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WORKSHOP IN HEALTH ADMINISTRATION STUDIES

SPRING, 1990

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"The Determinants of Resource Supply in Local Hospital Markets: Does Competition Matter?"

for

Thursday, May 3, 1990

Rosenwald 405

3:30 - 5:00 p.m.

Is Health Care Competition Wasteful? No!

by

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May 1, 1990

Preliminary -- Comments Welcome

This is a condensed version of a paper presented at the RAND Conference on Health Economics. The full length, uncut, unedited version is available through the Center for Health Administration Studies. The authors are indebted to the diligent research assistance of Wendell Brooks, Lawrence Wu, and Robert Bornholz. We received valuable comments from participants at the RAND Conference, workshops at the University of Chicago and UCLA, and the Department of Justice.

Is Health Care Competition Wasteful? No!

1. Introduction

Not all hospitals are the same. Hospitals within any market may offer markedly different arrays of services to markedly different mixes of patients. Some may offer only a few basic hospital services such as acute medical and surgical care, deliveries, care for normal newborns, routine diagnostics, etc. Others may offer more specialized services, such as cancer therapy, heart surgery, neonatology, CAT scans, etc. Similarly, large differences may be found across markets. The typical hospital in a large urban area offers a much wider and more specialized range of services than its counterpart in a small urban or rural area. Our purpose in this paper is to explain intermarket differences in the scope and level of services. We contrast the hypothesis that the number of providers is determined by the "extent of the market" against the hypothesis that non-price competition leads to wasteful duplication of specialized services.

A leading explanation of intermarket differences in hospital service availability is linked to variation in the degree of competition across markets. It is hypothesized that hospitals in more competitive markets provide duplicative services (i.e., services in excess of that which would be demanded by the market) in order to attract physicians. The seminal statement of this position appears in Robinson and Luft (1985). Although these authors focus on service provision, they analyse costs. They apparently find that hospitals in close proximity to many other hospitals are more costly than hospitals with few surrounding competitors. From this result, they infer that these high costs are indicative of costly and inefficient "quality

2. Theories of Service Provision

We consider two theories of service provision: the extent of the market and the medical arms race.

The extent of the market

The extent of the market explanation builds on the fundamental principles of microeconomics. The number of sellers in a market is determined jointly by the market demand, economies of scale, and the nature of competition between sellers. Generally speaking, one expects more sellers whenever:

- Demand is greater;
- There are few exploitable scale economies in the production of services; and
- Pricing is not competitive; i.e., profits are not dissipated by new entrants.

In short, services are provided only when additional expenditures are warranted in the face of increasing demand.

The Medical Arms Race

Health economics researchers have hypothesized that competition has a dramatically different effect on resource supply. The medical arms race hypothesis of Robinson and Luft (1985), Luft et al. (1986), Robinson (1988), Robinson et al. (1988), and Noether (1988) is that hospitals in more "competitive" markets compete on the basis of quality, where quality is synonymous with costly, frequently "high tech", services. Thus, the supply of services per unit of demand in more competitive markets exceeds the supply

An alternative explanation for intermarket differences in service supply is that there are variations in demand for services, along with non-constant returns to scale in the production of services. To paraphrase Adam Smith, the supply of specialized hospital services is limited by the extent of the market. To our knowledge, there has been no comprehensive test of this explanation. We attempt to distinguish between these two explanations by directly examining various determinants of service availability in local hospital markets. While the two alternative explanations are not mutually exclusive, the evidence that we present below suggests that the latter explanation (supply and demand) is the only one needed and that the alternative does not hold up.

Distinguishing between these competing hypotheses -- excess quality competition versus the extent of the market -- has profound implications for hospital anti-trust policies. In a recent hospital merger case (USA versus Carilion Health System and Community Hospital of Roanoke Valley), the economist for the defendants presented evidence that hospital rates are lower where there are fewer competitors. The judge accepted this evidence, stating, "as a general rule hospital rates are lower, the fewer the number of hospitals in an area." By implication the judge felt that, *ceteris paribus*, consolidation in the market would result in lower rates. Similar issues are likely to be important in the appeal of a related case in Rockford, Illinois (USA versus Rockford Memorial Corporation and SwedishAmerican Corporation).

data tape, which reports service availability in 1982-1983. Zwanziger and Melnick (1988) replicated Robinson and Luft's (1985) MAR-like results up through those years.

Our interest is in exploring the relative availability of hospital services in different markets. Before we specify an empirical methodology, it is therefore useful to explain how we (1) identify distinct markets, and (2) identify distinct services.

Market identification

We identified a total of 103 markets, with 445 community hospitals. As our interest is in measuring competitive effects, we restrict our analysis to the 87 markets in which there is at least one hospital. The hospitals in these markets account for 98% of all of the community hospitals in California, and all but one of the community hospitals with over 100 beds. A complete list of markets, along with some demographic and geographic information, appears in Appendix One of the complete paper.

The markets that we examine are treated as independent observations when in fact they may be spatially related. Thus residents of one market may constitute a fringe demand for services provided in another. Conversely, hospitals in one market may constitute a fringe supplier to other markets. Failure to account for fringe supply and fringe demand will bias the estimated effects of other variables by underspecifying the overall extent of the market. We control for this by including in our analysis measures of the geographic proximity of markets. As our results suggest, the significant MAR effect documented elsewhere may be an artifact of the failure of other researchers to properly specify fringe supply and fringe demand.

found in less competitive markets, <u>ceteris paribus</u>. The rationale for this hypothesis is as follows.

According to these authors hospitals compete by trying to increase market share. Hospitals take steps to make themselves more attractive to physicians, in the belief that physician preferences determine admission patterns. For example hospitals will offer the latest advances in technology, such as CAT scans or magnetic resonance imaging units. Hospitals need not worry about costs because many insurers reimburse on the basis of accounting costs. By implication, this service-based competition between hospitals is inefficient.

The MAR hypothesis turns anti-trust analysis on its head. Competition is inefficient. It leads to too many sellers of costly services in a market.

3. Data

The data that we analyze comes from the California Office of Statewide Health Planning. Every year, each hospital in the state reports detailed financial and utilization data, which the state of California makes available to the public at modest cost. The financial information includes standard accounting reports, patient census data, and revenues and expenditures broken down by cost center. In addition, hospitals report the presence or absence of 171 specific hospital services. The utilization information includes details about every admission, including the diagnosis, and the patient's residence zip code. Both the financial and utilization data have been widely used by academic researchers and appear to be of high quality.

We wished to use recent data while at the same time maximizing the possibility of finding support for the MAR hypothesis. Previous studies of the MAR mostly used data from the 1970s. We use the 1983 California financial

4. Methods

We estimate equations predicting how many specialized providers of service we find in a given market. We examine nine service categories and four specific services, yielding thirteen prediction equations.

Prediction model

We posit that the number of specialized service providers in a market is a function of the following independent variables:

- Demand -- local and fringe;
- Supply -- local costs, scale economies, fringe suppliers; and
- Competition.

We measure these variables as follows.

Dependent Variable

- The dependent variable N_{ij} is the number of hospitals in market i defined to be a specialized provider of service j.

Independent Variables

- The independent variables specific to local demand are POP, defined to be the natural log of local population, and INCOME, defined to be the mean family income. Both variables are determined from the 1980 census. We used a log transformation of POP both to take account of potential scale economies, and because it affords a better fit for the other variables in the model.

Service identification

The surveys indicate the presence or absence of 171 different services. It would be inappropriate to analyse each of the 171 different services separately because:

- Some services are close substitutes both in treatment of patients and in attracting physicians; and
- There may be scope economies so that services are offered in conjunction with others.

We deal with the above considerations by aggregating the 171 service offerings into distinct service groupings. We exclude services provided by virtually all hospitals, as well as those with substantial outpatient substitutes. We place the remaining 64 services into ten service groupings, based on clinical or technological compatibility. Examples include cardiology, neonatology, and diagnostics. A list of service categories and component services appears in Appendix Two of the complete paper. Specialized providers within a given service category are defined to be those hospitals that offer the most types of services within the category. For a typical category, a specialized provider is in the upper 30% of service offerings.[1]

At the cost of ignoring the issues that led us to aggregate, we independently analyze the provision of four specific hospital services: open heart surgery, full body CAT scans, radiation therapy and radioisotope therapy. Each of these has substantial fixed costs, so that unnecessary duplication of any of these services would be economically wasteful.

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[1] For example, consider neonatology. The neonatology category consists of four services (e.g., newborn intensive care). Hospitals classified as specialized providers of neonatology offered at least three of these services.

We may write our initial model as follows:

(1) $N_{i,j}$ = f(POP, FRINGEPOP, DISTANCE, INCOME, JANCOST, HERF).

Two econometric issues arise in estimating such a model.

First, the dependent variable is categorical. An appropriate technique for estimating the relationship between a categorical dependent variable and its independent predictors is an "ordered probit" model. The advantages of using ordered probit are discussed more fully in the complete paper.

The second problem is that Herfindahl is highly correlated with the other demand and supply shifters, thereby compromising inferences about the effects of the right hand side variables. We address this problem by constructing a residualized value of the Herfindahl index. The Herfindahl index is regressed on our set of demand shifters.[3] The residual from this regression, denoted HERFRES, can be interpreted as that portion of the Herfindahl that is unrelated to the "size" of the market. HERFRES is used in our service prediction equations.

This approach points out that there two distinct ways that the Herfindahl can change. First, holding the extent of the market constant, the Herfindahl can vary for <u>exogenous</u> reasons, such as historical factors, regulatory factors, or merger activity. Second, as the extent of the market increases, the number of hospitals increases, causing an <u>endogenous</u> decrease in the Herfindahl. Note that the former is of interest for anti-trust analysis; the only solution to inefficiencies resulting from the latter change in Herfindahl is to change the extent of the market!

The dual components of HERF are illustrated in Figure 1. The horizontal axis indicates the extent of the market, indicated here solely by POP. The

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[3] We regress Herfindahl on POP, FRINGEPOP and DISTANCE.

• In order to control for differences in variable costs (especially labor costs) across markets we include JANCOST, defined to be the average expenditure for aides and orderlies per bed in thousands of dollars.

• We define our fringe supply measure, DISTANCE, as follows. For urbanized areas this is the log of the distance to the nearest more populous urbanized area. For non-urbanized areas this is the log of the distance to the nearest urbanized area.[2] We define our fringe demand measure, FRINGEPOP as follows. For any given market Y, FRINGEPOP is the log of the total population of all other markets X, such that X has the following characteristics: (1) X is less populous than Y; and (2) of all markets more populous than X, Y is the closest. We predict that for services for which geographic considerations are important, (e.g., not for emergency services), the coefficients on both DISTANCE and FRINGEPOP should be positive. Moreover, to the extent that local service supply responds more to local demand, we predict that the coefficient on FRINGEPOP will be less than the coefficient on POP. Further discussion of the fringe supply and fringe demand variables appears in the complete paper.

• Our final predictor is a measure of competition, the Herfindahl index (HERF). The Herfindahl index is simply the sum of squared market shares. More competitive markets have lower Herfindahls.

Table 1 presents summary statistics for each of the variables.

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[2] We used the 1989 Rand McNally Road Atlas to determine highway distances between cities. When possible and reasonable, we used interstate highway miles. The value of DISTANCE for Los Angeles was the distance to San Francisco. Our logic was that this was the only market offering an array of services fully competitive with those offered in Los Angeles.

coefficients from the ordered probit analysis. The last row indicates, for each independent variable, whether the average coefficient across the thirteen service categories is positive or negative, and whether it is significant under the assumption that the services are independent. Table 3 reports the prediction accuracy of the ordered probit models.[5]

As seen in Table 2, the coefficient on POP is positive and significant for all services. This means that increases in local population lead to increases in the number of services. The coefficient on FRINGEPOP is also positive and generally significant. The coefficient on DISTANCE is usually positive but not significant. The positive coefficients on FRINGEPOP and DISTANCE imply that fringe demand and fringe supply influence resource availability in a manner that is consistent with the extent of the market theory. Joint tests on both FRINGEPOP and DISTANCE suggest that the pattern of positive coefficients is not due to chance.

Two points about FRINGEPOP are worth noting. First, the effect of FRINGEPOP is smallest for emergency services. This makes sense. When specialized emergency services are needed, travel is prohibitively costly. Second, the coefficients on FRINGEPOP are consistently one-fifth to one-tenth the magnitude of the coefficients on POP. We are led to conclude that local resource supply responds mostly to local demand.

The remaining variables, INCOME, JANCOST and HERFRES, are generally non-significant in individual equations but marginally significant in joint hypothesis tests. The signs are generally as expected. Higher incomes result in greater service availability. Higher costs reduce service availability.

[5] Prediction accuracy is defined as the percentage of the time that the predicted ordinal level of service provision is the correct level.

vertical axis measures the number of services available. The solid curve represents the availability of services in the absence of a MAR. In this example as POP increases from POP_0 to POP_1, the number of services increases from S_0 to S_1. (I.e., from point X to point Y.)

The steeper dashed curve in Figure 1 represents the MAR. As the market grows, more hospitals enter. Competitive interaction of these hospitals leads to the additional provision of services above and beyond those required to meet demand. This is the endogenous effect. At the initial population POP_0, the level of services is S_2 (point M). As population increases to POP_1, the level of services increases to S_3 (point N). The additional amount of service due to the competitive effect equals $(S_3 - S_2) - (S_1 - S_0)$, which is positive.

Point Q in Figure 1 represents the effect of an exogenous decrease in the Herfindahl (i.e., increase in competition) in a market with population POP_1. As illustrated, there is an additional MAR effect equal to S_4-S_3.

5. Results

To preview our results, we have plotted in Figure 2 the number of specialized providers per capita against the number of hospitals in the market for a representative specialized service, cardiology.[4] If the MAR story is dominant, we would expect this plot to show an upward trend -- as more hospitals appear in a market, they add services beyond the level demanded by the population. In fact, the plot shows a downward trend.

The ordered probit analysis more fully controls for the factors that determine resource supply. Table 2 presents, for each service, the estimated

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[4] For presentation purposes, we have omitted from the figure all markets with no specialized providers, as well as San Francisco and Los Angeles.

comparable to the mean market population in our study. The MAR effect is somewhat more important in larger, more competitive markets.

The importance of FRINGEPOP and DISTANCE

Not only are FRINGEPOP and DISTANCE significant and somewhat important predictors of the level of services, omitting them imparts a serious bias to competition variables. The estimated coefficient on HERFRES increases by 25% to 80% when FRINGEPOP is omitted. This happens because, in our data, competitive markets draw from large fringe populations. The estimated coefficient on HERFRES increases by as much as 25% when DISTANCE is omitted. Omitting either FRINGEPOP or DISTANCE also increases the statistical significance of HERFRES. For example, when FRINGEPOP is omitted, the joint test on HERFRES is significant at p = .04 (versus p=.10 when FRINGEPOP is included).

FRINGEPOP and DISTANCE provide particularly important examples of the implications of underspecifying the extent of the market. We acknowledge that our study may exclude important determinants of the extent of the market; hence, our coefficients may be biased as well. An implication is that our results likely reflect an upper bound on the importance of competition.

Evidence on price competition and scale economies

We can use the probit results to investigate the pattern of entry in hospital markets as a function of demand. Table 6 reports the minimum population necessary to support various levels of service in a market.[6] It

[6] These estimates are based on the reduced form coefficients on POP. Since the medical arms race story appears to be of little economic importance, the estimates largely reflect the direct effect of population on the extent of

Greater competition, as measured by lowered values of HERFRES, also increases service availability. The statistical significance of the coefficients does not imply economic significance.

The economic significance of these coefficients can be assessed by determining how resource availability changes with changes in independent variables. Table 4 examines the effect of a one standard deviation change in the value of each of the independent variables on the predicted number of services in a market. These are computed holding all other independent variables constant at their mean values and are rounded to the nearest one-half provider. Thus, a zero indicates that the change in the number of providers is less than .25.

The results in Table 4 are striking. POP matters a lot. FRINGEPOP matters sometimes. Little else matters. Changes in other independent predictors, including HERFRES, do not increase resource availability.

We can decompose the POP coefficient into two parts: the direct population effect and the endogenous medical arms effect. We can then determine the economic importance of the endogenous MAR effect in a manner analalogous to that used to identify the importance of the HERFRES effect. Detailed exposition is contained in the complete paper.

Table 5 reports the endogenous MAR effect on the predicted level of service availability, exactly as in Table 4. The effect is calculate both at the mean level of population and at one standard deviation above the mean. The endogenous MAR effect is trivial when calculated at the mean level of population. In no case does it lead to the existence of even one more provider of services in the market. This has particularly important antitrust implications; the contested markets in Roanoke and Rockford have populations taken for granted. Our analysis shows that it should not be taken for granted. Specifically, local population is a powerful predictor, and any specification that does not carefully consider population is lacking. Measures of fringe supply and demand are also important. When these basic measures of the extent of the market are included in the model, the importance of market competition is greatly reduced. Given the omitted variable bias associated with the market competition variable, it is difficult to maintain any role for market competition as a determinant of resource supply.

Our results augment those of Bresnahan and Reiss (1989), who find that the number of sellers of a variety of services does not increase as fast as does local demand. They interpret this as a competitive effect; i.e., profit margins fall as the number of sellers increase. If we offer this interpretation for our results, then the MAR hypothesis is turned on its head. That is, competition drives down profit margins with the result that fewer services are provided. This reversal of the MAR hypothesis highlights the importance of the endogeneity of the degree of competition in local markets. If we instead argue that there is no role for competition in determining hospital resource supply, then our results suggest substantial scale economies.

The public policy ramifications of our analysis are substantial. First, our results undermine those of recent studies that have questioned the application to hospitals of the fundamental tenet of anti-trust theory -- that competition promotes efficiency. Our results cast doubt on claims that hospital mergers increase efficiency by reducing competition. Second, our results suggest there may be unexploited scale economies in smaller markets also reports the incremental populations necessary to support additional providers. For example, in the case of cardiology, it takes a local population of 60,000 to support one specialized provider. A second provider enters at a population of 233,000. Additional population increases of 300,000-400,000 lead to the entry of additional providers. A similar pattern appears for most of the remaining services: the population necessary to support one provider is relatively small; the incremental population necessary to support a second provider is somewhat larger; additional providers enter at relatively constant, albeit larger, increments. In two cases (open heart surgery and radiation therapy) the increments stabilize after just one entrant. In two other cases (neonatology and pediatrics), the pattern of entry is contrary to expectations.

These results are broadly consistent with the existence of scale and scope economies in the provision of specialized hospital services. A number of alternative explanations are discussed in the complete paper. We can not, however, support the MAR hypothesis. If the MAR hypothesis was correct, then we would expect that the incremental population necessary to support additional providers would <u>decline</u> as the market grew.

5. Discussion

Heretofore, discussions of the determinants of hospital service provision have focused on the role of quality competition. The empirical analyses associated with these discussions have devoted little attention to a simpler explanation -- that the supply of resources is determined by the extent of the market. The empirical specification of the extent of the market has been

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the market. The estimates are evaluated at the means of the other variables.

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-- this may be a superior justification for hospital mergers. The potential for economies in services such as deliveries was an important stated rationale for the Roanoke merger (which was approved by the district court). Ironically, the hospitals in the Rockford case (in which the district court denied the merger) did not emphasize scale economies in either their pre-merger analyses or their pre-trial briefs.

The focus on "inefficient competition" in the recent district court ruling in the Roanoke case is troublesome. The presumption that hospital services do not follow the dynamics of supply and demand was too easily accepted. As our analysis shows, one needs to examine alternatives to traditional market models with great scrutiny. The null hypothesis -- that the supply of services is determined by the extent of the market -- has shown its usefulness for two hundred years.

Table 1 - Descriptive Statistics for Independent Variables

Variable	Mean	Median	Std. Deviation	Range
Ln(Population)[a]	-.95	-1.2	1.41	-2.9 to 4.5
Ln(FringePop)[b]	-3.51	-3.9	1.98	-4.6 to 2.5
Ln(Distance)	3.56	3.1	.82	2.3 to 5.3
Income (000's)	1.92	1.8	.29	1.4 to 3.0
Janitor Cost[c]	3.17	2.7	1.44	0.6 to 8.7
Herfres	0	-1.3	17.8	-46 to 34

[a] Population in 100,000's. Variables were scaled such that the independent variable set was of approximately the same magnitude. This increases the efficiency of the non-linear ordered probit estimation techniques.

[b] Fringe Population in 100,000's. Markets with no fringe population were coded as 0.01.

[c] Average expenditures on janitors, aides and orderlies per bed. In $1000's.

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Table 3 - **Model Prediction Accuracy: Percentage of Markets Where the Level of Services is Correctly Predicted By the Model**

Service	% Correctly Predicted
Cardiology	77
Deliveries	75
Diagnostics	81
Emergency	61
Neonatology	64
Pediatrics	73
Pharmacy	61
Teaching	93
Specialized	75
CT Scans	75
Open Heart Surgery	91
Radiation Therapy	81
Radio-isotope Therapy	80

Table 2 - **Probit Results: Demand Coefficients** (t-statistics in parentheses)

Service	POP	FRINGE-POP	DISTANCE	INCOME	JANCOST	HERFRES
Cardiology	.927[c]	.200[a]	.250	.234	-.109[a]	-.009
	(3.60)	(1.74)	(.86)	(.28)	(-1.10)	(-.83)
Deliveries	.766[c]	.191[a]	.264	-.538[a]	-.134[a]	-.008
	(3.88)	(1.94)	(1.28)	(-1.74)	(-2.07)	(-.39)
Diagnostics	1.794[c]	.084[a]	.262	.469	-.112	-.015
	(5.46)	(1.68)	(.75)	(.76)	(-.72)	(-1.24)
Emergency	.813[c]	.032	.086	.417[a]	-.052	-.018[a]
	(2.93)	(.30)	(.35)	(1.69)	(-1.37)	(-1.84)
Neonatology	.914[c]	.163[a]	.151[a]	-.214	-.014	-.009
	(4.78)	(1.69)	(1.73)	(-.61)	(-.15)	(-.59)
Pediatrics	.689[c]	.109[a]	.416[a]	.389	.057	-.016
	(3.85)	(1.83)	(1.65)	(.85)	(.44)	(-1.04)
Pharmacy	.952[c]	.241[b]	-.046	.402	-.102[a]	-.016[a]
	(4.57)	(2.15)	(-.21)	(1.01)	(-1.91)	(-1.83)
Teaching	1.70[a]	-.277	.769	.739	.337	.028
	(2.08)	(.66)	(1.15)	(.64)	(.64)	(.81)
Specialized	1.54[c]	.142	-.058	.219	-.037	-.003
	(4.50)	(1.19)	(-.23)	(.61)	(-.53)	(-.24)
CAT Scans	1.08[c]	.076	-.022	.246	-.288[c]	-.015
	(3.41)	(.56)	(-.06)	(.73)	(-2.45)	(-1.41)
Open Heart Surgery	1.28[b]	.065	.281	1.05[a]	-.345	-.026
	(1.99)	(.82)	(.30)	(1.80)	(-1.35)	(-1.15)
Radiation Therapy	.828[c]	.065	.521[a]	.209	-.040	-.004
	(3.37)	(.46)	(1.68)	(.29)	(-.42)	(-.40)
Radio-isotope Therapy	1.89[c]	.289[b]	.069	.148	.179	-.009
	(2.91)	(1.99)	(.20)	(.11)	(.89)	(-.90)
Joint Test	+[c]	+[c]	+[a]	+[a]	-[a]	-[a]

[a] - Sign. at $p < .10$ [b] - Sign. at $p < .05$ [c] - Sign. at $p < .01$

Table 5 - Estimated Effect of Competition on the Provision of Services

Service	Bias in Pop. Coefficient	Additional Services at: Mean Xß	+1 Std.Dev Xß
Cardiology	.144	0	0
Deliveries	.121	0	0
Diagnostics	.251	0	.5
Emergency	.279	0	.5
Neonatology	.147	0	0
Pediatrics	.309	.5	.5
Pharmacy	.255	0	.5
Teaching	.330	0	0
Specialized	.041	0	0
CAT Scan	.169	0	0
Open Heart Surgery	.246	.5	.5
Radiation Therapy	.060	0	0
Radio-isotope Therapy	.205	0	.5

Variables on the Number of Services in a Market (Rounded to nearest one-half service)

Service	Mean Providers[b]	POP	FRINGE-POP	DISTANCE	INCOME	JANCOST	HERFRES
Cardiology	1.9	1.5	.5	0	0	0	0
Deliveries	2.0	1.5	.5	0	0	0	0
Diagnostics	2.2	2.0	0	0	0	0	0
Emergency	1.6	1.0	0	0	0	0	0
Neonatology	2.1	1.5	.5	0	0	0	0
Pediatrics	.91	1.0	0	.5	0	0	0
Pharmacy	2.3	1.0	.5	0	0	0	0
Teaching	.70	1.0	0	.5	.5	0	.5
Specialized	1.9	1.5	.5	0	0	0	0
CT Scans	1.8	1.5	0	0	0	-.5	0
Open Heart Surgery	1.4	1.5	0	.5	.5	-.5	-.5
Radiation Therapy	1.2	1.0	0	.5	0	0	0
Radio-isot. Therapy	1.7	1.5	.5	0	0	0	0

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[a] - Marginal effects computed holding all independent variables at their mean values.
[b] - Mean number of specialized providers per service per market.

Table 6 - **Population Necessary to Support "N" Services Per Market (in 1000's)**

(Differences between successive levels of service are in parentheses. If there is a jump, the difference is divided by two)

Number of Services

Service	1	2	3	4	5	6
Cardiology	60	233 (173)	667 (434)	943 (276)	1310 (367)	*
Deliveries	32	120 (88)	536 (416)	1050 (514)	*	1807 (379)
Diagnostics	47	114 (67)	232 (118)	341 (109)	*	594 (127)
Emergency Room	52	406 (354)	1275 (869)	2011 (736)	*	*
Neonatology	26	145 (119)	984 (839)	*	1481 (249)	*
Pediatrics	106	791 (685)	1281 (490)	*	1941 (330)	2301 (360)
Pharmacy	11	56 (45)	297 (241)	512 (215)	801 (289)	*
Teaching	224	527 (303)	905 (378)	*	*	*
Specialty	62	200 (138)	479 (279)	*	1081 (301)	*
CT Scan	64	182 (118)	*	643 (231)	841 (198)	*
Open Heart Surgery	175	547 (372)	796 (249)	*	1565 (385)	1905 (340)
Radiation Therapy	100	462 (327)	*	980 (259)	*	*
Radio-isotope Therapy	51	277 (226)	543 (266)	867 (324)	*	1634 (384)

* - No observations for this service level.

Figure 1 - Competition and the Availability of Services

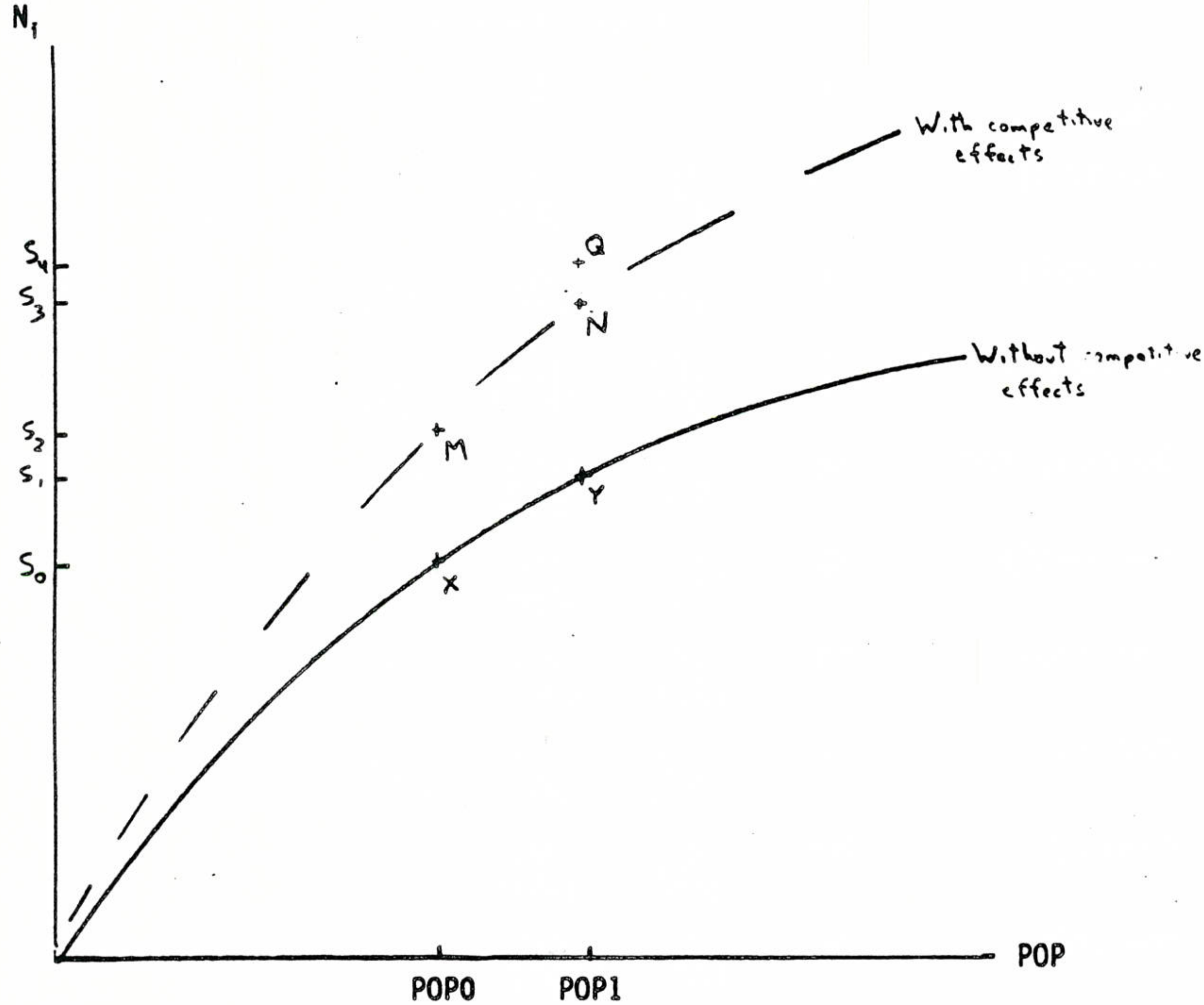
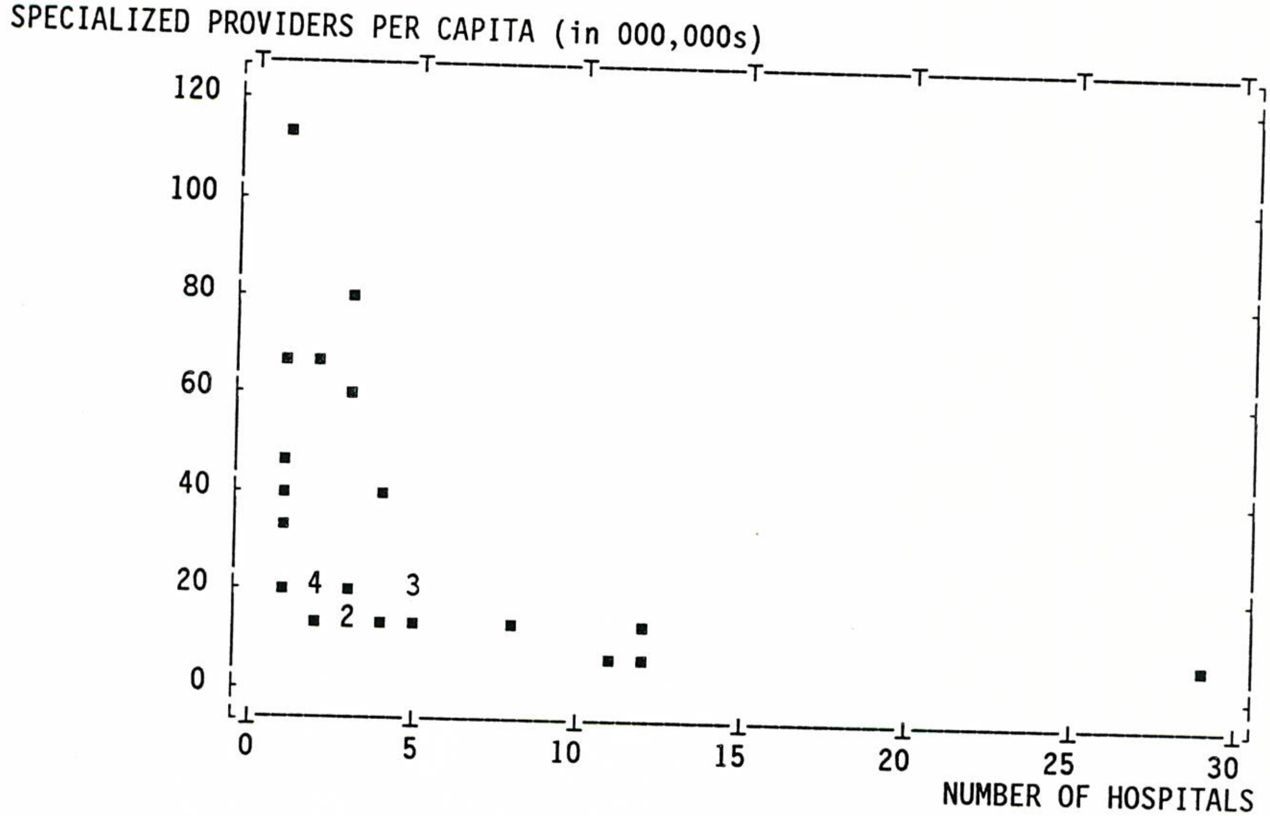


Figure 2 - SPECIALIZED CARDIOLOGY PROVIDERS PER CAPITA BY NUMBER OF HOSPITALS



Numbers in figures indicate multiple observations