets," *Journal of Economics & Management Strategy*, 09 1999, 8 (3), 315–350.
- Gandhi, Amit, Luke Froeb, Steven Tschantz, and Gregory Werden, Post-Merger Product Repositioning, *Journal of Industrial Economics*, 41 (March, 2008) pp. 49-67. Available at SSRN: <http://ssrn.com/abstract=1119635>
- Gaynor, Martin and William B Vogt, "Competition among Hospitals," *RAND Journal of Economics*, 2003, 34 (4), 764–785.
- Gaynor, Martin, Samuel A. Kleiner, and William B. Vogt, [Structural Approach to Market Definition with an Application to the Hospital Industry](#), NBER Working Paper 16656 (2011).
- Gowrisankaran, Gautam, "Estimating the Impact of a Hospital Merger Using the Difference-in-Difference of Prices," *International Journal of the Economics of Business*, forthcoming; working paper (October 18, 2010), available at http://www.u.arizona.edu/~gowrisan/pdf_papers/hospital_merger_diffdiff_prices.pdf

- Haas-Wilson, D., & Garmon, C. (2009). Two hospital mergers on Chicago's North Shore: A retrospective study. Bureau of Economics, Federal Trade Commission, Working Paper # 294.
- Hausman, Jerry and Daniel McFadden, [Specification Tests for the Multinomial Logit Model](#), *Econometrica*, Vol. 52, No. 5 (Sep., 1984), pp. 1219-1240.
- Ho, Katherine, "[Insurer-Provider Networks in the Medical Care Market](#)," *American Economic Review*, 2009, 99(1): 393-430.
- Ho, Katherine, "[The Welfare Effects of Restricted Hospital Choice in the US Medical Care Market](#)", *Journal of Applied Econometrics*, Vol. 21, No. 7, 2006, pp. 1039-1079.
- Haab, Timothy C. and Kenneth E. McConnell, *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*, Cheltenham UK: Edward Elgar Publishers, 2003.
- Kalnins, Arturs, Luke Froeb, and Steven Tschantz, Mergers Increase Output When Firms Compete by Managing Revenue, (*September 1, 2010*). Available at SSRN:<http://ssrn.com/abstract=1670278>
- Keeler, Emmett B., Glenn Melnick, and Jack Zwanziger, "The changing effects of competition on non-profit and for-profit hospital pricing behavior," *Journal of Health Economics*, January 1999, 18 (1), 69–86.
- Kessler, Daniel and Mark McClellan, "Designing Hospital Antitrust Policy to Promote Social Welfare," NBER Working Papers 6897, 1999.
- Melnick, Glenn and Emmett Keeler, "The effects of multi-hospital systems on hospital prices," *Journal of Health Economics*, March 2007, 26 (2), 400–413.
- Pakes, Ariel, "Alternative Models for Moment Inequalities," *Econometrica*, Vol. 78, No. 6 (November), pp. 1783-1822
- Perry, Jeffrey, Hospital Merger Simulation, Talk before the ABA, (Aug 19, 2010). Available at http://apps.americanbar.org/antitrust/at-committees/at-hcic/pdf/past-programs/20100601_perry.pdf
- Parsons, George R. and A. Brett Hauber. "Spatial Boundaries and Choice Set Definition in a Random Utility Model of Recreation Demand" *Land Economics* 74.1 (1998): 32-48.
Available at: http://works.bepress.com/george_parsons/22
- Pauly, Mark V., *Doctors and Their Workshops: Economic Models of Physician Behavior*, (National Bureau of Economic Research Monograph, 1980).
- Pauly, Mark V. and M. Redisch (1973), "The Not-for-Profit Hospital as a Physicians' Cooperative," *American Economic Review*, 63(1): 87-99.
- Tenn, Steven and John M. Yun, "Biases in Demand Analysis Due to Variation in Retail Distribution," FTC working paper No. 287 (February, 2007).

- Tenn, Steven. (2008). The price effects of hospital mergers: A case study of the Sutter-Summit transaction. Bureau of Economics, Federal Trade Commission, Working Paper # 293.
- Thomas, Brian J., Carlos Martins-Filho, and Scott J. Thomas, “Are Price Changes Sufficient for Evaluating the Competitive Effects of a Hospital Merger?” working paper, University of Colorado, 2011.
- Thompson, Aileen. (2009). The effect of hospital mergers on inpatient prices: A case study of the New Hanover-Cape Fear transaction. Federal Trade Commission, Bureau of Economics, Working Paper # 295.
- Town, Robert and Gregory Vistnes, “Hospital competition in HMO networks,” *Journal of Health Economics*, 2001, 20 (5), 733–753.
- Gregory Vistnes, Hospitals, Mergers, and Two-Stage Competition , *Antitrust Law Journal*, 67 (2000) pp. 671- XX.
- Werden, Gregory J., “The Limited Relevance of Patient Migration Data in Market Delineation for Hospital Merger Cases,” *Journal of Health Economics* 8 (1989) pp 363-XX.
- Werden, Gregory J., Froeb, Luke M. and Shor, Mikhael, Behavioral Antitrust and Merger Control. *Journal of Institutional and Theoretical Economics* (2011, forthcoming), available at SSRN: <http://ssrn.com/abstract=1612282>
- and — [2008a], “Unilateral Competitive Effects of Horizontal Mergers,” pp. 43–104 in: P. Buccirossi (ed.), *Handbook of Antitrust Economics*, The MIT Press: Cambridge, MA.
- Werden, Gregory and Luke Froeb, Unilateral Competitive Effects of Horizontal Mergers II: Auctions and Bargaining, *Issues in Competition Law and Policy*, W. Dale Collins (ed.), ABA Section of Antitrust Law, 2008b, vol. 2, 1343. Available at SSRN: <http://ssrn.com/abstract=956400>
- Werden, G. J., & Froeb, L. M. (1994). The effects of mergers in differentiated products industries: Logit demand and merger policy. *Journal of Law, Economics, & Organization*, 10, 407–426.
- , —, and D. T. Scheffman [2004], “A *Daubert* Discipline for Merger Simulation,” *Antitrust*, 18(3), 89–95.